B.E. (Automobile Engineering)

2018 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai

Approved by AICTE - Accredited by NAAC with 'A' Grade)

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BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM

REGULATIONS 2018

(CHOICE BASED CREDIT SYSTEM)

(Common to all B.E./B.Tech. Degree Programmes)

Regulation 2018 has been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating University incorporating the features of the Choice Based Credit System (CBCS). The Regulation 2018 is applicable to the candidates admitted to the Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) Degree Programmes of the Institution in the academic year 2018-2019 for Regular admission (Academic year 2019-2020 for Lateral Entry) and subsequently.

The regulations hereunder are subjected to amendments as may be decided by the Academic Council of the Institution from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already in the middle of the programme) as may be decided by the Academic Council.

1. ADMISSION

Candidate, seeking admission to the B.E./B.Tech. Programme, shall satisfy the conditions of admission prescribed by the Directorate of Technical Education and Anna University, Chennai as given below.

1.1 Regular Admission

Candidates, for admission to the first semester of the eight semesters B.E./B.Tech. Degree Programmes, shall be required to have passed:

- Higher Secondary Examination (10 +2) of curriculum (Regular Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics, and Chemistry as three of the four subjects of the study prescribed under Part-III or any other examinations of any Board or University or authority accepted by the Syndicate of the University / Directorate of Technical Education (DoTE), Chennai as equivalent thereto.

(or)

- Should have passed Higher Secondary Examination of Vocational Stream (Engineering/Technology), prescribed by the Government of Tamil Nadu.

1.2 Lateral Entry Admission

The candidates who possess Diploma in Engineering / Technology awarded by the State Board of Technical Education and Training, Tamil Nadu or its equivalent are eligible to apply for Lateral Entry admission to the third semester of B.E. / B.Tech. Programmes in the branch of study as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time.

(or)

The candidates who possess the Bachelor Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject in B.Sc. is eligible to apply for Lateral Entry admission to the third semester of B.E./B.Tech. Programmes, as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time. Such candidates shall undergo two additional Engineering subject(s) one each in third and fourth semesters, as bridge courses.

2. PROGRAMMES OFFERED

A candidate may be offered admission to any one of the programmes offered by the Institution for the candidates specified in Clause 1.1 and as per the eligibility criteria of DoTE for the candidates under Clause 1.2 from the list given below:

B. E. Programmes

- i. Aeronautical Engineering
- ii. Agricultural Engineering
- iii. Automobile Engineering
- iv. Civil Engineering
- v. Computer Science and Engineering
- vi. Electronics and Communication Engineering
- vii. Electrical and Electronics Engineering
- viii. Electronics and Instrumentation Engineering
- ix. Mechanical Engineering
- x. Mechatronics

B. Tech. Programmes

- i. Biotechnology
- ii. Fashion Technology
- iii. Food Technology
- iv. Information Technology
- v. Textile Technology

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme shall have a distinct curriculum with syllabi consisting of theory, laboratory, project, soft-skills and personality development courses, as prescribed by the respective Boards of Studies, broadly categorized under:

(i) **Basic Science** courses including Mathematics, Physics, Chemistry and further specialization in these subjects

(ii) **Basic Engineering** courses including Engineering Graphics, Engineering Practices, Basics of Electrical, Electronics, Civil, Mechanical Engineering, Engineering Mechanics and Computer Programming.

(iii) **Humanities and Social Science** courses including Language Courses, Management Courses, Soft Skills and Professional Ethics.

(iv) **Professional Courses** include Discipline Core Courses, Professional Electives, and Open Electives.

(v) **Employability Enhancement Courses (EEC)** includes Project Work and /or Internship, Seminar, Industrial /Practical Training, Value Added and Certificate Courses.

The medium of instruction is English for all the Courses, Examinations, Seminar Presentation, Projects and any other courses that a student registers for.

3.2 Each course is normally assigned a certain number of credits based on the following

Contact period per week	Credits
1 Lecture / 1 Tutorial period	1
2 laboratory Periods (Laboratory / Seminar / Project Work / etc.)	1

3.3 All the B.E. / B.Tech. Students will study Communicative English I during the First Semester. In the Second Semester, they will be divided into two streams based on their English language proficiency assessed in the Continuous Assessment during semesterI, in which the upper segment will be provided an option to enroll and study Communicative English II / German / Japanese / French / Chinese / Hindi while the lower segment will study Communicative English II.

3.4 Every student shall be required to opt for **Nine** electives from the list of electives. Students can opt for the electives (Core / Professional) from his / her own discipline courses, during V to VIII Semesters, if he/she satisfies the prerequisite for that particular course.

3.5 However, out of nine electives, every student shall be required to opt for, a minimum of one and subject to a maximum of three courses as open elective from the list of electives of the branch / branches other than his / her branch of specialisation, if he/shesatisfies the prerequisite for that particular course.

3.6 Students can also opt for **one-credit courses** of 15 to 20 hour duration, which will be offered by the experts from the industry on specialised topics. Students can opt for such **one-credit courses** during the semesters I to VI as and when these courses are offered. A student will also be permitted to register the **one-credit courses** offered by other Departments, provided the student has fulfilled the necessary pre-requisites or the courses that may not require any pre-requisites. Under no circumstances, the same one credit course shall be repeated in subsequent semesters in any Department / Centre for the same batch of the students and a maximum batch size for a given course shall not exceed 40. In case of disciplines with multiple divisions (intake more than 60) different course(s) shall be offered to other batch(es) of students.

On successful completion of one credit courses, credits will be indicated in the grade sheet as “Additional credits earned”, but will not be considered for computing the Semester Grade Point Average (SGPA)/ Cumulative Grade Point Average (CGPA).

3.7 A student can register for Self-Study Elective(s) over and above the electives from any branch of Engineering / Technology at the rate of one per semester starting from V semester onwards provided he/she maintains a Cumulative Grade Point Average (CGPA) of 8.50 or above till the previous semesters with no current arrears. Credits will be indicated for such courses in the grade sheets (additional credits) but will not beconsidered for computing the CGPA.

3.8 A Student may be permitted to credit only one online course with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of three credits. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by the CoE. A student can get exemption for a maximum of 3 credits during the entire programme (in lieu of Core elective or Open elective). The Head of the Department may identify a faculty member as coordinator for the course, who is responsible for the evaluation process. The course shall be evaluated through the End Semester Examination only. The evaluation methodology may be decided by the course faculty coordinator.

3.9 **Industrial Training / Internship**

The students may undergo Industrial training / Internship optionally for a period as specified in the table during summer / winter vacation and the credits earned will be indicated in the Mark Sheet. If the student earns three credits in Industrial Training / Internship, the student may drop one Professional Elective. In such cases, Industrial Training / Internship need to be undergone continuously from one organization only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for classification of the degree. The students may also undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) during summer / winter vacation, in lieu of Industrial training.

Duration of Training / Internship	Credits
2 Weeks	1
1 Month	2
2 Months	3

3.10 **Socially Relevant Projects**

A Student may be permitted to carry out a socially relevant project during semester II to semester VI in consultation with the Faculty Guide and submit the project report, in the prescribed format, at the end of the Semester for the valuation.

On successful completion of socially relevant project work, one credit will be indicated in the grade sheet (Additional credits), but these credits will not be considered for computing the CGPA.

4. VALUE ADDED COURSES

A Student can opt for the Value Added Courses offered by the various Department / Centres from Semester II to VII. Head of the Department / Centre shall submit the list of such courses, duly approved / ratified by the Academic Council, to the Controller of Examinations to administer the examination process. A separate Certificate will be issued on successful completion of the course by the Office of the Controller of Examinations.

5. DURATION OF THE PROGRAMME

5.1 A regular student (admitted after 10+2) or equivalent is normally expected to satisfactorily fulfil the requirements for award of the degree B.E. / B.Tech. within four academic years (8 semesters) from the date of admission but in any case not more than 7 years (14 Semesters); lateral entry students shall fulfil such requirements within three academic years (6 semesters) from the date of admission but in any case not more than six years (12 Semesters) leading to the award of Degree of Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) of Anna University, Chennai.

5.2 The total period for completion of the programme from the commencement of the semester, to which the student was admitted, shall not exceed the maximum period (Clause 5.1), regardless to the break-of-study (vide Clause 15) or period of prevention in order.

5.3 Each semester shall consist of minimum 90 working days. Head of the Department shall ensure that every faculty member teaches the subject / course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs over and above the number of periods normally specified (Remedial Classes), as decided by the Head of the Department, within the specified duration of the Semester / Programme.

6. COURSE ENROLLMENT AND REGISTRATION

6.1 Each student, on admission shall be assigned to a Faculty Advisor (vide Clause 8) who shall advise / counsel the student about the details of the academic programme and the choice of course(s) considering the student's academic background and career objectives.

6.2 Every student shall enroll for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the semester concerned.

6.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

6.3.1 Each student, on admission to the programme, shall register for **all the courses prescribed in the curriculum** in the **first Semester of study (III Semester** for students admitted under **lateral entry stream).**

6.3.2 The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II. In case, if a student fails to register in course(s), he/ she may be permitted to register the same, as specified in the Clause 6.5, in the subsequent semesters or when it is offered.

6.3.3 The enrollment for the courses of the Semesters III to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If a student wishes, the student may drop or add courses (vide Clause 6.4) within **five** working days after the commencement of the semester concerned and complete the registration process duly authorized by the Faculty Advisor.

6.4 Flexibility to Add or Drop courses

6.4.1 A student has to earn the total number of credits specified in the Curriculum of the respective Programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum by opting for one- credit courses, self study electives or additional courses.

6.4.2 From the III to VIII semesters (from IV to VIII Semesters in case of lateral entry students), the student has the option of registering for additional courses or dropping existing courses. The total number of credits that a student can add or drop is limited to 8, subject to a maximum of 2 courses in a given Semester. In such cases, the attendance requirement as stated in Clause 7 is mandatory.

6.4.3 The student shall register Project work I in semester VII and Project work II in semester VIII only.

6.5 Reappearance Registration

6.5.1 If a student fails in a theory course, the student shall do reappearance registration (Examination) for that course in the subsequent semesters or when it is offered next.

6.5.2 On registration, a student may attend the classes for the reappearance registration courses, if the student wishes, and the attendance requirement (vide Clause 7) is not compulsory for such courses.

6.5.3 However, if a student wishes to improve his/ her continuous assessment, in the second attempt during reappearance, he/she shall satisfy the Clause 6.5.5 and appear for continuous assessment as given for that particular course.

6.5.4 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for the same or any other professional elective or open elective course, respectively in the subsequent semesters. However, the change of elective courses is permitted only once.

6.5.5 In this case (Clause 6.5.4), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the End Semester Examination.

6.5.6 The student who fails in any continuous assessment courses (Laboratory/ Project work / Seminar or any other HSS/EEC courses) shall register for the same in the subsequent semesters or when offered next, and repeat the course as per Clause 6.5.5.

6.5.7 If a student is prevented from writing the end semester examination of a course or several courses due to lack of attendance, the student has to register for that / those course(s) again, when offered next, attend the classes and fulfill the requirements as per Clause 6.5.5 & 6.5.6. If the course, in which the student has 'lack of attendance', is a Core Elective or an Open Elective, the student may register for the same or any other Core Elective or Open Elective course(s) respectively in the subsequent semesters and appear in the examination as per Clause 6.5.5.

6.5.8 If a student fails to secure a pass in any theory courses (including elective) he/she is given a maximum of three arrear attempts to complete the courses. If the student still fails to secure a pass, he/she shall register for the same when offered next and repeat the course.

7. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide Clause 7.1 and 7.2) shall be deemed to have satisfied the attendance requirements for appearing for End Semester Examination of a particular course.

7.1 Every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.

7.2 If a student, secures attendance between 70% and 79% in any course(s) in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) or participation in Institution/ University/ State/ National/

International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate / participation certificate attested by the Head of the Department (along with Condonation form). Such certificates along with the condonation forms shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations. However during the entire programme of study, a student can avail such Condonation in any two semesters only (regardless the number of courses).

7.3 A student shall normally be permitted to appear for End Semester Examination of the course(s) if the student has satisfied the attendance requirements (vide Clause 7.1 – 7.2) and has registered for examination in those courses of that semester by paying the prescribed fee.

7.4 Students who do not satisfy Clause 7.1 and 7.2 and who secure less than 70% attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in the subsequent semesters or when it is offered next (vide Clause 6.5).

7.5 If a student has shortage of attendance in all the registered courses, he/she would not be permitted to move to the higher semester and has to repeat the current semester in the subsequent year.

7.6 In the case of reappearance (Arrear) registration for a course, the attendance requirement as mentioned in Clauses 7.1 - 7.3 is not applicable. However, the student has to register for examination in that course by paying the prescribed fee.

7.7 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of grades.

8. FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a Faculty member of the Department who shall function as Faculty Advisor for those students. The Faculty Advisor shall advise and guide the students in registering of courses, reappearance of courses, monitor their attendance and progress and counsel them periodically. The Faculty Advisor also discusses with or informs the parents about the progress / performance of the students concerned.

The responsibilities of the faculty advisor shall be:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrollment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

9. COMMITTEES

9.1 Common Course Committee

9.1.1 A theory course handled by more than one faculty including the discipline with multiple divisions (greater than or equal to 2) shall have a "Common Course Committee" comprising of all members of faculty teaching that course with one of the members as the Course Coordinator, nominated by the Head of the Institution (Head of the Department in the case of multiple divisions of a discipline) and student representatives (one per specialization or division) registered for that course in the current semester.

First meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

9.1.2 In addition, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during Continuous Assessment and End Semester Examinations.

9.2 Class Committee Meeting

For all the courses taught, prescribed in the curriculum, Class Committee meeting shall be convened thrice in a semester (first meeting within 15 days from the commencement of the semester and other two meetings at equal interval after the first meeting) comprising members of the faculty handling all the courses and two student representatives from the class.

One of the members of the faculty (preferably not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of the Committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

10. SYSTEM OF EXAMINATION

10.1 Performance in each course of study shall be evaluated based on (i) Continuous Assessment throughout the semester and (ii) End Semester examination at the end of the semester for the regular courses or as given in the Clause 16. However, the final examination in the case of certificate / value added courses may be conducted, as and when the course is completed, through the office of the Controller of Examinations.

10.2 Each course, both theory and laboratory including project work, shall be evaluated as per the Scheme of Assessment given in Clause 16.

10.3 The End Semester Examinations shall normally be conducted after satisfying the Clause 5.2.

10.4 For the End Semester examinations, both theory and project work, the internal and external examiners (from Academia or Industry) shall be appointed by the Controller of Examinations as per the guidelines given by the Examination cum Evaluation committee of the Institute.

11. PASSING REQUIREMENTS AND PROVISIONS

11.1 The Passing requirement for a student in a course is determined based on the marks obtained both in Continuous Assessment and End Semester Examinations. If the student gets <50% of marks in End Semester Examination, then the student will be awarded only RA (Reappearance) grade.

11.1.1 If a student fails to secure a pass in a particular course, i.e., failing to obtain minimum marks, as stated above, it is mandatory that he/she shall reappear for the examination in that course in the subsequent semester(s) whenever the examinations are conducted for that course, till he / she secures a 'Pass'.

Continuous Assessment (CA) marks obtained by the student in the first appearance shall be retained and considered valid for one subsequent attempt, except Clause 6.5.4, 6.5.5, 6.5.6 and 6.5.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 6 Grade Points (B Grade) in the course prescribed during the End Semester Examinations.

11.2 If a candidate fails in the seventh semester examinations of Project work I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the End semester examination of Project work II, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva-voce examination will be considered as reappearance with payment of exam fee. In case a student fails in the resubmission of a project report and subsequent viva-voce examination, the student shall register for the course again, when offered next.

11.3 The passing requirement for the courses which are assessed only through continuous assessment (Laboratory and EEC courses except project work), shall be fixed as minimum 50% and the remaining grades are decided as per clause 12.4. If a candidate fails in EEC courses (Except Project work), he/she has to register and repeat the course within 30 days from the date of declaration of the results. In case a student fails to register within 30 days, he/she shall register for the course again, when offered next.

11.4 The minimum number of total credits to be earned by a student to qualify for the award of Degree in the various branches of study as prescribed by the respective Boards of Studies is given below:

Branch of Study	**Minimum Credits**	
	Regular Admission	**Lateral Entry**
B.E. Programmes		
Aeronautical Engineering	172	135
Agricultural Engineering	172	134
Automobile Engineering	170	133
Civil Engineering	171	133
Computer Science and Engineering	171	133
Electronics and Communication Engineering	172	131
Electrical and Electronics Engineering	170	131
Electronics and Instrumentation Engineering	170	131
Mechanical Engineering	170	131
Mechatronics	170	132
B.Tech. Programmes		
Biotechnology	172	134
Fashion Technology	172	134
Food Technology	170	132
Information Technology	170	132
Textile Technology	171	133

11.5 Student Migration and Credit Transfer: Normalization of the Credits will be carried out in consultation with the Board of Studies of the programme concerned and approved by the Head of Institution, if a student migrates from other Autonomous institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.

11.6 A student shall be declared to have qualified for award of B.E/B.Tech. Degree if he/she successfully completes the course requirements (vide Clause 7, 10 and 11) and passed all the prescribed courses of study of the respective programme (listed in Clause 2), within the duration specified in Clause 5.1.

12. ASSESSMENT AND AWARD OF LETTER GRADES

12.1 The assessment shall be based on the performance in the End Semester Examinations and / or Continuous Assessment, carrying marks as specified in Clause 16. Letter Grades (based on Credit Point and Grade Point) are awarded to the students based on the performance in the evaluation process.

12.2 Credit Point is the product of Grade Point and number of credits for a course and Grade Point is a numerical weight allotted to each letter grade on a 10-point scale (as specified in the Clause 12.4), while the Letter Grade is an index of the performance of a student in a said course.

12.3 Condition for Relative Grading

The minimum number of students for applying relative grading system is 30. If thestudents' strength is less than 30 then absolute grading system will be applied. The relative grading system shall not be applied for laboratory and EEC courses.

12.4 The performance of a student will be reported using Letter Grades in absolute grading, each carrying certain points as detailed below: In relative grading, grades will be decided by the faculty concerned. A student who earns a minimum of 6 grade points in a course is declared to have successfully passed the course.

Range of Total Marks (as specified in Clause 16) / Specific Reason	**Grade Points**	**Letter Grade**
91 to 100	10	O (Outstanding)
81 to 90	9	A + (Excellent)
71 to 80	8	A (Very Good)
61 to 70	7	B + (Good)
50 to 60	6	B (Above average)
0 to 49	0	RA (Reappearance Registration)
Incomplete	0	I
Withdrawal	0	W
Absent	0	AB
Shortage of Attendance	0	SA

‘RA’ ---Reappearance registration is required for that particular course

‘I’ --- Continuous evaluation is required for that particular course in the subsequent examinations.

‘SA’ --- shortage of attendance (Clause 7) and hence prevented from writing end semester examination.

12.5 After completion of the evaluation process, Semester Grade Point Average (SGPA),and the Cumulative Grade Point Average (CGPA) is calculated using the formula:

$$\frac{\sum_1^n C\,i\ *\ g_i}{\sum_i^n Ci}$$

Where

C_i : Credit allotted to the course.

g_i : Grade Point secured corresponding to the course.

n : number of courses successfully cleared during the particular semester in the case of SGPA and all the semesters, under consideration, in the case CGPA.

12.6 A student who does not appear for the End Semester Examinations in a course, after registering for the same, shall be deemed to have appeared for that examination for the purpose of classification (Subject to Clause 14 and 15).

12.7 For the non credit courses grades shall be indicated as given in the Clause 16 and shall not be counted for the computation of SGPA/CGPA.

For the Co-curricular activities such as NCC / NSS / NSO / YRC, a satisfactory / not satisfactory grading will appear in the mark sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement in the second year. A satisfactory grade in the above co- curricular activities is compulsory for the award of degree.

12.8 Revaluation: A student, who seeks the re-valuation of the answer script, is directed to apply through proper application to the Controller of Examinations in the prescribed format through the Head of the Department. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses. In the case of theory courses with laboratory component, a student can seek revaluation for the theory component only, following the procedure stated above.

12.9 **Supplementary Examinations**: If a student fails to secure a pass in theory course(s) of VIII semester examination, he/she is eligible to appear for a one time Supplementary Examination which shall be conducted at the end of VIII semester, for the subjects of VIII semester alone within 30 days from the date of declaration of the results.

12.10 **Eligibility for the Award of Degree**

A student shall be declared to be eligible for the award of the B.E. / B.Tech. Degree provided the student has

i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.
ii. Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the courses prescribed in all the 8 semesters within a maximum period of 7 years reckoned from the commencement of the first semester to which the candidate was admitted.
iii. Successfully completed the NCC / NSS / NSO / YRC / Extra-curricular/ Co-curricular requirements.
iv. No disciplinary action is pending against the student.
v. The award of Degree must have been approved by the Syndicate of the University.

13. CLASSIFICATION OF THE DEGREE AWARDED

For the purpose of the 'Award of Degree', the duration of completion of the programme shall be the total duration taken by a student for completing first time registration of all the required courses and satisfying Clause 11, regardless to the period of Break-of-study as per Clause 15 and satisfy any one of the conditions required as given below.

13.1 **First Class with Distinction**: A student who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction**:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry students) in the student's First Appearance within five years, which includes authorized break of study of one year. Withdrawal from examination (vide Clause 15) will not be considered as an appearance.
- Should have secured a CGPA of **not less than 8.50**
- Should **NOT** have been prevented from writing end semester examination due to lack of attendance in any of the courses.

13.2 **First Class**: A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry students) within five years, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of **not less than 7.00**

13.3 **Second Class**: All other students (not covered in clauses 13.1 and 13.2) who qualify for the award of the degree shall be declared to have passed the examination in **Second Class.**

14. WITHDRAWAL FROM THE EXAMINATION

14.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme.

14.2 Withdrawal application shall be valid only, if the student is eligible to write the examination as per Clause 7 and, if it is made within TEN working days before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.

14.3 Notwithstanding the requirement of mandatory TEN working days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

14.4 If a student withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examination(s).

14.5 Withdrawal shall not be considered as an appearance in the examination for the eligibility of a student for First Class with Distinction or First Class.

14.6 Withdrawal is permitted for the end semester examinations in the final semester, only if the period of study of the student concerned does not exceed 5 years as per clause 13.1 & 13.2.

15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

15.1 A student is permitted to go on break of study for a fixed period of one year as a singlebreak in the entire course of study.

15.2 A student is normally not permitted to break the period of study temporarily. However,if a student happens to discontinue the programme temporarily during the middle of programme of study, for reasons such as personal accident or hospitalization due to ill health or in need of health care, he/she shall apply to the Head of the Institution in advance, in any case, not later than the last date for registering for the semester examination, through the Head of the Department stating the reasons for the break-of- study (for one academic semester or 6 months, whichever is earlier). However, a student detained for want of minimum attendance requirement as per Clause 7 shall not be considered as permitted 'Break of Study' and Clause 15.3 is not applicable for such case.

15.3 The student is permitted to rejoin the programme after the break / prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Dean Academics in the prescribed format through the Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

15.4 Authorized break of study will be counted towards the duration specified for passing all the courses (vide Clause 5.1 and 5.2) and for the purpose of classification of Degree(vide Clause 13).

15.5 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 5.1, irrespective of the period of break of study in order that he / she may be eligible, for the award of the degree (vide Clause 13).

15.6 In case of valid reasons (as stated in Clause 15.2) extended break-of-study may be granted by the Head of the Institution for a period not more than one year in addition to the earlier authorized break of study.

15.7 If a student does not report back to the Institute, even after the extended Break of Study, the name of the student shall be deleted permanently from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

16. SCHEME OF ASSESSMENT

Courses offered under B.E. / B.Tech. Programmes are assessed as given below:

I	**THEORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (10)	
	Periodical Test II (10)	
	Innovative Practices (30)	
	End Semester Examination	**50**
	Total Marks	**100**
II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Periodical Test I (10)	
	Periodical Test II (10)	
	Innovative Practices (30)	
	(Laboratory Assessment & Report)	
	End Semester Examination (QP pattern as per (I))	**50**
	Total Marks	**100**
III	**LABORATORY COURSES**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Conduct of Experiment	
	i. Preparation (20)	
	ii. Experiment and Analysis of Results (20)	
	iii. Record (10)	
	Test – Cycle I (25)	
	Test – Cycle II (25)	
	Total Marks	**100**
IV	**PROJECT WORK I**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Literature Survey (5)	
	Identification of topic and Justification (5)	
	Work plan (10)	
	Review II	
	Approach & Results (15)	
	Conclusion (15)	

	End Semester Examination	**50**
	Report[#] (20)	
	Presentation (20)	
	Viva voce (10)	
	Total Marks	**100**
V	**PROJECT WORK II**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I	
	Progress (10)	
	Review II	
	Approach & Results (10)	
	Review III	
	Conclusion & Final Presentation (10)	
	Report (15)	
	Publication of Paper in Conferences / Journals (5)	
	End Semester Examination	
	Presentation (30)	**50**
	Viva voce (20)	
	Total Marks	**100**
VI	**LANGUAGE ELECTIVE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test 1	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	Test 2	
	Listening (5)	
	Speaking (10)	**25**
	Reading (5)	
	Writing (5)	
	Oral Exam	**50**
	Total Marks	**100**
VII	**ONE-CREDIT COURSE**	**Marks**
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	**50**
	Quiz/ Assignment	**50**
	Total Marks	**100**

[#] *Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department*

VIII	**INDUSTRIAL TRAINING/ INTERNSHIP (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Assessment by Industry	**30**
	Viva-voce	**20**
	Presentation	**30**
	Case Study / Report	**20**
	Total Marks	**100**

IX	**SOFT SKILLS (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Examination	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	

X	**VALUE ADDED / CERTIFICATE COURSES (CONTINUOUS ASSESSMENT ONLY)**	**Marks**
	Test I	**25**
	Test II	**25**
	Final Evaluation / Test	**50**
	Total Marks	**100**
	Grades (Excellent / Good / Satisfactory)	

XI	**ENGINEERING GRAPHICS**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Exercise (Minimum 10 Exercises/Modelling)	**60**
	Model Examination	**40**
	Total Marks	**100**

Optional Test: *A student becomes eligible to appear for an optional test conducted after the Periodical Test II, only under the following circumstances: (i) absent for Test I or Test II or both on account of medical reasons (hospitalization / accident / specific illness), or (ii) participation in the College / University / State / National / International level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned member of faculty who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are not conducted for the courses under the categories III, IV, V, VI, VII, VIII, IX, X and XI listed above.*

17. FIELD / INDUSTRIAL VISIT / INTERNSHIP

In order to provide the experiential learning to the students, Head of the Department shall take efforts to arrange at least two industrial visits / field visits. The students may also undergo in-plant training / internship during summer / winter vacation between III and VII semesters.

18. PERSONALITY AND CHARACTER DEVELOPMENT

Every student shall be required to undergo a minimum of 40 hours of Personality Development Programmes viz, NSS / NCC / YRC / YOGA / Sports and Games / Technical and Non-technical Club activities during the first year. The attendance of the personality and character development courses / events shall be maintained on the regular basis by the concerned First Year Co-ordinators and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I or Semester II.

19. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the End Semester / Continuous Assessments, he / she shall be liable for punitive action as prescribed by the Institution / University from time to time.

20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The Institution reserves the right to revise/amend/change the Regulations, Curriculum, Syllabi, Scheme of Examinations and date of implementation and to introduce Additional Electives, Open Electives, One Credit Courses and Value Added Courses through the Academic Council.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

After graduation, the Graduates of Automobile Engineering will be able to

I. To impart knowledge and skill to formulate, analyze and solve engineering problems in automobiles to meet global challenges.

II. To promote lifelong learning through higher education and research in the automobile and allied engineering.

III. To create automobile technocrats with good communication skills, leadership qualities, team spirit and professional ethics to meet the needs of the society.

PROGRAM OUTCOMES (PO)

Engineering Graduates will be able to:

a. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. **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.

d. **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.

e. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. **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.

g. **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.

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **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.

k. **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.

l. **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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

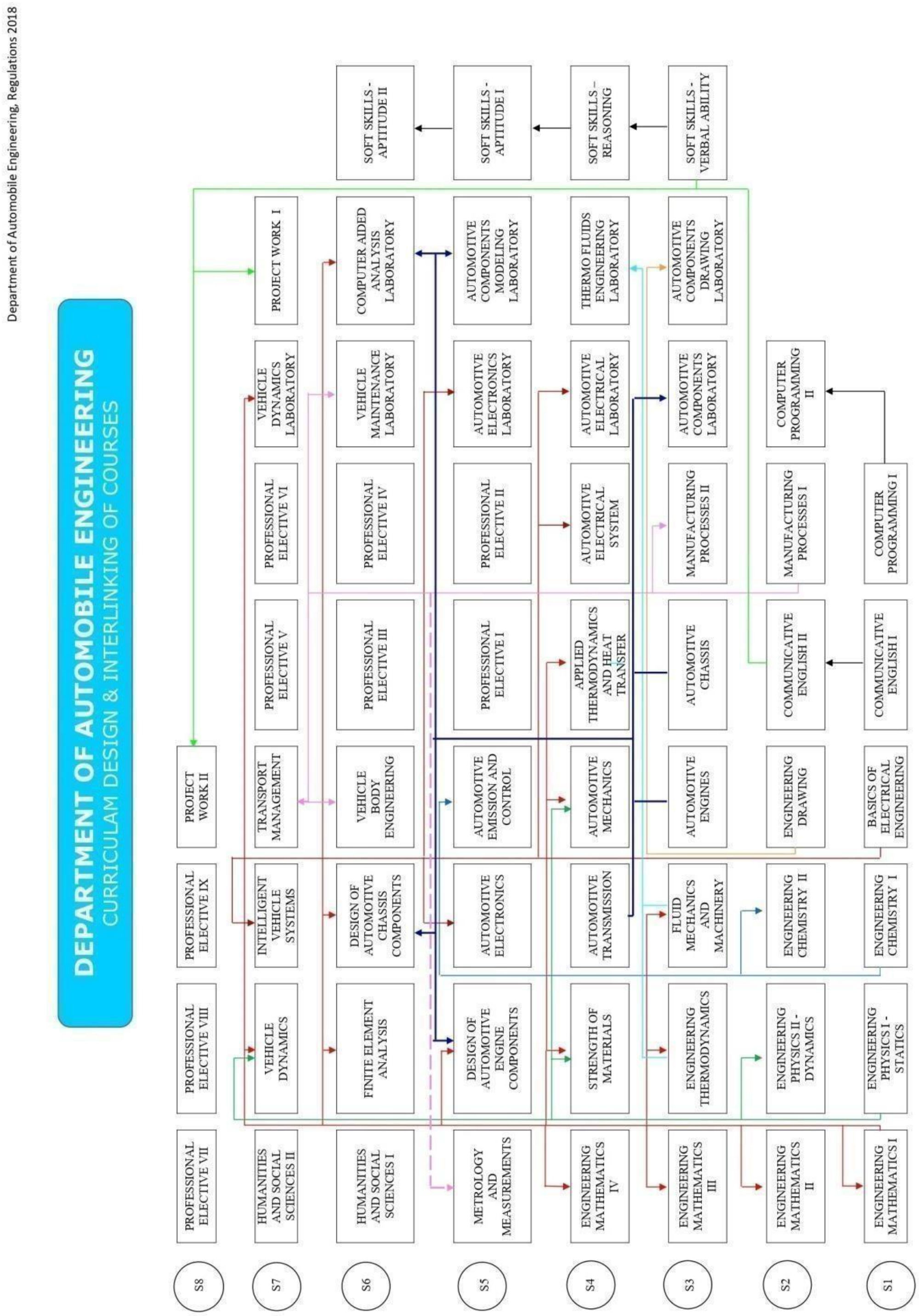
m. An ability to design, analyze and find the solutions for automotive related problems.

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

MAPPING OF PEOs WITH POs

PEOs	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
PEO I	X	X	X	X	X								X	
PEO II					X	X	X		X			X	X	
PEO III								X	X	X	X	X		X

CONNECTIVITY CHART



DEPARTMENT OF AUTOMOBILE ENGINEERING

Minimum Credits to be Earned : 170

I SEMESTER

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18AU101	ENGINEERING MATHEMATICS I	3	1	0	4	4	50	50	100	BS
18AU102	ENGINEERING PHYSICS I - STATICS	2	0	2	3	4	50	50	100	BS
18AU103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18AU104	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
18AU106	COMPUTER PROGRAMMING I	0	0	4	2	3	100	0	100	ES
Total		**10**	**1**	**12**	**17**	**22**	**400**	**200**	**600**	**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18AU201	ENGINEERING MATHEMATICS II	3	1	0	4	4	50	50	100	BS
18AU202	ENGINEERING PHYSICS II - DYNAMICS	2	1	0	3	3	50	50	100	BS
18AU203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18AU204	ENGINEERING DRAWING	0	0	4	2	4	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
18AU206	MANUFACTURING PROCESSES I	3	0	2	4	5	50	50	100	PC
18AU207	COMPUTER PROGRAMMING II	0	0	4	2	3	100	0	100	ES
Total		**11**	**2**	**14**	**20**	**26**	**450**	**250**	**700**	**-**

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18AU301	ENGINEERING MATHEMATICS III	3	1	0	4	4	50	50	100	BS
18AU302	ENGINEERING THERMODYNAMICS	3	1	0	4	4	50	50	100	ES
18AU303	FLUID MECHANICS AND MACHINERY	3	1	0	4	4	50	50	100	ES
18AU304	AUTOMOTIVE ENGINES	3	0	0	3	3	50	50	100	PC
18AU305	AUTOMOTIVE CHASSIS	3	0	0	3	3	50	50	100	PC
18AU306	MANUFACTURING PROCESSES II	3	0	2	4	5	50	50	100	PC
18AU307	AUTOMOTIVE COMPONENTS LABORATORY	0	0	2	1	2	100	0	100	PC
18AU308	AUTOMOTIVE COMPONENTS DRAWING LABORATORY	0	0	2	1	2	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
Total		**18**	**3**	**8**	**24**	**29**	**600**	**300**	**900**	**-**

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18AU401	ENGINEERING MATHEMATICS IV	3	1	0	4	4	50	50	100	BS
18AU402	STRENGTH OF MATERIALS	2	1	2	4	5	50	50	100	ES
18AU403	AUTOMOTIVE TRANSMISSION	3	0	0	3	3	50	50	100	PC
18AU404	AUTOMOTIVE MECHANICS	2	1	2	4	4	50	50	100	PC
18AU405	APPLIED THERMODYNAMICS AND HEAT TRANSFER	3	1	0	4	4	50	50	100	ES
18AU406	AUTOMOTIVE ELECTRICAL SYSTEM	3	0	0	3	3	50	50	100	PC
18AU407	AUTOMOTIVE ELECTRICAL LABORATORY	0	0	2	1	2	100	0	100	PC
18AU408	THERMO FLUIDS ENGINEERING LABORATORY	0	0	2	1	2	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	EEC
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**18**	**4**	**10**	**24**	**31**	**700**	**300**	**1000**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18AU501	METROLOGY AND MEASUREMENTS	3	0	2	4	5	50	50	100	PC
18AU502	DESIGN OF AUTOMOTIVE ENGINE COMPONENTS	3	1	0	4	4	50	50	100	PC
18AU503	AUTOMOTIVE ELECTRONICS	3	0	0	3	3	50	50	100	PC
18AU504	AUTOMOTIVE EMISSION AND CONTROL	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	50	50	100	PE
18AU507	AUTOMOTIVE ELECTRONICS LABORATORY	0	0	2	1	2	100	0	100	PC
18AU508	AUTOMOTIVE COMPONENTS MODELING LABORATORY	0	0	2	1	2	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**18**	**1**	**10**	**23**	**29**	**600**	**300**	**900**	**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS002	PROFESSIONAL ETHICS IN ENGINEERING	2	0	0	2	2	50	50	100	HSS
18AU602	FINITE ELEMENT ANALYSIS	3	1	0	4	4	50	50	100	PC
18AU603	DESIGN OF AUTOMOTIVE CHASSIS COMPONENTS	3	1	0	4	4	50	50	100	PC
18AU604	VEHICLE BODY ENGINEERING	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	50	50	100	PE
18AU607	VEHICLE MAINTENANCE LABORATORY	0	0	2	1	2	100	0	100	PC
18AU608	COMPUTER AIDED ANALYSIS LABORATORY	0	0	2	1	2	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**17**	**2**	**6**	**21**	**25**	**600**	**300**	**900**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS003	PRINCIPLES OF MANAGEMENT	2	0	0	2	2	50	50	100	HSS
18AU702	VEHICLE DYNAMICS	3	1	0	4	4	50	50	100	PC
18AU703	INTELLIGENT VEHICLE SYSTEMS	3	0	2	4	5	50	50	100	PC
18AU704	TRANSPORT MANAGEMENT	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	50	50	100	PE
18AU707	VEHICLE DYNAMICS LABORATORY	0	0	2	1	2	100	0	100	PC
18AU708	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total		**17**	**1**	**10**	**23**	**31**	**450**	**350**	**800**	**-**

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	50	50	100	PE
18AU804	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total		**9**	**0**	**18**	**18**	**27**	**200**	**200**	**400**	**-**

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
PHYSICS ELECTIVES										
18GE0P1	NANOMATERIALS SCIENCE	3	0	0	3	3	50	50	100	BS
18GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	50	50	100	BS
18GE0P3	APPLIED LASER SCIENCE	3	0	0	3	3	50	50	100	BS
CHEMISTRY ELECTIVES										
18GE0C1	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	50	50	100	BS
18GE0C2	ENERGY STORING DEVICES	3	0	0	3	3	50	50	100	BS
18GE0C3	POLYMER SCIENCE	3	0	0	3	3	50	50	100	BS
MATHEMATICS ELECTIVES										
18GE0M1	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	50	50	100	BS
18GE0M2	ALGEBRA AND NUMBER THEORY	3	0	0	3	3	50	50	100	BS
18GE0M3	MATHEMATICAL FINANCE AND QUEUEING THEORY	3	0	0	3	3	50	50	100	BS
DISCIPLINE ELECTIVES										
18AU001	AUTOMOTIVE PRODUCT DESIGN AND DEVELOPMENT	3	0	0	3	3	50	50	100	PE
18AU002	DESIGN FOR MANUFACTURE AND ASSEMBLY	3	0	0	3	3	50	50	100	PE
18AU003	DESIGN THINKING	3	0	0	3	3	50	50	100	PE
18AU004	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3	3	50	50	100	PE
18AU005	COMBUSTION THERMODYNAMICS AND HEAT TRANSFER	3	0	0	3	3	50	50	100	PE

18AU006	SUPERCHARGING AND SCAVENGING	3	0	0	3	3	50	50	100	PE
18AU007	FUELS AND COMBUSTION	3	0	0	3	3	50	50	100	PE
18AU008	ALTERNATE FUELS AND ENERGY SYSTEMS	3	0	0	3	3	50	50	100	PE
18AU009	AUTOMOTIVE AIR – CONDITIONING	3	0	0	3	3	50	50	100	PE
18AU010	COMPOSITE MATERIALS	3	0	0	3	3	50	50	100	PE
18AU011	ENGINEERING TRIBOLOGY	3	0	0	3	3	50	50	100	PE
18AU012	NON - TRADITIONAL MACHINING PROCESSES	3	0	0	3	3	50	50	100	PE
18AU013	ADDITIVE MANUFACTURING	3	0	0	3	3	50	50	100	PE
18AU014	NOISE,VIBRATION AND HARSHNESS CONTROL	3	0	0	3	3	50	50	100	PE
18AU015	IoT IN AUTOMOBILES	3	0	0	3	3	50	50	100	PE
18AU016	AUTOMOTIVE AERODYNAMICS	3	0	0	3	3	50	50	100	PE
18AU017	AUTOMOTIVE SAFETY AND ERGONOMICS	3	0	0	3	3	50	50	100	PE
18AU018	TWO AND THREE WHEELERS	3	0	0	3	3	50	50	100	PE
18AU019	OFF-ROAD VEHICLES	3	0	0	3	3	50	50	100	PE
18AU020	ELECTRIC AND HYBRID VEHICLES	3	0	0	3	3	50	50	100	PE
18AU021	SMART MOBILITY	3	0	0	3	3	50	50	100	PE
18AU022	MOTORSPORT TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18AU023	ADVANCED VEHICLE TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18AU024	TYRE TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18AU025	INDUSTRY 4.0	3	0	0	3	3	50	50	100	PE
18AU026	VEHICLE SYSTEM EVALUATION AND CERTIFICATION	3	0	0	3	3	50	50	100	PE
18AU027	HYDRAULICS AND PNUMATICS	3	0	0	3	3	50	50	100	PE
18AU028	INDUSTRIAL ENGINEERING	3	0	0	3	3	50	50	100	PE
18AU029	OPTIMIZATION TECHNIQUES	3	0	0	3	3	50	50	100	PE
18AU030	TOTAL QUALITY MANAGEMENT	3	0	0	3	3	50	50	100	PE
18AU031	VEHICLE MAINTENANCE	3	0	0	3	3	50	50	100	PE
18AU032	ENGINEERING ECONOMICS AND COST ANALYSIS	3	0	0	3	3	50	50	100	PE

18AU033	AUTOMOTIVE STYLING	3	0	0	3	3	50	50	100	PE
18AU034	AUTOMOTIVE EMBEDDED SYSTEMS	3	0	0	3	3	50	50	100	PE
18AU035	ELECTRO MAGNETIC INTERFERENCE AND ELECTRO MAGNETIC COMPATIBILITY	3	0	0	3	3	50	50	100	PE
18AU036	ELECTRIC MOTORS AND DRIVE SYSTEMS	3	0	0	3	3	50	50	100	PE
18AU037	LEAN MANUFACTURING	3	0	0	3	3	50	50	100	PE
18AU038	VIRTUAL INSTRUMENTATION IN AUTOMOBILE ENGINEERING	3	0	0	3	3	50	50	100	PE
18AU039	INDUSTRIAL ROBOTICS TECHNOLOGY	3	0	0	3	3	50	50	100	PE
18AU040	MACHINE LEARNING	3	0	0	3	3	50	50	100	PE
18AU041	MODEL BASED SYSTEM DESIGN	3	0	0	3	3	50	50	100	PE

ENTREPRENEURSHIP ELECTIVES										
18GE0E1	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	50	50	100	PE
18GE0E2	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	50	50	100	PE
OPEN ELECTIVES										
18AU0YA	AUTOMOTIVE ENGINEERING	3	0	0	3	3	50	50	100	PE
18AU0YB	VEHICLE CONTROL SYSTEMS	3	0	0	3	3	50	50	100	PE
18AU0YC	PUBLIC TRANSPORT MANAGEMENT	3	0	0	3	3	50	50	100	PE
18AU0YD	TECHNOLOGIES FOR GREEN MOBILITY	3	0	0	3	3	50	50	100	PE
18AU0YE	TROUBLE SHOOTING AND MAINTENANCE OF AUTOMOBILES	3	0	0	3	3	50	50	100	PE
ONE CREDIT COURSES										
18AU0XA	PLASTICS – DESIGN, PROCESSING, TOOLING, ASSEMBLY AND TESTING	0	0	0	1	15	100	0	100	EEC
18AU0XB	VEHICLE TESTING AND CERTIFICATION	0	0	0	1	15	100	0	100	EEC
18AU0XC	AUTOMOTIVE EMBEDDED SYSTEM	0	0	0	1	15	100	0	100	EEC

18AU0XD	GASOLINE INJECTION SYSTEMS	0	0	0	1	15	100	0	100	EEC
18AU0XE	ADVANCED MOTOR SPORTS ENGINEERING	0	0	0	1	15	100	0	100	EEC
18AU0XF	AUTOMOTIVE PRODUCT DEVELOPMENT	0	0	0	1	15	100	0	100	EEC
18AU0XG	AUTOMOTIVE INTERIOR COMPONENTS DESIGN	0	0	0	1	15	100	0	100	EEC
18AU0XH	CONNECTED VECHILES	0	0	0	1	15	100	0	100	EEC
ADDITIONAL ONE CREDIT COURSES										
18GE0XA	ETYMOLOGY	1	0	0	1	15	100	0	100	EEC
18GE0XB	GENERAL PSYCOLOGY	1	0	0	1	15	100	0	100	EEC
18GE0XC	NEURO BEHAVIOURAL SCIENCE	1	0	0	1	15	100	0	100	EEC
18GE0XD	VISUAL MEDIA AND FILM MAKING	1	0	0	1	15	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLENCE	1	0	0	1	15	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	1	0	0	1	15	100	0	100	EEC
18GE0XG	HEALTH AND FITNESS	1	0	0	1	15	100	0	100	EEC
18GE0XH	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	1	0	0	1	15	100	0	100	EEC
18GE0XI	BLOG WRITING	1	0	0	1	15	100	0	100	EEC
18GE0XJ	INTERPERSONAL SKILLS	1	0	0	1	15	100	0	100	EEC
18GE0XK	COMMUNITYSERVICE AND LEADERSHIP DEVELOPMENT	1	0	0	1	15	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	1	0	0	1	15	100	0	100	EEC
18GE0XM	NEW AGE INNOVATION AND ENTREPRENEURSHIP	1	0	0	1	15	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION BASED START UPACTIVITIES	1	0	0	1	15	100	0	100	EEC
18GE0XO	SOCIAL PSYCHLOGY	1	0	0	1	15	100	0	100	EEC
18GE0XP	FM RADIO BROADCASTING TECHNOLOGY	1	0	0	1	15	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S. No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4	4	-	-	-	-	28	16.47%	15%	20%
2	ES	5	4	8	8	-	-	-	-	25	14.70%	15%	20%
3	HSS	2	2	-	-	-	2	2	-	8	4.70%	5%	10%
4	PC	-	4	12	12	17	13	12	-	70	41.17%	30%	40%
5	PE	-	-	-	-	6	6	6	9	27	15.88%	10%	15%
6	EEC	-	-	-	-	-	-	3	9	12	7.1%	7%	10%
Total		17	20	24	24	23	21	23	18	170	100%	100	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and SocialSciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

18AU101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields.
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

Course Outcomes (COs)

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigen values and Eigenvectors.
2. Analyse various types of functions and their differentiation techniques involved in engineering fields.
3. Implement different methods of integration used in engineering problems.
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2												
3	1	2												
4	1	2												
5	1	2												

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices : Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hopitals Rule.
Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchys Integral Formula - Classification of Singularities - Cauchys Residue Theorem.

