KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI – 2018

(CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION)

(For the students admitted during 2018 - 2019 and onwards)

BACHELOR OF ENGINEERING DEGREE
IN
AUTOMOBILE ENGINEERING

DEPARTMENT OF AUTOMOBILE ENGINEERING

KONGU
Assuring the Best

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KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 060
(Autonomous)

INSTITUTE VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

INSTITUTE MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

QUALITY POLICY

We are committed to

- Provide value based quality education for the development of students as competent and responsible citizens.
- Contribute to the nation and beyond through research and development
- Continuously improve our services

DEPARTMENT OF AUTOMOBILE ENGINEERING

VISION

To be a centre of excellence for development and dissemination of knowledge in Automobile Engineering for the Nation and beyond.

MISSION

Department of Automobile Engineering is committed to:

MS1: Establish an academic center to develop quality automotive engineers through professional teaching learning process.

MS2: Develop research interest among the graduates through state of the art facilities.

MS3: Promote innovation and industrial consultancy to meet the societal needs.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Automobile Engineering will

PEO1: Pursue successful career in the domain of design, analysis, testing and diagnostics that meets the needs of global industries.

PEO2: Habituate continuous learning to carry out research and development activities for solving real time multi-disciplinary problems

PEO3: Demonstrate entrepreneurial skills and contribute to the society as an ethical and responsible citizen.

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	3	2
MS2	3	3	2
MS3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Graduates of Automobile Engineering will**:**

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

PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 **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.

PO4 **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.

PO5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **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.

PO7 **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.

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

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **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.

PO11 **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.

PO12 **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)	
Graduates of Automobile Engineering will**:**	
PSO1	Analyze the functioning of automotive engine, power train, chassis and other mechanical systems.
PSO2	Examine various electrical and electronic systems related to engine, transmission, braking, traction, cruise, safety, stability, comfort and convenience.

MAPPING OF PEOs WITH POs AND PSOs

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	3	3	3	3	3	3	3	2	2	3	2	3	3	3
PEO2	3	3	3	3	3	3	3	2	2	3	2	2	3	3
PEO3	2	2	2	2	3	3	3	3	3	3	3	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060

(Autonomous)

REGULATIONS 2018
(Revision: 4)

CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION

BACHELOR OF ENGINEERING (BE) / BACHELOR OF TECHNOLOGY (BTech)

DEGREE PROGRAMMES

These regulations are applicable to all candidates admitted into BE/BTech Degree programmes from the academic year 2018 – 2019 onwards.

1. DEFINITIONS AND NOMENCLATURE

In these Regulations, unless otherwise specified:

i. "University" means ANNA UNIVERSITY, Chennai.

ii. "College" means KONGU ENGINEERING COLLEGE.

iii. "Programme" means Bachelor of Engineering (BE) / Bachelor of Technology (BTech) Degree programme

iv. "Branch" means specialization or discipline of BE/BTech Degree programme, like Civil Engineering, Information Technology, etc.

v. "Course" means a Theory / Theory cum Practical / Practical course that is normally studied in a semester like Mathematics, Physics etc.

vi. "Credit" means a numerical value allocated to each course to describe the candidate's workload required per week.

vii. "Grade" means the letter grade assigned to each course based on the marks range specified.

viii. "Grade point" means a numerical value (0 to 10) allocated based on the grade assigned to each course.

ix. "Principal" means Chairman, Academic Council of the College.

x. "Controller of Examinations" means authorized person who is responsible for all examination related activities of the College.

xi. "Head of the Department" means Head of the Department concerned of the College.

2. PROGRAMMES AND BRANCHES OF STUDY

The following programmes and branches of study approved by Anna University, Chennai and All India Council for Technical Education, New Delhi are offered by the College.

Programme	Branch
BE	Civil Engineering
	Mechanical Engineering
	Electronics and Communication Engineering
	Computer Science and Engineering
	Electrical and Electronics Engineering
	Electronics and Instrumentation Engineering
	Mechatronics Engineering
	Automobile Engineering
BTech	Chemical Engineering
	Information Technology
	Food Technology

3. ADMISSION REQUIREMENTS

3.1 First Semester Admission

The candidates seeking admission to the first semester of the eight semester BE / BTech Degree Programme:

Should have passed the Higher Secondary Examination (10 + 2) in the academic stream with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III subjects of the study conducted by the Government of Tamil Nadu or any examination of any other University or authority accepted by the Anna University, Chennai as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

They should also satisfy other eligibility conditions as prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

3.2 Lateral Entry Admission

The candidates who hold a Diploma in Engineering / Technology awarded by the State Board of Technical Education, Tamilnadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of BE / BTech in relevant branches of study.