FOR FURTHER READINGS

Applications-Deflection of Beams, Buckling Analysis,Simple Harmonic motion application in Car Shock Absorbers.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley,2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
3. Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4thedition, McGraw Hill, 1999.

18AU102 ENGINEERING PHYSICS I - STATICS 2 0 2 3

Course Objectives

- Familiarise basic concepts and force systems in a real world environment
- Provide knowledge on statics of particles in space with moment
- Impart knowledge on equilibrium of rigid bodies.
- Study the moment of surfaces and solids.
- Learn the concepts of static friction.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

Course Outcomes (COs)

1. Draw a free body diagrams for given real world systems to compose and resolve forces involved.
2. Compute the moment created by the applied forces with reference to any centre/axis in 2D & 3D space.
3. Estimate the appropriate support system for the given force system by considering the force generated by various reactions.
4. Identify the location of the centroid, centre of gravity for a geometrical body and calculate the moment of inertia for 2D sections.
5. Compute the effect and resultant forces generated by the frictional forces involved in given systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2							2					
2	3	2							2					
3	3	2							2					
4	3	2							2					
5	3	2							2					

UNIT I **5 Hours**

BASIC CONCEPTS AND FORCE SYSTEM

Introduction to mechanics - idealization of mechanics - laws of mechanics - principle of transmissibility-vector - addition, subtraction and product. Force- types - system of forces - resultant forces - composition of forces - resolution of force- free body diagram real world systems

UNIT II **6 Hours**

STATICS OF PARTICLES AND FORCE SYSTEM

Equilibrium of particles, moment of force, moment of couple - equilibrant moment about point and specific axis - simplification of force and couple systems

UNIT III **7 Hours**

STATICS OF RIGID BODIES

Equilibrium of rigid bodies in two and three dimensions. Trusses - method of joints and method of sections beams - types of loads, supports and their reactions. Two and three force members-static determinacy

UNIT IV **6 Hours**

PROPERTIES OF SURFACES AND SOLIDS

Centroid - Determination of area, volume and mass - Pappus and Guldinus theorems - moment of inertia of plane and area - radius of gyration, parallel axis and perpendicular axis theorems. Product of inertia, mass moment of inertia

UNIT V **6 Hours**

FRICTION

Introduction - mechanism and microscopic origin of friction - Types of friction, Laws of friction, friction on horizontal and inclined planes, wedge friction, friction in screw jack, friction in open V belt drive

1 **3 Hours**

EXPERIMENT 1

Experimental verification of parallelogram law.

2 **3 Hours**

EXPERIMENT 2

Experimental verification of Lamis theorem.

3 **3 Hours**

EXPERIMENT 3

Experimental demonstration of principles of moments using bell crank lever apparatus

4 **3 Hours**

EXPERIMENT 4

Experimental study of equilibrium of forces in three concurrent co-planer systems

5 **3 Hours**

EXPERIMENT 5

Experimental analysis of the reaction forces of a simply supported beam and compare with analytical results.

6 **3 Hours**

EXPERIMENT 6

Determination of centroid of laminas

7 **3 Hours**

EXPERIMENT 7

Determination of moment of inertia of plane area

8 **3 Hours**

EXPERIMENT 8

Determination of mass moment of inertia of a disc - torsion pendulum apparatus

9 **3 Hours**

EXPERIMENT 9

Determination of coefficient of friction between two surfaces

10 **3 Hours**

EXPERIMENT 10

Demonstration of tipping and sliding

Total: 60 Hours

Reference(s)

1. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers - Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2007
2. N.H.Dubey, Engineering Mechanics- Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2013
3. Irving H. Shames, Engineering Mechanics - Statics and Dynamics, Pearson Education Asia Pvt. Ltd., 2006.
4. R.C.Hibbeller, Engineering Mechanics: Combined Statics & Dynamics, Prentice Hall, 2009.
5. D. P. Sharma, Engineering Mechanics, Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2010
6. S. Rajasekaran and G. Sankara subramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2005.

18AU103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Explain the terminologies of electrochemistry to indicate the function of batteries and fuelcells with its electrochemical reactions
- Analyze the three types of fuels based on calorific value for selected applications
- Outline the properties and applications of lubricants and adhesives
- Summarise the fundamentals of corrosion, types and its prevention

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Selection of battery for automobile application
2. Select suitable fuel cell for different automobile application
3. Distinguish the properties of fuel based on thecombustion
4. Identify the properties and application of lubricants used inautomobiles
5. Analyze the type of corrosion and control method in Automobiles

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2											2	
2	3	2											3	
3	2												3	
4	3	1											2	
5	2	2											2	

UNIT I **6 Hours**

BATTERIES

Introduction - battery terminology: Construction - working and applications of primary battery (Zinc-carbon)- Secondary battery: Lead Acid, nickel metal hydride, lithium ion and lithium polymer battery - Applications and maintenance of batteries in Automobiles

UNIT II **6 Hours**

FUEL CELLS

Principle - construction and applications of hydrogen-oxygen fuel cell, and Proton exchange membrane fuel cell, Direct-methanol fuel cells, Solid oxide fuel cell, Molten carbonate fuel cell

UNIT III **6 Hours**

FUELS AND COMBUSTION

Automotive Fuels - Types and Properties, Distillation process of crude oil. Combustion: Combustion reaction, Air-fuel mixture, Calorific value, Explosive range, Spontaneous ignition temperature, Abnormal combustion.

UNIT IV **6 Hours**

LUBRICANTS

Lubricants for automobiles - Classification, Functions and Properties: Viscosity index, Flash and fire point, Oiliness, Carbon residue, Aniline point, Cloud and pour point. Greases and synthetic lubricants, Grading of automotive lubricants.

UNIT V **6 Hours**

CORROSION

Corrosion - types of corrosions in automobiles - Uniform corrosion, Galvanic corrosion, Pitting corrosion, Crevice corrosion and Deposit corrosion - Root causes - Remedial measures for corrosion - Protective coatings, Paints, Electroplating

FURTHER READING

Cellulose-based battery used for commercial purposes. Economical loss incurred due to corrosion. Automotive Lubricants

1 **4 Hours**

EXPERIMENT 1

Preparation of N/10 oxalic acid and M/10 sodium carbonate solution

2 **6 Hours**

EXPERIMENT 2

Estimation of corrosion percentage by weight loss method

3 **4 Hours**

EXPERIMENT 3

Battery voltage test and hydrometer test (before and after charging)

4 **4 Hours**

EXPERIMENT 4

Determination of flash and fire point for petrol and diesel

5 **4 Hours**

EXPERIMENT 5

Construct a battery (using scrap metal/ other sources) exhibiting valid output and compare it with the existing commercial batteries based on cost and output. (Marks awarded based on battery output)

6 **4 Hours**

EXPERIMENT 6

Determination of cloud and pour point for petrol and diesel

7 **4 Hours**

EXPERIMENT 7

Determination of viscosity by using Redwood viscometer and Sayboltviscometer

Total: 60 Hours

Reference(s)

1. P. C. Jain and Monica Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publisher, New Delhi, (2013).
2. Charles P.Poole Jr, and Frank J Owens, Introduction to Nanotechnology, John Wiley andSons (2006).
3. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogels Text Book of Quantitative Chemical Analysis, Oxford, ELBS, London, 2002.
4. R. Mukhopadhy and S. Datta, Engineering Chemistry, New Age International Pvt. Ltd, New Delhi, (2010).
5. Shoemaker D.P. and C.W. Garland., Experiments in Physical Chemistry, TataMcGraw-Hill Pub. Co., Ltd., London, 2003.
6. Vogels Text book of quantitative chemistry analysis 5th Edittion, Longman scientific and technical, John Wiely and Sons, New York

18AU104 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- To understand the types of batteries used inautomobiles
- To illustrate the construction and operation of electrical machines
- To understand the basic concepts of electronic control unit
- To develop a electrical wiring diagram between various parts in automobiles.
- To understand the various components used in protection andtesting.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Explain the types of batteries and its testing methods used in automobiles
2. Illustrate the operating principle of various electrical machines and itsbraking methods.
3. Explain the various components used in electronic control unit and its earthing methods
4. Construct a wiring diagram between between various parts in car.
5. Differentiate the different types of protective schemes and testing used inautomobiles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	
2	3	2											2	
3	2	2	2										2	
4	2	1	3										3	
5	2	2	1										2	

UNIT I **6 Hours**

BATTERY

Types of battery, Rating-12V and 24V system, capacity and efficiency of battery, Various testing methods for battery: Water lever, Voltage level, Cable connections, Temperature, Cranking amperage rating, and Insulator test, Charging methods.

UNIT II **7 Hours**

ELECTRICAL MACHINES

Alternator, Voltage and Current regulators, Construction, operating characteristics and speed control of Permanent Magnet motor, BLDC motor, Electric braking: Eddy current braking and regenerative braking

UNIT III **6 Hours**

POWER SUPPLY AND PROTECTION CIRCUIT FOR ECU

Power supply, rating of power supply and power supply back-up system: ECU, sensors, relays, actuators and display systems. Protection: Over current sensing mechanism, Types of fuses and fuse holders in ECU, Neutral safety switch, Earthing and types of earthing in ECU

UNIT IV **5 Hours**

ELECTRICAL WIRINGDIAGRAM

Types of wires, cables, wiring symbols, wiring diagram between alternator, cut outs, battery, starter motor, wiring diagram of battery to different types of lamps, wiring diagram of battery to drive systems, wiring diagram of audio system.

UNIT V **6 Hours**

PROTECTION AND TESTING

Insulation and earth return system, Fuse, Types of fuses in automobiles, Circuit breakers, Relays, Switches. Testing: Alternator drive belt and Starter motor testing.

1 **6 Hours**

EXPERIMENT 1

Develop a wiring diagram for connecting battery with alternator and cut out.

2 **6 Hours**

EXPERIMENT 2

Develop a wiring diagram between battery and head lamps with necessary protection circuits.

3 **6 Hours**

EXPERIMENT 3

Develop a prototype braking methods for 12V DC motor.

4 **6 Hours**

EXPERIMENT 4

Water level, Voltage level and cable connection testing of batteries

5 **6 Hours**

EXPERIMENT 5

Fuse replacement and earthing methods in automobiles.

Total: 60 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall(India) Pvt. Ltd., 2010
3. V. D. Toro, Electrical Engineering Fundamentals, Prentice Hall India, 2014.
4. T.Denton, Automotive Electrical and Electronic System, UK: Elsevier Butterworth-Heinemann, 2004.
5. A.P. Young and L. Griffith, Automobile Electrical Equipment, London: ELBS and NewPress, 1999.

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

j. 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.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Preliminary examlevel
2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature
3. Write formal, routine letters of factual nature, and make notes on routine matters, such as taking/placing orders
4. Follow simple presentations/demonstrations
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2									2					
3														
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.Goodbye party for Miss Pushpa T S - Nissim Ezekiel 2.Our Casuarina Tree - Toru Dutt 3.Palanquin Bearers - Sarojini Naidu 4.The Tyger - William Blake 5.Ode on a Grecian Urn - John Keats

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

18AU106 COMPUTER PROGRAMMING I 0 0 4 2

Course Objectives

- Understand the basics of C primitives, operators and expressions
- Gain knowledge about the different primitive and user defined data types
- Impart knowledge about the structural programming concepts

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Implement C programs using operators, type conversion and input-output functions
2. Apply decision making and looping statements in writing C programs
3. Develop C programs using the concepts of Arrays and Strings.
4. Design applications using structures in C.
5. Apply the concepts of functions in writing C programs.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3			3									
2	2	3			3									
3	2	3			3									
4	1	3			3									
5	1	3			3									

1 **6 Hours**

EXPERIMENT 1

Implement a C program which include a Fundamental Data types Integer, Float, double and Character.

2 **3 Hours**

EXPERIMENT 2

Implement a C program to perform the Arithmetic Operations using primitive data types.

3 **6 Hours**

EXPERIMENT 3

Implementation of logical, relational, bitwise, increment/decrement and conditional Operators in C.

4 **3 Hours**

EXPERIMENT 4

Implementation of Simple if else Conditional Statement.

5 **3 Hours**

EXPERIMENT 5
Implementation of nested if else Conditional Statement.

6 **3 Hours**

EXPERIMENT 6
Implementation of Switch Case Statement.

7 **3 Hours**

EXPERIMENT 7
Implement a C program using for Looping Statement.

8 **3 Hours**

EXPERIMENT 8
Implement a C program using Do-While Looping Statement.

9 **3 Hours**

EXPERIMENT 9
Implement a C program using While Looping Statement.

10 **3 Hours**

EXPERIMENT 10
Implementation of Jumping Statements

11 **3 Hours**

EXPERIMENT 11
Implementation of One Dimensional Array.

12 **6 Hours**

EXPERIMENT 12
Implementation of Two Dimensional Array.

13 **3 Hours**

EXPERIMENT 13
Implement a C program to perform String Manipulation Functions.

14 **6 Hours**

EXPERIMENT 14
Implement a C program using structures.

15 **6 Hours**

EXPERIMENT 15
Implement a C program which includes four categories of functions and recursive functions.

Total: 60 Hours

18AU201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinarydifferential equation and solve it by appropriate method.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.

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

Course Outcomes (COs)

1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	2												
3	2	1												
4	2	1												
5	2	1												

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoullis equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley,2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.

18AU202 ENGINEERING PHYSICS II - DYNAMICS 2 1 0 3

Course Objectives

- Impart knowledge in kinematics of particles
- Familiarize the basic concepts of force, mass and acceleration
- Determine the nature of force associated with work andenergy
- Summarize the motion of rigid bodies
- Solve the realistic problems related to rigid bodykinetics

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Determine the solution for the problems related to kinematics ofparticles.
2. Evaluate the relation existing among force, mass and acceleration ofparticles.
3. Calculate forces associated with work, energy, impulse and momentum.
4. Analyze the geometric motion of rigid bodies.
5. Apply the concepts of rigid body kinetics to solve engineeringproblems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1											2	
2	2	1											2	
3	2	1											3	
4	2	1											2	
5	2	1											2	

UNIT I **6 Hours**

KINEMATICS OF PARTICLES

Introduction to dynamics - Rectilinear motion - displacement, velocity and acceleration - Equations of motion - Curvilinear motion - angular displacement, velocity and acceleration, simple relative motion. Types of coordinates system - rectangular, tangential and normal, radial and transverse.

UNIT II **6 Hours**

KINETICS OF PARTICLES I: FORCE, MASS AND ACCELERATION

Introduction to kinetics - Newton's second law of motion - Equations of motion - Problems on rectangular coordinates, normal and tangential components, cylindrical coordinates - Dynamic equilibrium - D'Alembert's principle.

UNIT III **6 Hours**

KINETICS OF PARTICLES II: WORK ENERGY AND IMPULSE MOMENTUM

Principle of work - conservative and non-conservative forces. Principle of energy - potential energy, kinetic energy, conservation of energy. Principles of Impulse and Momentum - principle of conservation of linear momentum.Impact - direct, central, non-central, oblique - coefficient of restitution.

UNIT IV **6 Hours**

KINEMATICS OF RIGID BODIES

Introduction to planar kinematics - Types of motion - Rectilinear and curvilinear Translation motion, Rotational motion about a fixed axis, General plane motion - Absolute and relative velocity - Instantaneous centre of rotation and acceleration.

UNIT V **6 Hours**

KINETICS OF RIGID BODIES

Introduction to 2-D kinetics - Force and Acceleration - General equations of motion. Principle of work and Energy - work done by a couple, spring - principle of conservation of energy. Principle of impulse and momentum - linear momentum.

Total: 45 Hours

Reference(s)

1. Beer, Johnston, Mazurek, Cornwells and Sanghi, Vector Mechanics for Engineers: Statics, Dynamics, 10th Edition, Tata McGraw Hill - Noida, Uttar Pradesh, 2013.
2. N.H. Dubey, Engineering Mechanics - Statics and Dynamics, First Edition, McGraw-Hill Education India Private Ltd., New Delhi, 2012.
3. R.C. Hibbeler, Engineering Mechanics: Dynamics, 13th Edition, Prentice Hall, 2012.
4. J.L. Meriam and L.G. Kraige, Engineering Mechanics: Dynamics, 7th Edition, Wiley India Private Limited, 2013.
5. Irving H. Shames, Engineering Mechanics - Statics and Dynamics, 4th Edition, Pearson India, 2011.

18AU203 ENGINEERING CHEMISTRY II **2 0 2 3**

Course Objectives

- Summarize the physical metallurgy of metals through the study of phase diagrams
- Outline the classification, and heat treatment methods of engineering materials
- Indicate the properties and applications of various metals and non-metals used in engineering industries
- Outline the mechanical properties evaluation and testing methods of engineering materials
- Infer the material behavior through structure-property correlation

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Analyse the phase changes using phasediagrams
2. Compare the properties of engineering metals and alloy steels and select a suitable metal and alloy for various Engineering applications
3. Analyse the micro-structural changes of steels during heat treatment process and compare the properties of microstructures
4. Select the suitable Polymers and engineering materials for engineering applications and compare the properties
5. Outline the various processing of composite materials

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3											1	
2	3	2											2	
3	3	3											1	
4	3	2											2	
5	3	2											1	

UNIT I **6 Hours**

IRON AND STEEL

Iron carbon system: Allotropes of Iron, Micro constituents of Fe-C phase diagram.Types of steel - low, medium and high carbon steel .types of cast iron -grey, white ,malleable and spheroidal cast iron, application in Automobiles.

UNIT II **6 Hours**

ALLOYS

Alloys: Definition, Purpose of making alloys, Effect of alloying elements, Ferrous alloys - nichrome steel, stainless steel, high speed steel, high strength low alloy steel. Non Ferrous alloys: Aluminium alloys-classification, composition, properties and application of 6111 and 6061. Copper alloys - brass and bronze . Properties and applications of bearing materials, typical application inAutomobiles.

UNIT III **5 Hours**

HEAT TREATMENT OF STEELS

Purpose of heat treatment- full annealing, stress relief, recrystallization, spheroidizing, hardening, tempering, normalizing, case hardening - carburizing, nitriding, carbontiriding, flame hardening and induction hardening. Harden ability and its testing.

UNIT IV **7 Hours**

INTRODUCTION TO POLYMERS AND ENGINEERING CERAMICS

Polymers- classification of polymers. Types of polymerization: addition, condensation and copolymerization. Properties and applications of thermosetting- epoxy resin, phenol formaldehyde, PMMA and nylon 66. Thermoplastics- polyethylene(PE), polypropylene(PP), polystyrene(PS), polyvinylchloride(PVC), polytetrafluoroethylene(PTFE) and acrylonitrile butadiene styrene (ABS). Ceramics materials-SiC,SiO2, Partially Stabilized Zirconia (PSZ).

UNIT V **6 Hours**

COMPOSITE MATERIALS

Composite material - definition, classification based on matrix and fiber, processing of polymer matrix composite- hand layup- spray layup-pultrusion, filament winding, Resin transfer moulding, sheet moulding, processing of metal matrix composites - Stir casting , Squeeze casting, typical Automotive applications.

SELF STUDY

Phase rule and applications (one component- Water system and two component- Lead-Silver System). Natural polymers, biodegradable polymers, polymer moulding techniques and extraction of metal from ores.

1 **3 Hours**

EXPERIMENT 1

Microstructure analysis of low, medium and high carbon steels

2 **3 Hours**

EXPERIMENT 2

Microstructure analysis of gray, white, malleable and spheroidal cast iron

3 **3 Hours**

EXPERIMENT 3

Estimation of copper content in brass by EDTA method

4 **3 Hours**

EXPERIMENT 4

Microstructure analysis of stainless steel, high speed steel and aluminum alloy

5 **3 Hours**

EXPERIMENT 5

Determination of hardenability using Jominy end quench test

6 **3 Hours**

EXPERIMENT 6

Analysis of hardening of steel in water and oil quenching medium

7 **3 Hours**

EXPERIMENT 7

Analysis of impact strength of PVC, Nylon and ABS plastics

8 **3 Hours**

EXPERIMENT 8

Analysis of tensile properties PVC, Nylon and ABS plastics

9 **3 Hours**

EXPERIMENT 9

Analysis of impact strength of glass fiber reinforce polymer(GFRP)composites

10 **3 Hours**

EXPERIMENT 10

Analysis of tensile strength of glass fiber reinforce polymer (GFRP) composites

Total: 60 Hours

Reference(s)

1. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogel's Text Book of Quantitative Chemical Analysis, Oxford, ELBS, London, 2002.
2. Shoemaker D.P. and C.W. Garland., Experiments in Physical Chemistry, TataMcGraw-Hill Pub. Co., Ltd., London, 2003.
3. Shoba U.S., Sivahari R. and Mayildurai R., Practical Chemistry, Inder Publications, Coimbatore, 2009.
4. Vogel's Text book of quantitative chemistry analysis 5thEdittion, Longman scientific and technical, John Wiely and Sons, New York.
5. C.P.Sharma, Engineering Materials-Properties and Applications of Metals and Alloys, Prentice Hall of India, New Delhi, 2004.
6. G. Murray, C. White and W. Weise, Introduction to Engineering Materials, 2nd Edition, Chemical Rubber Company (CRC) Press, Taylor & Francis Group, Florida, 2007.

18AU204 ENGINEERING DRAWING 0 0 4 2

Course Objectives

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on orthographic projections of points and lines.
- To familiarize on projection of planes and simplesolids.
- To provide knowledge on section of solids and development of surfaces of simple solids.
- To impart skill on conversion of isometric view to orthographic projection and viceversa.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

j. 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.

m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Understand the engineering drawing concepts as per industrial standards.
2. Construct orthographic projections of points and lines.
3. Draw the projection of planes and simplesolids.
4. Draw the section of solids and development of surfaces.
5. Draw the orthographic projection from isometric view and vice versa.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3									2			2	
2	2									3			2	
3	2									2			3	
4	2									3			2	
5	3									2			2	

1 10 Hours

EXPERIMENT 1

Definition, standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimension of drawings. Construction of conic sections-ellipse, parabola and hyperbola using eccentricity method.

2 12 Hours

EXPERIMENT 2

Principles of projection, projection of points in four quadrants, first angle projection of straight lines - perpendicular to one plane, parallel and inclined to both planes.

3 10 Hours

EXPERIMENT 3

Projection of simple planes and projection of simple solids, axis parallel, perpendicular and inclined to one plane using change of position method.

4 **12 Hours**

EXPERIMENT 4
Section of solids - simple position with cutting plane parallel, perpendicular and inclined to one plane.Development of surfaces - simple and truncated solids.

5 **16 Hours**

EXPERIMENT 5
Orthographic projections and isometric view of components used in engineering applications.

Total: 60 Hours

Reference(s)

1. K. Venugpoal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2011.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46, 2008.
4. N.D. Bhatt and V.M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

18AU206 MANUFACTURING PROCESSES I 3 0 2 4

Course Objectives

- To develop understanding of the basic manufacturing concepts and techniques
- To impart knowledge on appropriate parameters to be used for various machining operations
- To acquire knowledge and skill on metal joining processes along with various equipment and its defects

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Analyze the characteristics of casting processes and its defects.
2. Select the suitable metal joining process for automotive applications.
3. Illustrate the construction and working of lathe and drilling machine
4. Analyze the various operation on milling & gear cutting machines
5. Apply suitable finishing process in manufacturing of automotive components

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	
2	3	2	3										2	
3	2	2	2										2	
4	2	2	3										2	
5	3	2	2										2	

UNIT I **9 Hours**

CASTING

Casting process, Patterns-materials and allowances, Moulding tools, Procedure to make sand mould, Core and core making, Special moulding processes- CO2 process, shell moulding, investment casting, die casting, cleaning of castings, inspection methods, casting defects, causes and remedies.

UNIT II **9 Hours**

METAL JOINING PROCESSES

Principle of Gas welding and arc welding - Electrodes, Fluxes and filler materials. Resistance welding - Spot, butt and seam. Gas metal arc welding(GMAW), Tungsten Inert Gas welding(TIG), Plasma arc welding, Thermit welding, Electron beam welding, laser beam welding and Friction welding - Weld defects - Brazing and soldering

UNIT III **9 Hours**

LATHE

Centre Lathe - Construction, specification. Work holding devices - Centres, chucks, carrier with catch plate and face plates. Operations-turning, facing, and drilling. Boring, taper turning, threading and knurling. Drilling - universal drilling machine, specification , types of drills and nomenclature of twist drill, operations- drilling and reaming.

UNIT IV **8 Hours**

MILLING MACHINE AND GEAR CUTTING MACHINES

Milling - Introduction, types-horizontal and vertical, types of milling - up milling and down milling, operations-Face milling, End milling, T slot milling, gear cutting. Nomenclature of plain milling cutter.. Gear cutting- gear shaper and gear hobbing.

UNIT V **10 Hours**

RECIPROCATING AND SURFACE FINISHING MACHINE TOOLS

Shaper and Slotter - specification. Broaching-types. Finishing processes - Grinding - surface and cylindrical, grinding wheel- specification, Fine finishing processes - Honing, lapping, polishing, buffing and super finishing.

1 **2 Hours**

EXPERIMENT 1

To prepare a mould using split pattern in sand casting process

2 **2 Hours**

EXPERIMENT 2

To prepare a mould for gear pattern

3 **2 Hours**

EXPERIMENT 3

Fabrication of simple structural shapes using manual Metal Arc Welding

4 **2 Hours**

EXPERIMENT 4

Fabrication of simple structural shapes using TIG welding

5 **4 Hours**

EXPERIMENT 5

Exercise on Facing, Step Turning, Boring

6 **4 Hours**

EXPERIMENT 6

Exercise on Taper Turing, Knurling, thread cutting

7 **4 Hours**

EXPERIMENT 7

Exercises on end and face milling

8 **4 Hours**

EXPERIMENT 8
Exercise on Spur Gear Cutting in milling machine

9 **4 Hours**

EXPERIMENT 9
Shaping of square slot

10 **2 Hours**

EXPERIMENT 10
Slotting of key and key way

Total: 75 Hours

Reference(s)

1. SeropeKalpakjian and Steven R Schmid, Manufacturing Engineering and Technology, Pearson Education Limited., New Delhi, 2013.
2. P. N. Rao, Manufacturing Technology- Metal Cutting and Machine Tools, Tata McGrawHill Publishing Company Private Limited., New Delhi, 2013
3. S. K. HajraChoudhury, Elements of Workshop Technology. Vol. I & II, Media Promoters & Publishers Private Limited., Mumbai, 2013.
4. P.C Sharma, Manufacturing Technology - II, S.Chand & Company Limited. New Delhi, 2012
5. J. P. Kaushish, Manufacturing Processes, Prentice Hall India Learning Private Limited., New Delhi, 2013

18AU207 COMPUTER PROGRAMMING II 0 0 4 2

Course Objectives

- To understand the basics of C++ and Java primitives, operators, and expressions, conditional and looping statements.
- To understand and apply the concepts of classes, inheritance, interfaces and packages.
- To develop programs using Stings and exception handling.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

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

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Implement C++ and java programs using data types, operators, arrays, control and looping statements.
2. Apply class, objects, methods and inheritance in C++.
3. Develop java programs using the concepts of its basic primitives, class and methods.
4. Design applications using inheritance, interface and package.
5. Apply the concepts of strings and exception handling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3			3									2
2	2	3			2									3
3	2	2			2									2
4	2	2			2									3
5	2	2			2									2

1 **3 Hours**

EXPERIMENT 1

Working with basic data types and arrays.

2 **3 Hours**

EXPERIMENT 2

Implementation of control statements.

3 **3 Hours**

EXPERIMENT 3

Implementation of looping statements.

4 **3 Hours**

EXPERIMENT 4
Implementation of class and objects.

5 **3 Hours**

EXPERIMENT 5
Working with constructor and destructor.

6 **3 Hours**

EXPERIMENT 6
Implementation of types of Inheritance.

7 **3 Hours**

EXPERIMENT 7
Working with call by value and call by reference.

8 **3 Hours**

EXPERIMENT 8
Implementation of friend function.

9 **3 Hours**

EXPERIMENT 9
Implementation of overloading.

10 **3 Hours**

EXPERIMENT 10
Working with basic data types, static variables and arrays.

11 **6 Hours**

EXPERIMENT 11
Program on Classes and objects.

12 **6 Hours**

EXPERIMENT 12
Working with Methods.

13 **6 Hours**

EXPERIMENT 13
Implementation of Inheritance.

14 **6 Hours**

EXPERIMENT 14
Implementation of Overloading and Overriding.

15 **6 Hours**

EXPERIMENT 15

Implementation of Packages.

Total: 60 Hours

18AU301 ENGINEERING MATHEMATICS III 3 1 0 4

Course Objectives

- Understand the concepts of Fourier series, Transforms and Boundary Conditions, whichwill enable them to model and analyze the physicalphenomena.
- Summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation.
- Understand the basic concepts of probability and the distributions with characteristics andalso the mathematical statistics.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.

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

Course Outcomes (COs)

1. Identify the periodicity of a function and formulate the same as a combination of sine andcosine using Fourier series.
2. Apply the Fourier transform, which converts the time function into a sum of sine wavesof different frequencies, each of which represents a frequency component.
3. Formulate a function in frequency domain whenever the function is defined in timedomain.
4. Classify a partial differential equation and able to solve them.
5. Apply the basic probability axioms and concepts of probability distributions in their coreareas.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	2												
3	1	2												
4	2	1												
5	2	1												

UNIT I **10 Hours**

FOURIER SERIES

Dirichlet conditions-General Fourier series-Odd and even functions-Half range cosine and sine series-Root mean square value.

UNIT II **9 Hours**

FOURIER TRANSFORM

Fourier Integral Theorem-Fourier Transform and Inverse Fourier Transform-Sine and Cosine Transforms -Properties- Transforms of Simple Functions-Convolution Theorem-Parsevals Identity.

UNIT III **9 Hours**

PARTIAL DIFFERENTIAL EQUATION

Introduction to partial differential equations- One-dimensional wave equation-Method of separation of variables-D Alemberts solution of the wave equation-Heat equation-Laplace s equation-Telegraph equations-Laplace transform method ofsolution.

UNIT IV **9 Hours**

LAPLACE TRANSFORM

Properties and theorems of Laplace transform-Shifting theorems-Convolution-Applications to ordinary differential equations. Applications to linear system analysis.

UNIT V **8 Hours**

PROBABILITY THEORY

Probability- Random variables- probability densities and distributions-mean and variance of a distribution -Conditional probability-Bayes theorem-Binomial, Poisson and normal distributions.

Total: 60 Hours

Reference(s)

1. KreyszigErwin, Advanced Engineering Mathematics, 10th Edition, John Wiley, 2011.
2. Johnson Richard A. and BhaltacharyyaGouri K., Statistics, Principles and Methods, 7th Edition, John Wiley, 2014.
3. ONeil Peter V., Advanced Engineering Mathematics, 7th Edition, PWS-Kent, 2011.
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 4th Edition, 2011.
5. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 4th Edition, 2003.
6. https://nptel.ac.in/syllabus/syllabus.php?subjectId=122107037

18AU302 ENGINEERING THERMODYNAMICS 3 1 0 4

Course Objectives

- To acquire knowledge on fundamentals of thermodynamic laws, concepts, principles and mechanism in accounting for the macroscopic physical systems.
- To formulate and solve engineering problems involving classical thermodynamics for closed and open systems.
- To familiarize the students with basic concepts of Second Law of Thermodynamics andentropy
- To grasp knowledge about thermodynamic property of pure substances and its phase change processes.
- To learn about principles of psychrometry and concepts of air standard cycles.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Exemplify the basic concepts and zeroth law of thermodynamics.
2. Apply the first law of thermodynamics to closed and opensystems
3. Apply the second law of thermodynamics for the calculation of entropy and compare heat engine and heat pump.
4. Determine the thermodynamic properties of pure substances and its phase changeprocesses.
5. Analyze the air standard performance of heat engines and properties of gas mixtures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											2	
2	2	3											2	
3	3	2											3	
4	3	2	3	2									3	
5	2	3		3									3	

UNIT I **8 Hours**

INTRODUCTION AND ZEROTH LAW OF THERMODYNAMICS

Definitions and concepts- heat, work, thermodynamic equilibrium, system and types, surroundings, Properties- intensive and extensive properties, Path and point functions, Energy- macroscopic and microscopic modes of energy, Thermodynamic processes and cycle, State postulate, Zeroth law of thermodynamics.

UNIT II **10 Hours**

FIRST LAW OF THERMODYNAMICS

First law of thermodynamics, First law for Closed systems - constant pressure process, constant volume process, constant temperature process, adiabatic process, polytropic process, throttling process. First law for open systems -Steady state flow processes, Steady flow energy equation (SFEE), Application of SFEE-turbines and compressors, nozzles and diffusers, throttling valves, heat exchangers.

UNIT III **8 Hours**

SECOND LAW OF THERMODYNAMICS

Limitations of First law of thermodynamics, Second law of thermodynamics- Kelvin - Planck and Clausius statements, Heat Engine, heat pump and refrigerator, Reversibility and irreversibility- irreversible and reversible processes, Carnot"s principles, Thermodynamic temperature scale, Clausius inequality, Entropy- principle of entropy increase, Availability & irreversibility.

UNIT IV **9 Hours**

PROPERTIES OF PURE SUBSTANCES

Thermodynamic properties of fluids.Pure substance-phases - Phase change processes, Property diagrams - pressure-volume (P-V), pressure-temperature (P-T), temperature-volume (T-V), temperature-entropy (T-s), and enthalpy-entropy (h-s) diagrams.Steam tables - Problems on flow and non-flow processes.Ideal gas - equation of state, Van der Waals equation and compressibility chart.

UNIT V **10 Hours**

GAS MIXTURES AND GAS POWER CYCLES

Thermodynamics of ideal gas mixture- mixture of ideal gas, mixture of perfect gases, Dalton"s law of partial pressure, Amagat"slaw,Thermodynamic properties, Psychrometric properties and processes - Psychrometric chart. Air standard cycles - Otto, Diesel and Dual - Calculation of mean effective pressure and air standard efficiency.

Total: 60 Hours

Reference(s)

1. Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGrawHill Publishing Company Pvt Ltd, New Delhi, SiE,7e,2016
2. R.K.Rajput, Engineering Thermodynamics, Laxmi Publications Pvt.Ltd., New Delhi, 2015.
3. R. S. Khurmi, Steam table with Psychometric chart, S. Chand Publications, New Delhi 2009.
4. J. P. Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi 2002.
5. P.K Nag, Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 2016.
6. https://nptel.ac.in/courses/101104063/

18AU303 FLUID MECHANICS AND MACHINERY 3 1 0 4

Course Objectives

- To understand the basics of fluid properties and the laws of fluid mechanics.
- To acquire required knowledge to solve internal and externalflows.
- To understand the concept of flow through pipes including major and minor losses.
- To understand the concept of dimensional analysis and modelling techniques.
- To gain knowledge on the working principles and performance analysis fluid machineries.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Solve problems for velocity, flow and force using fundamental laws fluids.
2. Apply internal and external flow mechanisms to design fluid components.
3. Apply the fluid mechanics principles to solve the problems on flow through pipes andpipe networks.
4. Model fluid flow prototype components using models and modelling laws.
5. Analyse turbines and pumps for optimum performance conditions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											2	
2	3	2	3	1									1	
3	3	2	3	2									3	
4	3	2	3										2	
5	3	2	3	2									2	

UNIT I **8 Hours**

INTRODUCTION TO FLUID AND FLUID MOTION

Fluid- Fluid mechanics -Laws of Fluid Mechanics-Properties of fluid and its application-Types of fluid -Types of fluid flow-Measurement of pressure-U-tube and differential manometer- Measurement of velocity using Discharge -Actual discharge-Flow pattern-law of conservation of Mass, Energy, Momentum -continuity equation. Buoyancy-meta centre, conditions of equilibrium of floating and submerged bodies.

UNIT II **10 Hours**

FLUID DYNAMICS AND FLUID FLOW IN CONDUITS

Forces acting on a fluid element- Euler"s and Bernoulli"s theorem- Application in internal and external flow measuring instruments Ã¢?? Applications of Momentum equation for bend in pipes - Major losses and Minor losses in pipes -Darcy Weisbach equation -pipes in series and pipes in parallel. Identification of laminar and turbulent flow in closed conduits, flow in circular pipe. Fuel and lubricants flow.

UNIT III **10 Hours**

EXTERNAL FLOW OVER BODIES AND DIMENSIONAL ANALYSIS

Fluid flow over Bodies: Boundary layer theory, Flow separation-Boundary layer development on a flat plate -Lift and drag of an aerofoil& Car. Need for dimensional analysis - dimensional analysis using Buckingham pi theorem - Similitude -types of similitude - Dimensionless parameters- application of dimensionless parameters - Model analysis through Reynolds and Froude"s Model law.

UNIT IV **8 Hours**

HYDRAULIC TURBINES

Turbine -Classification -Impulse turbine -Reaction turbine-Francis turbine - working principles and velocity triangle- Work done by water on the runner - Specific speed - unit quantities - performance curves.

UNIT V **9 Hours**

HYDRAULIC PUMPS

Centrifugal pump -Classification -Construction - working principle and velocity Triangle-Head-Losses and efficiencies-Specific speed -Priming and cavitation effects of centrifugal pump. Reciprocating pump - Classification - Working Principle.

Total: 60 Hours

Reference(s)

1. Yunus Cengel and John Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 4th edition, 2017.
2. Frank M. White, Fluid Mechanics (in SI Units), McGraw-Hill Education / Asia, 2011
3. R.K.Bansal, A Text book of Fluid Mechanics and Machinery, Laxmi Publications (P) Ltd., New Delhi, Revised 9th edition, 2018.
4. Victor L. Streeter, K.W. Bedford and Wylie E. Benjamin , Fluid Mechanics, Tata McGraw Hill Publishing Company Pvt Ltd., New York, Revised 9th Edition 2010.
5. Bruce R Munson , Donald F Young, Theodore H Okiishi and Wade W. Huebsch, Fundamentals of Fluid Mechanics, John Wiley & Sons, 8th edition 2016.
6. https://nptel.ac.in/courses/112105171/

18AU304 AUTOMOTIVE ENGINES 3 0 0 3

Course Objectives

- To acquire knowledge on the primary engine components and the subsystems ofautomotive engines
- To understand spark ignition and compression ignition engines fuel systems inautomotives.
- To develop understanding of combustion process in SI and CI engines.
- To develop the requirements of cooling and lubricationsystems.
- To carry out performance test on automotive engines.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Select the suitable engine components and valve operating mechanisms for modernautomobiles.
2. Select the suitable fuel supply system for modern vehicles.
3. Differentiate spark ignition and compression ignition combustion chambers used in automotive engines.
4. Select appropriate cooling system for automobile engines.
5. Compare turbo and supercharging systems and performance characteristics of engines using dynamometers.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3												
2	3	3											2	
3	2	3											3	
4	2	2												
5	2	3											2	

UNIT I **8 Hours**

ENGINE COMPONENTS

Four stroke, Two stroke, SI and CI engines- constructional details and materials of engine components, cylinder, piston assembly, connecting rod, crankshaft, cam shaft, flywheel, cylinder head, valves, Intake and exhaust system components, Valve operating mechanisms, Valve timing and port timing diagrams.

UNIT II **9 Hours**

FUEL SYSTEM

Air-fuel ratio requirements of SI engines, SI engine fuel systems, Carburetors- types, Gasoline fuel injection systems- Multi Point Fuel Injection (MPFI), throttle body injection , Electronic fuel injection- Gasoline Direct Injection System (GDI), CI engine fuel injection systems- unit injector and Common Rail Direct Injection(CRDI) systems, inline plunger injection pump, distributor pump, Injection nozzles-types, Mechanical governor for fuel injection pumps.

UNIT III **10 Hours**

COMBUSTION AND COMBUSTION CHAMBERS

Stages of combustion in SI engines, Factors affecting ignition delay and flame propagation, Abnormal combustion-knocking, control of knock, octane rating of SI engine fuel, Combustion chambers for SI engines, Stages of combustion in CI engines- factors affecting ignition delay, CI engine knock, cetanerating of CI engine fuel, Comparison of SI engine and CI engine knock, Direct and indirect injection combustion chambers for CI engines- importance of swirl, squish and turbulence in CI engines.

UNIT IV **9 Hours**

COOLING AND LUBRICATION SYSTEMS

Need for cooling, Effects of over cooling, Air and liquid cooling systems- thermo siphon, forced circulation and pressure cooling systems, components liquid cooling system, Requirements of coolants- anti freezing agents, Requirements of lubrication system, Types- mist, pressure feed, dry and wet sump systems.

UNIT V **9 Hours**

SUPERCHARGING, TURBO CHARGING AND ENGINE TESTING

Supercharging- need and methods, Turbocharging-Engine exhaust manifold arrangements, Engine performance- indicated, brake and friction power, indicated thermal, brake thermal and volumetric efficiencies, specific fuel consumption, Measurement of engine power- fuel consumption, air flow rate and speed, Engine loading- types of dynamometers , Morse test and heat balance test.

Total: 45 Hours

Reference(s)

1. V. Ganesan , Internal Combustion Engineering, New Delhi :Tata McGraw-Hill PublishingCo, 2012.
2. J.B.Heywood , Internal Combustion Engine Fundamentals, New Delhi :Tata McGraw-Hill Publishing Co, 2011.
3. K.K. Ramalingam , Internal Combustion Engines, Sci-Tech Publications, 2009.
4. Heisler, "Advanced Engine Technology" SAE Publication, 1995.
5. H.N. Gupta, Fundamentals of Internal Combustion Engines, PHI Learning Pvt. Ltd. 2013.
6. M.L. Mathur, R.P. Sharma,A course in internal combustion engines, Dhanpatraipublication, 2010.

18AU305 AUTOMOTIVE CHASSIS 3 0 0 3

Course Objectives

- To acquire knowledge on types of chassis frames and drive axles.
- To understand the constructional details of suspension system, brake system and steeringsystem of road vehicles
- To explain the layout and components of vehicles with front, rear and four wheel drive

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Summarize the chassis layout, frames and drive axles of anautomobile.
2. Analyze the mechanisms and geometry of steering system.
3. Differentiate the suspension systems based on their application.
4. Contrast the functions of the drive line components depending on their location.
5. Compare the various braking systems based on their construction and workingprinciples.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2									
2	2	3			3	3							3	
3	2	3			3	2							3	
4	2	3			3	2							3	
5	2				3	3								

UNIT I **9 Hours**

CHASSIS FRAMES AND AXLES

Types of chassis layout with reference to power plant location and drive, Frames- types, loads acting on frame and materials, testing of frames, Front Axles and stub axles- types, Drive axles- loads acting on drive axles, Types of drive axles- full floating, three quarter floating and semi floating axles, axle housings and types.

UNIT II **9 Hours**

STEERING SYSTEM

Condition for true rolling motion of wheels during steering- Ackerman''s and Davis steering mechanisms, steering linkages, steering columns, steering gear box, rack and pinion type, recirculating ball type, Power steering- hydraulic and electronic power steering, Steering geometry- castor, camber, steering axis inclination, turning radius and toe, Four wheel steering.