(OR)

The candidates who hold a BSc degree (10+2+3 stream) with mathematics as one of the subjects at the BSc level from a recognised University are eligible to apply for Lateral entry admission to the third semester of BE / BTech. Such candidates shall undergo two additional Engineering course(s) in the third and fourth semesters as prescribed by the College.

They should satisfy other eligibility conditions prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

4. STRUCTURE OF PROGRAMMES

4.1 Categorisation of Courses

The BE / BTech programme shall have a curriculum with syllabi comprising of theory, theory cum practical, practical courses in each semester, professional skills training/industrial training, project work, internship, etc. that have been approved by the respective Board of Studies and Academic Council of the College. All the programmes have well defined Programme Outcomes (PO), Programme Specific Outcomes (PSO) and Programme Educational Objectives (PEOs) as per Outcome Based Education (OBE). The content of each course is designed based on the Course Outcomes (CO). The courses shall be categorized as follows:

i. Humanities and Social Sciences (HS) including Management Courses

ii. Basic Science (BS) Courses

iii. Engineering Science (ES) Courses

iv. Professional Core (PC) Courses

v. Professional Elective (PE) Courses

vi. Open Elective (OE) Courses

vii. Employability Enhancement Courses (EC) like Project work, Professional Skills/Industrial Training, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship in Industry or elsewhere

viii. Audit Courses (AC)

ix. Mandatory Courses (MC)

4.2 Credit Assignment

4.2.1. Credit Assignment

Each course is assigned certain number of credits as follows:

Contact period per week	Credits
1 Lecture / Tutorial Period	1
2 Practical Periods	1
2 Project Work Periods	1
40 Training / Internship Periods	1

The minimum number of credits to complete the programme shall vary from 168 to 173 as per the chosen programme of study.

4.3 Employability Enhancement Courses

A candidate shall be offered with the employability enhancement courses like project work, professional skills training/industrial training, comprehensive test & viva, industrial training, internship and entrepreneurships/start ups during the programme to gain/exhibit the knowledge/skills.

4.3.1 Professional Skills Training/Industrial Training/ Entrepreneurships/Start Ups

A candidate may be offered with appropriate training courses imparting programming skills, communication skills, problem solving skills, aptitude skills etc. It is offered in two phases as phase I in fifth semester and phase II in sixth semester including vacation periods and each phase can carry two credits.

(OR)

A candidate may be allowed to go for training at research organizations or industries for a required number of hours in sixth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training course II in sixth semester. He/She shall attend Professional Skills Training Phase I in fifth semester and can earn two credits.

(OR)

A candidate may be allowed to set up a start up and working part-time for the start ups by applying his/her innovations and can become a student entrepreneur during BE/BTech programme. Candidates can set up their start up from fifth semester onwards either inside or outside of the college. Such student entrepreneurs may earn a maximum of 2 credits per semester for two semesters each in place of either Professional Skills Training I or Professional Skills Training II. The area in which the candidate wants to initiate a start up may be interdisciplinary or multidisciplinary. The progress of the startup shall be evaluated by a panel of members constituted by the Principal through periodic reviews.

4.3.2 Comprehensive Test and Viva

The overall knowledge of the candidate in various courses he/she studied shall be evaluated by (i) conducting comprehensive tests with multiple choice questions generally with pattern similar to GATE and/or (ii) viva-voce examination conducted by a panel of experts assigned by the Head of the department. The members can examine the knowledge of the candidate by asking questions from various domains and the marks will be assigned based on their answers. This course shall carry two credits.

4.3.3 Internships

The curriculum enables a candidate to go for full time projects through internship during a part of seventh semester and/or entire final semester and can earn credits vide clause 7.6 and clause 7.11.

A candidate is permitted to go for full time projects through internship in seventh semester with the following condition: The candidate shall complete a part of the seventh semester courses with a total credit of about 50% of the total credits of seventh semester including Project Work I Phase II in the first two months from the commencement of the seventh semester under fast track mode. The balance credits required to complete the seventh semester shall be earned by the candidate through either approved Value Added Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

A candidate is permitted to go for full time projects through internship during eighth semester. Such candidate shall earn the minimum number of credits required to complete eighth semester other than project through either approved Value Added Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

Assessment procedure is to be followed as specified in the guidelines approved by the Academic Council.

4.4 Value Added Courses / Online Courses / Self Study Courses

The candidates may optionally undergo Value Added Courses / Online Courses / Self Study Courses as elective courses.

4.4.1 Value Added Courses: Value Added courses each with One / Two credits shall be offered by the college with the approval from respective Board of Studies. A candidate can earn a maximum of six credits through value added courses during the entire duration of the programme.

4.4.2 Online Courses: Candidates may be permitted to earn credits for online courses, offered by NPTEL / SWAYAM / a University / Other Agencies, approved by respective Board of Studies.