UNIT III **9 Hours**

SUSPENSION SYSTEM

Purpose and components of suspension system, Types of suspension springs, Sprung and unsprung weight, Front suspension system- Macpherson strut, torsion bar, coil spring and leaf spring front suspension, Rear suspension system- leaf spring, coil spring, strut type and torsion bar rear suspension, Shock absorber- purpose, types and operation, pneumatic and hydro , Elastic suspension spring systems, Active suspension system.

UNIT IV **9 Hours**

DRIVE LINE

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive and torque tube drive- radius rods and stabilizers, Propeller shaft- universal joints, constant velocity universal joints, slip joints, Front wheel drive, Final drive- double reduction and twin speed final drives, Differential- function, principle and types, differential housings, limited slip differential, differential locks.

UNIT V **9 Hours**

BRAKING SYSTEM, WHEELS AND TYRES

Need for brake systems, Drum brake and disc brake- construction and working of mechanical braking system, hydraulic braking system and pneumatic braking system, Power-assisted braking system- servo brakes, antilock braking systems, Electronic Stability Program. Wheels - type and construction, Tyres- radial and bias tyres, construction, tyre pressure, effects of over and under inflation, tubeless tyres, tyre specifications, tyre manufacturing.

Total: 45 Hours

Reference(s)

1. P.M. Heldt, Automotive Chassis, New York: Chilton Co, 2014.
2. K. Singh, Automobile Engineering-Volume 1, Delhi: Standard Publishes Distributors, 2012.
3. R.K. Rajput, A Text Book of Automobile Engineering, Delhi: Laxmi Publications Private Limited, 2007.
4. N.K. Giri, Automotive Mechanics, New Delhi: Khanna Publishers, 2005.
5. N.Steeds and Garret, Motor Vehicles, London: Butterworth, 2005.
6. H. Hazler, Modern Vehicle Technology, London: Butterworth, 2005.

18AU306 MANUFACTURING PROCESSES II 3 0 2 4

Course Objectives

- To learn the metal cutting theory, measure the forces acting on the single point tool and calculate various forces involved in it.
- To provide working skill and knowledge on construction and working of special lathes and CNC machines and also gain basic working skills for making simple components in automaticlathe.
- To impart the knowledge on working of metal forming process and provide working skill on sheet metal operations.
- To familiarize about the working of powder metallurgy processes and to provide working skills in non-traditional machining process (EDM).
- To provide knowledge on working of plastic manufacturing methods and to gain basic working skills in injection moulding process.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
l. 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.
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Explain the metal cutting theory and calculate the various forces acting on the lathe turningtool using Merchant circle.
2. Find out the suitable lathe machine/CNC machine based on the application and produce simple components using these machines.
3. Analyse the metal forming and sheet metal operations for the production of components and make simple components using theseprocesses.
4. Select the suitable powder metallurgy and non-traditional machining process based on the application and produce simple components using grindingmachines.
5. Choose the suitable plastic manufacturing method based on the application and producesimple components using inject moulding process.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3					1		2			1		3
2	2	3							2			1		3
3	2	3							2			1		3
4	2	3							2			1		3
5	2	3							2			1		3

UNIT I **10 Hours**

THEORY OF METAL CUTTING

Introduction to metal cutting method-mechanics of metal Cutting-orthogonal-oblique-Merchant"s circle diagram-details of derivation-chip formation-chip thickness ratio and shear plane-cutting tool nomenclature-tool wear, cutting tool life cutting speed, feed, depth of cut, cutting tool materials and cutting fluids, Recent developments and applications-dry machining, high speed machining.

UNIT II **9 Hours**

SPECIAL LATHES AND CNC MACHINES

Capstan and turret lathes - constructional features, specification, operations-Automats-Single spindle automatic lathe, multiple spindle automatic lathes-constructional features, specification, operations. Numerical Control (NC) machine tools-CNC types, constructional details, special features-coordinate system-Preparatory functions, Axis motion commands, Feed and speed commands, Miscellaneous command.

UNIT III **9 Hours**

METAL FORMING AND SHEET METAL PROCESS

Hot working and cold working of metals-Forging-open die forging, closed die forging-Rolling of metals-types of rolling - Extrusion-hot and cold extrusion-Sheet metal characteristics-shearing, blanking, punching, bending, trimming, perforating and drawing operations-Stretch forming-rubber forming-hydro forming-Thermoforming-Mechanical, vacuum, pressure.

UNIT IV **9 Hours**

POWDER METALLURGY AND NON CONVENTIONAL MACHINING PROCESS

Introduction to Powder Metallurgy process-preparation of powders, types & function of binders, green compaction-sintering process-Introduction to non-traditional machining process-water jet machining(WJM), wire cut EDM-laser beam machining-electron beam machining-electro chemical machining-plasma arc machining.

UNIT V **8 Hours**

FORMING AND SHAPING OF PLASTICS

Types of plastics - Moulding of Thermoplastics-Working principles and typical applications of Injection moulding-Plunger and screw machines-Blow moulding-Rotational moulding, Extrusion-Typical industrial applications, Thermoforming-Processing of Thermosets-Working principles and typical applications-Compression moulding-Transfer moulding.

1 **3 Hours**

EXPERIMENT 1

Study and practice of orthogonal and oblique cutting on lathe

2 **3 Hours**

EXPERIMENT 2

Measurement of cutting forces acting on the tool using dynamometer

3 **3 Hours**

EXPERIMENT 3

Making of hexagonal component using special lathes

4 **3 Hours**

EXPERIMENT 4
Making of stepped pulley using CNC machines

5 **3 Hours**

EXPERIMENT 5
Making of sheet metal component using shearing and bending operation

6 **3 Hours**

EXPERIMENT 6
Drawing of cup shaped product from sheet metal

7 **3 Hours**

EXPERIMENT 7
Preparation of solid component using sintering process

8 **3 Hours**

EXPERIMENT 8
Cutting operation of cast iron using wire cut EDM

9 **3 Hours**

EXPERIMENT 9
Preparation of simple component using Injection moulding process

10 **3 Hours**

EXPERIMENT 10
Moulding of simple component using thermoset / thermoplastic materials.

Total: 75 Hours

Reference(s)

1. SeropeKalpakjian and Steven R Schmid, Manufacturing Engineering and Technology, Pearson Education Limited., New Delhi, 7e, 2018.
2. S. K. Hajra Choudhury, Elements of Workshop Technology. Vol. II, Media Promoters & Publishers Private Limited., Mumbai, 2013.
3. P. N. Rao, Manufacturing Technology- Metal Cutting and Machine Tools, Tata McGraw Hill Publishing Company Private Limited., New Delhi, 2017
4. J. P. Kaushish, Manufacturing Processes, Prentice Hall India Learning Private Limited., New Delhi, 2013.
5. V. K. Jain, Advanced machining processes, 1st Edition, Allied publishers, 2010
6. http://nptel.ac.in/courses/112105126/1

18AU307 AUTOMOTIVE COMPONENTS LABORATORY

0 0 2 1

Course Objectives

- To experience the skill of dismantling and assembling of engines.
- To optimize the combustion process in SI and CIengines.
- To understand the requirements of fuel systems in automobile vehicle.
- To examine the malfunctioning of thesystem.
- To understand the mounting of components, the basic working principle of components with the engine for accurate operations.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. 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.
m. An ability to design, analyze and find the solutions for automotive relatedproblems

Course Outcomes (COs)

1. Select the type of automobile engine based on construction, shape andapplication.
2. Compare petrol and diesel fuel supply systems in modernautomobiles.
3. Explain the procedure for dismantling differential and clutch invehicles.
4. Demonstrate front and rear axles and steering systems.
5. Select the suitable gear box and determine the gear ratio for automobile vehicles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			2	2	3							1	2	
2	2			2	3									
3			2	2	3							1	3	
4				2	2									
5				2	3								2	

1 **4 Hours**

EXPERIMENT 1

Dismantling and study of Multi-cylinder Petrol Engine

2 **2 Hours**

EXPERIMENT 2
Assembling of Multi-cylinder Petrol Engine

3 **4 Hours**

EXPERIMENT 3
Dismantling and study of Multi-cylinder Diesel Engine

4 **2 Hours**

EXPERIMENT 4
Assembling of Multi-cylinder Diesel Engine

5 **2 Hours**

EXPERIMENT 5
Measurement of light Vehicle Frame

6 **4 Hours**

EXPERIMENT 6
Exercise on dismantling and assembling of front, rear axles and determination of differential gear ratio.

7 **4 Hours**

EXPERIMENT 7
Exercise on brake adjustment and brake bleeding of braking system

8 **2 Hours**

EXPERIMENT 8
Exercise on adjustment of slipping, grabbing, dragging, pedal pulsation of clutch.

9 **4 Hours**

EXPERIMENT 9
Exercise on dismantling and determining the gear ratio of synchromesh gear box

10 **2 Hours**

EXPERIMENT 10
Measurement of steering ratio, steering angle and turning radius of steering system

Total: 30 Hours

18AU308 AUTOMOTIVE COMPONENTS DRAWING LABORATORY

0 0 2 1

Course Objectives

- To impart the knowledge of limits, fits and tolerances, orthographic-sectional and assembly drawing procedures.
- To apply different sectional views in engineering drawing.
- To recognize the drawing notations of standard machineelements.
- To provide the practice to draw assembly orthographic views of various machine parts usedin industry.
- To provide the training to convert the detailed part drawing from physicalproducts.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Select fits, limits and tolerance for engineering applications.
2. Identify sectional view, assembly and orthographic concepts to draw various automotive parts.
3. Select and draw the standard mechanical elements like bolt, nut, screw etc.
4. Select the assembly drawing of automobile and mechanical components.
5. Identify the drawing notations of standard automotive elements and draw the detailed drawing of a given components.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2		2				2				2	
2	3		3		2				2				2	
3	3		2		3				2				3	
4	2		2		2				3				2	
5	2		3		2				2				2	

1 **5 Hours**

LIMITS, FITS AND TOLERANCES

Limit System- Tolerance, Limits , Deviation, Actual Deviation , Upper Deviation , Lower Deviation-Allowance , Basic Size , Design Size , Actual Size- Fits- Types, Tolerances of Form and Position- Form and Position Variation, Geometrical dimensioning and Tolerance - Tolerance Zone, Indicating Geometrical Tolerances-Indication of Surface Roughness, Standard Abbreviations and Symbols used in industries.

2 **5 Hours**

AUTOMOTIVE ELEMENT DRAWINGS

Drawing standards and Designation -Bolts, nuts, screws, keys, pins, Rivets, Welded Joints-Dimensioning of Welds, Belt Driven Pulleys, Chain and Gears Drives.

3 **5 Hours**

SECTIONAL VIEWS

Sections- Hatching of Sections, Cutting Planes- Revolved or Removed Section- Sectional Views- Full Section, Half Sections and Auxiliary Sections- Conventional Representation.

4 **8 Hours**

ASSEMBLY DRAWINGS

Manual parts drawing and assembled sectional views from orthographic part drawings -Automobile components- Single plate clutch, Multi plate clutch, Fuel Injector, Piston -Preparation of Bill of materials and tolerance data sheet. (Diagrams are not available for covering all the components)

5 **7 Hours**

REAL PRODUCTS TO MACHINE DRAWING CONVERSION

Manual part drawings - assembled sectional views- Vice, Fork, Cotter Joint, Knuckle Joint, Belt Driven Pulley - Preparation of Bill of materials and tolerance data sheet.

Total: 30 Hours

Reference(s)

1. N.D. Bhatt, Machine Drawing,CharotarPublishing House Pvt. Ltd., 2014
2. P.S.Gill, A Text Book of Machine Drawing,Katson books, 2013
3. R.K.Dhawan, A Text Book of Machine Drawing,S.Chand,2012
4. K.C. John, Textbook of Machine Drawing,PHI Learning Pvt. Ltd.,2009

18GE301 SOFT SKILLS - VERBAL ABILITY 0 0 2 0

Course Objectives

- To help students gain adequate proficiency invocabulary
- To read and understand unabridged text
- To help students become proficient in basic writing skills related to work placecommunication

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

j. 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.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Take up verbal ability part of the placement tests with confidence
2. Write with confidence in professional and workplacecommunication
3. Distinguish fact from opinion by reading passages from atext

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2											2			
3									2					

UNIT I **15 Hours**

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

UNIT II **15 Hours**

BASICS OF VERBAL APTITUDE

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

18AU401 ENGINEERING MATHEMATICS IV 3 1 0 4

Course Objectives

- Understand the methods to solve polynomial equations and Implement the mathematical ideas for interpolation numerically.
- Summarize and apply the methodologies involved in solving problems related to ordinary differential equations
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supportingenvironment

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

Course Outcomes (COs)

1. Classify the equations into algebraic, transcendental or simultaneous and apply the techniques to solve them numerically.
2. Find the interpolation, differentiation and integration of functions using the numericaltechniques.
3. Compute the solutions of ordinary differential equations, numerically.
4. Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.
5. Compute the occurrence of numerical errors.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	1												
3	1	2												
4	1	2												
5	2	2												

UNIT I **11 Hours**

ALGEBRAIC, SYSTEM OF LINEAR EQUATIONS AND EIGEN VALUE PROBLEMS

Solution of algebraic and transcendental equations: Newton- Raphson method - Solution of system of linear equations: Gauss elimination method - Inverse of a matrix: Gauss-Jordan method- Eigen values of a matrix by Power method.

UNIT II **9 Hours**

INTERPOLATION, DIFFERENTIATION AND INTEGRATION

Interpolation: Newtons forward and backward interpolation formulae - Numerical differentiation: Newtons forward and backward interpolation formulae. Numerical integration: Trapezoidal rule- Simpsons rules for single integrals- Two point Gaussian quadrature formula.

UNIT III **9 Hours**

INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS

Single step Methods : Taylor Series method for solving first order equations - Eulers and Modified Eulers methods - Fourth order Runge-Kutta method for solving first order equations - Multistep methods : Milnes predictor and corrector methods.

UNIT IV **11 Hours**

MATHEMATICAL STATISTICS

Sample mean and variance - Sampling distributions - Statistical estimation of parameters - confidence intervals - Testing of hypotheses : one-sample and two-sample inferences. Applications to statistical quality control and reliability analysis.

UNIT V **5 Hours**

ERROR ANALYSIS

Errors, Truncation and round off errors, measurement errors, Chebychevs Polynomial and data filtering.

Total: 60 Hours

Reference(s)

1. Greenberg Michael D., Advanced Engineering Mathematics, Prentice-Hall International Inc, 2 nd Edition 1998.
2. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 4th Edition 2011.
3. KreyszigErwin, Advanced Engineering Mathematics, 10th Edition, John Wiley, 2011.
4. Grewal B. S, Numerical Methods in Engineering and Science with Programms in C & C++, Ninth Edition, Khanna Publications, 2010.
5. https://nptel.ac.in/syllabus/syllabus.php?subjectId=111107062

18AU402 STRENGTH OF MATERIALS 2 1 2 4

Course Objectives

- To estimate the stress distribution and strains in regular and composite structures subjectedto axial loads and thermal effects.
- To analyse two dimensional stress systems and stresses in thincylinders.
- To draw shear force, bending moment diagrams and evaluate the bending stress in different beams under transverse loading.
- To impart knowledge on finding slope and deflection of beams and buckling of columnsfor different boundary conditions.
- To design shafts and helical springs based on theory of torsion.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Determine the axial stresses and strains developed due to mechanical and thermal effects.
2. Analyze the stresses induced in two dimensional stress system and the thincylinders.
3. Determine the shear force, bending moment, bending stresses for various beams under different loading conditions.
4. Compute the deformation of beams and columns under static equilibrium conditions.
5. Analyze the stresses induced in the shaft and helicalsprings.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										1	
2	2	3	2										2	
3	2	3	1										2	
4	2	3	1										2	
5	1	2	3										2	

UNIT I **6 Hours**

STRESS, STRAIN AND DEFORMATION OF SOLIDS

Introduction to mechanical properties-Hardness, Impact, Tensile, Compression, Torsion. Stresses and strains due to axial force in Stepped and Composite bars, Stresses due to thermal effect in composite bars, Stress-strain curve for ductile and brittle materials - Hooke""s law - Factor of safety - Poisson""s ratio. Elastic constants and their relationship.

UNIT II **6 Hours**

STRESSES IN TWO DIMENSIONS

State of stresses at a point, Normal and shear stresses on inclined planes, Principal planes and Principal stresses, Plane of maximum shear stress, analytical and graphical method. Hoop and longitudinal stresses in thin cylindrical vessels, Maximum Shear stress, Changes in dimensions and volume.

UNIT III **6 Hours**

SHEAR FORCE, BENDING MOMENT AND STRESSES IN BEAMS

Types of supports, Loads and beams, Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads, maximum bending moment and Point of contraflexure. Theory of Simple Bending, Bending stress and stress variation along the length and section of the beam, Sectionmodulus.

UNIT IV **6 Hours**

DEFLECTION OF BEAMS AND COLUMNS

Slope and Deflection of cantilever and simply supported beams by Double integration method and Macaulay""s method.Types of Columns, Equivalent length, Euler and Rankine""s formulae, Slenderness ratio.

UNIT V **6 Hours**

TORSION IN SHAFT AND HELICAL SPRING

Theory of torsion and assumptions - torsion equation, polar modulus, stresses in solid and hollow circular shafts, power transmitted by a shaft. Closed coil helical spring-stresses and deflection under axial load, Maximum shear stress in spring section including Wahl"s Factor.

1 **3 Hours**

EXPERIMENT 1

Find the hardness of the materials used in Gears, Brake parts using Rockwell hardness tester.

2 **3 Hours**

EXPERIMENT 2

Calculate the hardness of the materials used in crank shaft, cams using Brinell hardness tester.

3 **3 Hours**

EXPERIMENT 3

Calculate the hardness of the materials used in piston, cylinder using Vickers hardness tester.

4 **3 Hours**

EXPERIMENT 4

Plot stress-strain curve by observing the tensile behaviour of the materials used in piston, vehicle body.

5 **3 Hours**

EXPERIMENT 5

Study the deflection of an axles and chassis frames under simply supported beam concept and compare the experimental values of deflection with the theoretical values.

6 **3 Hours**

EXPERIMENT 6
Determine the compressive strength of the materials used in connecting rod, piston.

7 **3 Hours**

EXPERIMENT 7
Calculate the strains in cylinders subjected to internal pressure through thin cylinder test setup.

8 **3 Hours**

EXPERIMENT 8
Experimentally calculate the strain energy of Bumper material subjected to impact loading.

9 **3 Hours**

EXPERIMENT 9
Determination of spring constant for suspension springs, Valve springs through load vs deflection curve.

10 **3 Hours**

EXPERIMENT 10
Experimental analysis of a materials used in Torsion bars, Propeller shafts under torsion to obtain stiffness and angle of twist.

Total: 75 Hours

Reference(s)

1. Hibbeler R.C, Mechanics of Materials, Pearson Education, New Jersey, 2018.
2. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India Learning Pvt Ltd, New Delhi, 2010.
3. F. P. Beer and R. Johnston, Mechanics of Materials, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2015.
4. S.S.Rattan, Strength of Materials, McGraw Hill Education (India) Private Limited, Chennai, Third Edition, 2017.
5. S.S.Bhavikatti, Strength of Materials, Vikas Publishing House, New Delhi, Fourth edition, 2013
6. https://onlinecourses.nptel.ac.in/noc18_ce17/preview

18AU403 AUTOMOTIVE TRANSMISSION 3 0 0 3

Course Objectives

- To explain the concept of torque multiplication by gears and torqueconverters
- To acquire knowledge on concept, construction and principle of operation of mechanical, hydrodynamic, hydrostatic devices and automatic transmission systems
- To understand the purpose of clutch, gear box, fluid coupling and hydraulic systemsin automotive transmission.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Appraise the needs and functions of transmission system inautomobiles.
2. Select appropriate clutch from different types of Clutches used inautomobiles.
3. Choose appropriate gearbox from different types of manual gearbox used in automobiles.
4. Analyze hydrodynamic and hydrostatic transmission with performance parameter.
5. Choose appropriate automotive gearbox for modern automobiles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										2	
2	2	3	2										2	
3	1	3		2									3	
4	1	3		2									2	
5	2	3	2										3	

UNIT I **9 Hours**

INTRODUCTION

Need for Transmission system, Components in transmission system, Types of Transmission system, Tractive Effort and Resistances to Motion of a vehicle, Requirements and Classification of Transmission systems. Objective and need of the Gear Box, Determination of gear ratios for vehicles, Performance characteristics in different speeds, Power and economy modes in gearbox.

UNIT II **9 Hours**

CLUTCH

Clutches- requirement, types, principle of friction clutch, construction and operation of Single plate coil spring, Diaphragm spring clutches, Multiplate clutch, Cone clutch, Electromagnetic clutch, Centrifugal and Semi-Centrifugal Clutch, dry and wet type of clutch, Friction lining materials.

UNIT III **9 Hours**

MANUAL GEARBOX

Gear boxes -Sliding, Constant and Synchromesh type, Transfer box, Transaxles, Overdrives, Gear shifting mechanisms, Sequential, Selective Gearbox, Mechanical link and wire types.

UNIT IV **9 Hours**

HYDRAULIC TRANSMISSION

Fluid coupling- principle of operation, construction, performance characteristics, Torque converter- principle of operation, construction, performance characteristics, Multistage torque converters and Polyphase torque converters. Hydrostatic drives- principle, advantages & limitations, Janny hydrostatic drive- construction and working.

UNIT V **9 Hours**

AUTOMATIC TRANSMISSION

Epicyclic gearboxes - Gear Ratio calculation, Automatic transmission- merits and demerits, Typical automatic transmissions - Wilson gearbox, Chevy turboglide, Automated Manual transmission, Dual Clutch transmission, Continuously varying Transmission, Modern Transmission techniques.

Total: 45 Hours

Reference(s)

1. Newton and Steeds, Motor vehicles, London: Illife Publishers, 2002.
2. Heldt .P.M, Torque converters, Pennsylvania: Chilton Book Co., 2014.
3. Judge.A.W. Modern Transmission systems, London: Chapman and Hall Ltd, 2000.
4. Heisler. H, Advanced Vehicle Technology, Oxford: Butterworth Heinemann, 2002.

18AU404 AUTOMOTIVE MECHANICS 2 1 2 4

Course Objectives

- To acquire knowledge on the principles in the kinematics of mechanisms and static forces.
- To provide knowledge on the balancing of systems based on dynamic analysis fordifferent mechanisms.
- To design gears and cams for modern automobiles.
- To appreciate the effect of fuel governing mechanisms and gyroscopic effects.
- To analyze the forces and vibrations of simple mechanicalsystems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. An ability to design, analyze and find the solutions for automotive relatedproblems
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Analyse the static forces acting on simple mechanisms
2. Analyse the dynamic forces for balancing of the mechanism
3. Categorize the mechanism involved in cam and geartrain
4. Analyse the effect of fuel governing mechanism and gyroscopic mechanism
5. Inspect the system to reduce thevibration

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2										3	3
2	3	3	2		2								3	3
3	3	3	3		3								3	
4	3	3	3		3								3	
5	3	3	3		-								3	

UNIT I **6 Hours**

MECHANISM AND STATIC FORCE ANALYSIS

Machine , Structure - Kinematic link, pair and chain - Constrained motion - Degrees of freedom - Grueblers and Kutzback criteria - Inversions of Four bar mechanism and Inversion of single & double slidercrank mechanisms - Forces - Applied and Constraint-Free Body Diagrams-Static equilibrium conditions; two, three and four force members-Static force analysis in simple mechanisms.

UNIT II **6 Hours**

DYNAMIC FORCE ANALYSIS AND BALANCING

Inertia force and torque-D"Alemberts Principle-Dynamic force analysis in Reciprocating engine: Gas force, Equivalent mass, Bearing Loads, Crank shaft torque-Engine shaking forces-Ackermann Steering mechanism

Static and dynamic balancing-Balancing of rotating and reciprocating masses.

UNIT III **6 Hours**

CAM AND GEAR MECHANISMS

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

Gear terminology, types of gears, law of gearing -Nomenclature of spur and helical gears - Gear trains: simple, compound gear trains and epicylic gear trains.

UNIT IV **6 Hours**

GOVERNING AND GYROSCOPIC MECHANISM

Governors: working principle, types, construction, sensitivity, controlling force-Gyroscopic principle-Gyroscopic couple-Centrifugal couple-effect on four wheeled vehicles-Gyroscopic forces, torques and stabilization.

UNIT V **6 Hours**

FUNDAMENTALS OF VIBRATION

Terminologies, types of vibration, equation of motion -Free undamped vibration, free damped vibration - Damping ratio, damping coefficient, logarithmic decrement, critical speed - Torsional vibration -Single, two and three rotor system.

1 **3 Hours**

EXPERIMENT 1

Analyse the four bar mechanism for simple forces

2 **3 Hours**

EXPERIMENT 2

Analyse the crank and slider mechanism for simple forces

3 **3 Hours**

EXPERIMENT 3

Analyse the Ackerman steering mechanism used in an automobile

4 **3 Hours**

EXPERIMENT 4

(i) Balance a system of rotating masses at single and different planes
(ii) Balance a system of reciprocating masses

5 **3 Hours**

EXPERIMENT 5

Generate the cam profile for a typical automotive engine

6 **3 Hours**

EXPERIMENT 6
Generate the profile of a spur gear and helical gear for automotive application

7 **3 Hours**

EXPERIMENT 7
Compute the sensitivity and controlling force of an automotive fuel governor

8 **3 Hours**

EXPERIMENT 8
Analyse the gyroscopic effect on a two wheeler

9 **3 Hours**

EXPERIMENT 9
Compute a method to reduce vibration in a two rotor system

10 **3 Hours**

EXPERIMENT 10
Compute a method to reduce vibration in a three rotor system

Total: 60 Hours

Reference(s)

1. Shigley J.E. and Uicker J.J., Theory of Machines and Mechanisms, McGraw Hill. Inc., 2017.
2. S.S. Rattan, Theory of Machines, Tata McGraw-Hill Publishing Co., New Delhi, 2014.
3. S.S. Rao, Mechanical Vibrations, Prentice Hall of India, New Delhi, 2017.
4. Thomas Bevan, The Theory of Machines, Pearson Education, 2010.
5. https://nptel.ac.in/courses/112104121/

18AU405 APPLIED THERMODYNAMICS AND HEAT TRANSFER **3 1 0 4**

Course Objectives

- To acquire knowledge on air compressors, gas turbines and their performance
- To apply the thermodynamic concepts to air compressors, refrigeration and air conditioning systems
- To build up necessary background for understanding the physical behavior of three modes of heat transfer

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Analyze Performance of the air compressors and gas turbines thermodynamically.
2. Apply thermodynamic principles and psychrometry to evaluate the performance of refrigeration and air conditioning systems
3. Analyze heat transfer by conduction in steady state systems, unsteady systems and fins for practical problems
4. Apply the convection and radiation heat transfer principles to practical problems.
5. Design and analyze the performance of heat exchangers.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		3									3	
2	3	2		1									3	
3	2	3		2									2	
4	3	2	3	1									2	
5	2	3	3	1									3	

UNIT I **9 Hours**

AIR COMPRESSORS AND GAS TURBINES

Types-Work required-Effect of clearance volume, volumetric efficiency, isothermal efficiency, free air delivery- Multistage compression, condition for minimum work- Working principle of rotary compressor-Centrifugal Compressors.
Gas turbine plants - Open and closed cycles - Thermodynamic cycles - Regeneration, reheating, intercooling - Performance of gas turbines.

UNIT II **9 Hours**

REFRIGERATION AND AIR CONDITIONING

Vapour compression Refrigeration cycle - Effect of superheat, sub cooling of refrigerant - Performance calculations- Vapour absorption system-Ammonia- water and Lithium bromide water systems(Descriptiononly)

Air conditioning- Psychromterty of air conditioning systems- RSHF, GSHF, ESHF, Cooling and heating load calculations for typical automobiles- Air conditioning systems.

UNIT III **10 Hours**

CONDUCTION

Basic concepts - Mechanism of heat transfer - Conduction, convection and radiation - General differential equation of heat conduction - Fourier law of conduction - One dimensional steady state heat conduction - Conduction through plane wall, cylinders and spherical systems - Composite systems - Heat transfer from finned surfaces -Fins of uniform cross section- Fin efficiency and effectiveness-Unsteady heat conduction - Lumped analysis - Use of Heislers chart.

UNIT IV **8 Hours**

CONVECTION AND RADIATION

Basic concepts - Convective heat transfer coefficients - Boundary layer concept - Forced convection, dimensional analysis, external flow, flow over plates, cylinders and spheres - Internal flow, laminar and turbulent flow- Flow over bank of tubes - Free convection, dimensional analysis, flow over vertical plate and horizontal plate. Shape factor-Radiation shields -Gas radiation.

UNIT V **9 Hours**

HEAT EXCHANGERS

Single and multi tube heat exchangers - Parallel, counter and cross flow heat exchangers, overall heat transfer coefficient, LMTD and effectiveness (NTU) methods- Fouling factor - compact heat exchangers.

Total: 60 Hours

Reference(s)

1. Y.Cengel and M. Boles, Thermodynamics: An Engineering Approach, New Delhi: Tata McGraw- Hill Publishing Company, 2014.
2. T. D. Eastop and A. McConkey, Applied Thermodynamics for Engineering Technologists, New Delhi: Pearson Education, 2009.
3. P. K. Nag, Basic and Applied Thermodynamics, New Delhi: Tata McGraw- Hill Publishing Company, 2009.
4. T. L. Bergman, A. S. Lavine, F. P. Incropera and D. P. DeWitt, Fundamentals of Heat and Mass Transfer, New Jersey: John Wiley & Sons, 2011.
5. J.P. Holman, Heat transfer, New Delhi: Tata McGraw- Hill Publishing Company, 2008.
6. https://nptel.ac.in/courses/112101097/

18AU406 AUTOMOTIVE ELECTRICAL SYSTEM 3 0 0 3

Course Objectives

- To acquire knowledge on batteries and lighting systems
- To describe starting, charging, ignition and injection systems
- To understand the role of sensors and actuators invehicles

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Select the appropriate Battery from different types of Battery used inautomobiles.
2. Access the performance of Lighting System used inautomobiles.
3. Analyze the Starting and Charging System with their performance used inautomobiles.
4. Analyze the Ignition System with their performance parameter used inautomobiles.
5. Choose appropriate automotive Sensors and Actuators for modernautomobile

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1					1						2	
2	3	1	1										2	
3	2	3		1									2	
4	2	3		2									2	
5	3	1	2										2	

UNIT I **9 Hours**

LIGHTING SYSTEM

Lighting System - insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods, anti-dazzling and dipper details, Smart lighting system, Dashboard instruments. Selection of Fuses, cables, connectors; multiplexing and de-multiplexing. Automotive wiring system.

UNIT II **9 Hours**

ELECTRICAL DEVICES

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators types, construction and Characteristics. Voltage and Current Regulation, cut Ã¢??out relays and regulators, Charging circuits for D.C. Generator, A.C. Alternators.

UNIT III **9 Hours**

SENSORS

Microprocessor architecture, open and closed loop control strategies, Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, air mass flow, crank shaft position, cam position, engine and wheel speed, fuel level, exhaust oxygen level, knock, engine temperature, manifold temperature and pressure sensors. Infrared sensors, Ultra sonic sensors, LIDAR, RADAR, voltage sensor.

UNIT IV **9 Hours**

SAFETY SYSTEMS

ABS system-layout and working. Electronic control of suspension, Electric power steering, Supplementary Restraint System of air bag system-crash sensor, seat belt tightening. Cruise control. Vehicle security systems- alarms, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.

UNIT V **9 Hours**

E MOBILITY

Power grids- Definition, sources for power grid, Types. Battery Management system- need for BMS, battery heat problems, over charging and undercharging problems. Electric motors- BLDC, Induction motors, Difference between BLDC and Induction motors. Electric drives- AC drives, DC drives.

Total: 45 Hours

Reference(s)

1. Robert Bosch, Automotive Handbook, Bentley Publishers, 2011
2. Tom Denton, Automobile Electrical and Electronic Systems, UK:Taylor & Francis Ltd,V edition,2017
3. Ali Emadi,Advanced Electric Drive Vehicle, McMaster University, Hamilton, Ontario, Canada, 2017.
4. Austin Huges and Bill Drury, Ã¢??Electric Motors and Drives fundamentals, types and applicationsÃ¢??,4th Edition.

18AU407 AUTOMOTIVE ELCTRICAL LABORATORY 0 0 2 1

Course Objectives

- To acquire skills in inspecting and testing vehicle electricalsystems.
- To acquire knowledge on vehicle wiring.
- To acquire skills in diagnosis of ignition systemfailures.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Perform inspection on headlights, horn and sidelamps
2. Perform and inspect various tests on batteries, starter motor and alternator
3. Interface analog sensors to micro controller to perform automaticoperations.
4. Perform simple data acquisition from automotivesystem
5. Perform inspection on motor drives and power grids.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1				3		1		2				2	
2	2	2			3		2		2				2	
3	2	1			3		1		2				2	
4	2	2			2		2		2				2	
5	2	2			3		2		2				2	

1 **3 Hours**

EXPERIMENT 1

Connection and observation of headlights, horn and sidelamps.

2 **3 Hours**

EXPERIMENT 2

Demonstration of Automobile electrical wiring Testing of battery with hydrometer and high rate discharge tester

3 **3 Hours**

EXPERIMENT 3
Testing of starting motors.

4 **3 Hours**

EXPERIMENT 4
Testing of generators

5 **3 Hours**

EXPERIMENT 5
Construction and observation of obstacle sensors.

6 **3 Hours**

EXPERIMENT 6
Construction and observation of Powertrain sensors.

7 **3 Hours**

EXPERIMENT 7
Testing of battery with hydrometer and high rate discharge tester

8 **3 Hours**

EXPERIMENT 8
Charging characteristics of Battery

9 **3 Hours**

EXPERIMENT 9
Observation of motor drives.

10 **3 Hours**

EXPERIMENT 10
Study of Power and power grids

Total: 30 Hours

Reference(s)

1. P.L.Kohli, Automotive Electrical Equipment, New Delhi: Tata McGraw-Hill Education co ltd, 2004.
2. W.H.Crouse, Automobile Electrical Equipment, NY: McGraw-Hill Book Co Inc, 2005.
3. T.Denton, Automotive Electrical and Electronic System, UK: Elsevier Butterworth-Heinemann, 2004.

18AU408 THERMO FLUIDS ENGINEERING LABORATORY

0 0 2 1

Course Objectives

- To apply the theoretical and analytical skills acquired in thermodynamics, fluid mechanicsand heat transfer to laboratory experiments
- To evaluate the performance of air compressors, refrigeration systems, air conditioningsystems and pumps
- To analyze the heat transfer characteristics of parallel and counter flow heat exchangers

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.

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

c. 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.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Compute the coefficients of flow measuring devices.
2. Compute the friction losses in pipes.
3. Evaluate the performance of two stage reciprocating air compressor, positive displacement pump, refrigerator and air conditioning systems
4. Calculate the thermal conductivity of metals, the heat transfer coefficients offree and forced convection
5. Evaluate the performance characteristics of heat exchanger

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2					2				2	
2	2	3		1					2				2	
3	2	3	1	2					2				3	
4	3	2	1	2					2				1	
5	2	3		1					2				3	

1 **4 Hours**

EXPERIMENT 1

Fluid flow measurements using venturimeter, orificemeter and pitot tube

2 **2 Hours**

EXPERIMENT 2
Determination of friction losses in piping systems

3 **2 Hours**

EXPERIMENT 3
Determination of performance characteristics of positive displacement pump

4 **4 Hours**

EXPERIMENT 4
Determination of volumetric efficiency and overall efficiency of reciprocating air-compressor

5 **2 Hours**

EXPERIMENT 5
Determination of co-efficient of performance and ton of refrigeration of vapour compression refrigeration system

6 **4 Hours**

EXPERIMENT 6
Determination of co-efficient of performance and ton of refrigeration of air conditioning system

7 **2 Hours**

EXPERIMENT 7
Determination of thermal conductivity of metal rod

8 **4 Hours**

EXPERIMENT 8
Experimental study of heat transfer by natural convection

9 **4 Hours**

EXPERIMENT 9
Experimental study of heat transfer by forced convection

10 **2 Hours**

EXPERIMENT 10
Determination of performance characteristics of double pipe heat exchanger

Total: 30 Hours

Reference(s)

1. P. K. Nag, Basic and Applied Thermodynamics, New Delhi: Tata McGraw- Hill Publishing Company, 2016.
2. T. D. Eastop and A. McConkey, Applied Thermodynamics for Engineering Technologists, New Delhi: Pearson Education, 2009.
3. T. L. Bergman, A. S. Lavine, F. P. Incropera and D. P. DeWitt, Fundamentals of Heat and Mass Transfer, New Jersey: John Wiley & Sons, 2011.
4. P. K. Nag, Heat and Mass Transfer, New Delhi: Tata McGraw- Hill Publishing Company, 2011.
5. Y. Cengel and J. Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGrawHill Publishing Company Pvt Ltd., New Delhi 2009.
6. P.Purusothamaraj and V.Ramasamy, Fluid Mechanics and Machinery,Scitechpublications (India) Pvt.Ltd, Chennai, 2012.

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life andstimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Identify the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Correlate the impacts of population and human activities onenvironment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	1												
3	2	2					1							
4	1													
5	2													

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods Ã¢?? earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste.

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights:Biomedical waste -Identification of adulterants infoodmaterials

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and PollutionScience. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, NewDelhi, 2014

18GE401 SOFT SKILLS-BUSINESS ENGLISH 0 0 2 0

Course Objectives

- To acquire command ofboth the receptive skills (Listening, Reading) and the productiveskills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
j. 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.

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2										2				

UNIT I **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information
Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

UNIT II **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 30 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

18AU501 METROLOGY AND MEASUREMENTS 3 0 2 4

Course Objectives

- To understand the objectives of metrology and the concept of measurement.
- To explain the measurement techniques on linear and angular measurements.
- To describe the measurement techniques on gear, thread and radial profiles.
- To provide knowledge on recent trends in metrology and measurements.
- To deliver the various measurement techniques of mechanical parameters

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Explain the characteristics of measuring instruments and errors in measurements.
2. Select the suitable linear measuring instruments for measuring the component dimensions like piston pin, piston rings and crank shaft.
3. Choose the appropriate measuring instruments to measure the critical dimensions of screw threads and gears.
4. Find the suitable optical measuring instrument to measure flatness, squareness and surface roughness of the given component.
5. Show the suitable measuring instrument to measure force, power, pressure and temperature parameters.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2		2								2	
2	2	3	2		2				2				3	
3	2	3	2		2				2				3	
4	2	3	2		2				2				2	
5	2	3	2		2				2				3	

UNIT I **4 Hours**

CONCEPT OF MEASUREMENT

Introduction: Definition, Objectives, Need for Inspection, Elements of Measuring System, Accuracy and Precision - Units and Standards - Characteristics of measuring instrument: Sensitivity, Stability, Interchangeability, Range of accuracy, Readability, Reliability, Backlash, Repeatability and Reproducibility - Errors in Measurements: Static and dynamic errors - Calibration of Measuring Instruments - Care of Measuring Instruments.

UNIT II **6 Hours**

LINEAR AND ANGULAR MEASUREMENTS

Linear Measurements: Vernier Caliper, Vernier Height and Depth Gauges, Micrometer and depth micrometer, Slip gauge, limit gauge and its classification - Comparator: Mechanical, Pneumatic and Electrical types - Angular Measurements: Bevel protractor, Sine bar, Angle Decker, Autocollimator.

UNIT III **8 Hours**

FORM MEASUREMENT

Thread Measurement: Terminologies, Errors - External Thread Measurement: Pitch Gauge, Tool Makers microscope, Floating Carriage micrometer with One, Two and Three wires - Internal Thread Measurement: Taper Parallels and Rollers method. Gear Measurement: Terminologies, Errors, Gear Tooth Vernier caliper, Profile Projector, Base pitch measuring instrument, David Brown Tangent Comparator, Involute tester, Parkinson Gear Tester - External and Internal Radius measurements - Roundness measurement: Circumferential confining gauge, Assessment using V block and Rotating centers.

UNIT IV **6 Hours**

LASER AND ADVANCES IN METROLOGY

Interferometer: NPL Flatness, Laser, Michelson-Laser gun - Computer Aided Inspection - Digital Devices - Machine Vision System - Coordinate Measuring Machine: Basic concept, Types, Constructional features, Probes, Accessories - 3D scanner with blue light technology - Surface Roughness Measurement - Straightness Measurement -Squareness Measurement - Machine Tool Metrology.

UNIT V **6 Hours**

MEASUREMENT OF MECHANICAL PARAMETERS

Measurement of Force - Principle, platform balance, proving ring. Torque - Prony brake, hydraulic dynamometer, eddy current dynamometer and DC dynamometers Ã¢?? Tachometer - Pressure Measurement: Principle, use of elastic members, Bridgeman gauge, Mcleod gauge, Pirani gauge, Piezo-electric pressure pickup - Temperature Measurement: bimetallic strip, thermocouples, metal resistance thermometer, pyrometers- Introduction to Nanometrology.

1 **4 Hours**

EXPERIMENT 1

Comparing the accuracy of vernier caliper, vernier height gauge and micrometer to check the various dimensions of given automobile components.

2 **2 Hours**

EXPERIMENT 2

Checking the dimensional limits of ten similar automobile components using mechanical comparator.

3 **4 Hours**

EXPERIMENT 3
Measurement of taper angle of a given specimen by direct and indirect method.

4 **4 Hours**

EXPERIMENT 4
Measurement of screw thread specifications by using tool makers microscope.

5 **4 Hours**

EXPERIMENT 5
Measurement of gear tooth specifications by using Gear tooth verniercalliper / Tool maker microscope / Profile projector / Parkinson gear rolling tester.

6 **2 Hours**

EXPERIMENT 6
Measurement of surface finish of a given automobile component using profilometer.

7 **2 Hours**

EXPERIMENT 7
Measurement of dimensions of a given automobile component using Coordinate measuring machine.

8 **4 Hours**

EXPERIMENT 8
Measurement of straightness of a given automobile component by using Autocollimator and Interferometer.

9 **2 Hours**

EXPERIMENT 9
Machine tool alignment test on Lathe / Milling machine / Drilling machine.

10 **2 Hours**

EXPERIMENT 10
Temperature measurement by using Bimetallic strip / Thermocouples / Pyrometer.

Total: 60 Hours

Reference(s)

1. Beckwith, Marangoni, Lienhard, Mechanical Measurements, Pearson Education , 2014.
2. Bewoor and Vinay Kulkarni, Metrology & Measurement, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,2009.
3. Alan S. Morris, The Essence of Measurement, Prentice Hall of India, New Delhi,2001
4. R. K. Jain, Engineering Metrology, 21e, Khanna Publishers, New Delhi, 2016.
5. A. K. Jayal, Instrumentation and Mechanical Measurements, Galgotia Publications, NewDelhi 2000.
6. www.nptel.ac.in/courses/112104250

18AU502 DESIGN OF AUTOMOTIVE ENGINE COMPONENTS **3 1 0 4**

Course Objectives

- To understand the stresses induced in machine components by different types ofloads.
- To familiarize the various steps involved in the design process.
- To understand the principles involved in evaluating the shape and dimensions of an automotive engine component to satisfy functional and strengthrequirements.
- To learn to use standard practices and standarddata.
- To learn to use catalogues and standard machinecomponents.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Compute the stresses caused by different types of loads and theories of failure to design commonly used machine components.
2. Calculate the dimensions of cylinder, mountings, piston components and valve of an IC engine.
3. Analyse the design parameters of connecting rod andcrankshaft
4. Analyse the design parameters of flywheel and bearings
5. Compute the fuel system design parameters based on the engine performancerequirement

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3												2	
2	3	3	3					3			3		3	
3	3	3	3					3			3		3	
4	3	3	3					3			3		3	
5	3	3	3					3			3		3	

UNIT I **9 Hours**

INTRODUCTION

Introduction to the design process-Selection of Materials Based on Mechanical Properties, stresses due to eccentric loading, Design of straight and curved beams - "C" frame and crane hook. Stress concentration - Design for variable loading - Soderberg, Goodman, Gerber methods and Principal Stresses in members subjected to combination of static loads- Theories of failure.

UNIT II **9 Hours**

DESIGN OF CYLINDER, PISTON COMPONENTS AND VALVES

Design of cylinder wall-liner-cylinder head-calculations-engine mountings and types - Piston components-choice of material-gas force calculation-piston, piston pin, and piston rings design calculation-piston slap-piston failures. Valve train components-valves-types-materials-design calculation.