4.4.3 Self Study Courses: The Department may offer an elective course as a self study course. The syllabus of the course shall be approved by the respective Board of Studies. However, mode of assessment for a self study course will be the same as that used for other courses. The candidates shall study such courses on their own under the guidance of member of the faculty following due approval procedure. Self study course is limited to one per semester.

4.4.4 The elective courses in the final year may be exempted if a candidate earns the required credits vide clause 4.4.1, 4.4.2 and 4.4.3 by registering the required number of courses in advance.

4.4.5 A candidate can earn a maximum of 30 credits through all value added courses, online courses and self study courses.

4.5 Flexibility to Add or Drop Courses

4.5.1 A candidate 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 the candidate wishes, then the candidate is permitted to earn more than the total number of credits prescribed in the curriculum of the candidate's programme.

4.5.2 From the first to eighth semesters the candidates have the option of registering for additional elective courses or dropping of already registered additional elective courses within two weeks from the start of the semester. Add / Drop is only an option given to the candidates. Total number of credits of such courses during the entire programme of study cannot exceed eight.

4.6 Maximum number of credits the candidate can enroll in a particular semester cannot exceed 30 credits.

4.7 The blend of different courses shall be so designed that the candidate at the end of the programme would have been trained not only in his / her relevant professional field but also would have developed to become a socially conscious human being.

4.8 The medium of instruction, examinations and project report shall be English.

5. DURATION OF THE PROGRAMME

5.1 A candidate is normally expected to complete the BE / BTech Degree programme in 8 consecutive semesters/4 Years (6 semesters/3 Years for lateral entry candidate), but in any case not more than 14 semesters/7 Years (12 semesters/6 Years for lateral entry candidate).

5.2 Each semester shall consist of a minimum of 90 working days including continuous assessment test period. The Head of the Department shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus for the course being taught.

5.3 The total duration for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum duration specified in clause 5.1 irrespective of the period of break of study (vide clause 11) or prevention (vide clause 9) in order that the candidate may be eligible for the award of the degree (vide clause 16). Extension beyond the prescribed period shall not be permitted.

6. COURSE REGISTRATION FOR THE EXAMINATION

6.1 Registration for the end semester examination is mandatory for courses in the current semester as well as for the arrear courses failing which the candidate will not be permitted to move on to the higher semester. This will not be applicable for the courses which do not have an end semester examination.

6.2 The candidates who need to reappear for the courses which have only continuous assessment shall enroll for the same in the subsequent semester, when offered next, and repeat the course. In this case, the candidate shall attend the classes, satisfy the attendance requirements (vide clause 8) and earn continuous assessment marks. This will be considered as an attempt for the purpose of classification.

6.3 If a candidate is prevented from writing end semester examination of a course due to lack of attendance, the candidate has to attend the classes, when offered next, and fulfill the attendance requirements as per clause 8 and earn continuous assessment marks. If the course, in which the candidate has a lack of attendance, is an elective, the candidate may register for the same or any other elective course in the subsequent semesters and that will be considered as an attempt for the purpose of classification.

7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

7.1 The BE/BTech programmes consist of Theory Courses, Theory cum Practical courses, Practical courses, Comprehensive Test and Viva, Project Work, Professional Skills Training, Internship and Entrepreneurships/ Start ups. Performance in each course of study shall be evaluated based on (i) Continuous Assessments (CA) throughout the semester and (ii) End Semester Examination (ESE) at the end of the semester except for the courses which are evaluated based on continuous assessment only. Each course shall be evaluated for a maximum of 100 marks as shown below:

Sl. No.	Category of Course	Continuous Assessment Marks	End Semester Examination Marks
1.	Theory	50	50
2.	Theory cum Practical	The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.	
3.	Practical / Professional Skills Training / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work I Phase I / Mandatory Course/ Industrial Training/Universal Human Values	100	---
4.	Project Work I Phase II / Project Work II/ Internships	50	50
5.	Value Added Course	The distribution of marks shall be decided based on the credit weightage assigned	---
6.	All other Courses		

7.2 Examiners for setting end semester examination question papers for theory courses, theory cum practical courses and practical courses and evaluating end semester examination answer scripts, project works, internships and entrepreneurships/start ups shall be appointed by the Controller of Examinations after obtaining approval from the Principal.

7.3 Theory Courses

For all theory courses out of 100 marks, the continuous assessment shall be 50 marks and the end semester examination shall be for 50 marks. However, the end semester examinations shall be conducted for 100 marks and the marks obtained shall be reduced to 50. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. Three tests shall be conducted for 50 marks each and reduced to 30 marks each. The total of the continuous assessment marks and the end semester examination marks shall be rounded off to the nearest integer.