UNIT III **9 Hours**

DESIGN OF CONNECTING ROD AND CRANKSHAFT

Connecting rod-material-determining minimum length-small end design-shank design-design of big end cap bolts. Crankshaft-IC engines balancing-firing order-significance-material-design of crankshaft under bending and twisting.

UNIT IV **9 Hours**

DESIGN OF FLYWHEELS AND BEARINGS

Mass of a flywheel-coefficient of speed fluctuation-engine flywheel-stresses on the rim-Design of hubs and arms of the flywheel-turning moment diagram. Types and selection criteria - Design of journal bearings, collar bearing - Design of rolling contact bearing - Ball and roller bearing.

UNIT V **9 Hours**

DESIGN OF FUEL SYSTEM

SI engine-carburettor-venturi main jet-compensating jet-calculations. CI engine-fuel injection pump-theoretical fuel delivery-plunger diameter-complete plunger stroke-plunger active stroke-injector-fuel discharge time-mean velocity of fuel discharge-nozzle hole diameter.

Total: 60 Hours

Reference(s)

1. J.E. Shigley and C.R. Mischke, Mechanical Engineering Design, Tata McGraw - Hill Publishing Company Pvt. Ltd., New Delhi, 2017.
2. V.B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Education, 2017.
3. Khurmi. R.S. and Gupta. J.K., A Textbook of Machine Design, Eurasia Publishing House(Pvt) Ltd., 2005.
4. Richard van Basshuysen, Internal Combustion Engine Handbook, SAE International, 2004.
5. Kolchin and Demidov,Design of automotive engines, Mir Publishers Moscow, 1984.
6. http://www.nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/New_index1.html

18AU503 AUTOMOTIVE ELECTRONICS 3 0 0 3

Course Objectives

- To understand the concepts of Automotive Electronics and it"s evolution and trends
- To understand sensors and sensor monitoring mechanisms aligned to automotivesystems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
- To understand role of Microcontrollers in ECU design and choice of appropriate Hardware and Software.
- To describe various communication systems, wired and wireless protocols used in vehicle networking.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Identify the current trends of automotive electronics systems
2. Analyse different control module of automotive engine.
3. Select appropriate automotive Sensors and Actuators for modern automobiles
4. Understand Interfacing of sensors and actuators usingRTOS
5. Analyse the communication protocol suitable forautomobile

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2											2	
2	3	3	3		3								3	
3	2												2	
4	3	3	2		3								3	
5	2												3	

UNIT I **9 Hours**

ELECTRONICS IN AUTOMOBILE

Introduction- Body and convenience electronics: vehicle power supply controllers and lighting modules, door control modules, Safety electronics: active safety systems: ABS, ASR, ESP passive safety systems: Restraint systems and their associated sensors in an automobile. Infotainment electronics: Dashboard/instrument cluster, car audio, telematics systems, navigation systems, multimedia systems.

UNIT II **9 Hours**

ELECTRONIC ENGINE CONTROLS

Concept of an electronic engine control system: - electronic fuel injection - throttle body fuel injection, multi point fuel injection, gasoline direct injection, common rail direct injection, electronic ignition control, engine mapping, on-board diagnostics-engine control module and power train control module.

UNIT III **9 Hours**

AUTOMOTIVE NEURAL NETWORKS

ANN-Definition, artificial and biological neuron, learning (supervised and unsupervised learning). (Unsupervised learning) McCulloh-Pitts neuron, Linear separability, Hebb network. (Supervised learning) Perceptron Network, Adaline, Medaline. Convolution Neural Networks- Feed Forward networks, Back propagation network.

UNIT IV **9 Hours**

REAL TIME OPERATING SYSTEM (RTOS)

Comparison of conventional OS with RTOS. Tasks & task states (Pre-emptive & Non-pre-emptive, scheduler, interrupt -Interrupt latency and context switch latency)-Task, multi-tasking, task synchronization, inter-task communication, shared data problem and its prevention - Features of a typical embedded RTOS (MuC/OS-II).

UNIT V **9 Hours**

COMMUNICATION PROTOCOLS

Introduction to control networking-Communication protocols in embedded systems-SPI, I2C, USB. Vehicle communication protocols-Introduction to CAN, LIN, FLEXRAY, MOST, AUTO SAR.

Total: 45 Hours

Reference(s)

1. Robert Bosch,Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive, Springer Vieweg ,Plochingen, Germany, 2014.
2. William B Ribbens, Understnading Automotive Electronics- An Engineering Persepective, The Boulevard, Langford Lane, Kidlington, Oxford, 2017.
3. Barry Holembeak, Automotive Electricity and Electronics Delmar Publishers, Clifton Park, USA, 2010.
4. James D Halderman, Automotive Electricity and Electronics, Prentice Hall, USA, 2013.
5. Al Santini, Automotive Electricity and Electronics, Delmar Learning, 2011.
6. Charu C. Aggarwal Neural Networks and Deep Learning: A Text Book

18AU504 AUTOMOTIVE EMISSION AND CONTROL 3 0 2 4

Course Objectives

- To acquire knowledge on SI and CI engine emission
- To describe emission measurement, test procedure & regulations
- To apply control technologies for SI and CI engine emission

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.

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

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.

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

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Explain the emission scenario and sources of pollutants from vehicle
2. Analyze the causes, effects of pollutants from an S.Iengine
3. Analyze the causes, effects of pollutants from an C.Iengine
4. Indicate the emission controlling techniques used in anengine
5. Analyze the testing procedure methods for measuring emission in an engine

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2			2	2	2	2				2	
2	2	3					2	2	2				3	
3	2	2		2			1	2	2				2	
4	1	2		2	3		1	2	2				3	
5	2	3			2	3	2	2	2				3	

UNIT I **8 Hours**

INTRODUCTION

Automobile emission scenario-sources of emission from vehicle, contribution to pollution, Formation of pollutants- photochemical smog, primary and secondary pollutants, Effects on human health and environment- global warming, Types of emission, Transient operational effects on pollution.

UNIT II **9 Hours**

SI ENGINE EMISSION

Pollutant formation in SI Engines- HC and CO formation in four stroke and two stroke SI engines, NOx formation in SI engines, Effects of design and operating variables on emission formation- engine modifications, Effect of fuel properties and additives, Emissions from alternate fuels.

UNIT III **8 Hours**

CI ENGINE EMISSION

Pollutant formation in CI engines- smoke and particulate emissions in CI engines, Formation of HC and CO in CI engines-undermining and over mixing, NOx formation, Effects of design and operating variables on CI engine emissions- engine modifications.

UNIT IV **10 Hours**

EMISSION CONTROL TECHNIQUES

Add on systems to control emissions inside the engine- EGR, crankcase and evaporative emission control, Exhaust gas after treatment- secondary air injection, thermal and catalytic reactors, oxidation, reduction and 3-way catalytic reactors, lean de-NOx catalysts, NOx traps and SCR, Diesel particulate filters (DPF), DPF regeneration, CRT.

UNIT V **10 Hours**

EMISSION MEASUREMENT, TEST PROCEDURES

Instruments- non dispersive infrared (NDIR) analyzer, flame ionization detectors (FID), chemiluminescence analyzer, smoke meters, gas chromatograph, Test procedures - ECE, FTP Tests, SHED Test, chassis dynamometers, dilution tunnels, Trends in vehicle emission standards- emission limits, Driving cycles - USA, Japan, Euro and India.

1 **3 Hours**

EXPERIMENT 1

Case study on Emissions on Indian scenario

2 **4 Hours**

EXPERIMENT 2

Performance and emission tests on a two wheeler vehicle

3 **3 Hours**

EXPERIMENT 3

Performance and emission tests on automotive multi-cylinder SI engine

4 **3 Hours**

EXPERIMENT 4

Heat balance and Emission tests on automotive SI Engine

5 **3 Hours**

EXPERIMENT 5
Performance and emission tests on automotive multi-cylinder CI engine

6 **3 Hours**

EXPERIMENT 6
Heat balance and Emission tests on automotive CI Engine

7 **3 Hours**

EXPERIMENT 7
Performance and emission tests on automotive multi-cylinder CI engine with EGR

8 **3 Hours**

EXPERIMENT 8
Performance and emission tests on automotive multi-cylinder CI engine with Catalytic Converter

9 **3 Hours**

EXPERIMENT 9
Analyzing the combustion characteristics of automotive engines

10 **2 Hours**

EXPERIMENT 10
Case study on testing driving cycles followed in different countries.

Total: 75 Hours

Reference(s)

1. J.D. Halderman and J. Linder, Automotive Fuel and Emissions Control Systems, NJ: Pearson Education, 4th edition 2016.
2. B.P. Pundir, Engine Emissions: Pollutant Formation and Advances in Control Technology, New Delhi: Narosa Publishing House, 2017.
3. M. Adachi and H. Nakamura, Eds., Engine Emissions Measurement Handbook, PA: SAE International, 2014.
4. M.K.Khair and W.A.Majewski, Diesel Emissions and Their Control, PA: SAE International, 2014.

18AU507 AUTOMOTIVE ELECTRONICS LABORATORY

0 0 2 1

Course Objectives

- To acquire knowledge on microprocessor and control strategies
- To acquire skills in inspecting and testing vehicle electrical and electronics systems
- To acquire knowledge on vehicle wiring and sensors
- To acquire skills in diagnosis of electronic systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

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

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

m. An ability to design, analyze and find the solutions for automotive relatedproblems

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Perform sensor and actuator interfacing using PIC microcontroller.
2. Execute passenger door module control and repair.
3. Analyze sunroof module and electronic accelerator pedal
4. Analyze parameters of MPFI and CRDisystem
5. Determine diagnostics errors in vehicle using OBD

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2		2		3				2	3
2	2	3			2		2		3				3	3
3	2				2		2		3				2	3
4	2	3			2		2		3				3	3
5	2	3			2		2		3				3	3

1 **3 Hours**

EXPERIMENT 1

Perform LED Blinking, Digital Inputs and outputs using Microcontrollers

2 **3 Hours**

EXPERIMENT 2

Perform Interrupt, Buzzer and Input Capture using Microcontrollers

3 **3 Hours**

EXPERIMENT 3
Perform control of passenger door module.

4 **3 Hours**

EXPERIMENT 4
Control automotive central locking system

5 **3 Hours**

EXPERIMENT 5
Perform and control sunroof module

6 **3 Hours**

EXPERIMENT 6
Perform Electronic Accelerator pedal repair

7 **3 Hours**

EXPERIMENT 7
Determine parameters of MPFI and CRDi

8 **3 Hours**

EXPERIMENT 8
Perform control of lane assist system

9 **3 Hours**

EXPERIMENT 9
Analyze Electronic Suspension System

10 **3 Hours**

EXPERIMENT 10
Electronic Control System Diagnostics, OBD, Diagnostics
Fault Codes

Total: 30 Hours

Reference(s)

1. William.B.Ribbens , Understanding Automotive Electronics, 7th edition Butterworth-Heine publications,2012.
2. R.C Dorf and R.H. Bishop, Modern Control Systems, NJ: Prentice Hall, 2010
3. Robert Bosch Gmbh, Bosch Automotive Electric and Electronics, 5th edition Springer-Vieweg.2007
4. Tom Denton, Automobile Electrical and Electronic Systems, 3rd edition, Elsevier Butterworth-Heinemann 2004.
5. W.H.Crouse, Automobile Electrical Equipment, NY: McGraw-Hill Book Co Inc, 2005.
6. P.L.Kohli, Automotive Electrical Equipment, New Delhi: Tata McGraw-Hill Education co ltd, 2004.

18AU508 AUTOMOTIVE COMPONENTS MODELING LABORATORY

0 0 2 1

Course Objectives

- To impart knowledge on the optimization of design parameters for engine andchassis components.
- To educate with working knowledge on CAD software for the design and modelling ofengine and chassis components.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

l. 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.

m. An ability to design, analyze and find the solutions for automotive relatedproblems

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Understand the concepts of automotive components designparameters.
2. Design the engine components using analytical calculation and model the same using CAD software.
3. Create the assembled model of engine as a functional system.
4. Design the chassis components using analytical calculation and model the same usingCAD software.
5. Create the assembled model of chassis as a functional system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3		3				2			3	3	3
2	3	2			3				2			2	3	3
3	3	3	3		3				2			3	3	3
4	3	2			3				2			2	3	3
5	3	3	3		3				2			3	3	3

1 **3 Hours**

EXPERIMENT 1
Design Piston, piston pin and piston rings and generate the part model of the same.

2 **3 Hours**

EXPERIMENT 2
Design small-end, shank, big-end and big-end bolts of a connecting rod and create the part model of the same.

3 **4 Hours**

EXPERIMENT 3
(i) Design the crank web and bearing of a center crank shaft and construct the part model of the same.
(ii) Assemble the part models of piston, connecting rod and crankshaft as a system.

4 **3 Hours**

EXPERIMENT 4
Design rocker arm, push rod and inlet and exhaust valves of a valve actuating mechanism and create the part model of the same.

5 **4 Hours**

EXPERIMENT 5
(i) Design cam lobe and shaft of a cam shaft and construct the part model of thesame.
(ii) Assemble the camshaft, rocker-arm, push rod and inlet/exhaust valve as a system.

6 **2 Hours**

EXPERIMENT 6
Design web, rim and ring gear of a flywheel and generate the part model of the same.

7 **2 Hours**

EXPERIMENT 7
Design disc, shaft, friction lining and springs of a single plate clutch and create the part model of the same.

8 **2 Hours**

EXPERIMENT 8
Assemble the flywheel and clutch as a system.

9 **3 Hours**

EXPERIMENT 9
Design spur gear and shaft of a gear box; create and assemble the part model of the same.

10 **4 Hours**

EXPERIMENT 10
Design the coil spring and strut of an independent suspension; construct and assemble the part model of the same.

Total: 30 Hours

Reference(s)

1. Paul Tran, SOLIDWORKS 2018 Intermediate Skills, SDC Publications.
2. Randy Shih, SOLIDWORKS 2018 and Engineering Graphics, SDC Publications.
3. Nader G. Zamani, Jonathan M. Weaver, CATIA V5 Tutorials: Mechanism Design &Animation ; Release 19, SDC Publications.
4. Richard Cozzens , CATIA V5 Workbook Release 19, SDC Publications.

18GE501 SOFT SKILLS - APTITUDE I **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

f. 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

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

j. 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

Course Outcomes (COs)

1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportionand variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoningproblems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2		2		3				
2						2		2		3				
3						2		2		2				
4						2		2		2				

1 **1 Hours**

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process- Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility- Number of zeros in an expression.

2 **2 Hours**

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

3 **2 Hours**

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average- Replacement of some of the items.

4 **126 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios-Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

5 **2 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

6 **3 Hours**

TIME AND WORK

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

7 **3 Hours**

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

8 **3 Hours**

CODING AND DECODING

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

9 **3 Hours**

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

10 **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

11 **3 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction-Plotting diagrams.

12 **3 Hours**

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, McGraw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all CompetitiveExaminations, Revised Edition, Arihant Publications.

18HS002 PROFESSIONAL ETHICS IN ENGINEERING 2 0 0 2

Course Objectives

- To understand Human Values and ethical theory.
- To understand codes of ethics, work place responsibilities, rights, engineeringexperimentation, global issues and contemporary ethical issues.
- To understand personal ethics, legal ethics, cultural ethics and engineers responsibility.

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. 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.
l. 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.

Course Outcomes (COs)

1. Articulate engineering ethics theory with sustained lifelong learning.
2. Adopt a good character and follow high professional ethical life.
3. Contribute to shape a better character by following ethical actions.
4. Confront and resolve moral issues occurred during technological activities.
5. Resolve moral and ethical problems through exploration and assessment byestablished experiments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2	3		3		2		
2							3	2		3		3		
3							2	3		2		2		
4							3	2		2		2		
5							2	3		3		2		

UNIT I **6 Hours**

HUMAN VALUES

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others - Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy.

UNIT II **6 Hours**

ENGINEERING ETHICS AND PROFESSIONALISM

Scope of Engineering Ethics- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlbergs and Gilligans theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse.

UNIT III **6 Hours**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island andChernobyl.

UNIT IV **6 Hours**

WORKPLACE RESPONSIBILITIES AND RIGHTS

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights.

UNIT V **6 Hours**

GLOBAL ISSUES

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

FOR FURTHER READING

Sample code of ethics like IETE,ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

Total: 30 Hours

Reference(s)

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New ageinternational (P)limited, New Delhi,2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
6. http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics

18AU602 FINITE ELEMENT ANALYSIS 3 1 0 4

Course Objectives

- To impart basic knowledge in finite element method.
- To deliver knowledge in 1D elements.
- To provide knowledge in 2D elements.
- To practice approaching heat conduction problems using finite element method.
- To provide knowledge in higher order and iso-parametric elements.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Apply the numerical methods to formulate the simple finite elementproblems.
2. Develop one dimensional finite element method to solve bar, beam and truss typeproblems.
3. Appraise finite element method for plane stress, plane strain and axisymmetric conditions.
4. Evaluate temperature distribution of one and two dimensional heat transfer problems using one and two dimensional finite elements.
5. Analyse the numerical methods to formulate the higher order and isoperimetric problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1										3	
2	2	1	1										3	
3	2	3	1										3	
4	2	3	1										3	
5	3	2	2										3	

UNIT I **10 Hours**

INTRODUCTION

Relevance and scope of finite element methods - strain vs displacement relations - stresses and equilibrium - natural and essential boundary conditions - Rayleigh-Ritz - Galerkin method- FEA procedure - Discretisation of domain-element shapes, types, size, location, and numbers.

UNIT II **10 Hours**

ONE-DIMENSIONAL (1D) PROBLEMS

Coordinate systems-global, local and natural.Finite element formulation - shape function, stiffness matrix, load vector and assembly of global equation - 1D bar element and two nodded truss element-problems.Introduction to beam elements.

UNIT III **8 Hours**

TWO-DIMENSIONAL (2D) PROBLEMS

Finite Element Formulation - Shape function for linear triangular element, Constant Strain Triangular (CST) element. Strain vs displacement matrix of CST element, plane stress, plane strain and axisymmetric conditions - problems. Introduction to space frame and planar frame elements.

UNIT IV **9 Hours**

HEAT TRANSFER APPLICATIONS

Formulation of shape function, stiffness matrix, load vector, assembly of global equation - 1D and 2D elements with heat conduction, heat convection and internal heat generation conditions-problems. Introduction to 3D axisymmetric problems.

UNIT V **8 Hours**

HIGHER ORDER ELEMENTS AND ISOPARAMETRIC ELEMENT FORMULATION

Selection of order of polynomial-linear, simplex, complex and multiplex elements, mesh refinement methods and convergence requirements.Iso, Sub and Super parametric element, shape functions for a 2-D four nodded and eight nodded Isoparametric rectangular element using natural coordinate system - problems. Gaussian quadrature method-problems.

Total: 60 Hours

Reference(s)

1. KJ Bathe, Finite Element Procedures, PHI Learning, 2007.
2. Rao S. S., The Finite Element Method in Engineering, Elsevier, 6th Edition, 2017.
3. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering, Pearson Education, 4th Edition 2012.
4. David V Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Education, 2009.
5. https://nptel.ac.in/courses/112104116/
6. https://nptel.ac.in/courses/112104193/

18AU603 DESIGN OF AUTOMOTIVE CHASSIS COMPONENTS

3 1 0 4

Course Objectives

- To obtain the clarity on design parameters of vehicle frame and steeringsystem.
- To choose appropriate joints for various types of loadings.
- To understand the principles involved in evaluating the shape and dimensions of an automotive chassis component to satisfy functional and strength requirements.
- To recognize the types of shafts and couplings used in power transmission.
- To distinguish the choice of spring for suspension system and clutch.
- To analyse the controlling factors of a brakingsystem.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Design vehicle frames and steering system components for various application.
2. Analyse the loading types for appropriate selection of joints.
3. Compute the design parameters of axles, shafts and couplings.
4. Choose appropriate spring and clutch for suspension systems and power transmission systems respectively.
5. Analyse the parameters of an automotive brakingsystem.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3												2	
2	3	3	3					3			3		3	
3	3	3	3					3			3		3	
4	3	3	3					3			3		3	
5	3	3	3					3			3		3	

UNIT I **9 Hours**

VEHICLE FRAME AND STEERING COMPONENTS

Loads acting on frames, chassis operating conditions, Determination of Centre of gravity, Design of frame for passenger and commercial vehicle - Design of straight and curved beams - "C" frame and crane hook. - Condition for true rolling, calculation of Ackermann linkage geometry, steering box design.

UNIT II **9 Hours**

DESIGN OF JOINTS

Design of bolted joints - stresses due to static loading, eccentrical loading. Design of welded joints - Butt and Fillet welded Joints-weld symbols, Strength of parallel and tranverse fillet welded Joints - Eccentrically loaded joints.

UNIT III **9 Hours**

DESIGN OF AXLES, SHAFTS AND COUPLINGS

Analysis of loads, moments and stresses at different sections of front axle, Design of front axle. Determination of bearing loads at Kingpin bearings, Design of propeller shaft based on strength, rigidity and critical speed - design details of final drive gearing, full-floating, semi-floating, three quarter floating rear axle and housings. Torsion bar. Design of rigid flange coupling and flexible coupling. Design of Cotter & Knuckle Joints.

UNIT IV **9 Hours**

DESIGN OF SPRINGS AND CLUTCUES

Spring Types, End connections, design parameters and spring materials. Design of helical springs - Circular and non-circular wire - Concentric springs. Design of leaf and torsional springs under constant and varying loads - Wahl"s stress factor. Types of friction clutches, Torque capacity of clutch, Design of single plate, multi-plate clutch, cone clutch and centrifugal clutch, Design of clutch components.

UNIT V **9 Hours**

DESIGN OF BRAKES

Brakes function, weight transfer during braking, stopping distance, brake torque analysis of Internal expanding shoe brake. Calculation of mean lining pressure and heat generation during braking, design of disc brake, mechanics of hydraulic braking system and parking brake.

Total: 60 Hours

Reference(s)

1. J.E. Shigley and C.R. Mischke, Mechanical Engineering Design, Tata McGraw - Hill Publishing Company Pvt. Ltd., New Delhi, 2017.
2. V.B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Education, 2017.
3. Khurmi. R.S. and Gupta. J.K., A Textbook of Machine Design, Eurasia Publishing House(Pvt) Ltd., 2005.
4. Lukin P, Gasparyants G, Rodionov V, Automobile Chassis Design and Calculations, MIR Publishers, Moscow 1989.
5. Giri, N.K., Automobile Mechanics, Khanna publishers, New Delhi, 2008.
6. http://www.nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/New_index1.html

18AU604 VEHICLE BODY ENGINEERING 3 0 0 3

Course Objectives

- To acquire knowledge on types and construction of passenger and commercial vehicles body
- To understand the aerodynamics involved in vehicles
- To appreciate the mechanical design aspects related to vehicle bodyconstruction

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Illustrate the different types of car body.
2. Compare the commercial vehicle bodies and identify their types
3. Infer the parameters influencing the aerodynamics of the vehicle
4. Analyze the various loads acting on the vehiclebody.
5. Inspect the properties of materials used in vehicle body and explain the body painting and trimming processes.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	2		2											
3	3	3	3		3								3	
4	3	3	3	3									3	
5	3	3	2		3								3	

UNIT I **9 Hours**

CAR BODY

Car body types-hatchback, saloon, convertibles, limousine, estate car, racing and sports car, Visibility - Regulations, driver"s visibility, tests for visibility, methods of improving visibility and space in cars, Safety-design and equipments-crumple zone, Car body construction - Design criteria and initial tests.

UNIT II **9 Hours**

COMMERCIAL AND PASSENGER VEHICLES

Commercial vehicle body technology- trends, special goods vehicle, Types of commercial vehicle body-flat platform, drop side, fixed side, tipper body, tanker body, Dimensions of driver"s seat relation to controls.

Buses and coaches- structural design, mini bus, single Decker, double-decker, two level and articulated bus.

UNIT III **9 Hours**

VEHICLE AERODYNAMICS

Vehicle drag - types, Types of forces and moments- effects of forces and moments, side wind effects on forces and moments, Body optimization techniques for minimum drag, Wind tunnel-Principle and types, Flow optimization techniques.

UNIT IV **9 Hours**

VEHICLE BODY LOADS

Idealized structure, structural surface, shear panel method, symmetric and asymmetric vertical loads in a car, longitudinal load, different loading situations, chassis frame design, Construction of Doors, door apertures, windows. Spare wheel carrier construction and design for different types of vehicle and weight distribution criteria in relation to Spare wheel location. Sources of body noises testing and methods of elimination. Water leakage test.

UNIT V **9 Hours**

BODY MATERIALS, TRIM AND MECHANISMS

Materials- steel sheet, timber, plastic, GRP, Properties of materials, Hand tools-power tools-panel repair-repairing sheet metal-repairing plastics-body fillers-passenger compartment service, Corrosion-anticorrosion methods, Selection of paint and painting process.

Total: 45 Hours

Reference(s)

1. L. Morello, L.R. Rossini, G. Pia and A. Tonoli, The Automotive Body, Volume I: Components Design, London: Springer, 2011.
2. D.A. Crolla, Ed, Automotive Engineering: Power Train, Chassis System and Vehicle Body, Oxford: Butterworth-Heinemann Elsevier Ltd, 2009.
3. J. Fenton, Handbook of Automotive Body Construction and Design Analysis, New Delhi:Wiley India, 2010.
4. P. L. Kohli,Automotive Chassis & Body, Papyrus Publishing House, New Delhi.2010
5. J Powloski, Vehicle Body Engineering, Business Books Ltd., London
6. J.G. Giles, Body Construction and Design, Vol. 6., llefe Books/Butterworth & Co. London

18AU607 VEHICLE MAINTENANCE LABORATORY 0 0 2 1

Course Objectives

- To acquire knowledge in vehicle servicing andtesting.
- To acquire skills in wheel alignment and wheel balancing.
- To acquire knowledge in valve grinding, valve lapping and cylinder re boring operations.
- To acquire skills in testing of spark plug and headlight.
- To acquire knowledge in A/C recovery and refilling in automobiles.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Demonstrate testing of two wheeler chassis dynamometer.
2. Explain the procedure for wheel alignment and wheel balancing.
3. Demonstrate valve grinding, valve lapping and cylinder re boring operations.
4. Explain the testing procedure for spark plug and headlight.
5. Explain the procedure for recovering and refilling of A/C in automobiles

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1							1				1	
2	2	2							3				2	
3	2	1							2				1	
4	1	1							2				2	
5	1	1							1				1	

1 **3 Hours**

EXPERIMENT 1

Two wheeler chassis dynamometer testing

2 **4 Hours**

EXPERIMENT 2

Perform 3D wheel alignment for passenger vehicles

3 **4 Hours**

EXPERIMENT 3

Perform wheel balancing passenger and commercial vehicles.

4 **4 Hours**

EXPERIMENT 4
Tyre and wheel maintenance

5 **2 Hours**

EXPERIMENT 5
Perform valve grinding operation and valve lapping operation

6 **2 Hours**

EXPERIMENT 6
Perform 3D wheel alignment for commercial vehicles

7 **2 Hours**

EXPERIMENT 7
Perform cylinder re-boring operation

8 **2 Hours**

EXPERIMENT 8
Spark plug cleaning and gap adjustments

9 **3 Hours**

EXPERIMENT 9
Head light beam aligner

10 **4 Hours**

EXPERIMENT 10
Automotive A/C recovery and refilling

Total: 30 Hours

Reference(s)

1. P.M. Heldt, Automotive Chassis, New York : Chilton Co, 2014.
2. R.K. Rajput, A Text Book of Automobile Engineering, Delhi: Laxmi Publications Private Limited, 2007.
3. K. Singh, Automobile Engineering-Volume 1,Delhi: Standard Publishes Distributors, 2012.
4. N.K. Giri, Automotive Mechanics, New Delhi: Khanna Publishers, 2005.
5. T. Gilles, Automotive Chassis: Brakes, Suspension and Steering, New York: Thompson Delmar Learning, 2005.

18AU608 COMPUTER AIDED ANALYSIS LABORATORY **0 0 2 1**

Course Objectives

- To provide procedural knowledge on modeling and meshing of machine components in finite element method package.
- To gain knowledge for finding stresses induced in structural, dynamic and thermal related applications using Finite Element Method Package.
- To impart knowledge on validation of dimensional specification of the product by verifying the values of stresses induced in the component.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

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

m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Create geometry, descritize, apply boundary condition to solve problems of bars, truss, beams, plate to find stress with different loading conditions.
2. Identify the meshing elements, Boundary and load conditions for automotive components. Conditions by using Finite Element Method.
3. Structural Optimization of Automotive components for given Boundary and loadconditions.
4. Demonstrate the deflection of beams subjected to point, uniformly distributed and varyingloads further to use the available results to draw shear force and bending moment diagrams.
5. Analyze the structural and thermal Behavior for Automotive components use to solve the static and dynamics solver.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3		2								1	
2	1	2	3		2								2	
3	1	3	2		3								2	
4	1	2	2		3								2	
5	1	3	3		2								3	

1 **2 Hours**

EXPERIMENT 1

Structural analysis of stepped bar to perform displacement and stress analysis using ANSYS APDL.

2 **3 Hours**

EXPERIMENT 2

Structural analysis of a simple and composite truss subjected to point loads to observe the deformation and axial stress distribution using ANSYS

3 **2 Hours**

EXPERIMENT 3

Structural analysis of beam elements subjected to point loads with UDL and UVL to observe deformation, shear force, bending moment and von misses stress distribution using ANSYS APDL.

4 **3 Hours**

EXPERIMENT 4

Structural analysis of solid element with drilled holes (steel plate and L bracket) subjected to point loads to observe deformation and von misses stress distribution using ANSYS APDL.

5 **2 Hours**

EXPERIMENT 5

Thermal analysis of composite cylinder subjected to conduction and convection to determine the heat transfer, Thermal flux and thermal gradient using ANSYS APDL.

6 **3 Hours**

EXPERIMENT 6

Static structural analysis of 3D bridge truss element to determine maximum deformation and stress by using ANSYS Workbench.

7 **3 Hours**

EXPERIMENT 7

Analysis of steady state temperature distribution in a three dimensional circular fin. To determine the heat transfer using ANSYS Workbench.

8 **4 Hours**

EXPERIMENT 8

Natural frequency and harmonic response of beam element using ANSYS Workbench.

9 **4 Hours**

EXPERIMENT 9

Static structural analysis of automobile components to determine deformation and stress using ANSYS Workbench.

10 **4 Hours**

EXPERIMENT 10

Thermal analysis of automobile components to determine steady state temperature distribution using ANSYS Workbench.

Total: 30 Hours

Reference(s)

1. S. S. Rao, Finite Element Method in Engineering, Elsevier India, 2005.
2. David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2005.
3. Robert D. Cook, s. David ,Malkucs Michael E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New Delhi,2007.
4. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements Engineering, Pearson Education, New Delhi,2002
5. S. S. Bhavikati, Finite Element Analysis, New Age International Publishers, 2005

18GE601 SOFT SKILLS-APTITUDE II 0 0 2 0

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

f. 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

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

k. 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

Course Outcomes (COs)

1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyse objects involving cubes and cuboids in determining the number of sidescolored.
4. Interpret various data from graphs and tables to determine ratio, percentage andaverages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						3	2		2		3			
2						3	2		2		3			
3						2	3		3		2			
4						2	3		3		2			
5						3	2		2		3			

1 **2 Hours**

PERMUTATION AND COMBINATION

Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination.

2 **2 Hours**

PROBABILITY

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

3 **2 Hours**

SYLLOGISM AND VENN DIAGRAM

Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

4 **2 Hours**

SIMPLE INTEREST AND COMPOUND INTEREST

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound Interest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

5 **2 Hours**

MIXTURES AND ALLIGATION

Definition-Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

6 **2 Hours**

CUBE AND LOGARITHM

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

7 **2 Hours**

DATA INTERPRETATION

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

8 **2 Hours**

PROGRESSION AND LOGICAL REASONING

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

9 **2 Hours**

PROBLEM ON AGES

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

10 **3 Hours**

ANALYTICAL REASONING

Introduction-Basic concept-Non verbal Analytical Reasoning -Arrangements.

11 **3 Hours**

BLOOD RELATION

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations.

12 **3 Hours**

VISUAL REASONING

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

13 **3 Hours**

SIMPLIFICATIONS

Introduction-Basic concepts-Arithmetic operations-Equation solvingmethods-Puzzles.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, McGraw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for CompetitiveExaminations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all CompetitiveExaminations, Revised Edition, Arihant Publications.

18HS003 PRINCIPLES OF MANAGEMENT 2 0 0 2

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR relatedactivities.
- Learn the application of the theories in anorganization.
- Analyze the position of self and company goals towards business.

Programme Outcomes (POs)

f. 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

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

k. 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.

l. 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

Course Outcomes (COs)

Students will be able to

1. Understand the basic concepts ofManagement.
2. Have some basic knowledge on planning process and its Tools &Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2	3		2	2	2	2		
2						2	3		2	2	2	2		
3						2	2		2	2	3	3		
4						3	2		2	2	2	2		
5						2	3		3	3	3	2		

UNIT I **9 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management -Science or Art - Manager Vs Entrepreneur- types of managers - Managerial roles and skills - Evolution of Management - Scientific, Human Relations, System and Contingency approaches - Types of Business organization- Sole proprietorship, partnership, Company-public and private sector enterprises-Organization culture and Environment -Current Trends and issues in Management.

UNIT II **9 Hours**

PLANNING

Nature and purpose of planning-Planning process-Types of planning - Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

UNIT III **9 Hours**

ORGANISING

Nature and purpose - Formal and informal organization - Organization chart - Organization Structure and Types - Line and staff authority - Departmentalization - delegation of authority - Centralization and decentralization - Job Design-Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **9 Hours**

DIRECTING

Foundations of individual and group behaviour - Motivation - Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership - types and theories of leadership - Communication - Process of communication - Barrier in communication - Effective communication - Communication and IT.

UNIT V **9 Hours**

CONTROLLING

System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance - Direct and preventive control -Reporting.

Total: 45 Hours

Reference(s)

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals ofManagement, Pearson Education,7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007..
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGrawHill, 2008

18AU702 VEHICLE DYNAMICS 3 1 0 4

Course Objectives

- To acquire knowledge on road vehicle dynamics, stability and handling
- To develop an understanding of the relationships between vehicle design variables andvehicle dynamic behavior
- To apply modeling techniques to predict the dynamic behavior of road vehicles

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Apply laws of mechanics to calculate dynamic,road loads and equation motion.
2. Analyze gradeability, tractive force, barking force and stopping distance of avehicle.
3. Modeling the passenger car suspension of a vehicle.
4. Analyze the cornering and braking effort of a tire.
5. Apply steady state cornering model to design the steering system of avehicle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1										3	
2	3	2	1										3	
3	2	3	3										3	
4	2	3	1										3	
5	2	3	1										3	

UNIT I **9 Hours**

INTRODUCTION

Vehicle and Earth fixed coordinate system, Euler angles, Dynamic axle loads - static loads on level ground - low speed acceleration, Loads on Grades. Road loads - rolling resistance - grade resistance. Equation of motion for Forced Undamped and forced Damped Vibration, Single DOF, Two DOF and Multi DOF systems.

UNIT II **9 Hours**

PERFORMANCE MODE

Acceleration - free body diagram of accelerating vehicle, maximum transferable tractive force and gradability. Deceleration - free body diagram of decelerating vehicle, maximum decelerating rates, stopping distance and maximum braking force. Prediction of Vehicle performance. Antilock Brake Systems, Traction control.

UNIT III **9 Hours**

RIDE MODE

Human response to vibration, Sources of Vibration. Design and analysis of passive, semi-active and active suspension using quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tyre stiffness. Control law for LQR, H-infinite and skyhook damping. Air suspension system and their properties.

UNIT IV **9 Hours**

TIRE DYNAMICS

Tire forces and moments, tire structure, longitudinal and lateral force at various slip angles, rolling resistance, tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tires. Magic formulae tire model, Estimation of tire road friction. Test on various road surfaces. Tire vibration.

UNIT V **9 Hours**

HANDLING MODE

Vehicle control - low speed cornering and static steering - Steady-state cornering - steering factors, vehicle control parameters (under steer, neutral steer and over steer), roll steer, compliance steer, ride steer, slip angle steer. Steady state handling - lateral acceleration gain, characteristic speed, yaw velocity gain and critical speed. Effect of braking on vehicle handling.

Total: 60 Hours

Reference(s)

1. H.Pacejka, Tire and Vehicle Dynamics, Oxford: Butterworth-Heinemann Elsevier Ltd, 2012.
2. R.N. Jazar, Vehicle Dynamics: Theory and Application, NY: Springer, 2017.
3. T.D. Gillespie, Fundamentals of Vehicle Dynamics, Michigan: SAE International, 1992.
4. J.Y. Wong, Theory of Ground Vehicles, John Willey & Sons, 2008.
5. D. Karnopp, Vehicle Dynamics, Stability and Control, Boca Raton: CRC Press, 2013.
6. https://nptel.ac.in/courses/107106080/

18AU703 INTELLIGENT VEHICLE SYSTEMS 3 0 2 4

Course Objectives

- To acquire knowledge on intelligent systems, focusing on those in-vehicle solutionsspecifically designed to improve driving and travelling energyefficiency
- To appreciate the role of electronics in providing improved control to a variety of vehiclesystems
- To enable evaluation of appropriate methodologies and be aware of the design and implementation issues of advanced techniques

Programme Outcomes (POs)

c. 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.

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

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

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Analyze the importance of modern trends in vehicle System
2. Apply the knowledge for selection of sensor and communication protocols for interfacingsensors
3. Apply the knowledge for understanding the traffic information in thesurroundings
4. Compare the various intelligent systems used in automobiles and entertainment features inside the vehicle
5. Explain the intelligent systems associated with Autonomous vehicle

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			2		3		2							2
2			1		2		1							1
3			3		1		2							1
4			2		1		3							2
5			1		2		2							2

UNIT I **7 Hours**

INTRODUCTION TO INTELLIGENT VEHICLE SYSTEMS

Definition, modern trends in Auto industry, various intelligent systems present in the vehicle, Need for IVS, Benefits, Advanced Driver Assistance System-Types/Levels, Next Generation Intelligent Vehicles, General Vehicle Control.

UNIT II **10 Hours**

IOT IN AUTOMOBILES

Developments on IoT in Automotive Sector, Connected Car Services and Applications- Infotainment, Vehicle and Smartphone Integration, Driving Insights- Analytics, On Board Diagnostics, Real Time Driver Monitor, Geo fencing and Speed Monitoring, Stolen Vehicle Tracking, Biometrics Information for

Driver Identification, Vehicle Communication- V2V, V2X, V2R, IoT in Intelligent Transportation , Introduction to Autonomous Vehicle.

UNIT III **10 Hours**

TRAFFIC SURROUNDINGS

Modelling traffic and driver interactions, Simulation of driver and city interaction, Behavior and driving pattern, simulation of driver and highway interaction, Behavior and driving pattern, Application: Traffic alert - Real time road data on Navigation, Navigation System- Global Positioning System, Geographical Information Systems Architecture, Road Sign Recognition.

UNIT IV **9 Hours**

CONNECTED VEHICLE SYSTEMS

Introduction to CVS, Telematics control system architecture -driver information systems, Vehicle - vehicle interaction using TCS, Current trends in auto industry, In-Vehicle Entertainment System - Mirror link, Web link, App link, Apple Car Play, Android Auto. Application: ecall system - design, functions and limitations.

UNIT V **9 Hours**

AUTONOMOUS VEHICLE COMFORT SYSTEMS AND APPLICATIONS

Introduction- Design overview, circuit diagram and Algorithm, Driver safety systems- ABS, Driver Aid system- ESP, Blind Spot monitoring system, Collision mitigation system, Adaptive Headlamps, Automatic parking system, Eight way seating system, Adaptive cruise control system, Collapsible and tiltable steering column, Lane Departure Warning.

1 **3 Hours**

EXPERIMENT 1

Observe and implement the Lane Departure Warning system

2 **3 Hours**

EXPERIMENT 2

Experiment the Seat Belt Pretension with crash sensor

3 **3 Hours**

EXPERIMENT 3

Detecting faults using On Board Diagnostics

4 **3 Hours**

EXPERIMENT 4

Implementation of Driver Monitoring system

5 **3 Hours**

EXPERIMENT 5

Stolen Vehicle Tracking using GPS and GSM modem

6 **3 Hours**

EXPERIMENT 6

Road Sign Recognition using image processing

7 **3 Hours**

EXPERIMENT 7

Design and construction of Fleet management using Telematics

8 **3 Hours**

EXPERIMENT 8

Study and implementation of V2V system

9 **3 Hours**

EXPERIMENT 9

Design and implementation of Adaptive Cruise Control system

10 **3 Hours**

EXPERIMENT 10

Design and construction of Adaptive Headlamp system.

Total: 75 Hours

Reference(s)

1. A. Perallos, U. Hernandez-jayo, E. Onieva and I. Garcia-Zuazola (Eds.), Intelligent Transport Systems: Technologies and Applications, Wiley publications, 2015.
2. A. Eskandarian (Ed.), Handbook of Intelligent Vehicles, Springer-Verlag London Ltd, 2012.
3. R. K. Jurgen, Navigation and Intelligent Transportation Systems - Progress in Technology, Automotive Electronics Series, Warrendale, PA: SAE International, 2014.
4. H. Cheng, Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation, Berlin: Springer, 2011.
5. P. C. Cacciabue (Ed.), Modelling Driver Behavior in Automotive Environments: Critical Issues in Driver Interactions with Intelligent Transport Systems, Springer-Verlag London Ltd, 2007.

18AU704 TRANSPORT MANAGEMENT 3 0 0 3

Course Objectives

- To acquire knowledge on various transport systems and administration
- To plan vehicle routes, scheduling of vehicles and farestructure
- To design vehicle maintenance systems

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Analyze the selection process and training methods in personnel management.
2. Apply the motor vehicle act in terms of registration and describe the vehicles liketankers and conduct test for competence to drive.
3. Construct fare structure and analyze the methods of farecollection.
4. Analyze the vehicle parts and supply management and data processing.
5. Demonstrate an electronically controlled vehicle maintenance system and analyzethework scheduling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2	2	1			3		2	
2						3	2	1			2		2	
3						2	3				3		3	
4						1	2				3		3	
5						2	3	1			3		3	

UNIT I **9 Hours**

INTRODUCTION

Personnel management - objectives and functions.Psychology, sociology and their relevance to organization.Selection process - job description, employment tests, interviewing, introduction to training objectives, methods of training, training procedure and psychological tests.

UNIT II **9 Hours**

MOTOR VEHICLE ACT

Traffic signs, fitness certificate, registration requirements, permit, insurance and constructional regulations. Description of vehicle - tankers, tippers, delivery vans, recovery vans, power wagons and fire fighting vehicles. Spread over, running time and test for competence to drive.

UNIT III **9 Hours**

SCHEDULING AND FARE STRUCTURE

Route planning.Scheduling of transport vehicles.Preparation of timetable, costs, and fare structure.Methods of fare collection.Preparation of fare table.

UNIT IV **9 Hours**

VEHICLE PARTS, SUPPLY MANAGEMENT AND BUDGET

Cost of inventory - balancing inventory cost against downtime, parts control, bin tag systems, time management, time record keeping, budget activity and capital expenditures. Classification of vehicle expenses.Fleet management and data processing.Data processing systems. Models - computer controlling of fleet activity.