7.3.1 The assessment pattern for awarding continuous assessment marks shall be as follows:

Sl. No.	Type	Max. Marks	Remarks
1.	Test - I	30	Average of best two
	Test - II	30	
	Test - III	30	
2.	Tutorial	15	Should be of Open Book/Objective Type. Average of best 4 (or more, depending on the nature of the course, as may be approved by Principal)
3.	Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes	05	To be assessed by the Course Teacher based on any one type.
	Total	50	Rounded off to the one decimal place

However, the assessment pattern for awarding the continuous assessment marks may be changed based on the nature of the course and is to be approved by the Principal.

7.3.2 A reassessment test or tutorial covering the respective test or tutorial portions may be conducted for those candidates who were absent with valid reasons (Sports or any other reason approved by the Principal).

7.3.3 The end semester examination for theory courses shall be for a duration of three hours and shall be conducted between November and January during odd semesters and between April and June during even semesters every year.

7.4 Theory Cum Practical Courses

For courses involving theory and practical components, the evaluation pattern as per the clause 7.1 shall be followed. Depending on the nature of the course, the end semester examination shall be conducted for theory and the practical components. The apportionment of continuous assessment and end semester examination marks shall be decided based on the credit weightage assigned to theory and practical components approved by Principal.

7.5 Practical Courses

For all practical courses the continuous assessment shall be for 100 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidates' records maintained.

7.5.1 The apportionment of continuous assessment marks for each course shall be decided by the course coordinator based on rubrics of that particular course.

Type	Max. Marks	Remarks
Assessment based on rubrics for each experiment	50	Absolute Mark System
Assessment Test	50	
Total	100	Rounded off to one decimal place

7.6 Project Work II / Project Work I Phase II

7.6.1 Project work shall be assigned to a single candidate or to a group of candidates not exceeding 4 candidates in a group. The project work is mandatory for all the candidates.

7.6.2 The Head of the Department shall constitute review committee for project work. There shall be two assessments by the review committee during the semester. The candidate shall make presentation on the progress made by him/her before the committee.

7.6.3 The continuous assessment and end semester examination marks for Project Work II/ Project Work I Phase II and the Viva-Voce Examination shall be distributed as below:

Continuous Assessment (Max. 50 Marks)						End Semester Examination (Max. 50 Marks)			
Zeroth Review		Review I (Max.. 20 Marks)		Review II (Max. 30 Marks)		Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)		
Rv. Com	Super visor	Review Committee (excluding Super visor)	Super visor	Review Committee (excluding Super visor)	Super visor	Ext. Exr.	Super visor	Exr. 1	Exr. 2
0	0	10	10	15	15	20	10	10	10

7.6.4 The Project Report prepared according to approved guidelines and duly signed by the Supervisor shall be submitted to Head of the Department. The candidate(s) must submit the project report within the specified date as per the academic schedule of the semester. If the project report is not submitted within the specified date then the candidate is deemed to have failed in the Project Work and redo it in the subsequent semester.

7.6.5 If a candidate fails to secure 50% of the continuous assessment marks in the project work, he / she shall not be permitted to submit the report for that particular semester and shall have to redo it in the subsequent semester and satisfy attendance requirements.

7.6.6 The end semester examination of the project work shall be evaluated based on the project report submitted by the candidate in the respective semester and viva-voce examination by a committee consisting of two examiners and supervisor of the project work.

7.6.7 If a candidate fails to secure 50 % of the end semester examination marks in the project work, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted as per clause 7.6.6.

7.6.8 A copy of the approved project report after the successful completion of viva-voce examination shall be kept in the department library.

7.7 Project Work I Phase I/Industrial Training

The evaluation method shall be same as that of the Project Work II as per clause 7.6 excluding 7.6.3, 7.6.5, 7.6.6 and 7.6.7. The marks distribution is given below:

Continuous Assessment (Max. 100 Marks)								
Zeroth Review		Review I (Max.. 20 Marks)		Review II (Max.. 30 Marks)		Review III (Max. 50 Marks)		
						Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)	
Review Committee	Supervisor	Review Committee (excluding supervisor)	Supervisor	Review Committee (excluding supervisor)	Supervisor	Review Committee	Supervisor	Review Committee
0	0	10	10	15	15	20	10	20

If a candidate fails to secure 50 % of the continuous assessment marks in this course, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted.

7.8 Professional Skills Training

Phase I training shall be conducted for minimum of 80 hours in 4^{th} semester vacation and during 5^{th} semester. Phase II training shall be conducted for minimum of 80 hours in 5^{th} semester vacation and during 6^{th} semester. The evaluation procedure shall be approved by the Principal.

7.9 Comprehensive Test and Viva

A candidate can earn 2 credits by successfully completing this course. The evaluation procedures shall be approved by the Principal.