UNIT V **9 Hours**

MAINTENANCE

Scheduled and unscheduled maintenance.Evaluation of PMI programme. Work scheduling - overtime - breakdown analysis - control of repair backlogs - cost of options, electronically controlled vehicle maintenance system

Total: 45 Hours

Reference(s)

1. J. Dolce, Fleet management, NY: McGraw-Hill, 1984.
2. J. Dolce, Fleet Manager"s Guide to Vehicle Specification and Procurement, Michigan: SAE International, 2003.
3. R.P. Currie, M.B. Currie, G.M. Keen, Fleet Management, Florissant: Wandering Brothers Publishing, 2006.
4. The Motor Vehicle Act, Government Publication, 1989.
5. L.R. Kadiyali, Traffic Engineering and Transport Planning, New Delhi: Khanna Publishers, 2008.
6. https://nptel.ac.in/courses/105101008/50

18AU707 VEHICLE DYNAMICS LABORATORY 0 0 2 1

Course Objectives

- To gain knowledge on the dynamics of the power train, brakes, steering, suspension and wheel and tire subsystems and their interactions
- To provide practical knowledge on modeling and simulation of vehiclesystems
- To develop skills in evaluation of parameters that effect vehicle performance relative to drive-off, braking, directional control and rollover

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Identify important vehicle system parameters useful for effective application of vehicledynamics
2. Analyze the suspension, braking and steering system parameters in roadcondition
3. Analyze the car body and trailer parameters in different conditions
4. Analyze the modeled vehicle in different conditions by various maneuvers
5. Analyze the vehicle models with advanced driver assistancesystems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			3								2	
2	1	2	2		3								2	
3	1	2			3								3	
4	1	2			3								2	
5	1	2			3								2	

1 **2 Hours**

EXPERIMENT 1
Study on automotive systems simulation

2 **4 Hours**

EXPERIMENT 2
Simulation and analysis of rigid axle suspension system

3 **2 Hours**

EXPERIMENT 3

Simulation and analysis of independent suspension system

4 **4 Hours**

EXPERIMENT 4

Simulation and analysis of hydraulic brake system

5 **2 Hours**

EXPERIMENT 5

Simulation and analysis of air brake system

6 **2 Hours**

EXPERIMENT 6

Simulation of steady state cornering characteristics of vehicle

7 **4 Hours**

EXPERIMENT 7

Modeling of tires and analysis of cornering characteristics

8 **4 Hours**

EXPERIMENT 8

Roll stability and Rollover threshold analysis

9 **4 Hours**

EXPERIMENT 9

Simulation of a half car model for pitch and bounce

10 **2 Hours**

EXPERIMENT 10

Crash test simulation analysis of a four wheeler

Total: 30 Hours

Reference(s)

1. H.Pacejka, Tire and Vehicle Dynamics, Oxford: Butterworth-Heinemann Elsevier Ltd, 2012.
2. R.N. Jazar, Vehicle Dynamics: Theory and Application, NY: Springer, 2017.
3. T.D. Gillespie, Fundamentals of Vehicle Dynamics, Michigan: SAE International, 1992.
4. J.Y. Wong, Theory of Ground Vehicles, John Willey & Sons, 2008.
5. D. Karnopp, Vehicle Dynamics, Stability and Control, Boca Raton: CRC Press, 2013.
6. https://nptel.ac.in/courses/107106080/

18AU708 PROJECT WORK I **0 0 6 3**

Course Objectives
- To develop skills to formulate a technical project.
- To give guidance on the various tasks of the project and standardprocedures.
- To teach use of new tools, algorithms and techniques required to carry out theprojects.
- To give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
- To provide guidelines to prepare technical report of the project.

Programme Outcomes (POs)
a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
j. 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.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.

Course Outcomes (COs)
1. Formulate a real world problem, identify the requirement and develop the designsolutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of theproject.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare technical report and oralpresentations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		3	2			2	1							
2	2	2	1	3		2					2	2		
3			3	2	2			2			2	2		
4		1		2	3	1	2	2						
5									3	3		2		

18AU804 PROJECT WORK II 0 0 18 9

Course Objectives

- To develop skills to formulate a technicalproject.
- To develop skills to formulate a technicalproject.
- To teach use of new tools, algorithms and techniques required to carry out theprojects.
- To give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
- To provide guidelines to prepare technical report of the project.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
j. 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.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the designsolutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of theproject.
4. Test and validate through conformance of the developed prototype and analysis thecost effectiveness.
5. Prepare technical report and oral presentations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		3	2			2	1							
2	2	2	1	3		2					2	2		
3			3	2	2			2			2	2		
4		1		2	3	1	2	2						
5									3	3		2		

18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstracttopics
- Listen and understand technical discussions in his/her field ofspecialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

j. 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.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage examlevel.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routineletters
4. Ask for factual information and understand the answer; and take/pass on workplacemessages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2									2					
3									3					
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision- aking. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri

5. The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18HSC01 CHINESE 1 0 2 2

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. listen and identify individual sounds of Chinese
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

Hello | 1.Initials and Finals of Chinese | b,p,m,f,d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3.Chinese Syllables | 4.Tone S

UNIT II **9 Hours**

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

1. What""s your name - In the school; -In the classroom; -In the school | The Interrogative Pronoun | 2 The Sentence | 3 Interrogative Sentences with

UNIT IV **9 Hours**

She is my Chinese teacher | In the library | The Interrogative Pronouns | The Structural Particle | The interrogative Particle

UNIT V **9 Hours**

Her daughter is 20 years old this year | 1.The Interrogative Pronoun | 2. Numbers below 100 | 3.Indicating a Change | The Interrogative Phrase

Total: 45 Hours

18HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-dayscenarios

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. To help students acquire familiarity in the French alphabet & basicvocabulary
2. listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing languagetasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois.
Grammaire Les verbes s''appeler,etre, avoir, les articles definis, indefinis
Communication - Saluer, s''informer sur quelquun, demander de se presenter
Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l''annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites
Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) - Adjectifs les propositions de lieu
Communication - Chercher un logement, d''ecrire son voisin, s''informer sur un logement
Lexique - L''habitat, les pieces, l''equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT Ãƒ???Ãƒ??Ãƒ?Ã‚Â¢?? SÃƒ???Ãƒ??Ãƒ?Ã‚Â¢??OUVRIR Ãƒ????Ãƒ???Ãƒ??Ãƒ?Ã‚Â LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l"imparfait Communication - Propose aÃƒ?Ã‚Â quelqu""un de faire quelque chose, raconteur une sortie au passe parler un film
Lexique - Les sorties, la famille, art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite
Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant
Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

18HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German inday-to-dayscenarios

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. listen and identify individual sounds of German
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing languagetasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V **9 Hours**

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

18HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simpleday-to-daysituations
- To help students acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)
Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day-to-dayconversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														

UNIT I **9 Hours**

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People,Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

18HSJ01 JAPANESE 1 0 2 2

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										2				
4										2				
5										2				

UNIT I **9 Hours**

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

18GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives
- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

Course Outcomes (COs)
1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2							2					
2	3	2							2					
3	3	2							2					
4	3	2							2					
5	3	2							2					

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties - differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties& Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

18GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES

3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PNjunction
3. Illustrate the operation of Bipolar Junction transistor at different modes anddifferent configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2							2					
2	3	2							2					
3	3	2							2					
4	3	2							2					
5	3	2							2					

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley& Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

18GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2							2					
2	3	2							2					
3	3	2							2					
4	3	2							2					
5	3	2							2					

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein"s prediction - Einstein"s relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement – holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting- Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006.

18GE0C1 CORROSION SCIENCE AND ENGINEERING

3 0 0 3

Course Objectives

- Understand the loss incurred due to corrosion in different sectors and terminologies relatedto corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

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

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpaceIndependent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introductionto Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

18GE0C2 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles
- Identify the types of fuel cells and to relate the factors of energy andenvironment
- Analyze various energy storage devices and fuel cells

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

Course Outcomes (COs)

1. Explain the parameters required for operation of a cell to evaluate the capacity of energy storage devices
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Differentiate fuel cells based on its construction, production of current andapplications
4. Compare different methods of storing hydrogen fuel and its environmentalapplications
5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3												
3	3	1												
4	2	2												
5	3	3												

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries - zinc-carbon, magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009
2. F. Barbir,PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRCPress, 2016
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

18GE0C3 POLYMER SCIENCE **3 0 0 3**

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers and its processing
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high qualitypolymers
3. Characterize the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Identify and analyze the polymers used in electronic and biomedicalapplications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) - ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene - butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2015
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011

18GE0M1 GRAPH THEORY AND COMBINATORICS

3 0 0 3

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science& Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer Science.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	2												
3	2	1												
4	2	1												
5	2	1												

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

18GE0M2 ALGEBRA AND NUMBER THEORY 3 0 0 3

Course Objectives

- Understand the basic notions of groups, rings, fields which will then be used to solve related problems.
- Examine the key questions in the Theory of Numbers.
- Implement the integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

Course Outcomes (COs)

1. Exemplify the concepts of groups and fields in the areas of Engineering.
2. Classify the different types of fields.
3. Organize the divisibility in number theory in various areas of Engineering.
4. Identify the solution of some kinds of equations.
5. Demonstrate the theorems in number theory.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	2												
3	2	1												
4	2	1												
5	2	1												

UNIT I **9 Hours**

FIELDS

Group Theory - Rings and Polynomials - Fields.

UNIT II **9 Hours**

FINITE FIELDS AND POLYNOMIALS

Finite Fields - Irreducible Polynomials over Finite fields - Factorization of Polynomials over Finite Fields.

UNIT III **9 Hours**

DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS

Division algorithm- Base-b representations - number patterns - Prime and composite numbers - Fibonacci and Lucas numbers - Fermat numbers - GCD - Euclidean Algorithm - Fundamental theorem of Arithmetic - LCM.

UNIT IV **8 Hours**

DIOPHANTINE EQUATIONS AND CONGRUENCES

Linear Diophantine equations - Congruence s - Linear Congruence s - Applications: Divisibility tests - Modular Designs - Chinese remainder theorem - 2x2 linear systems.

UNIT V **10 Hours**

CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS

Wilson s theorem - Fermat s Little theorem - Euler s theorem - Euler s Phi functions - Tau and Sigma functions - Perfect numbers - Mersenne Primes - Mobius Function.

Total: 45 Hours

Reference(s)

1. Lidl.R., and Pilz. G., Applied Abstract Algebra, Springer-Verlag, New Delhi, 2nd Edition, 2006.
2. Thomas Koshy, Elementary Number Theory with Applications, Elsevier Publications, New Delhi, 2002.
3. San Ling and Chaoping Xing, Coding Theory: A first Course, Cambridge Publications, Cambridge, 2004.
4. Niven.I, Zuckerman.H.S., and Montgomery, H.L., An Introduction to Theory of Numbers, John Wiley and Sons, Singapore, 2004.

18GE0M3 MATHEMATICAL FINANCE AND QUEUEING THEORY

3 0 0 3

Course Objectives

- To provide the required fundamental concepts in probability and queueing models and apply these techniques innetworks, image processing etc.
- Acquire skills in analyzing queueing models.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineeringsciences.

Course Outcomes (COs)

1. Identify the properties of stochastic process in finance
2. Interpret the concept and applications of Statistics in finance.
3. Demonstrate the basics of finance using the notions of statistics.
4. Assess the classifications and the properties of queues.
5. Implement the concepts of queue in open and closed networks.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	2												
3	2	1												
4	2	1												
5	2	1												

UNIT I **9 Hours**

APPLIED STOCHASTIC CALCULUS

Brownian motion - Constructions - Non differentiability - Quadratic variation - Stochastic integration - Construction of Ito integral and properties ,the Ito formula - Feynman-Kac formula

UNIT II **9 Hours**

STATISTICS

Basic parameter estimation - Maximum likelihood estimation - Distributions - Regression techniques - Tests for normality - QQ plots - Hypothesis testing - Numerical examples in R.

UNIT III **9 Hours**

CONTINUOUS-TIME FINANCE

Black-Scholes-Merton model of stock prices as geometric Brownian motion, derivation of the Black-Scholes-Merton partial differential equation, the Black-Scholes formula and simple extensions of the model, self-financing strategies and model completeness, risk neutral measures, the fundamental theorems of asset pricing, continuous time optimal stopping and pricing of American options, forwards and futures in Black-Scholes-Merton model.

QUEUEING THEORY

Markovian queues - Birth and Death processes - Single and multiple server queueing models - Little s formula - Queues with finite waiting rooms - Finite source models.

UNIT V **9 Hours**

NON-MARKOVIAN QUEUES AND QUEUEINGNETWORKS

M/G/1 queue - Pollaczek Khinchin formula - M/D/1 and M/EK/1 as special cases - Series queues - Open and closed Jackson networks.

Total: 45 Hours

Reference(s)

1. M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer, 2005.
2. S. Shreve, Stochastic Calculus for Finance, Vol. 1 and Vol. 2, Springer, 2004.
3. G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, 3rd Edition, Oxford University Press, 2001.
4. Taha, H.A., Operations Research, Pearson Education, Asia, 8th Edition, 2007.

18AU001 AUTOMOTIVE PRODUCT DESIGN AND DEVELOPMENT 3 0 0 3

Course Objectives

- To acquire knowledge on product design and apply them inpractice
- To develop understanding of the fundamentals of new product development

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Analyze the parameters required for new product development.
2. Analyze the design requirement for new product development
3. Demonstrate product models produced using prototyping machines
4. Explain the various costs associated with the new product development
5. Implement recent advancements in product design.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2											1	
2	1	2											1	
3	2	1											1	
4	3	2											3	
5	1	2											1	

UNIT I **10 Hours**

NEW PRODUCT DEVELOPMENT

Importance of manufacturing-Basic concepts-Capital Circulation, manufacturing capability, mass production, Interchangeability, Product Life Cycle, The S-Curve of Technology Growth Cycle, Concurrent Engineering , Design for X , Engineering problem solving process, Key factors to develop successful products, Strategy for new product development.

UNIT II **8 Hours**

PRODUCT DESIGN

Requirements of design - design process- Top Down and Bottom up Approach, design review,Quality Control- Reactive vs Proactive, Six sigma, Poka-yoke, Consideration and selection of Materials,selection of process and design consideration, case studies- Guidelines for Casting, Forging and Extrusion.

UNIT III **9 Hours**

PRODUCT MODELING

Product modeling - definition of concept, types of product models, types of process chains, industrial demands, Prototyping - principles, technologies, robust design, process.

UNIT IV **9 Hours**

PRODUCT COSTING

Bill of materials - outline process charts , cost estimating procedure, methods of costing , material cost, Labor cost, Overheads ,Depreciation , Break even analysis - problems.

UNIT V **9 Hours**

RECENT ADVANCES AND CONCEPTS IN PRODUCT DESIGN

Fundamentals of FEM, Significance to product design, Product life cycle management,Functional Analysis System Techniques,Ergonomics in Product Design, Management information system ,need, application, functions.

Total: 45 Hours

Reference(s)

1. K.T. Ulrich, S. D. Eppinger, Product Design and Development, McGraw-Hill, 2011.
2. G.E. Dieter, Engineering Design- A Materials and process approach, Tata McGraw-Hill,2008
3. D. E. Carter, Concurrent Engineering, Addison Wesley, 2004.
4. Anil Mital, Anoop Desai, Aashi mital, Product Development: A StructuredApproach to Design and Manufacture, Butterworth-Heinemann ,2008.
5. https://onlinecourses.nptel.ac.in/noc19_me21/preview

18AU002 DESIGN FOR MANUFACTURE AND ASSEMBLY **3 0 0 3**

Course Objectives

- To learn the way of specifying geometric dimensioning and tolerancing in engineering drawing
- To familiarize the design considerations for designing components for the casting, welding and forming processes.
- To familiarize the design guidelines while designing components which are manufacturing by different machining processes.
- To learn the factors affecting easy assembly of parts into a finalproduct
- To impart knowledge about the product life cycle assessments and environmental impact of materials,manufacturing methods and the way to minimize it

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

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

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

l. 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.

m. An ability to design, analyze and find the solutions for automotive relatedproblems

Course Outcomes (COs)

1. Apply geometric dimensioning and tolerancing techniques in engineering drawing
2. Select appropriate design considerations to minimize difficulty to produce components by casting, welding and forming processes
3. Use the design for manufacturing concept to reduce machining time and manufacturing cost
4. Analyze and design the parts for easy assembly using DFAguidelines
5. Design the components by considering the product life cycle and its environmentalimpact

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1		1							1	2	
2	2	2	1									1	2	
3	2	2	1									1	2	
4	2	2	1									1	2	
5	2	2	2				2					1	2	

UNIT I **10 Hours**

GEOMETRIC DIMENSIONING AND TOLERANCING

Tolerance Chains and identification of functionally important dimensions. International Tolerance Grades, Surface finish, Attainable tolerance grades and different machining processes. Geometric Dimensioning and Tolerancing - Location, Form, profile, orientation, run out and Feature tolerance. Tolerance Limits for Assembly
- Cumulative effect of Tolerances

UNIT II **10 Hours**

DESIGN CONSIDERATIONS FOR CASTINGS, WELDING AND FORMING

Casting - Pattern, Mould, Casting hole - cast, Cored and Machined holes, Parting line - Redesign of castings based on parting line considerations, Minimizing core requirements. Welding - Stresses in welding - Measures to combat contraction stresses - Welding sequence - Joints in Welding - Weldability of steel - Design of welded structures. Form design aspects for Forging and sheet metal components

UNIT III **8 Hours**

DESIGN FOR MANUFACTURE - MACHINING CONSIDERATIONS

Design for Assembly(DFA) Guidelines - Minimizing number of Parts - Insertion and Fastening - Design Guidelines for Part Handling - Effect of Part Symmetry, Part Thickness, Part Size, Weight on Handling Time - Types of Manual Assembly Methods - Effect of Assembly layout on Part Acquisition Time - Assembly Efficiency - DFA index.

UNIT IV **8 Hours**

DESIGN FOR ASSEMBLY

Design for Assembly(DFA) Guidelines - Minimizing number of Parts - Insertion and Fastening - Design Guidelines for Part Handling - Effect of Part Symmetry, Part Thickness, Part Size, Weight on Handling Time - Types of Manual Assembly Methods - Effect of Assembly layout on Part Acquisition Time - Assembly Efficiency - DFA index.

UNIT V **9 Hours**

DESIGN FOR ENVIRONMENT

Environmental objectives - Global issues, Regional and local issues - Basic Design for Environment (DFE) methods - Design guide lines - Lifecycle assessment - AT&T"s (American Telephone and Telegraph Company) environmentally responsible product assessment, Weighted sum assessment method, Lifecycle assessment method - Techniques to reduce environmental impact - Design to minimize material usage - Design for disassembly, Recyclability, Remanufacture, Energy efficiency - Design to regulations and standards.

Total: 45 Hours

Reference(s)

1. Gene R. Cogorno, Geometric Dimensioning and Tolerancing for Mechanical Design,McGraw- HillProfessional, New Delhi, 2011
2. Harry Peck, Designing for Manufacture, Pitman Publishing, London, 1973
3. Robert Matousek, Engineering Design - A Systematic Approach, Blackie and Son Limited,London, 1974.
4. M. F. Spotts, Dimensioning and Tolerance for Quantity Production, Prentice Hall, New Jersey, 2007.
5. J.G. Bralla, Hand Book of Product Design for Manufacturing, McGraw-Hill Publications, New Delhi,2000.
6. Kevin otto, Kristin wood, Product Design: Techniques in Reverse Engineering and New ProductDevelopment, Pearson education, 2003.

18AU003 DESIGN THINKING

3 0 0 3

Course Objectives

- To acquire knowledge on the basic concepts and techniques of engineering and reverse engineering
- To develop understanding of the fundamentals of process of design, analytical thinking and ideas.
- To understand the basics and development of engineering drawing, application of engineering drawing with computer aide

Programme Outcomes (POs)

a. Apply the fundamental knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, automotive engines, automotive mechanics, automotive electrical system, thermodynamics, material and manufacturing sciences.
m. Design, analyze and optimize the solutions for automotive components and systems.

Course Outcomes (COs)

1. Appreciate various design process procedure
2. Generate and develop design ideas through different technique
3. Identify the significance of reverse Engineering to Understand products
4. Draw technical drawing for design ideas
5. Implement recent advancements in product design.

Articultion Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2											1		
2	1	2											1		
3	2	1											1		
4	3	2											3		
5	1	2											1		

UNIT I **8 Hours**

PROCESS OF DESIGN

Introduction – Product Life Cycle - Design Ethics - Design Process - Four Step - Five Step - Twelve Step - Creativity and Innovation in Design Process - Design limitation.

UNIT II **10 Hours**

GENERATING AND DEVELOPING IDEAS

Introduction - Create Thinking - Generating Design Ideas - Lateral Thinking – Anologies – Brainstorming - Mind mapping - National Group Technique – Synectics - Development of work - Analytical Thinking - Group Activities Recommended

UNIT III **9 Hours**

REVERSE ENGINEERING
Introduction - Reverse Engineering Leads to New Understanding about Products - Reasons for Reverse Engineering - Reverse Engineering Process - Step by Step - Case Study..

UNIT IV **9 Hours**

BASICS OF DRAWING TO DEVELOP DESIGN IDEAs
Introduction - Many Uses of Drawing - Communication through Drawing - Drawing Basis –Line - Shape/ Form – Value – Colour – Texture - Practice using Auto CAD recommended.

UNIT V **9 Hours**

TECHNICAL DRAWING TO DEVELOP DESIGN
Introduction - Perspective Drawing - One Point Perspective - Two Point Perspective - Isometric Drawing - Orthographic Drawing - Sectional Views - Practice using Auto CAD recommended.

Total: 45 Hours

Reference(s)

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design",Cengage learning (International edition) Second Edition, 2013.
2. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", CengageLearning, Second Edition, 2011.
3. www.tutor2u.net/business/presentations/.../productlifecycle/default.html
4. https://docs.oracle.com/cd/E11108_02/otn/pdf/.../E11087_01.pdf
   www.bizfilings.com ›
   Home ›
   Marketing › Product Developmen
5. https://www.mindtools.com/brainstm.html
6. https://www.quicksprout.com/.../how-to-reverse-engineer-your-competit
7. www.vertabelo.com/blog/documentation/reverse-engineering
8. https://support.microsoft.com/en-us/kb/273814
9. https://support.google.com/docs/answer/179740?hl=en
10. https://www.youtube.com/watch?v=2mjSDIBaUlM
11. thevirtualinstructor.com/foreshortening.html

18AU004 COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

Course Objectives

- To provide the knowledge on fundamental governing equations of fluid mechanics andheat transfer
- To acquire knowledge on formulation of governing Equations for fluid flow problems in finite difference method
- To study the steady and unsteady state diffusion type problems using finite volumemethod.
- To impart one dimensional and two dimensional elements in finite element techniques for fluid flow problems.
- To learn the structured and unstructured grids generationtechniques.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. An ability to design, analyze and find the solutions for automotive relatedproblems
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Formulate the fundamental governing equations of fluid mechanics and heat transfer.
2. Solve the fluid dynamics problems using finite difference method.
3. Construct finite volume equations for steady and unsteady state diffusion typeproblems.
4. Apply the finite element methods for fluid flow problems.
5. Generate the grids using grid generation techniques for simple and complex geometries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3											3	
2	2	3		2	2								3	
3	3	2			2								3	
4	2	3			2								3	
5	2		3	2										3

UNIT I **9 Hours**

INTRODUCTION

Introduction - Applications and impact of CFD in diverse fields - Navier Stroke equations in fluid dynamics-continuity - momentum and energy - generic integral form for governing equations -Initial and Boundary conditions. Classification of partial differential equations-Elliptic, Parabolic and Hyperbolic types.

UNIT II **9 Hours**

FINITE DIFFERENCE METHOD

Basics and discretization of simple and complex governing equations. Applications. Incompressible in-viscid Flows - Illustrative and physical examples of Elliptic, Parabolic and Hyperbolic equations - Discretization of partial Differential Equations. Implicit, explicit and Crank Nicolson finite difference methods for viscous flows. Stability, convergence, accuracy.

UNIT III **9 Hours**

FINITE VOLUME METHOD

Basic rules for FV Discretization. Finite Volume (FV) Discretization of one and two dimensional steady state diffusion type problems - 1-D convection-diffusion type problem - Unsteady flows - implementation of boundary conditions in Finite Volume. Solution of discretized equations. Solution algorithm for Pressure Velocity coupling in steady flows - Pressure-velocity coupling - SIMPLE scheme.

UNIT IV **9 Hours**

FINITE ELEMENT METHOD IN FLUIDS

Over view of Finite Element Techniques in Computational Fluid Dynamics. Weighted residual and Variational formulations. Finite element interpolation. One and two dimensional elements. Steady state conduction and incompressible potential flow problems.

UNIT V **9 Hours**

NUMERICAL GRID GENERATION

Introduction.Algebraic grid generation. Differential Grid Generation.Structured and unstructured grids. Body fitted Coordinate Method.

Total: 45 Hours

Reference(s)

1. J. D. Anderson., Jr. Computational Fluid Dynamics- The Basic with Applications, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2004
2. S. C. Gupta, Applied Computational Fluid Dynamics, Wiley India Pvt. Ltd., New Delhi, 2019
3. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere, New York, 2004.
4. H. K. Versteeg and W. Malalasakera, An Introduction to Computational Fluid Dynamics The Finite Volume Method, Pearson Education Ltd., New Delhi, 2007.
5. K. A. Hoffman, Computational Fluid Dynamics for Engineering, Engineering Education System, Austin, Texas 2005.
6. Introduction to computational fluid dynamics http://nptel.ac.in/courses/112105045/.

18AU005 COMBUSTION THERMODYNAMICS AND HEAT TRANSFER

3 0 0 3

Course Objectives

- To analyze combustion processes using first and second laws ofthermodynamics
- To evaluate enthalpy of combustion, adiabatic flame temperature and heatingvalues
- To acquire knowledge on combustion flames and reaction mechanisms
- To develop heat transfer correlations for engine

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Analyze combustion process in I.C engines from conservative laws and second lawperspectives
2. Compute the enthalpy of combustion, adiabatic flame temperature and heatingvalues
3. Examine the low temperature and high temperature combustion and its products.
4. Demonstrate the knowledge on combustion flames and reactionmechanisms
5. Develop heat transfer correlations and analyze the amount of heat transfer from the engines.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2									2	
2	2	3	1	2									3	
3	3	2		3									2	
4	2	2	3	1									2	
5	3	2	3	2									3	

UNIT I **7 Hours**

FUELS AND COMBUSTION

Liquid and gaseous fuels, Theoretical and actual combustion processes- equations of combustion, stoichiometric air-fuel ratio, excess air, analysis by mass, volume and their conversion.

UNIT II **10 Hours**

COMBUSTION THERMODYNAMICS

Ideal gas laws and properties of mixtures, Premixed and diffusion combustion process in IC engines, Application of first law of thermodynamics, Heat of reaction, Enthalpy of formation and enthalpy of combustion, Adiabatic flame temperature. Second law of thermodynamics applied to combustion entropy, maximum work and efficiency

UNIT III **9 Hours**

THERMO CHEMISTRY

Chemical equilibrium - equilibrium combustion products, chemical disassociation, Dynamic properties of working fluids - unburned mixture, low temperature and high temperature combustion products, Cool flames, Species concentration and products formation.

UNIT IV **9 Hours**

COMBUSTION AND FLAMES

Types- steady and unsteady, Laminar premixed flame- flame speed correlations, quenching, flammability, and ignition, Laminar diffusion flames, Turbulent premixed flames, Combustion in SI engine-stages, reasons for abnormal combustion, effects of abnormal combustion, Combustion in CI engine- stages, diesel knock.

UNIT V **10 Hours**

ENGINE HEAT TRANSFER

Importance, Heat transfer and engine energy balance, Convective and radiation heat transfer, Engine operating characteristics, Temperature distribution and thermal stresses in piston, cylinder linear, cylinder head, fins and valves, Heat transfer correlations for engines, Temperature measurement in piston, cylinder liner, cylinder head and engine valves.

Total: 45 Hours

Reference(s)

1. S. McAllister, J. Y. Chen and A. C. Fernandez-Pello, Fundamentals of Combustion Processes, NY: Springer, 2011.
2. I. Glassman, R. A. Yetter and N. G. Glumac, Combustion, Waltham: Academic Press, 2014.
3. G.L. Borman and K. W. Ragland, Combustion Engineering, Boca Raton: CRC Press, 2011.
4. B.P. Pundir, Engine Combustion and Emission, New Delhi: Narosa Publishing House, 2011.
5. Y.Cengel and M. Boles, Thermodynamics: An Engineering Approach, New Delhi: Tata McGraw- Hill Publishing Company, 2014
6. F. W. Sears and G. L. Salinger, Thermodynamics, Kinetic Theory and Statistical Thermodynamics, New Delhi: Narosa Publishing House, 2013.

18AU006 SUPERCHARGING AND SCAVENGING 3 0 0 3

Course Objectives

- To acquire knowledge on methods of supercharging and scavenging
- To understand the design concepts of ports and muffler
- To identify experimental techniques for evaluation of scavenging process

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Analyze the engine modification and supercharging effects on engineperformance.
2. Differentiate variable area turbocharger and variable geometry turbo charging and compare the matching of compressor with turbine and engine
3. Analyze the charging processes in two stroke engine and classify the three scavengingsystems
4. Design the intake and exhaust systems and draw the port flow characteristicscurves.
5. Compare firing and non-firing engine tests and explain the recent developments in two stroke engines

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1										1	
2	2	3	1	2									2	
3	2	3	1	1									2	
4	1	2	3										3	
5	2	3	1				2						3	

UNIT I **10 Hours**

SUPERCHARGING

Definition and engine modification required. Effects on engine performance. Types of compressors - positive displacement blowers, centrifugal compressors - performance characteristic curves. Suitability for engine application. Matching of supercharger compressor and engine.

UNIT II **9 Hours**

TURBOCHARGING

Turbocharging - turbocharging methods. Engine exhaust manifolds arrangements. Waste gate, variable nozzle turbochargers and variable geometry turbocharging. Surging and matching of compressor, turbine and engine.

UNIT III **9 Hours**

SCAVENGING OF TWO STROKE ENGINES

Classification of scavenging systems. Charging processes in two stroke engine - Sankey diagram. Scavengingmodeling - scavenging models. Mixture control through reed valve induction.

UNIT IV **8 Hours**

PORTS AND MUFFLER DESIGN

Porting - port flow characteristics - design considerations. Design of intake and exhaust systems - Kadenacysystem.

UNIT V **9 Hours**

EXPERIMENTAL METHODS AND RECENT TRENDS IN TWO STROKE ENGINES

Experimental techniques for evaluating scavenging. Firing engine tests and non-firing engine tests. Developmentin two stroke engines for improving scavenging. Direct injection in two stroke concepts.

Total: 45 Hours

Reference(s)

1. A.Allard, Turbocharging and Supercharging, NY: HarperCollins Publishers Ltd, 1987.
2. E. Davis, Supercharging, Turbocharging and Nitrous Oxide Performance, USA: Motorbooks, 2002.
3. J.K. Miller, Turbo: Real World High-Performance Turbocharger Systems, USA: CarTech, 2008.
4. A.G.Bell, Forced Induction Performance Tuning A Practical Guide to SuperchargingandTurbocharging, Somerset: Haynes Publishing, 2003.
5. J.B. Heywood, Two-Stroke Cycle Engine: It"s Development, Operation and Design, Boca Raton: CRCPress, 1999.
6. Jeff Hartman, Supercharging Performance Handbook , Motorbooks , 2011

18AU007 FUELS AND COMBUSTION

3 0 0 3

Course Objectives

- To Explain available energy sources for internal combustion engine
- To Determine correct A/F ratio for a given fuel
- To Explain stages of combustion in S.I. & C.I. engines
- To Design SI & CI engine combustion chambers
- To Explain and differentiate between multi fuel and duel fuel engines

Programme Outcomes (POs)

a. Apply the fundamental knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, automotive engines, automotive mechanics, automotive electrical system, thermodynamics, material and manufacturing sciences.

c. 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 with the knowledge of vehicle body engineering, design of automotive chassis components, automotive emission and control and design of automotive engine components.

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

m. Design, analyze and optimize the solutions for automotive components and systems.

o. Apply the broad knowledge and understanding of the concepts, theories and principles of automotive engineering to investigate emerging technologies and applications in the Automotive field

Course Outcomes (COs)

1. Explain available energy sources for internal combustion engine.
2. Determine correct A/F ratio for a given fuel
3. Explain stages of combustion in S.I. & C.I. engines
4. Design SI & CI engine combustion chambers.
5. Explain and differentiate between multi fuel and duel fuel engines

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1				2						2		2
2	3	2	2				2						3		
3	3	1	1				2						3		
4	2	3	1				2						3		
5	2	2	1				2						3		

UNIT I **10 Hours**

ENERGY SOURCES AND LIQUID FUELS

Exhaustible sources - crude oil, Natural gas, Inexhaustible sources - Solar energy, Wind power, Tidal Power, Geo-thermal power. Energy from Bio-gas, Synthetic fuels-Fuel Cells, Hydrogen- only a brief introduction. Origin of petroleum, its chemistry, normal paraffin's, iso-paraffins, olefins, naphthalene and aromatics. Refining of petroleum: Fractional distillation, Cracking, Reforming process, Thermal reforming, polymerization, alkylation, and isomerisation. Properties and tests : Specific Gravity, viscosity, flash and fire points, calorific value, rating of fuels, vapour pressure, cloud and pour point, annealing point, diesel index, carbon residue and ash content determination.

UNIT II **9 Hours**

I,C, ENGINE FUELS AND COMBUSTION EQUATIONS

Properties and rating of fuels, chemical energy of fuels, Reaction Equation, Properties of A/F mixture, combustion temp, combustion charts, Lead free gasoline's, low and ultra – low sulphur diesels, LPG, CNG, Alcohols, Biodiesels, Gaseous Fuel Injections, Dual Fueling and Controls – CNG and Gasoline, Hydrogen and Diesel, Alcohols and Diesels etc. Combustion equation, conversion of gravimetric to volumetric analysis. Determination of theoretical minimum quantity of air for complete combustion. Determination of air fuel ratio for a given fuel. Numerical problems, flue gas analysis, gas Chromatograph.

UNIT III **9 Hours**

COMBUSTION IN S.I. AND C.I. ENGINES

Initiation of combustion, combustion stages, flame velocities, effect of variables on ignition lag and flame propagation, normal and abnormal combustion, pre-ignition, surface ignition, detonation, theories of detonation, effects of engine variables on detonation, effects of detonation, control of detonation, features and design consideration of combustion chambers, types of combustion chambers. Various stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl, squish, tumble flow, velocities, diesel knock and its effect, methods of controlling diesel knock, features and design considerations of combustion chambers, types of combustion chambers.

UNIT IV **9 Hours**

ENGINE TESTING AND PERFORMANCE

Performance parameters, Basic measurements, Measurements of Speed, Fuel consumption, air consumption, brake power and different types of dynamometers, frictional power measurement by willam's line method, Morse test and other methods, indicated power, blow by measurement, performance maps, and heat balance and related numerical.

UNIT V **8 Hours**

DUAL FUEL AND MULTI- FUEL ENGINES

Combustion in dual fuel engines, Factor affecting combustion. Main types of gaseous fuels, Supercharge knock control & Performance of diesel fuel engines. Characteristics of multi fuel engines, Modification of fuel system, suitability of various engines as multi fuel unit, performance of multi fuel engines.

Total: 45 Hours

Reference(s)

1. Mathur& Sharma, I. C. Engines, Dhanpat Rai& Sons, New Delhi, 1994.
2. S. P. Sharma & Chandra Mohan, Fuels & Combustion, Tata McGraw-Hill, New Delhi, 1987.
3. Ganesan, V, Internal Combustion Engines, Tata McGraw Hill Book Co., 1995.
4. John B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Book,1998.
5. Obert, E. F., Internal Combustion Engine and Air Pollution, International Text Book Publisher, 1983

18AU008 ALTERNATE FUELS AND ENERGY SYSTEMS — 3 0 0 3

Course Objectives

- To evaluate the potentials of various alternative fuels for I.C. engines operation
- To develop understanding on production methods of alternative fuels
- To acquire knowledge on principles of electric, hybrid and fuel cell powered vehicles

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

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

m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Analyze the Performance, emission and combustion characteristics of alcohol used in CI and SI engines.
2. Compare the properties of various vegetable oil and explain the performance emission and combustion characteristics
3. Compare the different method of using hydrogen as a fuel in SI and CIengines
4. Analyze Performance and emission characteristics of biogas, NG and LPG in SI and CIengines.
5. Analyze the principle, construction, and limitations of electric, hybrid and fuel cellpowered vehicle

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1				2						2	
2	3	2	2				2						3	
3	3	1	1				2						3	
4	2	3	1				2						3	
5	2	2	1				2						3	

UNIT I — **10 Hours**

ALCOHOLS AS FUELS

Introduction - need for alternative fuels, availability of different alternative fuels for SI and CI engines, Alcohols as fuels- properties of alcohols as fuels, Production methods of alcohols, Methods of using alcohols in CI and SI engines- blending, dual fuel operation, surface ignition and oxygenated additives, Performance emission and combustion characteristics in CI and SI engines.

UNIT II **9 Hours**

VEGETABLE OILS AS FUELS

Various vegetable oils and their important properties, property enhancing methods- Methods of using vegetable oils in engines - blending, preheating , Esterification, Transesterification and emulsification of vegetable oils, Performance in engines -performance, emission and combustion characteristics.

UNIT III **9 Hours**

HYDROGEN AS ENGINE FUEL

Properties of hydrogen - Production methods of hydrogen, Combustive properties of hydrogen, Problems associated with hydrogen as fuel and solutions, Different methods of using hydrogen in SI and CI engines- performance, emission and combustion analysis, Hydrogen storage - safety aspects of hydrogen.

UNIT IV **9 Hours**

BIOGAS, NATURAL GAS AND LPG AS FUELS

Production methods of Biogas- natural gas and LPG, properties, CO2 and H2S scrubbing in biogas, Modification required to use in SI and CI Engines, Performance and emission characteristics of biogas, NG and LPG in SI and CI engines.

UNIT V **8 Hours**

ELECTRIC, HYBRID AND FUEL CELL VEHICLES

Layout and principle of electric and hybrid vehicles- advantages and drawbacks of electric and hybrid vehicles, system components, electronic control system, different configurations of hybrid vehicles, Fuel cell electric vehicles- operating principle, fuel cell technologies.

Total: 45 Hours

Reference(s)

1. S.S .Thipse, Alternate Fuels Concepts, Technologies and Dvelopments, Delhi :Jaico Publishing House, 2010.
2. V. Ganesan, Internal Combustion Engines, New Delhi : Tata Mcgraw Hill Publishing Co. Ltd, 2012.
3. L .Mathur, R.P. Sharma, Internal Combustion Engines, New Delhi :DhanpatRai Publications (P), Ltd, 8th edition, 2010.
4. R. L. Bechfold, Alternative Fuels Guide Book, Warrendale : SAE International,1997.
5. Alcohols as motor fuels progress in technology, Series No.19, USA: SAE Publication, 1980.

18AU009 AUTOMOTIVE AIR-CONDITIONING 3 0 0 3

Course Objectives

- To develop understanding on operation of ventilation, heating and air conditioning systems in automobiles
- To acquire knowledge on the components, refrigerants, and control systems ofautomotive ventilation, heating air conditioning systems
- To diagnose and repair troubles in air conditioner and heater

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Choose appropriate system ventilation, heating and air conditioning systems inautomobiles
2. Select appropriate refrigerants for Air-conditioning systems in automobiles.
3. Design appropriate control valves and switches for automotive air-conditioning system.
4. Select suitable temperature control systems for HVAC.
5. Choose appropriate Service type for Air-conditioner & Heater.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	3			2						2	
2	2		1	2			2						2	
3	2		2	3									2	
4	2			2	1		2						2	
5	2		1	3			2						3	

UNIT I **10 Hours**

INTRODUCTION

Need for air conditioner in vehicles, Sources of heat, HVAC system operation-ventilating the passenger compartment- solar powered ventilation, heating system-parts and operation, Refrigeration and cooling-vapour compression refrigeration system, basic air conditioning system, location of air conditioning components in a car, compressor components, defrost, expansion valve system, fixed orifice system.

UNIT II **8 Hours**

AIR-CONDITIONING COMPONENTS AND REFRIGERANTS

Compressor, condenser, receiver-drier/accumulator, expansion valve/fixed orifice valve, evaporator, anti-frosting devices, Refrigerants-requirements, types, R-134a vs R-12

UNIT III **9 Hours**

CONTROL VALVES AND SWITCHES

Expansion - thermostatic expansion valve, fixed orifice tubes, electronic expansion valves, controlling evaporator temperature, evaporator pressure controls-types, Compressor clutch controls- pressure cycling switches, thermostatic temperature cycling switches, pressure and temperature sensors, System protection switches and valves-pressure cutoff, temperature cutoff, thermal limiters.

UNIT IV **10 Hours**

HVAC CONTROLS

Control system purposes, HVAC control system modes, Manual system controls-parts, electrical and electronic controls, compressor controls, control system operation, Mechanical and electromechanical temperature control systems, Automatic temperature control systems-types, temperature control loops, Electronic temperature control-automatic and semi-automatic, parts, operation.

UNIT V **8 Hours**

AIR CONDITIONER AND HEATER SERVICE

Safety and service cautions for service, Air conditioner-quick check-visual inspection, performance test, leak detection, Service- discharging, evacuation, charging, replacing components, Heater- troubles, testing the vacuum control system, replacing components.

Total: 45 Hours

Reference(s)

1. J. D. Halderman, Automotive Heating and Air Conditioning, NY:Pearson Education, 2014.
2. M. Schnubel, Automotive Heating and Air Conditioning, NY: Delmar Cengage Learning, 2009.
3. T.W. Birch, Automotive Heating and Air Conditioning, NJ: Prentice Hall, 2009.
4. S. Daly, Automotive Air Conditioning and Climate Control Systems, Oxford: Butterworth-Heinemann, 2006.
5. B. H. Dwigging, Automotive Air Conditioning, NY: Delmar Cengage Learning, 2001.
6. M. Prasad, Refrigeration and Air Conditioning, New Delhi: New Age Publishers, 2009.

18AU010 COMPOSITE MATERIALS 3 0 0 3

Course Objectives

- Introduce students to the concepts of modern composite materials and equip themwith knowledge on how to fabricate thecomposites.
- To understand the different types of composite materials, their properties and applications.
- Describe fundamental fabrication processes for polymer matrix, metal matrix and ceramic matrix composites.
- Ability to do research and present on an advanced materialtopics.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
l. 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.
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Explain the different types of composite materials, their properties and applications
2. Select the suitable manufacturing process to produce PMC product based ontheapplications
3. Choose the suitable manufacturing process to produce MMC product based ontheapplications
4. Select the suitable manufacturing process to produce CMC product based ontheapplications
5. Find the advances in composite materials and their applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2										1		3
2	3	3										1		3
3	2	2										1		3
4	2	3										1		3
5	2	2										2		3

UNIT I **9 Hours**

INTRODUCTION TO COMPOSITES

Introduction to composites, reinforcements and matrices - types of matrices - types of reinforcements- fiber orientations - types of composites - properties of composites in comparison with standard materials - applications of metal, ceramic and polymer matrix composites.

UNIT II **9 Hours**

POLYMER MATRIX COMPOSITES

Introduction to polymers and Polymer matrix composites - thermosetting, thermoplastic-various types of reinforcements used in PMC, merits, demerits and applications of PMC - PMC manufacturing processes - Hand layup processes, Spray up processes, Compression moulding, Reinforced reaction injection moulding, Resin transfer moulding, Pultrusion, Filament winding, Injection moulding.

UNIT III **9 Hours**

METAL MATRIX COMPOSITES

Introduction to metals and metal matrix composites- types of Metal matrix composites - types of reinforcements used in MMC, Volume fraction, Rule of mixtures, merits, demerits and applications of MMC - Processing of MMC-Powder metallurgy process - diffusion bonding, stir casting, squeeze casting.

UNIT IV **9 Hours**

CERAMIC MATRIX COMPOSITES

Introduction to ceramics and ceramic matrix composites, and various types of CMC, merits, demerits and applications of CMC. Processing of CMC: Sintering - Hot pressing, Cold isostatic pressing (CIP), Hot isostatic pressing.

UNIT V **9 Hours**

ADVANCES IN COMPOSITES

Introduction to Carbon-carbon composites, merits, demerits and applications of CCC. Processing of CCC - chemical vapour deposition, Sol-gel technique - composite material for automotive, aerospace and industrial applications.

Total: 45 Hours

Reference(s)

1. Ronald, F. Gibson, Principles of Composite Material Mechanics, Fourth Edition, 2016
2. Daniel Gay, Composite Materials: Design and Applications, Third Edition, 2014
3. P.K Mallick, Fiber reinforced composites: Materials, Manufacturing and Design, Third Edition, 2008. B.E. MECHANICAL ENGINEERING 722
4. Deborah D.L. Chung,Composite Materials, Second Edition, 2014
5. http://nptel.ac.in/courses/112104168/Composite materials
6. https://www.youtube.com/watch?v=VMH6qbED7pg

18AU011 ENGINEERING TRIBOLOGY 3 0 0 3

Course Objectives

- To impart the concepts of the theory of friction and wearphenomenon.
- To provide knowledge on hydrodynamic and hydrostatic lubrication system.
- To gain knowledge on Tribology in design andindustry.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Apply the fundamentals of theory of friction and wear mechanisms in machinecomponents.
2. Select appropriate lubrication system for bearings.
3. Apply the hydrostatic lubrication and Squeeze film lubrication conceptinbearings.
4. Apply Elastohydrodynamic Lubrication and Gas lubrication Principles inbearings.
5. Apply Tribology concepts in industry applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	2									1	
2	3	2		1									1	
3	3	2	2	2									1	
4	3	2	1	1										
5	3	2	1	1									1	

UNIT I **9 Hours**

SURFACES, FRICTION AND WEAR

Topography of Engineering surfaces, Adhesion, Ploughing, Energy dissipation mechanisms Friction Characteristics of metals.Laws of friction, Kinds of friction, causes of friction, friction measurement, Theories of friction. Wear-Types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, Theories of wear.