7.10 Entrepreneurships/ Start ups

A start up/business model may be started by a candidate individually or by a group of maximum of three candidates during the programme vide clause 4.3.1. The head of the department concerned shall assign a faculty member as a mentor for each start up.

A review committee shall be formed by the Principal for reviewing the progress of the Start ups / Business models, innovativeness, etc. The review committee can recommend the appropriate grades for academic performance for the candidate(s) involved in the start ups. This course shall carry a maximum of two credits in fifth semester and two credits in sixth semester respectively and shall be evaluated through continuous assessments for a maximum of 100 marks vide clause 7.1. A report about the start ups is to be submitted to the review committee for evaluation for each start up and the marks will be given to Controller of Examinations after getting approval from Principal.

7.11 Projects through Internships

Each candidate shall submit a certificate issued from the organization concerned at the time of Viva-voce examination to the review committee. The evaluation method shall be same as that of the Project Work II as per clause 7.6.

7.12 Value Added Course

Minimum of two assessments shall be conducted during the value added course duration by the offering department concerned.

7.13 Online Course

The Board of Studies will provide methodology for the evaluation of the online courses. The Board can decide whether to evaluate the online courses through continuous assessment and end semester examination or through end semester examination only. In case of credits earned through online mode from NPTEL / SWAYAM / a University / Other Agencies approved by Chairman, Academic Council, the credits may be transferred and grades shall be assigned accordingly.

7.14 Self Study Course

The member of faculty approved by the Head of the Department shall be responsible for periodic monitoring and evaluation of the course. The course shall be evaluated through continuous assessment and end semester examination. The evaluation methodology shall be the same as that of a theory course.

7.15 Audit Course

A candidate may be permitted to register for specific course not listed in his/her programme curriculum and without undergoing the rigors of getting a 'good' grade, as an Audit course, subject to the following conditions.

The candidate can register only one Audit course in a semester starting from second semester subject to a maximum of two courses during the entire programme of study. Such courses shall be indicated as 'Audit' during the time of registration itself. Only courses currently offered for credit to the candidates of other branches can be audited.

A course appearing in the curriculum of a candidate cannot be considered as an audit course. However, if a candidate has already met the Professional Elective and Open Elective credit requirements as stipulated in the curriculum, then, a Professional Elective or an Open Elective course listed in the curriculum and not taken by the candidate for credit can be considered as an audit course.

Candidates registering for an audit course shall meet all the assessment and examination requirements applicable for a credit candidate of that course. Only if the candidate obtains a performance grade, the course will be listed in the semester Grade Sheet and in the Consolidated Grade Sheet along with the grade SF (Satisfactory). Performance grade will not be shown for the audit course.

Since an audit course has no grade points assigned, it will not be counted for the purpose of GPA and CGPA calculations.

7.16 Universal Human Values

The course imparting the human values shall be taught for all candidates who have joined in various branches of all BE/BTech programmes. This course shall carry a maximum of 100 marks and shall be evaluated through continuous assessment tests only vide clause 7.1. The candidate(s) can earn 2 credits by successfully completing this course. Two continuous assessment tests will be conducted and the average marks will be taken for the GPA and CGPA calculations.

8. REQUIREMENTS FOR COMPLETION OF A SEMESTER

8.1 A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester and permitted to appear for the examinations of that semester.

8.1.1 Ideally, every candidate is expected to attend all classes and secure 100 % attendance. However, a candidate shall secure not less than 80 % (after rounding off to the nearest integer) of the overall attendance taking into account the total number of working days in a semester.

8.1.2 A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to medical reasons (hospitalization / accident / specific illness) but has secured not less than 70 % in the current semester may be permitted to appear for the current semester examinations with the approval of the Principal on payment of a condonation fee as may be fixed by the authorities from time to time. The medical certificate needs to be submitted along with the leave application. A candidate can avail this provision only twice during the entire duration of the degree programme.

A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to his/her entrepreneurships/ start ups activities, but has secured not less than 60 % in the current semester can be permitted to appear for the current semester examinations with the recommendation of review committee and approval from the Principal.

8.1.3 In addition to clause 8.1.1 or 8.1.2, a candidate shall secure not less than 60 % attendance in each course.

8.1.4 A candidate shall be deemed to have completed the requirements of study of any semester only if he/she has satisfied the attendance requirements (vide clause 8.1.1 to 8.1.3) and has registered for examination by paying the prescribed fee.

8.1.5 Candidate's progress is satisfactory.

8.1.6 Candidate's conduct is satisfactory and he/she was not involved in any indisciplined activities in the current semester.

8.2. The candidates who do not complete the semester as per clauses from 8.1.1 to 8.1.6 except 8.1.3 shall not be permitted to appear for the examinations at the end of the semester and not be permitted to go to the next semester. They have to repeat the incomplete semester in next academic year.

8.3 The candidates who satisfy the clause 8.1.1 or 8.1.2 but do not complete the course as per clause 8.1.3 shall not be permitted to appear for the end semester examination of that course alone. They have to repeat the incomplete course in the subsequent semester and satisfy the attendance requirements.

9. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

9.1 A candidate shall normally be permitted to appear for end semester examination of the current semester if he/she has satisfied the semester completion requirements as per clause 8, and has registered for examination in all courses of that semester. Registration is mandatory for current semester examinations as well as for arrear examinations failing which the candidate shall not be permitted to move on to the higher semester.

9.2 When a candidate is deputed for a National / International Sports event during End Semester examination period, supplementary examination shall be conducted for such a candidate on return after participating in the event within a reasonable period of time. Such appearance shall be considered as first appearance.

9.3 A candidate 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 letter grades / marks.

10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

10.1 A candidate may, for valid reasons, be granted permission to withdraw from appearing for the examination in any regular course or all regular courses registered in a particular semester. Application for withdrawal is permitted only once during the entire duration of the degree programme.

10.2 The withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination (vide clause 9) and has applied to the Principal for permission prior to the last examination of that semester after duly recommended by the Head of the Department.

10.3 The withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class with Distinction/First Class.

10.4 If a candidate 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 examinations. A final semester candidate who has withdrawn shall be permitted to appear for supplementary examination to be conducted within reasonable time as per clause 14.

10.5 The final semester candidate who has withdrawn from appearing for project viva-voce for genuine reasons shall be permitted to appear for supplementary viva-voce examination within reasonable time with proper application to Controller of Examinations and on payment of prescribed fee.

11. PROVISION FOR BREAK OF STUDY

11.1 A candidate is normally permitted to avail the authorised break of study under valid reasons (such as accident or hospitalization due to prolonged ill health or any other valid reasons) and to rejoin the programme in a later semester. He/She shall apply in advance to the Principal, through the Head of the Department, stating the reasons therefore, in any case, not later than the last date for registering for that semester examination.

A candidate is permitted to avail the authorised break of study only once during the entire period of study for a maximum period of one year. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for the break of study.

11.2 The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance shall be governed by the rules and regulations in force at the time of rejoining.

11.3 The candidates rejoining in new Regulations shall apply to the Principal in the prescribed format through 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.

11.4 The total period of completion of the programme reckoned from the commencement of the semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5 irrespective of the period of break of study in order to qualify for the award of the degree.

11.5 If any candidate is prevented for want of required attendance, the period of prevention shall not be considered as authorized break of study.

11.6 If a candidate has not reported to the college for a period of two consecutive semesters without any intimation, the name of the candidate shall be deleted permanently from the college enrollment. Such candidates are not entitled to seek readmission under any circumstances.

12. PASSING REQUIREMENTS

12.1 A candidate who secures not less than 50 % of total marks (continuous assessment and end semester examination put together) prescribed for the course with a minimum of 45 % of the marks prescribed for the end semester examination in all category of courses vide clause 7.1 except for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course in the examination.

12.2 A candidate who secures not less than 50 % in continuous assessment marks prescribed for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course. If a candidate secures less than 50% in the continuous assessment marks, he / she shall have to re-enroll for the same in the subsequent semester and satisfy the attendance requirements.

12.3 For a candidate who does not satisfy the clause 12.1, the continuous assessment marks secured by the candidate in the first attempt shall be retained and considered valid for subsequent attempts. However, from the fourth attempt onwards the marks scored in the end semester examinations alone shall be considered, in which case the candidate shall secure minimum 50 % marks in the end semester examinations to satisfy the passing requirements.

13. REVALUATION OF ANSWER SCRIPTS

A candidate shall apply for a photocopy of his / her semester examination answer script within a reasonable time from the declaration of results, on payment of a prescribed fee by submitting the proper application to the Controller of Examinations. The answer script shall be pursued and justified jointly by a faculty member who has handled the course and the course coordinator and recommended for revaluation. Based on the recommendation, the candidate can register for revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for revaluation and the results will be intimated to the candidate concerned. Revaluation is permitted only for Theory courses and Theory cum Practical courses where end semester examination is involved.

14. SUPPLEMENTARY EXAMINATION

If a candidate fails to clear all courses in the final semester after the announcement of final end semester examination results, he/she shall be allowed to take up supplementary examinations to be conducted within a reasonable time for the courses of final semester alone, so that he/she gets a chance to complete the programme.