UNIT II **9 Hours**

HYDRODYNAMIC LUBRICATION

Hydrodynamic lubrication-Mechanics of Fluid Flow, Theory of hydrodynamic lubrication, Mechanism of pressure development in oil film. Two Dimensional ReynoldsÃ¢??s Equation and its Limitations. Idealized Bearings, Infinitely Long Journal Bearings, Infinitely Short Journal Bearings. Finite bearing. Hydrodynamic thrust bearing - flat plate thrust bearing, Tilting pad thrust bearing.

UNIT III **9 Hours**

HYDROSTATIC LUBRICATION AND SQUEEZE FILM LUBRICATION

Hydrostatic lubrication- Basic concept, advantages and limitations, viscous flow through rectangular slot, load carrying capacity and flow requirement of hydrostatic step bearing, energy losses, optimum design. Squeeze film lubrication: Basic concept - Squeeze action between circular and rectangular plates - Squeeze action under variable and alternating loads.

UNIT IV **9 Hours**

ELASTO-HYDRODYNAMIC LUBRICATION AND GAS LUBRICATION

Elastohydrodynamic Lubrication- Principle and application, pressure - viscosity term in Reynold"s equation, Hertz,s theory. Ertel-GrubinEquation.Gas lubrication- Introduction, merits and demerits, applications.Tilting pad bearings, Hydrostatic bearings with air lubrication, Hydrodynamic bearings with air lubrication, Thrust bearings with air lubrication.

UNIT V **9 Hours**

TRIBOLOGY - INDUSTRY

Tribology in design, Tribology in industry, economic aspects of Tribology, lubrication, basic modes of lubrication, lubricants, properties of lubricants - physical and chemical, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, disposal of scrap oil, oil emulsion.

Total: 45 Hours

Reference(s)

1. John Williams, Engineering Tribology, Cambridge University Press, 2005.
2. B Bhushan, Introduction to Tribology, Wiley Publication , 2nd Edition. March 2013.
3. Ian Hutchings, Philip Shipway , Tribology: Friction and Wear of EngineeringMaterials, Butterworth-Heinemann; 2 edition, 2017.
4. Prasanta Sahoo, Engineering Tribology, PHI Learning , 2005.
5. E.P. Bowden and D. Tabor, Friction and Lubrication, Oxford University Press, 2001.
6. https://nptel.ac.in/courses/112102014/

18AU012 NON-TRADITIONAL MACHINING PROCESSES

3 0 0 3

Course Objectives

- To introduce basics of non-traditional machining processes.
- To study the mechanical energy based non-traditional machiningprocesses.
- To provide knowledge on electrical energy based non-traditional machining process
- To impart knowledge on chemical and electro-chemical energy basedprocesses.
- To impart knowledge on thermal energy based machining processes.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Explain the basics of non-traditional machining processes.
2. Select the suitable mechanical energy based non-traditional machining processes for thegiven industrial applications.
3. Find the suitable machining processes for machining electrically conductive materials.
4. Choose appropriate chemical and electro-chemical energy based processes for precision machining
5. Select the suitable thermal energy based process for cutting and machining of the hardmaterials.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2			2								2	
2	2	2			2								2	
3	2	2			2								2	
4	2	2			2								2	
5	2	2			2								2	

UNIT I **7 Hours**

NON TRADITIONAL MACHINING PROCESS

Introduction - Need - Classification - Energies employed in the processes - Brief overview of Abrasive jet machining(AJM), Water jet machining(WJM), Ultrasonic machining(USM), Electric discharge machining(EBM), Electro-chemical machining(ECM), Electron beam machining(EBM), Laser beam machining(LBM), Plasma arc machining(PAM).

UNIT II **10 Hours**

MECHANICAL ENERGY BASED PROCESSES

Abrasive Jet Machining, Water Jet Machining and Ultrasonic Machining - Working Principles,Equipment, Process parameters, Material removal rate, Applications.

UNIT III **10 Hours**

ELECTRICAL ENERGY BASED PROCESSES

Electric Discharge Machining - Working Principles, Equipment, Process Parameters, Material removal rate, Electrode / Tool, Power Circuits, Tool Wear, Dielectric, Flushing, Wire cut EDM Applications.

UNIT IV **10 Hours**

CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES

Chemical machining - Etchants, Maskants - techniques. Electro-chemical machining - Workingprinciple, Equipment, Process Parameters, Material removal rate, Electrical circuit.Electro-chemical grinding - Electro-chemical honing - Applications.

UNIT V **8 Hours**

THERMAL ENERGY BASED PROCESSES

Laser Beam machining, Plasma Arc Machining - Principles, Equipment. Electron Beam Machining - Principles, Equipment, Types, Beam control techniques, Material removal rate-Applications.

Total: 45 Hours

Reference(s)

1. P. K. Mishra, Non Conventional Machining, Narosa Publishing House, New Delhi, 2007
2. P. C. Pandey and H.S.Shan, Modern Machining Processes, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2008.
3. Joao Paulo Davim, Nontraditional Machining Processes: Research Advances, Springer, NewYork,2013.
4. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, Material and Processes in Manufacturing,Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
5. Vijaya Kumar Jain, Advanced Machining Processes, Allied Publishers Pvt. Ltd., New Delhi,2005.
6. Hassan El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Professional, New delhi, 2005

18AU013 ADDITIVE MANUFACTURING 3 0 0 3

Course Objectives

- To provide knowledge on generic steps of Additive Manufacturing (AM) technique.
- To learn the concept and applications of liquid and solid based AMprocesses
- To impart knowledge on powder based AM processes.
- To introduce the concept of open source 3D printers and rapidtooling
- To expose the emerging trends and applications of Additive Manufacturingtechnology

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

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

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Explain the generic steps and classification of Additive Manufacturingprocesses.
2. Select the suitable material and AM process based onapplications.
3. Identify the suitable AM process to fabricate metalliccomponents.
4. Design their own open source 3D printer based on application.
5. Implement the reverse engineering techniques for developing prototype

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2		2									2
2	2	2	1		2									2
3	2	2	1		2									2
4	2	2	1		2									2
5	2	2	2		2									2

UNIT I **7 Hours**

INTRODUCTION

Needs - Impact of AM and Rapid Tooling on Product Development - Distinction between AM and CNC Machining- The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - RP Benefits - Classification of RP systems

UNIT II **7 Hours**

LIQUID POLYMER AND SOLID BASED SYSTEMS

Stereolithography Apparatus (SLA), Digital Light Projection (DLP), Continuous Liquid Interface Production (CLIP), Photo polymerization process, Fused Deposition Modeling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Materials and Applications.

UNIT III **10 Hours**

POWDER BASED SYSTEMS

Selective Laser Sintering (SLS), Color Jet Printing, Direct Metal Deposition (DMD), Ballistic Particle Manufacturing (BPM), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS)- Working Principle, Construction, Process Variables, Materials and Applications

UNIT IV **11 Hours**

OPEN SOURCE PRINTER AND RAPID TOOLING

Concept of open source 3D printer - Structural details, Control mechanism - Materials and Applications. Introduction to rapid tooling (RT) - Direct and Indirect tooling - Silicone rubber moulding, Epoxy tooling, Spray Metal Coating, 3D printing direct, Electro Optical Sintering (EOS) - Working Principle, Materials and Applications

UNIT V **10 Hours**

REVERSE ENGINEERING AND APPLICATIONS OF ADDITIVE MANUFACTURING

Reverse Engineering - Application of CMM, Laser scanner, CT and MRI scan in acquiring point data - Software for STL file processing. Application of Rapid prototyping in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries. Leading manufacturer of RP systems

Total: 45 Hours

Reference(s)

1. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
2. D. T.Pham and S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
3. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015 http://www.springer.com/978-1-4939-2112-6
4. L.W. Liou, F.W. Liou, Rapid Prototyping and Engineering applications: A toolbox for prototype development, CRC Press, 2013.
5. Yang, L., Hsu, K., Baughman, B., Godfrey, D., Medina, F., Menon, M., Wiener, S., Additive Manufacturing of Metals: The Technology, Materials, Design and Production, Springer, 2017 https://doi.org/10.1007/978-3-319-55128-9
6. www.all3dp.com, www.3dprintingindustry.com, www.reprap.org, www.thingiverse.com

18AU014 NOISE, VIBRATION AND HARSHNESS CONTROL

3 0 0 3

Course Objectives

- To acquire knowledge on sources of noise, vibration and harshness
- To Understand the effect of noise on human comfort and environment
- To explain measurement techniques and control techniques of vibration and noise

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.

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

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Explain the basic concept of vibration, sources of vibration and noises in automobiles
2. Analyse the effect of noise and vibration on human beings and nature
3. Analyse the various methods to predict and control the noise and vibration in different components of automobiles.
4. Find out the suitable transducers to reduce the noise and vibration inautomobiles
5. Explain the different NVH controlling techniques in an interior transportation and safety precautions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3					2	3							2
2						2	3							2
3		2				2	3							2
4		1				2	3							2
5	3	2				2	3							2

UNIT I **9 Hours**

INTRODUCTION TO NOISE, VIBRATION AND HARSHNESS

Definition of Noise, Vibrations & Harshness in reference to Vehicular application - Noise - Definition, basic attributes of sound and units (wavelength, period, frequency velocity, speed, pressure, power and sound intensity - sound wave -properties, sound sources, sound propagation in the atmosphere, sound radiation from Structures - General Introduction to Vibration, free and forced vibration, undamped and damped vibration, linear and non linear vibration.

UNIT II **9 Hours**

EFFECTS OF NOISE AND VIBRATION ON PEOPLE

Effects on people and hearing conservation, sleep disturbance due to transportation noise exposure, noise-induced annoyance, effects of infrasound, low-frequency noise and ultrasound on people, auditory hazards of impulse and impact noise, effects of intense noise on people and hearing loss, effects of vibration on people, rating measures, and procedures for determining human response to noise and vibration.

UNIT III **9 Hours**

TRANSPORTATION NOISE AND VIBRATION Ã,?? SOURCES AND CONTROL

Internal Combustion Engine Noise - Prediction and Control, Diesel exhaust and intake noise and acoustical design of mufflers - Tire/Road Noise - Generation, Measurement, and Abatement - Aerodynamic Sound Sources in Vehicles - Prediction and Control, Transmission, Gearbox Noise, Vibration, prediction and control, Brake Noise Prediction and Control.

UNIT IV **9 Hours**

TRANSDUCERS AND MEASUREMENT TECHNIQUES

Transducers and exciters - Sound pressure, intensity and power measurement. Sound level meters, noise dosimeters, analyzers and signal generators, equipment for data acquisition and digital signal processing - Calibration of measurement microphones, calibration of shock and vibration transducers, metrology and traceability of vibration and shock measurements.

UNIT V **9 Hours**

NOISE AND VIBRATION IN INTERIOR TRANSPORTATION AND SAFETY

Interior Transportation Noise and Vibration - Introduction - Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors-Prediction and Control - Study of NVH - Legislations applicable for vehicles in India-Safety - Passive safety Active safety. Study of Safety Regulations for vehicular application

Total: 45 Hours

Reference(s)

1. David A.Bies and Colin H.Hansen, Engineering Noise Control: Theory and Practice, Spon Press, London, 2009
2. Xu Wang, Vehicle Noise and Vibration Refinement, Sawston, Cambridge: Woodhead Publishing Ltd, 2010.
3. M.Harrison, Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Oxford: Butterworth-Heinemann Elsevier Ltd, 2004.
4. C.W. de Silva, Vibration Monitoring, Testing, and Instrumentation, Boca Raton: CRC Press, 2007.

18AU015 IOT IN AUTOMOBILES 3 0 0 3

Course Objectives

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

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

m. An ability to design, analyze and find the solutions for automotive relatedproblems

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Understand functional blocks in an IoT System and their Applications
2. Analyze the elements of an IoT system needed for automotive application.
3. Analyze various protocols for IoT.
4. Implement IoT base application in automobile.
5. Analyze and compare various applications of IoT in real time scenario forautomobile.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2								2	2
2	2		3		3								2	2
3	3	2			3								2	2
4	3	2	3		3								2	2
5	3	3	3		3								2	2

UNIT I **9 Hours**

INTERNET OFTHINGS

Architectural overview, design principles and needed capabilities, IOT applications, Sensing, actuation, Basis of Netwoking, Machine to Machine(M2M) and IOT Technology fundamentals-Devices and gateways, data management, Business process in IoT, Everything as a Service, Role of Cloud in IoT, Security aspects in IoT

UNIT II **9 Hours**

ELEMENTS OF IOT

Hardware Components- computing (Arduino, RaspberryPi), Communication, Sensing, Actuation, I/O interfaces.

Software Components-Programming API"s(using Python/Arduino) for communication protocols-MQTT, Zigbee, Bluetooth, CoAP, UDP,TCP

UNIT III **9 Hours**

IOT PROTOCOLS

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE-Network Layer: IP versions, ConstrainedNodes and Constrained Networks-Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over LowPower and Lossy Networks-Application Transport Methods: Supervisory Control and DataAcquisition-Application Layer Protocols: CoAP and MQTT

UNIT IV **9 Hours**

IOT IN AUTOMOBILE

In-vehicle infotainment, Predictive maintenance, Data analysis and dashboard reporting, Real time monitoring, Vehicle management system. Engine management systems.

UNIT V **9 Hours**

IOT BASED SAFETY SYSTEM

Forward Collision Warning Plus,Highway Assist System,Traffic Sign Recognition,Anti Slip Regulation, Automatic Headlamps, Anti-Pinch Power Windows, Child Safety Locks,Speed Sensing Auto Door Lock, Anti-Lock Braking System, Central Locking. Impact Sensing Auto Door Unlock.Anti-Theft Alarm, Tyre Pressure Monitor, Engine Immobilizer, Blind Spot Monitor.

Total: 45 Hours

Reference(s)

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2. ArshdeepBahga, Vijay Madisetti, Internet of Things-A hands-on approach, Universities Press, 2015
3. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things-Key applications and Protocols, Wiley, 2012
4. Jan Holler, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Elsevier, 2014.
5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), Architecting the Internet of Things, Springer, 2011.
6. https://nptel.ac.in/courses/106105166/

18AU016 AUTOMOTIVE AERODYNAMICS 3 0 0 3

Course Objectives

- To understand the impact of aerodynamic forces and moments on performance of vehicle
- To acquire fundamental and applied understanding of air flows, vehicle aerodynamics andcontrol
- To develop design skills necessary for the aerodynamic design of road vehicles

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
m. An ability to design, analyze and find the solutions for automotive relatedproblems
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Analyze the internal and external flow in thevehicle.
2. Analyze the flow separation of bluff body to reduce the dragforces
3. Analyze the vehicle shape and size to make a good aerodynamicdesign.
4. Evaluate the aerodynamic force and moments on vehiclebody.
5. Demonstrate wind tunnel techniques to test the aerodynamic design.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		1									2	
2	2	3	2	1										3
3	2	2	3	1									2	
4	2	3	2	3									2	
5	1	2	3	2										2

UNIT I **9 Hours**

INTRODUCTION

Importance of vehicle aerodynamics, fluid mechanics related to vehicles - external and internal flow problem, resistance to vehicle motion, performance, fuel consumption, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

UNIT II **10 Hours**

AERODYNAMIC DRAG

Vehicle as a bluff body - flow field around car, drag force - types of drag force. Analysis of aerodynamic drag - drag coefficient. Strategies for aerodynamic development - low drag profiles.

UNIT III **9 Hours**

SHAPE OPTIMIZATION OF VEHICLES

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 and effect of fasteners.

UNIT IV **9 Hours**

VEHICLE HANDLING

Origin of forces and moments on a vehicle, lateral stability 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.

UNIT V **8 Hours**

WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS

Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

Total: 45 Hours

Reference(s)

1. Wolf-Heinrich Hucho, Aerodynamics for Road Vehicles, 4th Edition, Warrendale, PA: SAE International, 2014
2. J. Katz, Race car aerodynamics - Designing for speed, Cambridge, MA, Bentley Publishers, 2014 Pope .A, Low Speed Wind Tunnel Testing, New York, John Wiley&Sons2014.
3. Yomi Obidi, Theory and Applications of Aerodynamics for Ground Vehicles, Warrendale, PA: SAE International, 2014
4. R.H. Barnard, Road Vehicle Aerodynamic Design, 2nd edition, St Albans: MechAeroPublishing, 2001.
5. Introduction of Aerodynamics https://nptel.ac.in/courses/101105059/

18AU017 AUTOMOTIVE SAFETY AND ERGONOMICS **3 0 0 3**

Course Objectives

- To understand automotive safety in the broader context of transportationsafety.
- To evaluate the effects of collision of vehicles on human body.
- To acquire knowledge on the importance and use of safety systems in roadvehicles.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Understand the different types of active and passive safety system used inautomobiles.
2. Interpret the parameters of crash testing and evaluation of vehiclesafety.
3. Analyse the different types of vehicle safety systems used inautomobiles.
4. Inspect the factors of ergonomics and human response to impact.
5. Examine the collision warning and avoidance systems inautomobiles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			2	3	3								
2	2	2		2	2	3								
3	3	3		3	2	3							3	
4	2	2		3		3							2	
5	3	2		2	3	3							3	

UNIT I **9 Hours**

INTRODUCTION

Active and passive safety, driver assistance systems in automobiles. Vehicle structures - balance of stiffness and toughness characteristics and energy absorption characteristics, speed and acceleration characteristics of passenger compartment on impact, optimization of vehicle structures for crash worthiness.

UNIT II **9 Hours**

CRASH TESTING

Introduction - types of crash and roll over, Tests - types of impacts and impact with rebound, movable barrier tests, analysis of vehicle in barrier impacts, roll over crash tests, behaviour of specific body structures in crash testing and photographic analysis of impact tests, Crash test regulation and standards.

UNIT III **9 Hours**

VEHICLE SAFETY SYSTEMS

Survival space requirements, restraint systems used in automobiles, head restraints, safety belts - regulations, types, automatic seat belt tightening system. Air bags - electronic system for activating air bags, use of energy absorbing systems, impact protection from steering controls. Design of seats for safety and types of seats. Importance of bumpers, and damageability criteria in bumper designs.

UNIT IV **9 Hours**

ERGONOMICS AND HUMAN RESPONSE TO IMPACT

Importance of ergonomics in automotive safety, locations of controls, anthropometry and human impact tolerance. Determination of injury thresholds - severity index, study of comparative tolerance, application of Trauma for analysis of crash injuries, injury criteria and relation with crash study of crash dummies.

UNIT V **9 Hours**

COLLISION WARNING AND AVOIDANCE

Causes of rear end collision. Collision warning system - frontal object detection, rear vehicle object detection system and objects detection system with braking system interactions. Vehicle connectivity to assist drivers to prevent accidents and driver fitness detection, Under Vehicle Protection system.

Total: 45 Hours

Reference(s)

1. Bosch, Automotive Handbook, SAE Publication,10th Edition, 2018. George.A.Peters, Barbara.J.Peters, Automotive Vehicle Safety, CRC Press, First Edition, 2002.
2. Gereon Meyer, Jurgen Valldorf, Wolfgang Gessner, Advanced Microsystems for Automotive Applications 2009-Smart Systems for Safety, Sustainability, and Comfort, Springer, 2009.
3. J.Powloski, Vehicle Body Engineering, London: Business books limited, 2014.
4. R.K.Jurgen, Automotive Electronics Handbook, Second edition, London: McGraw-Hill Inc., 2006.
5. D.Vivek, Ergonomics in the Automotive Design Process, Boca Raton: CRC press, Taylor and Francis group, 2011
6. W.Johnson and A.G.Mamalis, Crashworthiness of Vehicles, London: MEP Publishers, 2005.

18AU018 TWO AND THREE WHEELERS 3 0 0 3

Course Objectives

- To acquire knowledge on the construction and working of power train and drive train of twoand three wheelers
- To familiarize with maintenance procedures of engine and subsystems of two and three wheelers
- To gain knowledge in three wheeler braking systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Construct the power train and frames of two and three wheelers of different layouts.
2. Design the two wheeler frames and three wheeler body.
3. Apply the clutch and gear box mechanism and construct the steering column and suspension system for two wheelers.
4. Analyze the Wheels and Tyres of two wheelers and Classify the Brakingsystem.
5. Construct the engines and drive trains for three wheelers and analyze the Suspension and braking system for autorickshaws.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1											2	
2	1	2	3										3	
3	3	1											2	
4	2	3											3	
5	2	3			-								3	

UNIT I **8 Hours**

INTRODUCTION

History of two & three wheeler vehicles, Classification & layouts of two wheelers - mopeds, motorcycles, scooters, Classification & layouts of three wheelers - passenger and goods auto rickshaws, two wheeler frames, main frame and types, three wheeler frame and body, Mono construction and composite construction.

UNIT II **10 Hours**

ENGINES

Selection criteria and design considerations for two wheeler engines, Types of engines in two wheelers-two stroke and four stroke engines, rotary valve engine, Scavenging and exhaust systems- scavenging pumps, exhaust pipe and header, muffler, Cranking system- basic cranking mechanisms, kick starter system, push starter.

UNIT III **10 Hours**

TRANSMISSION, STEERING AND SUSPENSION SYSTEMS

Clutch- single, multiple plate and centrifugal clutches, Gear box- constant mesh gear box, sequential gear box, Gear shifting mechanisms - continuously variable transmission, Gear shifting mechanisms-hand operated , foot operated , Final drive- belt, chain and rope drives. Steering column construction- handle bar, types, controls, Spring and shock absorber, Front and rear suspensions systems- telescopic suspension, single link type, double link type, swing armtype.

UNIT IV **8 Hours**

BRAKES, WHEELS AND TYRES

Braking system- drum brakes, disc brakes, Mechanical and hydraulic brake control systems, Wheels-spoked wheel, pressed steel wheel, alloy wheels, Tyres- tubed and tubeless tyres.

UNIT V **9 Hours**

THREE WHEELERS

Engines for three wheelers, CNG and diesel engines, Drive trains- drive train layout for passenger and loading rickshaws, propeller shaft, differential, Suspension and brakes- rear suspension for passenger and loading rickshaws, braking system for auto rickshaws.

Total: 45 Hours

Reference(s)

1. D.U .Panchal, Two and Three Wheeler Technology, New Delhi: PHI Learning Private Ltd, 2015.
2. P. E. Irving, Motor Cycle Engineering, London: Temple Press Book, 1992.
3. Encyclopedia of Motorcycling, UK : 20 volume Marshall, Cavensih,1989.
4. R.V. Brayant, Vespa, Maintenance and Repair Series, New Delhi :S.Chand& Co, 1986.
5. R B Lambretta, A Practical Guide to maintenance and repair, New Delhi: S.Chand& Co, 1987.
6. https://nptel.ac.in/courses/105107123/3

18AU019 OFF-ROAD VEHICLES 3 0 0 3

Course Objectives

- To acquire knowledge on construction and working of heavy-duty vehicles intended for off-road use
- To understand the basic differences between all the common transmissions and drivetrains used on off- road vehicles
- To explain the basic traction properties of off- road vehicles
- To understand the various farm equipment vehicle and their systems and features.
- To impart the knowledge on military and combat vehicles.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Select the suitable earth moving machines based on their power and load carrying capacities.
2. Demonstrate the application of construction Equipments.
3. Select the suitable tractor for given application.
4. Analyze the transmissions and drive trains used on military and combat vehicles.
5. Select the suitable hydraulic systems for Dumper and backhoe.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1										2	
2	2	2	1										2	
3	3	2	1										2	
4	1	3	2										2	
5	2	3	1										2	

UNIT I **9 Hours**

EARTH MOVING MACHINES

Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, scrapers, drag and self-powered types. Dump trucks and dumpers. Loaders - single bucket, multi bucket and rotary types, Excavators, Power and capacity of earth moving machines.

UNIT II **9 Hours**

SCRAPPERS, GRADERS, SHOVELS AND DITCHERS

Scrapers, elevating graders, self-powered scrapers and graders. Power shovel, revolving and stripper shovels, ditchers and capacity of shovels. Bush cutter, stampers, tree dozer and rippers.

UNIT III **9 Hours**

TRACTOR

Tractor-classification, Tractor controls and starting of tractor engine, Transmission- Stop and shift type, On the go shift type, transfer cases, Drive axles for wheeled tractor and row-crop tractors, rear axle of crawler tractor, Frame and suspension, Running gear of crawler tractor.

UNIT IV **9 Hours**

FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES

Farm equipment"s - power tiller, rotavator, gyrovator, laser leveller, cane thumper, sickle sword, fertilizer spreader, baler, mulcher, shredder, harvestor and rice transplanter. Special features and constructional details of tankers and gun carriers.

UNIT V **9 Hours**

HYDRAULICS AND HEAVY EQUIPMENT OPERATIONS

Basics hydraulics system-principle, components, advantages and disadvantages, Bulldozer hydraulic system, Dumper truck hydraulic system, Excavator hydraulic system, Scraper hydraulic system, Backhoes hydraulic system, Hydraulic traction booster for tractors.

Total: 45 Hours

Reference(s)

1. H.P. Smith, Farm Machinery and Equipment, Belgium: Morse Press, 2011.
2. D. Sheridan, Off-road vehicles on public land, Ann Arbor: University of Michigan Library, 1979.
3. C.P. Nakra, Farm Machines and Equipment, New Delhi: Dhanpat Rai Publishing Company Pvt. Ltd, 2003.
4. J.Y. Wong, Terramechanics and Off-road Vehicles, Oxford: Elsevier Science Ltd, 1989.
5. Graham, Off-Road Vehicles, London: Heinemann Library, 2008.
6. Ia. S. Ageikin, Off the Road Wheeled and Combined Traction Devices: Theory andCalculation, Burlington: Ashgate Publishing Co. Ltd, 1988.

18AU020 ELECTRIC AND HYBRID VEHICLES 3 0 0 3

Course Objectives

- To introduce fundamental concepts and specifications of electric and hybrid vehicles
- To acquire knowledge technologies related to electric, hybrid and fuel cell powered vehicles
- To appreciate the role of electronics in providing improved control to a variety ofvehiclesystems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Explain the current scenario of demand for fossil fuels, effects of automobile pollutionand strategy of next generation vehicles.
2. Identify the requirements of Electric Drive train for hybrid and electricvehicles.
3. Select appropriate electric motor and drive controls for EVs and HEVs.
4. Analyze the performance of energy storage systems in electric and hybridvehicles.
5. Select appropriate Fuel Cell Technology for EVs and HEVs.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3										2	
2	3	2	3										2	
3	2	3	2										2	
4	2	3	2										2	
5	2	3	2										2	

UNIT I **9 Hours**

INTRODUCTION

Usage Pattern of Automobiles in cities and highways, Air Pollution: NOx, CO, HC, PM emission, Global Warming Health Impacts, Petroleum Resources, Induced Costs, Importance of Different Transportation Development, Strategies to Future Oil Supply, Strategies for Next Generation Vehicles.

UNIT II **9 Hours**

ELECTRIC AND HYBRID VEHICLES

Configuration Layouts of early EVs and modern EVs, merits and demerits, Concept of Hybridization, Hybrid electric drive trains - types of hybrid drive train topologies, Speed & Torque Couplings, Types of HEVs, Regenerative braking strategies, Start/Stop in EVs and HEVs, Merits and demerits.

UNIT III **9 Hours**

PROPULSION SYSTEM FOR EVS

Basic concept of electric traction, Power-Torque Characteristic curves, Selection of Electric motors, Motors types: DC motor drives, induction motor drives, brushless DC PM motor drives, Switched Reluctance motor drives, starter/alternator, Electric Control Drives.

UNIT IV **9 Hours**

ENERGY MANAGEMENT SYSTEM FOR EVS

Energy storage requirements in HEVs and EVs, Energy storage techniques - battery based energy storage: Engine starter batteries, Traction Batteries, Super capacitor based energy storage and flywheel based energy storage, Hybridization of different energy storage devices.

UNIT V **9 Hours**

FUEL CELL TECHNOLOGIES

Fuel cell electric vehicles-operating principle, Fuel cell technologies- alkaline fuel cell- proton exchange Membrane, direct methanol fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, Fuel reformer, Hydrogen storage systems.

Total: 45 Hours

Reference(s)

1. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Boca Raton: CRC Press, 2018.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, Boca Raton: CRC Press, 2011
3. AuliceScibioh M. and Viswanathan B., Fuel Cells Principles and Applications, India: University Press, 2009.
4. Barbir F., PEM Fuel Cells: Theory and Practice, Burlington: Elsevier, 2012.
5. James Larminie and John Loury, Electric Vehicle Technology-Explained, New York: John Wiley & Sons Ltd., 2012.
6. https://nptel.ac.in/courses/108103009/

18AU021 SMART MOBILITY 3 0 0 3

Course Objectives

- To understand concept of autonomous and connected vehicle
- To learn about sensor technology of automated vehicle
- To understand about computer vision and deeplearning
- To acquire knowledge on localisation and pathplanning
- Become familiar with the concept of connectedvehicles

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. An ability to design, analyze and find the solutions for automotive relatedproblems
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Understand evolution of automotive electronic and connected vehicleconcepts
2. Analyse sensors for automotive application
3. Apply knowledge of Computer Vision and Deep learning in autonomous vehicle
4. Apply fundamentals of Localization and Path planning in autonomous vehicle
5. Analyze fundamentals of connected vehicle

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2		3								2	2
2	2	2	3		3								3	3
3	3	3	3		3								3	3
4	3	3	3		3								3	2
5	2	2	2		3								2	2

UNIT I **9 Hours**

INTRODUCTION

Introduction to the Concept of Automotive Electronics-History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Advanced Driver Assistance Electronic Systems Basic Control System Theory applied to Automobiles-Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy

UNIT II **9 Hours**

SENSOR TECHNOLOGY FOR AUTOMATED VEHICLES

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT III **9 Hours**

COMPUTER VISION AND DEEP LEARNING

Introduction, Computer Vision: - Computer Vision Fundamentals, Deep Learning:- Neural Networks, Deep Neural Networks, Convolutional Neural Networks, Keras ,TensorFlow, Sensor Fusion:- Kalman Filters

UNIT IV **9 Hours**

LOCALISATION AND PATH PLANNING

Introduction to Localization- Motion Models, Particle Filters, Implementation of a Particle Filter, Path Planning: -search, prediction, behaviour planning, trajectory generation, Control-PID, System Integration-ROS Driverless Car Technology: - Moral, Legal, Roadblock Issues, Technical Issues, Security Issues

UNIT V **9 Hours**

CONNECTED CAR TECHNOLOGY

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Wireless Security Overview

Connected Car Display Technology- Center Console Technology, Gauge Cluster Technology, Heads-Up Display Technology, Warning Technology-Driver Notification

Total: 45 Hours

Reference(s)

1. Markus Maurer, J. Christian Gerdes, Barbara Lenz, Hermann Winner , Autonomous Driving: Technical, Legal and Social Aspects, Springer,2016
2. Hod Lipson, Melba Kurman,Driverless: Intelligent Cars and the Road Ahead,MIT press, 2016
3. Michael E. McGrath , Autonomous Vehicles: Opportunities, Strategies,and disruptions, 2016
4. Vivekwadhwa , Alex salkever, The driver in the driverless car, 2017
5. G. Mullett, Wireless Telecommunications Systems and Networks, Thomson- Delmar Learning, ISNB#1-4018-8659-0, 2006
6. G. Mullett, Basic Telecommunications : The Physical Layer, Thomson-Delmar Learning, ISBN#1-4018-4339-5, 2003

18AU022 MOTORSPORT TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the fundamentals of racing vehiclecharacteristics.
- Understand aerodynamic requirements in racing vehicles.
- Understand the concepts of chassis behavior of racing vehicles.
- Gain knowledge about the concepts of suspension characteristics of racingvehicles.
- Understand the problems faced in drives and braking systems in motorsports.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

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

m. An ability to design, analyze and find the solutions for automotive relatedproblems

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Analyse the racing vehiclecharacteristics
2. Apply the aerodynamics in racing vehicles
3. Explain the concept of chassis behavior of racing vehicles
4. Analyse the suspension characteristics of racing vehicles
5. Analyse the problems faced in drives and braking systems in motor sports

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										2	2
2	3	2	3										3	2
3	2		3		-									2
4	3	2	2		2									3
5	2	2	2		2								2	

UNIT I **9 Hours**

RACE CAR DESIGN ANDDEVELOPMENT

Problems Imposed By Racing, Racing Objective, "g-g" Diagram. Constraints And Specifications-Performance, Handling, Structure. Driver Accommodation And Safety, Tires. Adjustable Features, Preliminary Design And Analysis. Driver-Vehicle Relationship. Desirable Vehicle Characteristics, Fundamentals Of Testing. Track Test Program Planning And Test Methodology. General Notes On Development-Circular Skid Pad Testing.

UNIT II **9 Hours**

RACE CAR AERODYNAMICS

Aerodynamic Force And Moment, Race Car Drag Components, Drag Improvement And Estimation. Ground Effects And Ground-Plane Simulation In Race Car Applications. Spoilers, Dams, Wings - Effectiveness Of Wings In Steady State Cornering. High Lift Devices- Flaps And Slats. Flow Control Devices Dams, Fences, Vanes, Skirts, Spoilers. Vortex Creating Devices- Ledges, Edges, Cusps, Lips. Pressure Change Creation Devices- Perforations, Vents, Bleeds, Scoops, Seals. Air-Foil Devices- Slats, Flaps, End Plates, Cuffs, Fillets, Trips. Active Flow Control Devices- Internal Airflow, RAM Air Ducted Radiator, Air Entrance Scoop.

UNIT III **9 Hours**

RACE CAR CHASSIS

Conditions For Traversing A 90Ã‚Â° Corner, Principle Chassis Tuning Items. Effects Of High Speed Braking, Cornering, Combined Braking Cornering. Steady State Cornering, Acceleration Out Of A Corner, Straight Line Acceleration. Throttle Behaviour, Steering Wheel Force And Kick Back. Moving CG Position, Roll Center Position Changing AntiPitch Geometry. Chassis Steering Axis Geometry, Changing Camber. Chassis Ride Roll Characteristics, Chassis Track Width. Chassis Ride Spring Rate, Tires And Rims, Adjusting Roll Stiffness And Roll Stiffness Distribution.

UNIT IV **9 Hours**

RACE CAR SUSPENSION SYSTEM

Front Suspension- General Design Issues, Camber Effects. SLA Suspension, McPherson Struts. Independent Rear Suspension- Trailing Arm Types, Instant Axis Concept. SLA Rear Suspension, Beam Axle Rear Suspensions. Torque Tube And Torque Arm Suspension, Decoupled Rear Axle Suspension. Suspension Springs- Torsion Springs, Coil Springs, Progressive Rate Coil Springs. Leaf Springs, Types, Installation Consideration, Inter Leaf Friction, Spring Fatigue. Damping In Racing- Ride/Handling Compromise, Steering Activity, And Transient Maneuvering, Bump Damping And Rebound Damping.

UNIT V **9 Hours**

RACE CARDRIVES AND BRAKING SYSTEMS

Merits Of Front, Rear And Four-Wheel Drive In Racing. Differentials Used In Racing- Open Differentials, Locked (Spool), Limited Slip Differentials. Traction Control And Other Electronic Improvements In Racing. Mechanical Components In Braking System. Limitations And Considerations Of Braking In Racing. Brake Boost, Effects Of "g" Force On Brake Fluids. Brake Hydraulics, Ventilation. Brake Distribution, ABS In Racing. Carbon-Carbon discs.

Total: 45 Hours

Reference(s)

1. William F.Milliken and Douglas L.Milliken, Race car vehicle dynamics, 11th edition,
2. Peter Wright, Formula 1 Technology,2001.
3. Thomas D. Gillespie, Fundamental of Vehicle Dynamics, Society of Automotive Engineers, USA 1994.
4. Wolf-Heinrich Hucho, Aerodynamics of road vehicles, 4th edition, 2000.

18AU023 ADVANCED VEHICLE TECHNOLOGY 3 0 0 3

Course Objectives

- Understand various trends in Automotive power plants.
- Gain knowledge about various modern suspension and braking systems.
- Understand various emissions and noise pollution control techniques.
- Understand the fundamentals of modern sensors, actuators, ignition and injection systems.
- Gain knowledge about Automated tracks for safe and fast travel

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.
m. An ability to design, analyze and find the solutions for automotive relatedproblems
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Explain the various trends in automotive power plants
2. Understand about various modern suspension and braking systems.
3. Compare various emissions and noise pollution techniques
4. Select the suitable modern sensors, actuators, ignition and injection systems for various application in automobiles
5. Analyse the feasibility of automated tracks for safe and fast travel

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			2	2	2								2	
2			3		1	2							2	
3			3	3	2	3								2
4			2	2	3	2								2
5	2		2			2							3	1

UNIT I **9 Hours**

TRENDS IN AUTOMOTIVE POWER PLANTS

Hybrid Vehicles-Stratified Charged / Lean Burn Engines Hydrogen Engines. Battery Vehicles-Electric Propulsion With Cables. Magnetic Track Vehicles.

UNIT II **9 Hours**

SUSPENSION BRAKES AND SAFETY

Interconnected Air And Liquid Suspensions. Hydro Elastic Suspension System, Hydro Gas Suspension, Closed Loop Suspension, Modern Rear Wheel Brake, Indirect Floating Caliper Disc Brake, Self Energizing Disc Brake, Brake Limiting Device, Anti-Skid System, Regenerative Braking, Passenger Comfort.

UNIT III **9 Hours**

EMISSION AND NOISE POLLUTION CONTROL

Engine Emissions, Types Of Catalytic Conversion. Open Loop And Closed Loop Operation To The Oxidizing Catalytic Converter. Evaporative Emissions, Internal And External Noise, Identification Of Noise Sources, Noise Control Techniques.

UNIT IV **9 Hours**

VEHICLE OPERATION AND CONTROL

Fundamentals of Automotive Electronics - sensors, actuators, Processors. Computer Control for pollution, noise and for fuel economy, Electronic Fuel Injection, Electronic Ignition system, Transducers And Operation Of The Vehicle Like Optimum Speed And Direction.

UNIT V **9 Hours**

VEHICLE AUTOMATED TRACKS

Preparation And Maintenance Of Proper Road Network. National Highway Network With Automated Roads And Vehicles. Satellite Control Of Vehicle Operation For Safe And Fast Travel.

Total: 45 Hours

Reference(s)

1. T. K. Garrett, The Motor Vechicle, 13th edition 2009.
2. Dr. N.K. Giri, Automobile Mechanic, Khanna Publishers, 2006.
3. Heinz Heisler, Advanced vehicle technology, elsevier Store.2002.
4. Crouse/Anglin, Automotive Mechanics, Career Education; 10th edition January 13, 1993.
5. Beranek. L.L, Noise Reduction, McGraw-Hill Book Co., Inc, Newyork, 1993.
6. Bosch Hand Book, 3rd Edition, SAE,1993.

18AU024 TYRE TECHNOLOGY 3 0 0 3

Course Objectives

- Understand various methods of tyre preparation.
- Gain knowledge about the forces and moments acting on tyres
- Understand wear possibilities, their causes and measurements
- Understand the safety of tyres and its failureanalysis.
- Gain knowledge about the tyre testing methods

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. An ability to design, analyze and find the solutions for automotive relatedproblems
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Explain the various method of tyrepreparataion
2. Analyse the forces and moments acting on tyres
3. Analyse the wear possibilities, their causes and measurements
4. Analyse the safety of tyres and its failureanalysis
5. Apply various tyre testing methods to test the tyres

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			2	2	3	2							2	
2	2	3	2										2	2
3				2		3	2						2	2
4			2	3		3							2	1
5				2	2	3							2	2

UNIT I **9 Hours**

AN OVERVIEW OF TYRE TECHNOLOGY

Introduction-Tyre Basic Function- Tire Types-DiagonalBelted Bias- Radial Bias. Tyre Components-Radial Tyre Components. Radial Tyre Design Process. Tyre Performance Criteria-Indoor Test And Outdoor Test. Tyre Manufacturing- Compound Preparation- Calendaring Tyre Assembly- Curing-Inspection- Quality Control Tests.

UNIT II **9 Hours**

TYRE FORCES AND MOMENTS

Forces And Moments. Rolling Resistance. Cornering Properties- Slip Angle And Cornering Force. Performance Of Tyre On Wet Surface. Ride Properties Of Tyres

UNIT III **9 Hours**

RUBBER ABRASION AND TYRE WEAR

Sliding Abrasion. Tyre Wear. Influence Of Road Surface- Driving Influences. Speed And Load Distributions. Road Wear And Force Distribution. Tire Construction

UNIT IV **9 Hours**

INTRODUCTION TO TIRE SAFETY, DURABILITY AND FAILURE ANALYSIS

Service- Maintenance Safety- On Vehicle- In-Service Safety. Fundamentals Of Tyre Durability. Nature Of Tyre Durability- Deflection, Heat, Speed, Tyre Structural Failures. Common In-Service Tyre Failure Modes. Run Low/ Flux Break- Tyre Tread Bead Detachment- Rapid Air Loss. Over Deflection- Intra-Carcass Pressurization- Cuts And Punctures- Improper Repair- Improper Repair- Tyre Defects

UNIT V **9 Hours**

NON-DESTRUCTIVE TESTS AND INSPECTIONS

Introduction Of Inspection Techniques. X-Ray Examination, Shearography, Ultrasound, Eddy Currents.

Total: 45 Hours

Reference(s)

1. J. Y. Wong, Theory of Ground Vehicles, 4th Edition, 2008
2. US Department of Transportation., The Pneumatic Tire,February 2006.
3. Reza N. Jazar, Vehicle Dynamics: Theory and Application, Springer 2008
4. Hans B. Pacejka, Tire and Vehicle Dynamics, 3rd Edition, 2002.
5. Rajesh Rajamani, Vehicle dynamics and control, Springer Science & Business Media, 2006.

18AU025 INDUSTRY 4.0 3 0 0 3

Course Objectives

- To understand the advantages compared to conventional production techniques
- To learn about how intelligent processes, big data, and artificial intelligence can be used to build up the production of the future.
- To understand basics, drivers and enablers of Industry 4.0.
- To apply modern methods and techniques of planning, dimensioning, design and optimization of Industry 4.0 production systems
- To learn about value chains in Industry.

Programme Outcomes (POs)

a. Apply the fundamental knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, automotive engines, automotive mechanics, automotive electrical system, thermodynamics, material and manufacturing sciences.
c. 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 with the knowledge of vehicle body engineering, design of automotive chassis components, automotive emission and control and design of automotive engine components.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
n. Use concepts, theories and principles of science, mathematics and information technology to develop intelligent vehicle systems and embedded systems for automotive applications.
o. Apply the broad knowledge and understanding of the concepts, theories and principles of automotive engineering to investigate emerging technologies and applications in the Automotive field

Course Outcomes (COs)

1. Understand basics, drivers and enablers of Industry 4.0
2. Analyze the elements of modern methods and techniques of planning, dimensioning.
3. Design and optimization of Industry 4.0 production systems.
4. Implement value chains in Industry.
5. Implement smart factory paradigm.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2				2									2	
2	2		3		3									2	2
3	3	2			3									2	2
4	3	2	3		3									2	
5	3	3	3		3									2	

UNIT I **9 Hours**

INTRODUCTION TO INDUSTRY 4.0

Definition of Industry 4.0, Developments in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and today's Factory, The 10 most important things that will change with Industry 4.0, Difference between conventional automation and Industry 4.0.

UNIT II **9 Hours**

BASIC PRINCIPLES AND TECHNOLOGIES OF A SMART FACTORY

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Big Data, Cyber- Physical Systems, value chains in manufacturing companies, Customization of products, Digital Twins, Cloud Computing / Cloud Manufacturing, Security issues within Industry 4.0 networks.

UNIT III **9 Hours**

THE SMART WORKPIECE

The intelligent work piece as basic functionality in implementing Industry 4.0, intelligent workpiece, Work piece tagging, QR codes and RFID, Communication between work piece and environment, Multi- agent systems in production, Applications for smart work pieces'

UNIT IV **9 Hours**

DIGITAL TWINS IN PRODUCTION

Basic concepts of Digital Twins, Benefits, impact and challenges, Features and Implementation of Digital Twins, Types of Digital Twins, Digital Twin use cases, Applications for digital twins in production.

UNIT V **9 Hours**

ASSISTANCE SYSTEMS FOR PRODUCTION

The connected worker within the Industry 4.0 scenario, Diversity-driven workplaces (barrier free workplaces, accessibility in production), Human-and task-centered assistance systems (e.g. motion capture system for training employees, etc.), Technical tools ("Ambient Assisted Working" (AAW)), Mobile information technologies, Shop floor information systems, Production line support systems (pick by light, assembly display systems, assembly control by vision, …), Manipulator systems and intelligent chairs, Human work support by using exoskeletons, Applications assistance systems in production.

Total: 45 Hours

Reference(s)

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2. ArshdeepBahga, Vijay Madisetti, Internet of Things-A hands-on approach, Universities Press, 2015
3. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things-Key applications and Protocols, Wiley, 2012
4. Jan Holler, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Elsevier, 2014.
5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), Architecting the Internet of Things, Springer, 2011

18AU026 VEHICLE SYSTEM EVALUATION AND CERTIFICATION **3 0 0 3**

Course Objectives

- To make the students familiarize with the various tests to be performed on the subsystems of a vehicle
- To study and analyze its performance andcharacteristics
- To classify the vehicle and identify the regulations governing for each vehicletype
- To perform and analyze the braking, steering systems, lighting systems, wheels, tires and windshields of any vehicle

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Classify the vehicle and identify the regulations governing for each vehicletype
2. Understand the various tests to be performed on the subsystems of a vehicle
3. Analyze the performance characteristics of the subsystems of a vehicle
4. Analyze the performance characteristics of the safety subsystems of a vehicle
5. Analyze the braking, steering systems, lighting systems, wheels, tires and windshields of a vehicle

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2									2	
2	2	3	1	2									2	
3	3	2		3									2	
4	2	2	3	1									2	
5	3	2	3	2									2	

UNIT I **7 Hours**

REGULATIONS

Specification & Classification of Vehicles (including M, N and O layout), Regulations overview (ECE, EEC, FMVSS, AIS, CMVR, ADR), Type approval and Conformity of Production, Engine and Vehicle specifications, Two Wheeler certification

UNIT II **10 Hours**

VEHICLE TESTING

Vehicle Testing - Photographs, CMVR physical verification, Vehicle weightment, Coast down test, Brake test, ABS, Turning circle diameter test, Steering effort test, Speedometer calibration, Pass by noise test, External projection test, Gradability test, Acceleration control system, Horn installation, Rear view mirror installation, Installation requirement for lighting & signaling devices, Wind screen wiping system.

UNIT III **9 Hours**

EMISSION TESTING

Steering Impact test (GVW<1500 kg), Body block test, Head form test, Fixtures charges, Crash test with dummies, OBD I, Bumper testing, Documentation SHL, Certification charges, Engine power test (petrol & diesel), Indian driving cycle, Vehicle mass emission, Evaporative emission (petrol vehicles), Broad band / Narrow band EMI test.

UNIT IV **9 Hours**

AUXILIARY SYSTEMS TESTING

Size and Ply rating of tyres, Safety Glasses: Windscreen laminated safety glass, Side window / door glass, Back light / Rear toughened glass, Wind screen wiping system, Wiper Blade, Hydraulic brake hose, Hydraulic brake fluid, Rear view mirror specification (Exterior), Rear view mirror specification (Interior), Wheel rims, Wheel nut, Wheel discs & hub caps, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints, door locks & door retention

UNIT V **10 Hours**

HEAD, TAIL AND SIDE LAMP TESTING

Performance requirement for lighting & signaling devices - Vertical orientation of dipped beam- head lamp, driveR"s field of vision, Head lamp assembly (glass lens & plastic lens), Head lamp + Front position lamp / Front indicator lamp / front fog lamp, Rear combinational lamp (each additional function), Independent front position lamp / Front direction indicator lamp / Front fog lamp, Rear combination lamp (single function), Warning triangles, Fuel tank: Metallic & Plastic (excluding fire resistance test).

Total: 45 Hours

Reference(s)

1. Raymond M. Brach and R. Matthew Brach, "Vehicle Accident Analysis and Reconstruction Methods", SAE International, 2011
2. Ulrich Seiffert and Lothar Wech, Automotive Safety Handbook, SAE International, 2007.
3. ISO Standards, ICS: 43.020, 43.040, 43.100
3. Automotive Industry Standards, AIS

18AU027 HYDRAULICS AND PNEUMATICS

3 0 0 3

Course Objectives

- To Explain basics of Hydraulics and pneumatics.
- To Describe Various components of hydraulic system and maintenance of hydraulic system
- To Design hydraulic system
- To Describe layout and details of pneumatic systems

Programme Outcomes (POs)

a. Apply the fundamental knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, automotive engines, automotive mechanics, automotive electrical system, thermodynamics, material and manufacturing sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health andsafety, and the cultural, societal, and environmental considerations with the knowledge of vehicle body engineering, design of automotive chassis components, automotive emission and control and design of automotive engine components.
d. 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 in the vehicle body engineering, design of automotive chassis components, automotive emission and control and design of automotive engine components.
m. Design, analyze and optimize the solutions for automotive components and systems.

Course Outcomes (COs)

1. Understand basics of Hydraulics and pneumatics
2. Describe Various components of hydraulic system and maintenance of hydraulic system
3. Design hydraulic system
4. Describe layout and details of pneumatic systems
5. Describe applications of hydraulics and pneumatics systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2		2									2		
2	2	3	1	2									2		
3	3	2		3									2		
4	2	2	3	1									2		
5	3	2	3	2									2		

UNIT I **7 Hours**

HYDRAULICS ACTUATORS AND MOTORS

Pascal’s law, The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, variable displacement pumps. Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors and piston motors

UNIT II **10 Hours**

HYDRAULIC SYSTEMS CONTROL AND MAINTENANCE

Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves. Hydraulic oils – Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting

UNIT III **9 Hours**

HYDRAULIC CIRCUIT DESIGN AND ANALYSIS

Control of single and Double – acting Hydraulic cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.

UNIT IV **9 Hours**

PNEUMATICS CONTROLS

Choice of working medium, characteristics of compressed air,.preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout. Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals. Rod – less cylinders – types, working advantages. Rotary cylinder types construction. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Direct and indirect actuation pneumatic cylinders. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve.

UNIT V **10 Hours**

MULTI CYLINDER APPLICATIONS AND ELECTRO-PNEUMATIC CONTROL

Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). Principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications.

Total: 45 Hours

Reference(s)

1. Anthony Esposito, Fluid Power with applications, Pearson education, Inc, 2000.
2. Andrew Parr, Pneumatics and Hydraulics, Jaico Publishing Co., 2000.
3. S. R. Majumdar, Systems – Principles and Maintenance, Tata McGraw Hill publishing company Ltd., 2001.
4. S. R. Majumdar, Pneumatic systems, Tata McGraw Hill publishing company Ltd., 1995.
5. Pippenger Hicks, Industrial Hydraulics, McGraw Hill, New York, 2001

18AU028 INDUSTRIAL ENGINEERING 3 0 0 3

Course Objectives

- To impart the knowledge on production system and layoutdesign.
- To learn about production planning and its control methods.
- To provide the knowledge of work study, process charts and ergonomic condition.
- To impart the knowledge on inventory control and material handling equipments.
- To learn about system analysis and different types of maintenance.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Select proper plant layout for the required production system.
2. Plan the resources required for the production and to perform the controlmethods.
3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
4. Analyze the inventory required based on production needs and material handling.
5. Explain the system and different types of maintenance process for smooth operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1		1								2	
2	2	2	1		2								2	
3	1	2	3		2								2	
4	2	3	1		2								2	
5	2	3	1		2								2	

UNIT I **9 Hours**

INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM

Industrial engineering - Concept, History and Development, Applications, Roles of Industrial engineer. Production management, Industrial engineering versus Production management, Operations management. Production system Analysis, Input-output model, Productivity, Factors affecting productivity. Plant layout, Criteria for a good layout, Types of layout - Process layout, Product layout, Combination layout, and Fixed position layout. Material flow pattern, Workstation design.

UNIT II **9 Hours**

PROCESS PLANNING AND PRODUCTION CONTROL

Introduction to Process planning- Definition, Procedure, Process selection, Machine capacity, Process sheet, Process analysis. Group technology - Definition, Classification and coding system, Formation of component family. Production planning - Introduction, Functions, Loading, Scheduling. Production control - Dispatching, Routing. Progress control - Bar, Curve, Gantt chart, Route and Schedule chart.

UNIT III **9 Hours**

WORK STUDY AND ERGONOMICS

Work study - Definition, Need, Advantages, Objectives of method study and work measurement, Method study procedure. Process chart - symbols, outline process chart, flow process chart. The flow diagram, String diagram, Multiple activity chart, Principles of motion economy, Therbligs, SIMO chart, Stopwatch procedure. Ergonomics- applications of ergonomic principles in the shop floor- work benches-seating arrangement.

UNIT IV **9 Hours**

INVENTORY MANAGEMENT AND MATERIAL HANDLING

Inventory - Definition, Objectives, Classification, Functions, Economic order quantity, Economic batch quantity, Inventory models, ABC analysis. Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, Just in Time manufacturing system, KANBAN technique, Material handling - Definition, Functions, Principles, Equipment selection, and Equipment types.

UNIT V **9 Hours**

SYSTEM ANALYSIS AND MAINTENANCE

System concept, System analysis, System engineering, Techniques, Applications. Value analysis/ Engineering - Definition, Types of values, Aim, Technique, Procedure, Advantages, Applications, Value engineering versus Value control. Plant maintenance department - Objectives, Importance, Duties, Functions, and Responsibilities. Types of maintenance - Breakdown, Scheduled, Preventive and Predictive. Plant maintenance schedule - Introduction, Procedure.

Total: 45 Hours

Reference(s)

1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications.,2010.
2. Panneerselvam R., Production and operations management, Heritage Publishers, 2006.
3. Martand T.Telsang, Industrial Engineering and Production Management, S Chand Publishers,2006.
4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009.
5. Jan Dul, Bernard Weerdmeester, Ergonomics for Beginners: A Quick Reference Guide, CRC Press, Taylor and Francis group,2008.
6. Lee J. Krajewski, Larry P.Ritaman, Operations Management, Addison Wesley, 2007.

18AU029 OPTIMIZATION TECHNIQUES 3 0 0 3

Course Objectives

- To impart knowledge on concept of optimization and problemformation.
- To provide knowledge on optimization methods for single variable unconstrained problems
- To educate about multi-objective unconstrained optimization problems solving algorithms.
- To impart concepts of constrained non-linear optimization problems
- To provide input on non-traditional optimization techniques to solve engineering problems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.

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

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.

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

j. 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.

l. 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.

m. An ability to design, analyze and find the solutions for automotive relatedproblems

Course Outcomes (COs)

1. Summarize the concepts of design optimization and problem formationprocedures.
2. Compute the solution for single variable unconstrained optimization problems
3. Determine the solution for multivariable unconstrainedoptimizationproblems
4. Find the solution for the constrained non-linear optimization problems
5. Apply non-traditional optimization techniques to solve engineering problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1				1				1		1	2	
2	3	2	2	1	1	1	1			1		1	2	
3	3	2	2	2	1	1	1			1		1	2	
4	3	2	2	2	1	1	1			1		1	2	
5	3	2	2	2	1	1	1			1		1	2	

UNIT I **9 Hours**

INTRODUCTION

Introduction to design optimization-Historical development, the design process, Conventional Vs Optimum design process - Statement of an optimization problem- Optimum design problem formulation - process steps, Problem formulation for engineering applications - Two-bar bracket, Design of coil springs-Classifications of optimization problems.

UNIT II **9 Hours**

SINGLE VARIABLE NONLINEAR UNCONSTRAINED OPTIMIZATION ALGORITHMS

Optimality criteria - Unimodal function - Eliminating methods - Exhaustive search, Dichotomous search, Interval halving method, Fibonacci search method, Golden section search method. Point estimation method (Powell"s algorithm) - Gradient-based methods - Newton-Raphson method (Taylor"s series expansion), Bisection method, Secant method, Cubic search method.

UNIT III **9 Hours**

MULTI VARIABLE NONLINEAR UNCONSTRAINED OPTIMIZATION ALGORITHMS

Optimality criteria - Unidirectional search - Direct search methods - Evolutionary optimization method, Random search methods, Simplex search method, Hooke-Jeeves pattern search method, Indirect search(gradient) methods- Cauchy"s (steepest descent) method, Newton"s method, Conjugategradient method.

UNIT IV **9 Hours**

CONSTRAINED NONLINEAR OPTIMIZATION ALGORITHMS AND SPECIALIZED PROGRAMMING

Introduction, Characteristics - Indirect search methods - Transformation methods, Penalty function method, Method of multipliers - Sensitivity analysis - Kuhn-Tucker conditions, Theorems. Test problems on three-bar truss, welded beam design. Direct search minimization methods- Variable elimination method, Complex search method and Random search methods - Feasible direction method. Integer programming - Penalty function method, Branch and Bound method.

UNIT V **9 Hours**

NONTRADITIONAL OPTIMIZATION TECHNIQUES

Genetic Algorithms (GA)- principle, difference and similarities between GA and traditional methods,constrained optimization, GA operators, Real-coded and Advanced GAs - Simulated Annealing - Neural Network based Optimization.

Total: 45 Hours

Reference(s)

1. SingiresuS.Rao, Engineering Optimization: Theory and Practice, Fourth Edition, Wiley IndiaPvt Ltd, Delhi,2009
2. Kalyanmoy Deb, Optimization for Engineering Design- Algorithms and Examples, Second Edition, PHI Learning Pvt. Ltd., New Delhi,2012.
3. Jasbir Singh Arora, Introduction to Optimum design, Third Edition, Elsevier India Pvt.Ltd, New Delhi, 2011.
4. R.Saravanan, Manufacturing optimization through intelligent techniques, First Edition, Taylor& Francis Publications, CRC Press, New Delhi, 2006.
5. Optimization Techniques and Applications with Examples, Xin-She Yang, Wiley India Pvt Ltd, Delhi,2018.

18AU030 TOTAL QUALITY MANAGEMENT 3 0 0 3

Course Objectives

- To learn concepts, dimension quality and philosophies of TQM
- To study the TQM principles and its strategies
- To learn the seven tools of statistical quality andmanagement
- To impart knowledge on TQM tools for continuous improvement
- To introduce international quality management systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

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

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.

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

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Use the concepts, dimension of quality and philosophies of TQM
2. Apply the principles of TQM and its strategies in industries
3. Apply the statistical quality tools and seven management tools
4. Choose the suitable TQM tools for continuous improvement
5. Use the concept of QMS, EMS and EnMS in industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1					2		3					1	
2						2		3			2		1	
3	2	3	1		2									
4	1	2	2										2	
5						1	2	2					1	

UNIT I **9 Hours**

INTRODUCTION

Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Analysis Techniques for Quality Costs - Basic concepts of Total Quality Management - Historical Review - Quality Statements - Strategic Planning, Deming Philosophy - Crosby philosophy - Continuous Process Improvement - Juran Trilogy, PDSA Cycle, 5S, Kaizen - Obstacles to TQM Implementation

UNIT II **9 Hours**

TQM PRINCIPLES

Principles of TQM, Leadership Concepts, Role of Senior Management, Quality Council, Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement - Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits - Supplier Partnership - Partnering, Sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures

UNIT III **9 Hours**

STATISTICAL PROCESS CONTROL (SPC)

The seven tools of quality - Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, nP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma - New seven Management tools

UNIT IV **9 Hours**

TQM TOOLS

Benchmarking, Quality Function Deployment (QFD) - House of Quality, QFD Process, and Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM), FMEA - Stages of FMEA, Case studies

UNIT V **9 Hours**

QUALITY SYSTEMS

Need for ISO 9000 and Other Quality Systems - Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2015, ISO 9001:2015 and ISO 9004:2018, TS 16949, ISO 14000, ISO 50001 - Concept, Requirements and Benefits

Total: 45 Hours

Reference(s)

1. Dale H.Bester filed, Total Quality Management, Pearson Education Inc., New Delhi, 2003
2. N.Gupta and B.Valarmathi, Total Quality Management, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2009
3. James R.Evans and William M.Lidsay, The Management and Control of Quality, SouthWestern 2002
4. Dr.S.Kumar, Total Quality Management, Laxmi Publications Ltd. New Delhi, 2006
5. P.N.Muherjee, Total Quality Management, Prentice Hall of India, New Delhi, 2006

18AU031 VEHICLE MAINTENANCE 3 0 0 3

Course Objectives

- To impart the knowledge on safety and tools used inworkshop.
- To learn about the maintenance procedure of engine and enginesubsystems.
- To provide the knowledge on transmission and driveline maintenanceprocedure.
- To impart the knowledge on the maintenance procedure of steering, brake, suspension andwheel maintenance.
- To learn about electrical and air conditioning maintenance procedure.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Compare the maintenance practices, safety and tools used in workshop.
2. Explain the engine and engine subsystem maintenance procedure.
3. Summarise the transmission and driveline maintenance procedure.
4. Explain the steering, brake, suspension and wheel maintenance maintenance procedure.
5. Summarise the electrical and air conditioning maintenance procedure.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3										2	
2	2	2	2										2	
3	2	3	2										3	
4	2	2	3										2	
5	2	3	2										2	

UNIT I **9 Hours**

MAINTENANCE WORKSHOP PRACTICES SAFETY AND TOOLS

Maintenance- Need, Importance, Primary and secondary functions, Policies,- Classifications of maintenance work - Vehicle Insurance - basic Problem Diagnosis. Automotive Service procedures- Work shop 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.

UNIT II **9 Hours**

ENGINE AND ENGINE SUBSYSTEM MAINTENANCE

General Engine service- Dismantling of Engine components- Engine repair - Working on the ancillaries- service of basic engine parts, cooling and lubricating system, Fuel system, Intake and exhaust systems, Electrical system- Electronic fuel injection and engine management service - Fault diagnosis -servicing emission controls.

UNIT III **9 Hours**

TRANSMISSION AND DRIVELINE MAINTENANCE

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

UNIT IV **9 Hours**

STEERING, BRAKE, SUSPENSION ANDWHEEL MAINTENANCE

Inspection,Maintenance and service of steering linkage, steering linkage, steering column, rack and pinion steering, recirculating ball steering service- worm type steering, power steering system. Inspection, maintenance and service of hydraulic brake, drum brake, disc brake, parking brake, bleeding of brakes. Inspection, Maintenance and service of McPherson strut, coilspring, leaf spring, shock absorber, Dismantling and assembling procedures.
Wheel alignment and balance, Removingand fitting of tyres, tyre wear and tyrerotation.

UNIT V **9 Hours**

ELECTRICAL, AIR CONDITIONING AND BODY MAINTENANCE

Maintenance of batteries, starting system, charging system and body electrical- Fault Diagnosis using scan tools.Maintenance of Air conditioning parts- compressor, condenser, expansion valve, evaporator- replacement of hoses- leak detection - AC Charging - Fault Diagnosis.Vehicle Body repair- panel beating, tinkering, soldering, polishing, painting.

Total: 45 Hours

Reference(s)

1. Ed May, Automobile Mechanics Volume one, McGraw Hill Publications, 2003.
2. Crouse W H, Automotive Transmissions and Power Trains, McGraw Hill Book Co., 5th edition,1976.
3. Bosch automotive handbook , Sixth Edition,2004.

18AU032 ENGINEERING ECONOMICS AND COSTANALYSIS

Course Objectives

- To introduce the concepts of micro, macro economic systems and business decisions in organizations.
- To acquire knowledge on laws of demand & supply and methods of forecasting the demand
- To emphasis the systematic evaluation of the costs, breakeven point for return on economics and diseconomies
- To acquaint in pricing methods, payback and competition in modern market structure
- To obtain knowledge on macro economics, various taxes and financial accounting procedures

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issuesand the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. 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.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in thebroadest context of technological change.

Course Outcomes (COs)

1. Explain the micro economic environment for creating a favourable business environment.
2. Make use of the major concepts and techniques of engineering economic analysis in real time applications.
3. Compare the cost of multiple projects by using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
4. Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annualcost, rate-of-return, payback, break-even, benefit-cost ratio.
5. Examine and evaluate the issues in macro-economic analysis.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2	2						
2							3	2						
3							2	2						
4							3	2						
5						2	2				2	2		

UNIT I **9 Hours**

INTRODUCTION

Introduction to Micro and Macro economics - Kinds of Economic Systems - Production Possibility Frontier -Opportunity Cost - Objective of Organizations - Kinds of Organization.

UNIT II **9 Hours**

DEMAND AND SUPPLY

Functions of Demand and Supply - Law of diminishing Marginal Utility - Law of Demand and Supply - Elasticityof Demand - Demand Forecasting Methods - Indifference curve.

UNIT III **9 Hours**

PRODUCTION AND COST

Production Function - Returns to Scale - Law of Variable Proportion - Cost and Revenue concepts and Cost Curves - Revenue curves - Economies and Dis-economies of scale - Break Even point.

UNIT IV **9 Hours**

MARKET STRUCTURE

Market Structure - Perfect Competition - Monopoly - Monopolistic - Oligopoly - Components of Pricing - Methodsof Pricing - Capital Budgeting IRR - ARR - NPV - Return on Investment - Payback Period.

UNIT V **9 Hours**

INTRODUCTION TO MACRO ECONOMICS AND FINANCIAL ACCOUNTING

National Income - Calculation Methods - Problems - Inflation - Deflation - Business Cycle - Taxes - Direct andIndirect Taxes - Fiscal and monetary policies.

Total: 45 Hours

Reference(s)

1. A Ramachandra Aryasri and V V Ramana Murthy, Engineering Economics and Financial Accounting, TataMcGraw Hill Publishing Company Limited, New Delhi, 2006.
2. V L Samuel Paul and G S Gupta,Managerial Economics Concepts and Cases, Tata McGraw Hill PublishingCompany Limited, New Delhi, 1981.
3. R Kesavan, C Elanchezhian and T Sunder Selwyn, Engineering Economics and Financial Accounting,Laxmi Publication (P) Ltd, New Delhi, 2005.
4. S N Maheswari, Financial and Management Accounting, Sultan Chand
5. V L Samuel Paul and G S Gupta, Managerial Economics-Concepts and Cases

18AU033 AUTOMOTIVE STYLING 3 0 0 3

Course Objectives

- To comprehend the concepts of automotive styling in the broader context of vehicle styling
- To appraise the possessions of interior and exterior designing of an automobile
- To procure knowledge on the clay modelling and software modelling of a vehicle

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

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

m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Understand the concepts of automotive interior and exterior design.
2. Identify the different materials and manufacturing processes used in designing bodies.
3. Apply the concepts adopted in designing automotive bodies.
4. Analyze the safety and impact analysis methods in automobiles.
5. Summarise the methodology, prototyping, digital design and visualization of automotive design management

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3										2	
2	3	2	3											
3	3	3	3		2								2	
4	3		3											
5	3		3		3								3	

UNIT I **9 Hours**

AUTOMOTIVE INTERIOR AND EXTERIOR DESIGN

Introduction - Creative and innovation - Modern automobile systems - Interior and exterior design – Colour selection - Automobile aesthetics - Vehicle body types - Body styles, front grill shapes, headlight shapes, side vent, rear side shapes, overall profiles, visual features, vehicle color codes, Introduction to computer- aided concept design system.

UNIT II **9 Hours**

LIGHT WEIGHT VEHICLE DESIGN

Introduction to light weight vehicle design - Composite material - The manufacturing challenge for automotive designers - Advances in manufacturing processes, structure, properties and manufacturing technology of automotive materials. Design to manufacture as a single process

UNIT III **9 Hours**

AUTOMOTIVE CONCEPT DESIGN

Body Design: Automotive styling and sketching - Streamlining - Automotive concept design using clay modelling and sculpting technique - Freeform and surface modelling - Vehicle aerodynamics and thermal management.

UNIT IV **9 Hours**

STRUCTURES, SAFETY AND IMPACT

Ergonomics in automotive design, driver comfort - Seating, visibility - Man-machine system - Passenger comfort - ingress and egress - Spaciousness - Ventilation - Temperature control, dust and fume prevention and vibration. Crashworthiness and its influence on vehicle design - Accident and injury analysis - Vehicle impacts: General dynamics.

UNIT V **9 Hours**

AUTOMOTIVE DESIGN MANAGEMENT

Design methodology and research - Automotive digital design - Digital visualization - Scale models – Digital prototyping and design management.

Total: 45 Hours

Reference(s)

1. Julian Happian Smith, An Introduction to Modern Vehicle Design, Butterworth Heinemann, 2004.
2. Vivek D. Bhise, Ergonomics in the Automotive Design Process, CRC Press, 2016.
3. William D. Callister, Jr., Materials Science and Engineering - An Introduction, 9th Edition, John Wiley & Sons, 2013.
4. John Fenton, Vehicle Body Layout and Analysis, Mechanical Engg. Publication Ltd., London, 1982.

18AU034 AUTOMOTIVE EMBEDDED SYSTEMS 3 0 0 3

Course Objectives

- To introduce the automotive embedded systems
- To understand Automotive Sensory Systems
- To explain the importance of automotive control in system design.
- To make student aware of different automotive protocols for vehicle communication

Programme Outcomes (POs)

f. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
g. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
h. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Understand the concepts of automotive interior and exterior design.
2. Identify the different materials and manufacturing processes used in designing bodies.
3. Apply the concepts adopted in designing automotive bodies.
4. Analyze the safety and impact analysis methods in automobiles.
5. Summarise the methodology, prototyping, digital design and visualization of automotive design management

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2											2	
2	1	2												
3	2	1											2	
4	3	2											3	
5	1	2											2	

UNIT I **10 Hours**

EMBEDDED SYSTEM

Introduction, Embedded system design process, Microcontroller v/s microprocessor, Architecture of 8 Bit controller - ADC, DAC, Memory, Timer and interrupts. Software development in IDE -Hardware/ Software configuration, Models of programs - Assembly, linking and loading. Structure of the Program - variables, functions, loops and I/O parameters.

UNIT II **8 Hours**

AUTOMOTIVE SENSORS

Automotive Sensors and Transducers: Temperature, Manifold and Barometric Pressures, Humidity, Carbon Dioxide (CO_2),Carbon Monoxide (CO), Oxygen (O_2) Sensor, Proximity Distance Sensors, Engine Speed sensor, Throttle Position Sensor, Pressure Sensors, Knock Sensor & Mass Flow Sensor. Typical Sensors Specifications & Microcontroller Interface Considerations, Sensor Calibration, Curve fitting.

UNIT III **9 Hours**

AUTOMOTIVE CONTROL SYSTEM DESIGN

Digital Engine Control, Features, Control Modes for Fuel Control, Discrete Time Idle Speed Control, EGR Control,Variable Valve Timing Control, Electronic Ignition Control, Integrated Engine Control System, Summary of Control Modes, Cruise Control System, Cruise Control Electronics, Anti-locking Braking System, Electronic Suspension System, Electronic Steering Control, Four-Wheel Steering.

UNIT IV **9 Hours**

INTERFACING WITH MICROCONTROLLER

Sensor Interfacing: Analog and digital sensor, keyboard interface with 8/32 bit controller. Actuator Interfacing: Motor control applications - Pulse width modulation (PWM), LCD display, relay and solenoid Interfacing with 8/32 bit controller. Serial communications inter facing.

UNIT V **9 Hours**

AUTOMOTIVE PROTOCOLS

The need for Protocol, Automotive Protocols : LIN, CAN, KWP2000 & J1939, FlexRay, Test, Calibration and Diagnostics tools for networking of electronic systems like ECU Software and Testing Tools , ECU Calibration Tools , Vehicle Network Simulation. Advanced Trends in Automotive Electronics: AUTOSAR Architecture.

Total: 45 Hours

Reference(s)

1. William B. Ribbens, Understanding Automotive Electronics-An Engineering Perspective, Seventh edition, Butterworth-Heinemann Publications.G.E. Dieter, Engineering Design-A Materials and process approach, Tata McGraw-Hill,2008.
2. Sensors and Transducers - Ronald K. Jurgen, 2nd Edition, SAE, 2003.
3. Automotive Sensors, BOSCH. 2002.
4. Automotive Electronics Design Fundamentals 1st ed. 2015 Edition by Najamuz Zaman.
5. Comprehensible Guide to Controller Area Network Paperback - 1 Aug 2005 by Wilfried Voss.

18AU035 ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY **3 0 0 3**

Course Objectives

- To formulate the various aspects EMI/EMC coupling
- To identify a suitable EMI testing and controlling techniques
- To understand the role of EMI and EMC in vehicles.

Programme Outcomes (POs)

i. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
j. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
k. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Understand Electromagnetic fields.
2. Understand the basic concepts of EMI/EMC.
3. Select the suitable the coupling methods and Automotive EMC approaches.
4. Analyse the issues in Automobile EMI/EMC.
5. Analyze the control techniques in EMI/EMC.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3										3	
2	3	2	3										3	
3	3		3		2								2	3
4	3		3			2							3	
5	3		3		2								2	3

UNIT I **9 Hours**

ELECTRO MAGNETIC FIELDS

Introduction, Characteristics of EM environment, comparison of circuit theory and EM field theory, Maxwells equation, Regions around the source, Polarization, EMC disciplines, Radiated Emission Diagnostics, Switching transients.

UNIT II **9 Hours**

INTRODUCTION AND BASIC CONCEPTS OF EMI AND EMC

EMI concepts and definitions, Sources of EMI, conducted and radiated EMI, Transient EMI, Time domain Vs Frequency domain EMI, EMC an introduction, System level issues - component and system, significance of EMC.

UNIT III **9 Hours**

EMI/EMC COUPLING

Coupling and Coupling methods, coupling between wires, Conducted emission and immunity, Automotive EMC approaches, Filter placement, Grounding and PCB layout, Ferrites, High frequency emissions.

UNIT IV **9 Hours**

ANALYSIS OF EMI/EMC IN AUTOMOBILE

Vehicle ABS, Flight controls, Blimp problems, Fuel systems, Aircraft, Runway wheel chairs, Ignition system, Inexpensive Shielding methods, EMC design for immunity, Automotive industry practices. Vehicle generated radiated emissions, Broadband noise, Narrowband noise, Signal characteristics, Vehicle radiated emission tests.

UNIT V **9 Hours**

EMI/EMC CONTROL TECHNIQUES

Grounding, safety grounding, single point ground, Shielding, enclosure shielding, shield discontinuities, filtering, filtering overview, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

Total: 45 Hours

Reference(s)

1. Automotive Electromagnetic compatibility-Terence Rybak, Mark steffka-Kluver Academic Publishers.
2. Balcells - J.; Gonzlez- D.; Gago- J. Cur so "EMC design in industrial systems". 2003.
3. Weston- D.A. Electromagnetic compatibility: principles and applications. 2nd ed. - rev. and exp. NeYork [etc.]:Marcel Dekker - 2001. ISBN 0824788893.
4. Weston- D.A. Electromagnetic compatibility: principles and applications. 2nd ed. - rev. and exp. NeYork [etc.]:Marcel Dekker - 2001. ISBN 0824788893.

18AU036 ELECTRIC MOTORS AND DRIVE SYSTEMS 3 0 0 3

Course Objectives

- To acquire knowledge on different motors in automobiles.
- To conclude the performance characteristics of DC motors.
- To conclude the performance characteristics of AC motors.
- To describe starting, braking, speed control and losses of DC motor.
- To describe starting, braking, speed control and losses of AC motor.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. An ability to design, analyse and find the solutions for automotive related problems.

Course Outcomes (COs)

1. Select the appropriate Motor from different types of motors used in automobiles.
2. Analysethe performance of DC motors used in automobiles.
3. Analyse the performance of AC motors used in automobiles.
4. Infer the need and various control mechanism of DC drives.
5. Infer the need and various control mechanism of AC drives.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1					1						2	
2	3	1	1										2	
3	2	3		1									2	
4	2	3		2									2	
5	3	1	2										2	

UNIT I **9 Hours**

INTRODUCTION

Basic Elements, Types of Electric Drives, factors influencing the choice of electrical drives, heating and cooling curves, Loading conditions and classes of duty, Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.

UNIT II **9 Hours**

DC MOTORS

Operating principle of Series, BLDC, PM motor, SRM etc, motor action, construction, types of excitations,emf & torque equations, power stages & efficiency. Commutation & Armature Reaction,characteristics & application of d.cmotors, electric braking.

UNIT III **9 Hours**

AC MOTORS

Three-phase induction motors - Principle of operation, construction, types.Rotating magnetic field, emf equation of an AC Machine, torque developed in an inductionmotor, equivalent circuit model, torque-speed characteristics.

Single phase induction motors - Principle of operation, torque-speed characteristics, application.

UNIT IV **9 Hours**

DC DRIVES

Starting, Braking and Speed Control, Transient analysis of separately excited motor with armature and field control, Energy losses during transient operation, Phase controlled converter fed DC drives, Dual-converter control of DC drive, Supply harmonics, Power factor and ripple in motor current, Chopper Control DC drives, Source current harmonic in Choppers.

UNIT V **9 Hours**

AC DRIVES

Starting, Braking and transient analysis, Calculation of energy losses, Speed control, Stator voltage control, Variable frequency control from voltage and current sources, Slip power recovery-Static Scherbius and Cramer drives.

Total: 45 Hours

Reference(s)

1. Electric Machinery, Fitzgerald, Kingslay, Umans, Tata McGraw-Hill, 3rd edition, 2018.
2. Electric Machinery Fundamentals, Chapman, McGraw-Hill Higher Education, 2nd edition, 2019.
3. Electric Machines, Nagrath and Kothari, Tata McGraw-Hill, Fifth edition, 2019.
4. G. K. Dubey: Fundamentals of Electrical Drives, 2nd Edition, Alpha Science International, 2017.
5. S. B. Dewan, Gordon R. Slemon and A. Straughen: Power Semiconductor Drives, John Wiley Pub.2016.

18AU037 LEAN MANUFACTURING 3 0 0 3

Course Objectives

- To impart the knowledge on the lean principles and the need to follow these principles in industries.
- To learn about the overview of the various tools and techniques involved in lean manufacturing used in industries.
- To provide the necessary skills needed to analyse a given situation to draw the current state map and to identify potential improvement areas and then draw the future state map.
- To impart the knowledge on understanding of the various tools used in a six sigma project for quality improvement.
- To provide an overview of the DMAIC methodology in a six sigma project.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

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

c. 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.

d. 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.

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

f. 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.

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

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex engineering activities with the engineering community and with the 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.

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

l. Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

m. An ability to design, analyse and find the solutions for automotive related problems.

Course Outcomes (COs)

1. Understand the importance and evolution of lean principles.
2. Apply the various tools, techniques and methodology of lean manufacturing to improve the efficiency of an organization.
3. Apply the technique of value stream mapping to improve an organization by drawing current and future state maps.
4. Analyze the various tools and techniques needed for a six sigma project.
5. Apply six sigma methodology to improve quality in a manufacturing organisation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2	2							
2		2	3	2				2			2	3	3	
3		2	3	2	2			1	2	2	3		2	
4		2	2	3	3			2				3	2	
5		2	3	2	3			2	2	2	3		3	

UNIT I **9 Hours**

EVOLUTION AND OVERVIEW OF LEAN MANUFACTURING

Evolution of Mass production, Traditional versus Mass production, Evolution of Toyota (Lean) Production System, Business Dynamics of Lean production, Principles of Lean production – Value, Value stream, Flow, Pull, Perfection.

UNIT II **9 Hours**

LEAN MANUFACTURING – TOOLS AND TECHNIQUES

3Ms – Muda, Mura, Muri, 7 Wastes in Manufacturing, Lean Tools to eliminate Muda - 5S, Standardised work, TPM, SMED, Jidoka – Poka Yoke, JIT, Heijunka, Kanban, One piece production, Case studies.

UNIT III **9 Hours**

VALUE STREAM MAPPING

Need for Value Stream mapping; Steps involved in Value stream mapping – Choose value stream – PQ and PR analysis, Current State map, Lean Metrics, Future State Map, Kaizen plans; Lean implementation - Cultural change, Hoshin planning; Lean in the Supply chain.

UNIT IV **9 Hours**

SIX SIGMA – TOOLS AND TECHNIQUES

Integrated quality control - Off-line vs On-line inspection, Cost of Quality – Conformance and Non Conformance cost, 7 Basic Quality Control Tools, Seven Management tools, FMEA.

UNIT V **9 Hours**

SIX SIGMA METHODOLOGY

Statistical theory, Need for Six Sigma, Six Sigma Team, DMAIC Methodology – Various quality tools used in the Define, Measure, Analyse, Improve and Control phases; Lean Six Sigma, Design for lean six sigma, Case studies.

Total: 45 Hours

Reference(s)

1. Issa Bass and Barbara Lawton, Lean Six Sigma using Sigma XL and Minitab, Tata McGraw Hill 2017.
2. Pascal Dennis, Lean production Simplified: A plain language guide to the world's most powerful Production system, Productivity Press 2017.
3. Askin R G and Goldberg J B, Design and Analysis of Lean Production Systems, John Wiley and Sons Inc., 2013.
4. Donna C. S. Summers, Six sigma: Basic tools and techniques, Pearson / Prentice Hall 2017.
5. James Womack, Daniel T. Jones, and Daniel Roos, The Machine that changed the world, Free Press 1990.
6. James Womack and Daniel T. Jones, Lean Thinking: Banish waste and create wealth in your organization, Free Press 2013.
7. Mike Rother and Rother Shook, Learning to See: Value-Stream Mapping to Create Value and Eliminate Muda, The Lean Enterprise Institute 2013.
8. Michael L. George, Lean Six Sigma: Combining Six Sigma Quality with Lean Production Speed, McGraw-Hill, 2012.

18AU038 VIRTUAL INSTRUMENTATION IN AUTOMOBILE ENGINEERING 3 0 0 3

Course Objectives

- To review background information required for studying virtual instrumentation.
- To study the basic building blocks of virtual instrumentation.
- To study the various techniques of interfacing of external instruments of PC.
- To study the various graphical programming environment in virtual instrumentation.
- To study a few applications in virtual instrumentation.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b.0Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

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

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex engineering activities with the engineering community and with the 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.

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

l. Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

m. An ability to design, analyse and find the solutions for automotive related problems.

Course Outcomes (COs)

1. Develop virtual instruments for specific application using LabVIEW software.
2. Apply the programming required to make computer interact with real world.
3. Analyse the throughput of any compactible system.
4. Apply the knowledge to connect with third party software and hardware.
5. Apply the Virtual instrumentation knowledge on Automotive Applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2						2							
2	2	2	3	2				2			2	3	3	
3		2	3	2				1	2	2	3		2	
4		2	2	3				2				3	2	
5		2	3	2				2	2	2	3		3	

UNIT I **9 Hours**

INTRODUCTION

Virtual Instrumentation-Definition and flexibility -Block diagram and Architecture of Virtual Instrumentation- Virtual instruments versus Traditional Instruments- Review of software in virtual Instrumentation- VI programming techniques- VI, sub VI, Loops and charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, string and File Input / Output.

UNIT II **9 Hours**

DATA ACQUISITION IN VI

A/D and D/A Converters, plug-in Analog input / Output cards- Digital Input and Output cards, Organization of the DAQ VI system- Opto Isolation- Performing analog input and analog output Scanning multiple analog channels- issues involved in selection of data acquisition cards- Data acquisition modules with serial communication- Design of digital voltmeter with transducer input Timers and Counters.

UNIT III **9 Hours**

COMMUNICATION NETWORKED MODULES

Introduction to PC buses-Local buses:-ISA,PCI,RS232,RS422 and RS 485- Interface buses:- USB,PCMCIA,VXI,SCXI and PXI – Instrumentation Buses:- Modbus and GPIB- Networked buses- ISO/OSI reference model, Ethernet and TCP/IP Protocols, Automobile communication, CAN Communication.

UNIT IV **9 Hours**

REAL TIME CONTROL IN VI

Design of ON/OFF controller and proportional controller for a mathematically described processes using VI software- Case Studies on development of HMI, SCADA in VI. Fuzzy Logic Controller.

UNIT V **9 Hours**

AUTOMOTIVE APPLICATIONS

Sensor technology and signal processing- virtual laboratory- spectrum analyzer- wave form generator- Data visualization and multiple locations - Vision and motion control. Case study related to automotive applications, Hardware in loop system, Digital twin system.

Total: 45 Hours

Reference(s)

1. Nadovich, C., “Synthetic Instruments Concepts and Applications”. Elsevier,2005.
2. Bitter, R., Mohiuddin, T. and Nawricki, M., “Labview Advanced programming Techniques”, CRC Press, 2nd Edition, 2007.
3. Gupta, S. and Gupta J. P., “PC Interfacing for Data Acquisition and Process Control”, 2nd Edition, Instrument Society of America, 1994.
4. Jamal, R. and Picklik, H., “Labview-Applications and Solutions “, National Instrument Release.
5. Johnson, G.,” Labview Graphical programming “ , McGraw-Hill, Newyork,1997.
6. Wells, L.K and Travis, J., “ Labview for Everyone”, Prentice Hall, New Jersey, 1997 4. Buchanan, W., ”Computer Busses ”, CRC Press, 2000.

18AU039 INDUSTRIAL ROBOTICS TECHNOLOGY 3 0 0 3

Course Objectives

- Reviewing the need and application of robots in different engineering fields.
- Exemplifying the different types of robot drive systems as well as robot end effectors.
- Applying the different sensors and image processing techniques in robotics to improve the ability of robots.
- Developing robotic programs for different tasks and analyzing the kinematics motions of robot.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
h. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. An ability to design, analyse and find the solutions for automotive related problems.

Course Outcomes (COs)

1. Explain the concepts of industrial robots with respect to its classification, specifications and coordinate systems.
2. Exemplify the different types of robot drive systems as well as robot end effectors.
3. Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
4. Develop robotic programs for different tasks and analyze the kinematics motions of robot.
5. Implement robots in various industrial sectors and interpolate the economic analysis of robots.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1		1									2	
2	3	1	2				1						2	
3	2	3											2	
4	2	2		2									2	
5	3	1	2										2	

UNIT I **9 Hours**

FUNDAMENTALS OF ROBOT

Robot - Definition - Robot Anatomy – Co-ordinate Systems, Work Envelope Types and Classification-Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II **9 Hours**

ROBOT DRIVE SYSTEMS AND END EFFECTORS

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III **9 Hours**

SENSORS AND MACHINE VISION

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications, Inspection, Identification, Visual Serving and Navigation, Visual vision based sensors.

UNIT IV **9 Hours**

ROBOT KINEMATICS AND ROBOT PROGRAMMING

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Expert system, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V **9 Hours**

IMPLEMENTATION OF MACHINE VISION

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations. Image acquisition, Image processing, Image analysis.

Total: 45 Hours

Reference(s)

1. Fu. K.S, Gonzalez. R.C, Lee. C.S.G "Robotics – Control, Sensing, Vision, and Intelligence", McGraw Hill, 2015.
2. GrooverMikell .P, "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2014.
3. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2009.
4. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2013.
5. Maja J Mataric, "The Robotics Primer "Universities Press. 2013.
6. Robin R. Murphy " Introduction to AI Robotics" PHI Learning Private Limited, 2000.

18AU040 MACHINE LEARNING 3 0 0 3

Course Objectives

- To understand the concepts of Machine Learning.
- To appreciate supervised learning and their applications.
- To appreciate the concepts and algorithms of unsupervised learning.
- To understand the basic concept of reinforcement learning algorithm and its applications.
- To study about modelling, aggregation and knowledge representation using graphical models.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.
m. An ability to design, analyse and find the solutions for automotive related problems.

Course Outcomes (COs)

1. Identify applications suitable for different types of Machine Learning with suitable justification.
2. Implement supervised Learning algorithms for real time data sets for Intelligent decision making.
3. Apply Machine Learning techniques to classification and clustering to unstructured data.
4. Apply reinforcement learning techniques for real life problems.
5. Implement probabilistic discriminate and generative algorithms for applications of your choice and analyze the results.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	2									2	
2	1	2	2	2	1	1							2	
3	1	1	2	1	1	2								
4	1	2	1											
5	1	2	2	2										

UNIT I **9 Hours**

INTRODUCTION TO MACHINE LEARNING

Machine Learning - Machine Learning Foundations - Overview - applications - Types of machine learning - basic concepts in machine learning Examples of Machine Learning -Applications - Linear Models for Regression - Linear Basis Function Models - The Bias-Variance Decomposition - Bayesian Linear Regression - Bayesian Model Comparison.

UNIT II **9 Hours**

SUPERVISED LEARNING

Linear Models for Classification - Discriminant Functions -Probabilistic Generative Models - Probabilistic Discriminative Models - Bayesian Logistic Regression. Decision Trees - Classification Trees- Regression Trees - Pruning. Ensemble methods- Bagging- Boosting.

UNIT III **9 Hours**

UNSUPERVISED LEARNING

Clustering- K-means - EM - Mixtures of Gaussians - The EM Algorithm in General -Model selection for latent variable models - high-dimensional spaces - The Curse of Dimensionality -Dimensionality Reduction - Factor analysis - Principal Component Analysis - Probabilistic PCA- Independent components analysis.