15. AWARD OF LETTER GRADES

Range of % of Total Marks	Letter Grade	Grade Point
91 to 100	O (Outstanding)	10
81 to 90	A+ (Excellent)	9
71 to 80	A (Very Good)	8
61 to 70	B+ (Good)	7
50 to 60	B (Average)	6
Less than 50	RA (Reappear)	0
Satisfactory	SF	0
Withdrawal	W	-
Absent	AB	-
Shortage of Attendance in a course	SA	-

The Grade Point Average (GPA) is calculated using the formula:

$$\text{GPA} = \frac{\sum[(\text{course credits})\times(\text{grade points})] \text{ for all courses in the specific semester}}{\sum(\text{course credits}) \text{ for all courses in the specific semester}}$$

The Cumulative Grade Point Average (CGPA) is calculated from first semester (third semester for lateral entry candidates) to final semester using the formula

$$\text{CGPA} = \frac{\sum[(\text{course credits})\times(\text{grade points})] \text{ for all courses in all the semesters so far}}{\sum(\text{course credits}) \text{ for all courses in all the semesters so far}}$$

The GPA and CGPA are computed only for the candidates with a pass in all the courses.

The GPA and CGPA indicate the academic performance of a candidate at the end of a semester and at the end of successive semesters respectively.

A grade sheet for each semester shall be issued containing Grade obtained in each course, GPA and CGPA.

A duplicate copy, if required can be obtained on payment of a prescribed fee and satisfying other procedure requirements.

Withholding of Grades: The grades of a candidate may be withheld if he/she has not cleared his/her dues or if there is a disciplinary case pending against him/her or for any other reason.

16. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the BE / BTech Degree provided the candidate has

i. Successfully completed all the courses under the different categories, as specified in the regulations.
ii. Successfully gained the required number of total credits as specified in the curriculum corresponding to the candidate's programme within the stipulated time (vide clause 5).
iii. Successfully passed any additional courses prescribed by the respective Board of Studies whenever readmitted under regulations other than R-2018 (vide clause 11.3)
iv. No disciplinary action pending against him / her.

17. CLASSIFICATION OF THE DEGREE AWARDED

17.1 First Class with Distinction:

17.1.1 A candidate who qualifies for the award of the degree (vide clause 16) and 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 candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50

(OR)

17.1.2 A candidate who joins from other institutions on transfer or a candidate who gets readmitted and has to move from one regulations to another regulations and who qualifies for the award of the degree (vide clause 16) and 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 candidates) in the First Appearance within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.

- Submission of equivalent course list approved by the respective Board of studies.

- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.

- Should have secured a CGPA of not less than 9.00

17.2 First Class:

A candidate who qualifies for the award of the degree (vide clause 16) and 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 candidates) within ten consecutive semesters (eight consecutive semesters for lateral entry candidates) excluding authorized break of study (vide clause 11) after the commencement of his / her study.

- Withdrawal from the examination (vide clause 10) shall not be considered as an appearance.

17.3 Second Class:

All other candidates (not covered in clauses 17.1 and 17.2) who qualify for the award of the degree (vide clause 16) shall be declared to have passed the examination in Second Class.

17.4 A candidate who is absent for end semester examination in a course / project work after having registered for the same shall be considered to have appeared for that examination for the purpose of classification.

18. MALPRACTICES IN TESTS AND EXAMINATIONS

If a candidate indulges in malpractice in any of the tests or end semester examinations, he/she shall be liable for punitive action as per the examination rules prescribed by the college from time to time.

19. AMENDMENTS

Notwithstanding anything contained in this manual, the Kongu Engineering College through the Academic council of the Kongu Engineering College, reserves the right to modify/amend without notice, the Regulations, Curricula, Syllabi, Scheme of Examinations, procedures, requirements, and rules pertaining to its BE / BTech programme.

All amendments until the 16th Academic council meeting have been incorporated.

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CURRICULUM BREAKDOWN STRUCTURE										
Summary of Credit Distribution										
Category	**Semester**								**Total number of credits**	**Curriculum Content (% of total number of credits of the program)**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
HS	**3**	**4**		**1**	**2**		**3**		**13**	**7.6%**
BS	**11**	**11**	**4**	**4**					**30**	**17.3%**
ES	**7**	**3**	**4**						**14**	**8%**
PC		**3**	**16**	**19**	**17**	**14**			**69**	**40%**
PE						**3**	**9**	**3**	**15**	**8.6%**
OE					**4**	**4**	**3**	**3**	**14**	**8%**
EC					**2**	**4**	**6**	**6**	**18**	**10.5%**
Semesterwise Total	**21**	**21**	**24**	**24**	**25**	**25**	**21**	**12**	**173**	**100.00**

Category	**Abbreviation**
Lecture hours per week	**L**
Tutorial hours per week	**T**
Practical, Project work, Internship, Professional Skill Training, Industrial Training hours per week	**P**
Credits	**C**