UNIT IV **9 Hours**

REINFORCEMENT LEARNING

Passive reinforcement learning- direct utility estimation- adaptive dynamic programming- temporal difference learning- active reinforcement learning- exploration- learning an action-utility function- Generalization in reinforcement learning- policy search- applications in game playing- applications in robot control.

UNIT V **9 Hours**

PROBABILISTIC GRAPHICAL MODELS

Graphical Models-Undirected Graphical Models-Markov Random Fields-Directed Graphical Models-Bayesian Networks-Conditional Independence properties-Markov Random Fields-Hidden Markov Models-Conditional Random Fields(CRFs).

Total: 45 Hours

Reference(s)

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Stephen Marsland, Machine Learning- An Algorithmic Perspective, Chapman and Hall, CRC Press, Second Edition, 2014.
3. EthemAlpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.
4. Christopher Bishop, Pattern Recognition and Machine Learning Springer, 2007.
5. P. Flach, Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.

18AU041 MODEL-BASED SYSTEM DESIGN 3 0 0 3

Course Objectives

- To know the various Model-Based System Design process.
- To understand the Model-in-the-Loop (MIL), Software-in-The-Loop Simulations (SIL), and Hardware-in-the-Loop (HIL) concepts.
- To learn about various Real-Time Simulation concepts.

Programme Outcomes (POs)

d. 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.
f. 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.
l. 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.
m. An ability to design, analyse and find the solutions for automotive related problems.

Course Outcomes (COs)

1. Understand mathematical models for components in a system.
2. Apply component models together to model a larger more complex system.
3. Analyze and run Model-in-the-Loop Simulations (MIL).
4. Analyze and run real-time simulations for a physical system.
5. Analyze and run Hardware-in-the-Loop Simulations (HIL).

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1				2		2						2		
2				2		2						3	2	
3				2		2						3		
4				2								2		
5				2		2						2	2	

UNIT I **9 Hours**

INTRODUCTION TO MODEL-BASED SYSTEM DESIGN

Introduction to Systems Engineering, Systems Engineering and the Life Cycle, Systems Engineering Process Overview, Business Impacts of Systems Engineering, Motor Model, Generator Model, Controller Model, SimDriveline Introduction.

UNIT II **10 Hours**

REAL-TIME SIMULATIONS

Processor In The Loop Real-Time Simulations, Controller on Freescale Target, Plant on Real-Time Target, Data Collection of Performance.
Model-in-the-Loop (MIL), Software-in-The-Loop Simulations (SIL), Hardware-in-the-Loop (HIL).
Introduction to Simulink Simulations- Implement controller Explore the system response using different control methods, Tune the system, explore system limitations, Understand and refine motor models.

UNIT III **9 Hours**

MODEL VERIFICATION

Test controller on real system – Observe system performance, Observe the effect of different control methods, Tune the system.

Data Collection of Physical Model Response, Comparison of Physical Plant Response to Model Response.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS

Automatically Generate Test Schedule to Obtain Data, Run Experiments and Collect Data, Generate Models for Components, Table-Lookup, Curve Fits. Design of Experiments to Collect Experimental Data on Motor and Generator.

UNIT V **8 Hours**

MODEL REFINEMENT AND RE-VERIFICATION

Compliance Adjustment of models, Comparison of observed and simulated behaviours, Update Models to Include Measured Data, Comparison of Updated Physical Plant to Model.

Total: 45 Hours

Reference(s)

1. Practical Model-Based Systems Engineering, by Jose L. Fernandez, Carl Hernandez.
2. Effective Model-Based Systems Engineering, John M. Borky, 2018.
3. Model-Based Systems Engineering, A. Wayne Wymore, CRC Press; 1st edition (April 5, 1993).
4. Model Based Systems Engineering: Fundamentals and Methods, Patrice Micouin, Wiley.
5. **https://in.mathworks.com/**.

18AU0YA AUTOMOTIVE ENGINEERING 3 0 0 3

Course Objectives

- To acquire knowledge on automobile vehicles and their classification
- To develop understanding of vehicle systems

Programme Outcomes (POs)

n. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
o. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
p. 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.
m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

6. Classify the vehicle based on power unit location,chassis frame,wheels and tyres
7. Analyze the different types of manual and automatic transmission systems used in vehicleand explain the drive line parts
8. Demonstrate the construction and working of steering, suspension and brakingsystems
9. Distinguish the various basic electrical systems of an automobile.
10. Demonstrate the construction and working of Electronic Engine Controls

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2										2	
2	2	2	1										2	
3	2	3	1										2	
4	3	2	1										2	
5	2	2	2										2	

UNIT I **8 Hours**

INTRODUCTION

History of Automobile, Classification of vehicles ,Vehicle layouts- front engine and front wheel drive, front engine and rear wheel drive, rear engine and rear wheel drive, Types of chassis frames- construction of chassis frame, Types of wheel- rims, tread patterns of tyre, tubeless tyres, specifications of tyres.

UNIT II **9 Hours**

CLUTCH, TRANSMISSION

Functions and type of clutches- single plate, multiple plates, centrifugal, clutch lining materials, Manual Gear Boxes - sliding mesh, constant mesh, synchromesh, epicyclical gear boxes,Automatic transmission, Torque converter, Fluid Coupling- principles of working, characteristics, Propellers shaft, Final drive-Construction and differential, Front and Rear Axle Types

UNIT III **10 Hours**

STEERING,SUSPENSION

Steering requirements, Steering gears box types- steering system and linkages, steering geometry, wheel alignment, toe- in, toe-out, caster, camber, power steering, Purpose of front and rear suspension, Types of suspension system- coil spring, leaf spring, torsion bars, shock absorbers, air suspensions, independent suspension and McPherson strut, Braking System- principle, classifications, requirements, drum brake, disc brake, parking brakes, mechanical brake ,hydraulic brakes, vacuum servo brakes, air brakes, , introduction to Anti-lock braking system.

UNIT IV **9 Hours**

ELECTRICAL SYSTEMS

Automotive Battery-principle, types, characteristics. Ignition system-battery coil, magneto coil and electronic ignition system. Starting system-starter motor and drive types, Alternator charging system. Lighting system, horn and wiper system.

UNIT V **9 Hours**

ELECTRONIC ENGINE CONTROLS

Concept of an electronic engine control system, electronic fuel injection - throttle body fuel injection, multi point fuel injection, gasoline direct injection, common rail direct injection, electronic ignition control, engine mapping, on-board diagnostics-engine control module

Total: 45 Hours

Reference(s)

5. R.K. Rajput, A Text Book of Automobile Engineering , Laxmi Publications (P) Ltd, 2014.
6. K. Ramakrishna, Automobile Engineering, Printice Hall of India, 2012
7. D.L. Anglin, W.H. Crouse, Automotive Mechanics, New Delhi: Tata McGraw Hill Education, 2006.
8. K Singh, Automobile Engineering (Volume1&2), Standard Publishers Distributors, 2014.
9. Tom Denton, Automobile Electrical and Electronic systems, Butterworth-Heinemann; 3rd Edition 2004.

18AU0YB VEHICLE CONTROL SYSTEMS 3 0 0 3

Course Objectives

- To understand the technologies relevant to intelligent vehicle systems
- To appreciate the role of electronics in providing improved control to a variety of vehiclesystems

Programme Outcomes (POs)

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

c. 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.

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

m. An ability to design, analyze and find the solutions for automotive related problems

Course Outcomes (COs)

1. Describe the principle of operation and application of the components in intelligent ground vehicles
2. Demonstrate knowledge on intelligent sensors, vehicle control, navigation, andcommunications systems
3. Identify the recent trends in Vehicle Comfort System
4. Explain the various security systems associated with vehicle system
5. Implement recent trends and intelligent technologies associated with modern day vehicles

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	3		1								1	
2		2	3		1								3	
3		3	2		2								2	
4		2	2		1								1	
5		3	3		1								1	

UNIT I **9 Hours**

DRIVER ASSISTANCE SYSTEMS

Advanced Driver Assistance System Types/Levels, Driver information, driver perception, driver convenience, driver monitoring, general vehicle control, longitudinal and lateral control, collision avoidance, vehicle monitoring.

UNIT II **9 Hours**

TELEMATICS

Global positioning system, geographical information systems, navigation system, architecture, automotive vision system, road recognition.

UNIT III **9 Hours**

COMFORT SYSTEMS

Adaptive cruise control system, active suspension system, power steering, collapsible and tiltable steering column, power windows, eight way seating system and climate control system, Adaptive Lighting Systems , Automatic Wiper system

UNIT IV **9 Hours**

SECURITY SYSTEMS

Anti-theft technologies mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, smart card system, number plate coding.

UNIT V **9 Hours**

INTELLIGENT AND SAFETY SYSTEMS

Lane Departure Warning System, Adaptive Headlight Systems, Day time running lights (DRL), Active and Passive Safety, Airbags, Seat Belt Tightening System, Forward Collision Warning Systems, Child Lock, Antilock Braking System, Vehicle communication-Car to X communication.

Total: 45 Hours

Reference(s)

1. Ronald K Jurgen, Navigation and Intelligent Transportation Systems - Progress in Technology, Automotive Electronics Series, Warrendale, PA: SAE International, 2014
2. Ozguner, TankutAcarman, Keith Redmill, Autonomous Ground Vehicles, London: ArtechHouse Publishers, 2011.
3. Robert Bosch,Automotive Hand Book, Warrendale, PA: SAE International, 2014
4. Hong Cheng, Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation, Berlin: Springer, 2011.
5. LjuboVlacic, Michel Parent and Fumio Harashima, Intelligent Vehicle Technologies, Oxford: Butterworth-Heinemann Publications, 2001.
6. Christopher Kilian, Modern Control Technology. Thompson Delmar Learning. Toebenn Drive, 2006

18AU0YC PUBLIC TRANSPORT MANAGEMENT 3 0 0 3

Course Objectives

- To introduce the fundamental concepts of public transport system such as system, technology and quality of service
- To manage a transport fleet and their related activities for minimizing operational cost
- To understand the need of urban mass transportation in developing countries

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Explain the important concepts about public transport system
2. Analyse the various modes of transportation with their relative merits and demerits
3. Explain the various motor vehicle act in India
4. Choose the suitable insurance policy and vehicle maintenance of public transportsystem
5. Explain the recent development in roads and road transport

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2				3	1							2
2	3	2				3	3							2
3	3	2				3	2							2
4	3	2				2	1							2
5	3	2				2	2							2

UNIT I **9 Hours**

INTRODUCTION

Transportation - features, importance, functions, role, operational characteristics of transport, development of transport in India - Transport functions and systems - Challenges faced by Indian transport system - Impact of Transportation - Advantages of motor transport -Principal function of administrative, traffic, secretarial and engineering divisions - chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

UNIT II **9 Hours**

MODES OF TRANSPORT

Modes of transport- air, water, land and others - Means of transportation in India - Traditional Public road transport, Urban rail transport, Other local transport, Long distance transport, Aviation, Ports & shipping, Waterways, Pipelines, Utility vehicle, Heavy hauler, BRTS - Elements and components of transport - Transport Units - Multi- Modal Transport - Intermodal Transport.

UNIT III **9 Hours**

MOTOR VEHICLE ACT

Laws governing to use of motor vehicle & vehicle transport- licensing of drivers & conductors, registration of vehicle, state & interstate permits, Traffic rules, signals & controls, Accidents, causes & analysis- liabilities & preventive measures, offences, penalties & procedures, Responsibility of driver, Different types of forms- Government administration structure- personnel, authorities & duties.

UNIT IV **9 Hours**

INSURANCE AND MAINTENANCE

Insurance types & significance- comprehensive, third party insurance, Furnishing of particulars of vehicles involved in accident, MACT (Motor Accident Claims Tribunal), Solatium fund, Hit & Run case, Duty of driver in case of accident, Surveyor & loss assessor-Surveyors report. Preventive maintenance system in transport industry, tyre maintenance procedures - causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

UNIT V **9 Hours**

RECENT DEVELOPMENT INROADS

National Urban Renewal Mission (NURM) - National Highways, Strategic roads, Roads of Economic and Inter- State importance, Road development in sensitive border areas and tribal roads. Review and Monitoring of National Highway Development Project comprising Golden Quadrilateral and North-South, East-West corridor projects.

Total: 45 Hours

Reference(s)

1. Michael Meyer & Eric Miller, Urban Transportation Planning, McGraw Hill, 2001
2. Vukan R. Vuchic, Urban Transit Systems and Technology, John Wiley and Sons, 2007.
3. Motor Vehicle Act, Govt. of India Publications, 2018.
4. Kitchin.L.D, Bus Operatio, III edition, Illiffee and Sons, 1992
5. John Duke, Fleet Management, McGraw-Hill, 1984.

18AU0YD TECHNOLOGIES FOR GREEN MOBILITY 3 0 0 3

Course Objectives

- To evaluate the potentials of various alternative fuels for vehicles operation
- To develop an understanding of modern fuel efficient power train technologies
- To acquire knowledge on technologies related to electric, hybrid and fuel cell powered vehicles

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.

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

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Explain the basic concepts of fuel economy, engine emission and availability of greentechnology
2. Find out the suitable modern power train technologies for improving fuel efficiency
3. Choose the appropriate alternate fuels for Automobiles
4. Exemplify the basic concept of hybrid electric vehicle technologies.
5. Analyse the suitable energy storage systems for HEV andEV

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2				2	3							3
2	2	1				2	3							3
3	3	2				2	3							3
4	3	2				2	3							3
5	3	2				2	3							3

UNIT I **8 Hours**

INTRODUCTION

Vehicle energy efficiency-internal and external losses, fuel economy, factors affecting fuel economy, carbon foot print, Engine emission- sources, CO2 contribution of road transport, various pollutants, environmental effects, targets, regulations, Need for green mobility, Available green technologies - overview.

UNIT II **10 Hours**

TECHNOLOGIES FOR POWER TRAINS

Fuel injection-direct injection and port injection for petrol engines, common rail injection for diesel injection, Downsizing new generation variable geometry turbocharger for diesel engine, smaller petrol engine with turbocharger, Variable valve lift and timing, Cylinder deactivation, Automated manual transmission, NOx control systems- selective catalytic reduction and exhaust gas recirculation.

UNIT III **9 Hours**

ALTERNATE FUELS

Need for alternate fuels - natural gas - alcohol fuels-water gasoline mixture-vegetable oil-bio diesel-LPG & CNG-benzol - hydrogen, compressed air, Properties, emission performance and green benefits of alternate fuels - challenges in adoption - required engine modifications.

UNIT IV **9 Hours**

HYBRID ELECTRIC VEHICLES

Hybrid electric vehicles-components, series, parallel & series, parallel architectures, power flow control in each case, advantages and limitations. Electric vehicles- concept of electric traction, layout of electric vehicles, components, transmission requirements, advantages and limitations.

UNIT V **9 Hours**

ENERGY STORAGE FOR HEV AND EV

Energy storage requirements in HEV and EV, Energy storage techniques- battery based energy storage, super capacitor based energy storage and flywheel based energy storage, Fuel cell electric vehicles- operating principle, fuel cell technologies, Hybridization of different energy storage devices.

Total: 45 Hours

Reference(s)

1. R. Folkson, Ed., Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance, Sawston: Woodhead Publishing, 2014.
2. S. S. Thipse, Alternate Fuels - Concepts, Technologies and Developments, New Delhi: Jaico Publishing House, 2010.
3. M. Ehsani, Y. Gao and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design, Boca Raton: CRC Press, 2010.
4. I. Hussain, Electric & Hybrid Vehicles - Design Fundamentals, Boca Raton: CRC Press, 2011.
5. H. Heisler, Advanced Vehicle Technology, Oxford: Butterworth-Heinemann, 2002.
6. M. Mathur and R. Kidambi, "Cost-Effective Green Mobility, CII and A.T. Kearney Ltd., New Delhi, Apr.2013.

18AU0YE TROUBLE SHOOTING AND MAINTENANCE OF AUTOMOBILES

3 0 0 3

Course Objectives

- To comprehend the concepts of automotive inspection methods.
- To identify and provide solutions to troubleshooting engine components
- To Find faults and suggest servicing methods for troubleshooting chassis systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

m. Design, analyze and optimize the solutions for automotive components and systems.

o. Apply the broad knowledge and understanding of the concepts, theories and principles of automotive engineering to investigate emerging technologies and applications in the Automotive field.

Course Outcomes (COs)

1. Recall vehicle inspection methods
2. Identify and provide solutions to troubleshooting engine components
3. Find faults and suggest servicing methods for troubleshooting chassis systems
4. List procedures and functions involved in vehicle body repair
5. Predict and suggest to replace the failed electrical component

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2											2		
2	2	2											2		
3	3												3		
4	3												3		
5	3												2		2

UNIT I **8 Hours**

MAINTENANCE

Importance of maintenance. Scheduled and unscheduled maintenance. Scope for maintenance. Vehicle down time. Vehicle inspection - reports, log books and trip sheet.

UNIT II **10 Hours**

LIGHT WEIGHT VEHICLE DESIGN

Dismantling of SI & CI engines and its components. Cleaning methods. Inspection and checking. Oil filter, diesel filter and air filter replacement. Reconditioning and replacement of piston, piston rings, cylinder liners, gaskets, journal bearings and valves. Maintenance - Ignition system, fuel injection system, cooling system, lubrication system. Engine Valve and timing adjustment. Trouble shooting chart for MPFI & CRDI Engines.

UNIT III **12 Hours**

CHASSIS COMPONENTS REPAIR AND OVERHAULING

Repair and replacement of clutch plate, diaphragm cover assembly, release bearing, hydraulic cylinders, fluid coupling and torque converters. Clutch pedal adjustment and bleeding. Repair and replacement of manual gear boxes, universal joint, centre bearing, propeller shaft, differential pinion, differential gear and live axle. Repair and replacement of wheel bearing, brake lining, brake shoes, brake master cylinder, brake booster and wheel drum. Brake adjustment and bleeding. Grease packing to wheel bearings in heavy vehicles. Repair and replacement of recirculating ball steering gear box, rack & pinion steering gear box and hydraulic power assisted recirculating ball steering gear box.

UNIT IV **7 Hours**

VEHICLE BODY REPAIR

Body panel tools for repairing. Dent removal kits, dashboard removal tools and gas welding for car body panels. Grinding, tinkering, metalloid paste and painting. Puffing of vehicle body. Scratches removal for a car.

UNIT V **8 Hours**

MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS

Testing and replacing of battery. Repair and reconditioning of starter motor and alternator. Fuses replacement and Light & horn relay replacement. Head lamp, brake lamp, indicator lamp and reverse lamp replacement. Head light focus adjustment. Horn replacement and tone adjustment. Brake light switch and reverse light switch replacement.

Total: 45 Hours

Reference(s)

1. Jigar A. Doshi , “ Vehicle Maintenance and Garage Practice ”, Prentice Hall India Learning Private Limited, 2014.
2. J.D. Halderman & C.D. Mitchell, “Automotive Engines Theory & Services ”, Pearson Education (singapore) Pte Ltd, 2007.
3. Paul Cangialosi, “ How to Rebuild & Modify High Performance Manual Transmissions ”, 2 nd Edition, CarTech Inc, 2010.
4. Tony Candela, “ Automotive Wiring and Electrical Systems”, CarTech Inc, 2009.
5. MattJoseph, “ Automotive Bodywork and Rust Repair”, CarTech Inc, 2010

18AU0XA PLASTICS-DESIGN, PROCESSING, TOOLING, ASSEMBLY AND TESTING

1 0 0 1

Course Objectives

- To know the various plastic materials used in Automotive, home appliance and Medicalfields.
- To understand the basic and advanced methods of plastic processing and the tooling and equipment used for it.
- To learn various post processing requirements such as painting, foiling and padpainting.
- To learn the various plastic joining processes and plastic testing methods.

Programme Outcomes (POs)

d. 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.
f. 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.
l. 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.
m. An ability to design, analyze and find the solutions for automotive relatedproblems

Course Outcomes (COs)

1. Understand the plastic material types and its applications.
2. Summarize the plastic processing methods, machine and tooling used forit.
3. Classify the post processing requirements and their importance
4. Understand the plastic joining processes like USW, VW, Etc.,
5. Understand plastic testing methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2						2		
2						2						3	2	
3						2						3		
4												2		
5				2		2						2	2	

UNIT I **15 Hours**

PLASTICS - DESIGN, PROCESSING, TOOLING, ASSEMBLY AND TESTING

Introduction on plastics, Types of plastics - Thermo plastics, Thermo setting plastics, Applications in Automobiles, Home appliances etc., Basic concepts on plastics design, Mould flow analysis, Plastic processing - Preheating, Molding, Molding types - Injection molding, compression molding, Rot molding, 2K molding, Tooling - Core, cavity, inserts, Heating and cooling circuits, Tool materials, Molding machines - Types, tonnage and other specifications. Molding defects - Warpage, Catching, Weld line, burning, Sink marks etc., Method of avoiding defects, Post molding process - Annealing, Texturing, color foiling, pad painting, Painting, etc., Assembly of plastics - Ultrasonic welding, Heat sinking, Vibration welding. Testing of plastics - UV Testing, Scratch resistance, Flammability, resistance against chemicals, impact test.

Total: 15 Hours

Reference(s)

1. Charles A Harper, Hand book of plastic technologies
2. Crawford R.J, Plastic engineering
3. Charles A Harper and Edward M petrie, Plastic materials and Processes - A conciseEncyclopedia

18AU0XB VEHICLE TESTING AND CERTIFICATION 1 0 0 1

Course Objectives

- To impart knowledge on motor vehicles emission inspections to determine compliance with established emissions standards
- To develop knowledge required for validation of vehicle components and systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. 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.
m. An ability to design, analyze and find the solutions for automotive relatedproblems
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Compare the emission norms of different Categories of Vehicle
2. Expalin the procedure for vehicletesting

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	2	3							2	2	
2	1		1	2	2							2	3	2

UNIT I **4 Hours**

HOMOLOGATION, CERTIFICATION

Introduction about Homologation, India Automotive Industry, Vehicle Category (UNECE), Overview of Vehicle type & approval, Environmental Regulation, Decade of Road Safety.

UNIT II **8 Hours**

EMISSION REGULATION, TESTING METHODS

Emission Norms for Different Categories of Vehicle and Engines, Idling CO and HC Test, Free Acceleration Test, Crankcase & Evaporative test, Type Approval of Instruments for checking the emission from in service vehicles.

UNIT III **8 Hours**

VEHICLE TESTING

Durability Testing -Types , Procedures & Measurements Methods, Components validation -Types , Procedures & Measurements Methods, Testing Measurement Instruments - Types ,Procedures & Measurements Methods, Vehicle Calibration & Testing -Types , Procedures & Measurements Methods.

Total: 20 Hours

18AU0XC AUTOMOBILE EMBEDDED SYSTEM 1 0 0 1

Course Objectives

- To provide students the skills required to interface devices and build a complete systems of automobiles

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. 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.
m. An ability to design, analyze and find the solutions for automotive relatedproblems
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Explain automotive Embedded Systems and their Features
2. Compare the function of varies brake control module

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2		2							2	2	2
2	2	1	2		3							2		3

UNIT I **4 Hours**

INTRODUCTION TO AE

Automotive Embedded Systems and their Features, Classification of Automotive Embedded Systems, Example Systems-Engine Management, Evolution Steps of Automotive Control Systems, Current Problems of Automotive Embedded Systems, Platform-base Development, AUTOSAR, JASPAR, ISO 26262-Functional Safety Standard

UNIT II **4 Hours**

ROLE OF ECUS IN AE

Door control unit, Engine control unit, Electric Power Steering Control Unit, Human-machine interface (HMI), Power train control module (PCM):Seat Control Unit, Speed control unit, Telematic control unit, Transmission control unit, Brake Control Module (BCM; ABS or ESC), Battery management system

UNIT III **4 Hours**

HOW AN ECU IS BUILD

PCB manufacturing process, Component selection & norms, Housing/Enclosure of ECUs

UNIT IV **4 Hours**

DIAGNOSTICS AND ITS TYPES

Importance of CAN, Standard interfaces, OBD-II signal protocols, OBD applications, Hands on experience of Onboard diagnostics

UNIT V **4 Hours**

OS(OPERATING SYSTEM/ OPEN SOURCE)

Types of RTOS,Open Source RTOS,Free RTOS,OSEK standards, AUTOSAR OS

Total: 20 Hours

18AU0XD GASOLINE INJECTION SYSTEMS 1 0 0 1

Course Objectives

- To provide knowledge on recent developments in gasoline injection systems which includes direction injection for SI engines

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. 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.
n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Compare the function of different SI Engine injectionsystems
2. Analyze the importance of ECU in Engine Managementsystems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2	2	1							2		2
2	2		2		3							2		2

UNIT I **5 Hours**

GASOLINE INJECTION SYSTEM

Introduction to SI engine management systems, Different Injection systems employed in SI system, Group and Sequential injection techniques, GDI techniques an overview.

UNIT II **5 Hours**

GASOLINE DIRECT INJECTION SYSTEM

GDI techniques to control Fuel Injection, Ignition control methodologies, Lambda control, idle speed control, Adaptive knock control, Combustion and Torque estimation.

UNIT III **5 Hours**

OVERVIEW OF ECU ON EMS AND TYPE OF GDI INJECTORS

Introduction to Engine control units for GDI systems, Role of sensors and actuators in Injection systems, different kind of Injectors used in GDI systems, Performance (Speed, Power, and Torque), Control (Emission, Fuel Economy, Drivability and Safety) & Legislation (Environmental legislation for pollution and safety Norms).

Total: 15 Hours

18AU0XE ADVANCED MOTOR SPORTS ENGINEERING

1 0 0 1

Course Objectives

- To provide students with a sound understanding of the fundamental scientific, engineering and design principles involved in motorsport, and their implementation within a high performance technology context

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information toprovide validconclusions.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technologicalchange.
m. An ability to design, analyze and find the solutions for automotive relatedproblems

Course Outcomes (COs)

1. Design of intake and exhaust system for SI engine
2. select appropriate air fuel ratio & spark timings for racing engine

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2									2	2	
2	2		2	1								2		

UNIT I **5 Hours**

INTRODUCTION TO MOTORSPORTS ENGINEERING

History of motorsports.A brief look at the events, SAE Events-Baja SAE, SAE Supra.

UNIT II **15 Hours**

RACING VEHICLE DESIGN

Design of intake & Exhaust system-design of runner length & diameter & plenum volume, ram theory, high performance exhaust configuration 4-1 & 4-2-1 configuration etc. Design & modification of high performance Engine for Racing-selection of compression ratio, high performance cam shaft , Calibration & Testing of racing vehicles in Engine chassis dynamometer-selection of appropriate air fuel ratio & spark timings for racing engine. Data Logging & Analysis-Real time data logging in race track and analysis.

Total: 20 Hours

18AU0XF AUTOMOTIVE PRODUCT DEVELOPMENT 1 0 0 1

Course Objectives

- To provide knowledge on recent developments in product development in automotive field.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

f. 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.

g. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.

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

l. 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.

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

3. Compare the function of different SI Engine injectionsystems
4. Analyze the importance of ECU in Engine Managementsystems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2	2	1							2		2
2	2		2		3							2		2

UNIT I **5 Hours**

INTRODUCTION

Introduction, Overview of mechanical product development process, Workflow in product development and functions / departments, Systems engineering of vehicle, Internal and external complexity, Concurrent engineering, Product development funnel.

UNIT II **5 Hours**

PRODUCT PLANNING AND CONCEPT DEVELOPMENT

Product planning, Concept development, Automotive design and aerodynamics, Points on automotive design, Ergonomics, Ergonomics analyses and seating buck, Vehicle specification.

UNIT III **5 Hours**

VEHICLE ARCHITECTURE AND SYSTEM DESIGN

Vehicle architecture, Powertrain arrangement, Middle engine arrangement, Vehicle constructin, Suspension configuration, selection and Modular platforms, Powertrain development process.

Total: 15 Hours

18AU0XG AUTOMOTIVE INTERIOR COMPONENTS DEVELOPMENT 1 0 0 1

Course Objectives

- To provide knowledge on recent developments in interior components design.
- To provide the knowledge on CATIA modeling and drafting.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. 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.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.

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

l. 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.

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Understand the Interior and Exterior trim design requirements.
2. Apply CATIA tool to model the interior components design.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2	2	1							2		2
2	2		2		3							2		2

UNIT I **5 Hours**

AUTOMOTIVE TRIM DESIGN

Automotive Product development-Introduction, Automotive sketching, clay modeling, Industrial Engineering Drawing, Introdruction about Interior and exterior trims - styling and master section, Injection moulding concepts, Product Design Considerations, Real time Part showing and detailing, Introduction about CATIA - CATIA Part modeling and drafting, Project work flow.

Total: 15 Hours

18AU0XH CONNECTED VEHILCLES 1 0 0 1

Course Objectives

- To provide knowledge on recent developments in Mobility Engineering this includes Connected Vehicles.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. 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.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.

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

l. 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.

n. An ability to use computer knowledge, IT for designing and improving the performance of the automobiles

Course Outcomes (COs)

1. Compare the function of different Automotive Communication Networks, Sensors.
2. Analyze the importance of Connected Vehicle Applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2	2	1							2		2
2	2		2		3							2		2

UNIT I **5 Hours**

AUTOMOTIVE SENSORS

Automotive Sensors - Types, Engine and Vehicle Sensors – Characteristics and Parameters, Environmental Sensors – Characteristics and Parameters.

UNIT II **5 Hours**

AUTOMOTIVE COMMUNICATION NETWORKS AND DATA ACQUISTION ANALYSIS

Different Types of Automotive Communication Networks, CAN, LIN, J1939, Gateways and Controllers, Different Layers in Networks, Data acquisition Methods , OBD Protocols, Data Analysis. Fuzzy logic and its control techniques.

UNIT III **5 Hours**

CONNECTED VEHICLE APPLICATIONS

Telematic systems, Vehicle Tracking systems, Machine Fault Diagnosis ,Usage based Insurance, Network Optimisation ,Vehicle to Vehicle, Vehicle to Radar, Vehicle to Satellite communication systems.

UNIT IV **5 Hours**

CYBER SECURITY DATA SECURITY AND PIRACY

Threat Matrix in Vehicle systems, Vulnerability of current Autonomous systems, Data security in connected Vehicle applications, Legal aspects of Connected Vehicle systems, privacy and security aspects in Connected Vehicles.

Total: 20 Hours

18GE0XA ETYMOLOGY 1 0 0 1

Course Objectives

- To increase vocabulary and enhance use, knowledge, and understanding of the English language.
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic.
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication.

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				

UNIT I **7 Hours**

CONVENTIONS

Acronyms, Abbreviations, Initialises, Jargon Neologisms - Idiomatic Expressions, Euphemisms Spoonerisms Malapropisms ; Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Apheresis - Blend word Assimilation - Colloquial language Clipped word

UNIT II **8 Hours**

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis ; Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total: 15 Hours

Reference(s)

1. Norman, Lewis. Word Power Made Easy, Goyal Publisher. Edition 2. 2014.
2. C T Onions. The Oxford Dictionary of English Etymology, Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont, Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library. 1961.

18GE0XB GENERAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of psychology.
- Defining Psychology and the subject matter of psychology.
- To provide an awareness of various methods and branches of psychology.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large.
2. Understand the different fields of psychology and its uses.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								2	1					
2								2	2					
3								2	3					

UNIT I **15 Hours**

GENERAL PSYCOLOGY

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology -Motivation- Types of Needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ- measurement - Social psychology: individual behavior and group behavior - Group dynamics- group formation- social influence- social cognition, stereotypes- prejudice- discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude.

Total: 15 Hours

Reference(s)

1. Atkinson & Atkinson, Introduction to Psychology, 6th Ed McGraw-Hill Publications. 1975
2. Mishra, B. K, Psychology: The study of human behavior, 2nd Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016.
3. Baron, R.A., Branscombe. N.R, Social Psychology, 14th Ed. New Delhi; Pearson Education. 2016
4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7th Ed. New Delhi: Tata McGraw Hill. 1993

18GE0XC NEURO BEHAVIORAL SCIENCE 1 0 0 1

Course Objectives

- To provide an introduction to the Cognitive Neuro Science oflanguages.
- To provide an understanding of the Cognitiveprocesses.

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Identify the psychological problems that will impact mental health.
2. Value ethical conduct in professional and personal life.
3. Recognize the need for rationale and evidence in decision-making.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2									2					
3									3					

UNIT I **15 Hours**

NEURO BEHAVIOURAL SCIENCE

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds

Total: 15 Hours

Reference(s)

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
2. Horon C Philip. Sexology and Mind. Academic Press. 1993
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996

18GE0XD VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of filmmaking as an art
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issuesand the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, anddemonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2	2							
2						2	2							

UNIT I **15 Hours**

ART OF FILMMAKING

History of Cinema (Origin and Narrative) Cinema as a visual medium -Significance of Editing Styles of Editing Editing as a methodology (Hollywood s Invisible Editing) Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) Different types of shots and angles

- Film style and Narrative (Italian Neo-realism, Avant Garde, Russain Formalism, Alternative Cinema etc.,) Regional Cinema to National Cinema Basics of Script Writing (Double and Single Column) Basics of Video Production (script to screen) Final submission of a script for five minutes short film

Total: 15 Hours

Reference(s)

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

18GE0XE YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individualconsciousness
- To apply the knowledge by the way of practice and introspection

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								2	2					
2								2	2					
3								2	2					

UNIT I **15 Hours**

YOGA FOR HUMAN EXCELLENCE

What is Yoga , History of Yoga - Yoga in todays scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar Standing Asanas - Sitting Asanas
- Prone Asanas - Supine Asanas - MudrasRelaxation - Pranayama - Meditation

Total: 15 Hours

Reference(s)

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
3. Ramesh Partani, The Complete Secret, Ru Education, 2013.
4. http://www.sarvyoga.com/
5. http://www.wikihow.com/Do-Superbrain-Yoga

18GE0XF VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3												

UNIT I **15 Hours**

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

Reference(s)

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997

18GE0XG HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness

Programme Outcomes (POs)

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretationof data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issuesand the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts
2. Understand the fundamental concepts of yogic practice and physical fitness
3. To acquire the knowledge about nutrition and health consciousness

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							1		2					
2				2		2			2					
3				2		2			2					

UNIT I **5 Hours**

FITNESS

Meaning & Definition, Need & importance of Physical fitness, Types Physical fitness - Exercise, Training andConditioning and it is important

UNIT II **5 Hours**

YOGA AND MEDITATION

Meaning and definition; Principles of practicing;Basic Asana and it important; Pranayama and Meditation - Relaxation Techniques

UNIT III **5 Hours**

NUTRITION AND BALANCE DIET

Nutrition and Balance Diet: Needs and Important, Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases - cause prevention-First aid for common sports injuries.

Total: 15 Hours

Reference(s)

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men&Women. Mumbai: Jaico Publishing House

2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics

3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers

4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications

5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited

18GE0XH CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING

1 0 0 1

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact procedures of biodegradation of unwanted solid residues

Programme Outcomes (POs)

f. 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.

Course Outcomes (COs)

1. Understand therole of recycling of garbage leading to thesustenance of our healthand environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2								
2						2								
3						2								

UNIT I **15 Hours**

VERMICOMPOSTING TECHNOLOGY

Ecological roles and economic importance of earthworms - need for earthworm culture, scope and importance of vermiculture , limiting factors - types of worm culturing and the relative benefits Small scale and commercial methods: process & advantages , Vermicomposting equipments, devices, Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle), vermicastings in organic farming/horticulture - Marketing the products of vermiculture quality control, market research, marketing techniques , Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times , Scientists Hope to Cultivate and Immune System for Crops

18GE0XI BLOG WRITING 1 0 0 1

Course Objectives

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a web designer.

Programme Outcomes (POs)

f. 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.

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

j. 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.

Course Outcomes (COs)

1. Understand the flow of language in natural manner.
2. Understand the elements of a blog and be able to use them effectively.
3. Find a niche for a long-term blog.
4. Gain insight into the strategies, methods and writing of successful bloggers.
5. Develop their creative thinking.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2										1				
3						2								
4							2							
5							2							

UNIT I **7 Hours**

UNIT I

Concept: What is blog writing? Types of blog posts -personal experience, opinion, reviews, advice, news/updates. Focusing your blog - concept, audience, uniqueness, posts. Company blogs. Structure: Types of structure - inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

UNIT II **8 Hours**

UNIT II

Voice: Defining and achieving voice. Exploring various voices. Stylistic tipsÃƒÂ¢??rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. Reliability - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

Total: 15 Hours

Reference(s)

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. $29.95 paperback.
2. Blogging Heroes, by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
3. Complete Guide to Blogging, Huffinghton Post

18GE0XJ INTERPERSONAL SKILLS 1 0 0 1

Course Objectives

- To communicate and work effectively, both individually and in groups
- To be able to understand and manage ones own and others emotions
- To define and solve problems by making decisions about the best course of action

Programme Outcomes (POs)

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Express themselves clearly and confidently
2. Listen to others completely and with empathy
3. Assert an opinion without diminishing others opinion
4. Be responsible and timely with a willingness to collaborate
5. Develop innate personality traits to handle certain socialsituations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2		2					
2							2		2					
3							2		2					
4							2		2					
5							2		2					

UNIT I **7 Hours**

INTRODUCTION

Conversational Skills - Active Listening - Team working Empathy - Emotional Intelligence

UNIT II **8 Hours**

SKILLS

Conflict Resolution and Mediation skills - Decision making and Problem Solving - Negotiation and Persuasion skills

Total: 15 Hours

Reference(s)

1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015
2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006
3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organisations, McGraw-Hill Education; 5th Edition, 2014

1 0 0 1

18GE0XK COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

Course Objectives

- Understand the role of National Service Scheme incommunity
- Identify the needs and problems of the community and involve in problemsolving
- Develop competence required for group living and acquire leadership qualities

Programme Outcomes (POs)

Course Outcomes (COs)

1. understand the community in which they work and render their service
2. develop among themselves a sense of social and civic responsibility

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														

UNIT I **15 Hours**

COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structure Ã¢?? roles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, Day Camps-Basis of adoption of village/slums-Methodology of conducting Survey-Financial pattern of the scheme -Coordination with different agencies-Maintenance of the Diary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth-adult partnership. Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise-Role of financial and support service Institutions.

Total: 15 Hours

Reference(s)

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
2. http://nss.nic.in/intro.asp
3. Delgado-Gaitn and Concha, The Power of Community: Mobilizing for Family and SchoolingNew York: Rowman & Littlefield Publishing, Inc. 2001
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World health organization, 2nd edition. 1980
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009

18GE0XL NATIONAL CADET CORPS 1 0 0 1

Course Objectives

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity
- To identify the utility of smart materials in engineering applications.

Programme Outcomes (POs)

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Recall the motto and aim of NCC.
2. Implement synergy in disaster management.
3. Execute an example patriotic leader to serve nation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2		2					
2							1		2					
3							1		2					

UNIT I **12 Hours**

NCC STRUCTURE AND TRAINING

NCC ORGANIZATION

National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets.

DRILL AND WEAPON TRAINING

Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22 and INSAS - Stripping, Assembling and Cleaning of weapons.

NATIONAL INTEGRATION AND SOCIAL AWARENESS

National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGOs role and Contribution - Social Security schemes.

UNIT II **8 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

PERSONALITY DEVELOPMENT AND LEADERSHIP

Personality Development: Introduction - Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader. DISASTER MANAGEMENT AND FIRST AID

Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipments - First aid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

Total: 20 Hours

Reference(s)

1. Cadets Hand book Common subject, DG NCC, New Delhi.
2. Cadets Hand book Special subject, DG NCC, New Delhi
3. Misra R.C and Sanjaykumar Mishra, A HAND BOOK OF NCC(English), Kanti Prakashan, 2016
4. Gupta R. K, NCC: Handbook of NCC Cadets for A, B and C Certificate Examinations (English) RPHEditorial Board, 2018.

18GE0XM NEW AGE INNOVATION AND ENTREPRENEURSHIP 1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task of setting independent businessunits and on the various facets of running a business
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
f. 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.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1.Understanding entrepreneurship as an important career option

2.Concept and methodology of idea translation to viable start-ups

3.Events to occur in the building of a technology based venture for students or working professionals or women

4.Overview of Indian trends in the start-up scene

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2		2						
2						2		2						
3		2				2		2						
4			2			2		2						

UNIT I **15 Hours**

NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification ideation -MVPPositioning as an Entrepreneur Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business PlanMentoring Session with Investors- Legal and Ethical Foundation for Startup. Types of startups and licensing systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship
– Intrapreneurship Sustainability - Exit strategies and Start-up trends in India.

Total: 15 Hours

Reference(s)

1. Kathleen R. Allen, Launching New Ventures, South-WesternCengage Learning, 6th Edition, 2012
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, publishedby the authors, 2010
3. Branson. R. Ãƒ?Ã‚Â¢??Business stripped bareÃƒ?Ã‚Â¢??, New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3 edition, Mason, Oh;CENGAGE/SOUTH WESTERN publisher, 2011

18GE0XN DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task disruption led innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity based disruption strategy

Programme Outcomes (POs)

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

g. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Understanding contemporary entrepreneurship as an important career option
2. Concept and methodology of creative disruption to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
4. Overview of Indian trends with reference to disruptive innovation based start-ups

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2	2						
2							2	2						
3							2	2						
4							2	2						

UNIT I **15 Hours**

DISRUPTIVE INNOVATION

Creativity linked innovation Ã¢?? Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market? Ã¢?? Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company"s capabilities and rethinking product, market and strategy - Right customers for DI: strategy in a world that is changing so rapidly Ã¢?? Application of disruptive theories to complex problems and opportunities.

Total: 15 Hours

Reference(s)

1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x
2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation
3. https://hbr.org/2006/12/disruptive-innovation-for-social-change

18GE0XO SOCIAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of social psychology.
- Defining psychological & physical changes during puberty age.
- To provide an awareness of various psychological problems and socialproblems.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the various psychological, physical, social problems and management skills.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2	2		1					
2						1	2		1					
3						2	2		3					

UNIT I **7 Hours**

INTRODUCTION

Introduction - Ice breaker - Time Line - Tasks and Challenges of the age(Erik Erikson)Physical changes - Introduction to Reproductive Health - Reproductive Organs - Menstruation - Changes during Puberty - Abortions - Contraception - Difference between Sex and Gender - Introduction to the origins of Patriarchy
- Gender.

UNIT II **8 Hours**

PSYCHOLOGY

Developmental changes - Attraction - Friendship - Differences and Similarities - Images of Beauty and Body Image -Introduction to Media-Feedback - Sexuality - Boundaries Relationships - Marriage - Love - Emotional Health - Sexual Abuse and Safety - Role of Media - Abortions, Contraception, Wrapping up the Course.

Total: 15 Hours

Reference(s)

1. Baron, R. A.,Branscombe.N.R.(2016).Social Psychology,14th Ed. New Delhi;Pearson Education
2. Morgan,C.T., King,R.A.,Weisz,J.R.,&Schopler,J.(1993). Introduction to Psychology,7th Ed.New Dehi:Tata McGraw Hill.

18GE0XP FM RADIO BROADCASTING TECHNOLOGY 1 0 0 1

Course Objectives

- The course focuses on community radio technology and various program productions techniques for FM Radio Broadcasting.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

c. 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.

Course Outcomes (COs)

1. Understand the hardware required for field recording and setting up a studio and carry out studio and field recording.
2. Examine the available options for telephony interfaces for radio.
3. Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2											
2	2	2	2											
3	2	2	2											

UNIT I **3 Hours**

INTRODUCTION TO AM/ FM RADIO

History of Radio-Types of Radio and its Reach- Entertainment Radio- Community Radio- Internet Radio- Satellite Radio. Evolution of Community Radio (CR) in India- principles behind setting up of FM/CR- policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

UNIT II **3 Hours**

STUDIO TECHNOLOGY

Use of Microphones-Console handling-OB Recordings & Live Shows-Properties and components of sound- difference between analogue and digital audio-hardware required for field recording and setting up a studio- fundamental principles for setting up an audio studio.

UNIT III **3 Hours**

AUDIO PRODUCTION

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production-telephony interfaces for radio- audio Post Production. Voice Culture Exercise- Radio Production Techniques & Tools.

UNIT IV **3 Hours**

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance ofstudio and equipment.

UNIT V **3 Hours**

RADIO TRANSMISSION TECHNOLOGY

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable-propagation and coverage of RF signals-FM transmitter setup- Radio audience -measurements systems.

Total: 15 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, Other Voices: The Struggle for Community Radio in India, SAGEPublications India, 2007.
3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, Sean O Siochru, Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and Regulation, University of Michigan Press, 2008.
4. www.floridasound.com
5. www.mediacollege.com
6. www.mediacollege.com