CATEGORISATION OF COURSES							
HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18EGT11	English for Communication I	3	0	0	3	I
2.	18VEC11	Value Education	2	0	1	1	II
3.	18EGT21	English for Communication II	3	0	0	3	II
4.	18EGL31	English for Workplace Communication	0	0	2	1	IV
5.	18GET51	Universal Human Values	2	0	0	2	V
6.	18MBT71	Engineering Economics and Management	3	0	0	3	VII
Total Credits to be earned						**13**	

BASIC SCIENCE (BS)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18MAC11	Mathematics I	3	1*	2*	4	I
2.	18PHC11	Applied Physics	3	0	2*	3.5	I
3.	18CYC11	Applied Chemistry	3	0	2*	3.5	I
4.	18MAC21	Mathematics II	3	1*	2*	4	II
5.	18PHC23	Materials Science and Metallurgy	3	0	2*	3.5	II
6.	18CYC32	Environmental Chemistry in Automobile	3	0	2*	3.5	II
7.	18MAC31	Mathematics III	3	1*	2*	4	III
8.	18MAC41	Statistics and Numerical Methods	3	1*	2*	4	IV
Total Credits to be earned						**30**	

ENGINEERING SCIENCE (ES)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18GET11	Introduction to Engineering	3	0	0	3	I
2.	18MEC11	Engineering Drawing	2	0	2	3	I
3.	18MEL11	Engineering Practices Laboratory	0	0	2	1	I
4.	18CSC11	Problem Solving and Programming	2	0	2	3	II
5.	18AUT31	Statics and Dynamics	3	1	0	4	III
Total Credits to be earned						**14**	

EMPLOYABILITY ENHANCEMENT COURSES (EC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18GEL51/ 18GEI51	Professional Skills Training I / Industrial Training I	0	0	0	2	V
2.	18GEL61/ 18GEI61	Professional Skills Training II / Industrial Training II	0	0	0	2	VI
3.	18GEP71	Comprehensive Test and Viva	0	0	0	2	VII
4.	18MEP61	Project Work I Phase I	0	0	4	2	VI
5.	18MEP71	Project Work I Phase II	0	0	8	4	VII
6.	18MEP81	Project Work II	0	0	12	6	VIII
Total Credits to be earned						**18**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	18AUC21	Basics of Automobile Engineering	2	0	2	3	II	AUTO
2.	18MTT32	Manufacturing Processes	3	0	0	3	III	MFG
3.	18AUT32	Mechanics of Fluids and Hydraulic Machines	3	0	0	3	III	TF
4.	18AUT33	Thermodynamics	3	1	0	4	III	TF
5.	18AUT34	Automotive Powertrain	3	0	0	3	III	AUTO
6.	18MTL32	Manufacturing Processes Laboratory	0	0	2	1	III	MFG
7.	18AUL31	Automotive Power Train Laboratory	0	0	2	1	III	AUTO
8.	18AUL32	Computer Aided Machine Drawing Laboratory	0	0	2	1	III	DSN
9.	18AUT41	Mechanics of Deformable Bodies	3	0	0	3	IV	DSN
10.	18AUT42	Thermal Science	3	1	0	4	IV	TF
11.	18AUT43	Automotive Chassis	3	0	0	3	IV	AUTO
12.	18AUT44	Basics of Automotive Electrical and Electronics	3	0	0	3	IV	EE
13.	18AUT45	Hydraulics and Pneumatics	3	0	0	3	IV	TF
14.	18AUL41	Mechanics of Deformable Bodies Laboratory	0	0	2	1	IV	DSN
15.	18AUL42	Automotive Chassis Components Laboratory	0	0	2	1	IV	AUTO
16.	18AUL43	Basics of Automotive Electrical and Electronics Laboratory	0	0	2	1	IV	EE
19.	18AUT51	Automotive Electrical Systems	3	0	0	3	V	EE
20.	18AUT52	Automotive Sensors and Controllers	3	0	0	3	V	EE
17.	18AUT53	Vehicle Dynamics	3	1	0	4	V	AUTO
18.	18AUT54	Mechanics of Machinery	3	1	0	4	V	DSN
21.	18AUL51	Automotive Electrical Systems Laboratory	0	0	2	1	V	EE
22.	18AUL52	Automotive Sensors and Controllers Laboratory	0	0	2	1	V	EE
23.	18AUL53	Fuels and Lubricants Laboratory	0	0	2	1	V	TF
24.	18AUT61	Automotive Embedded Systems	3	0	0	3	VI	EE
25.	18AUT62	Design of Automotive Chassis Components	3	1	0	4	VI	DSN
26.	18AUT63	Finite Element Method	3	1	0	4	VI	DSN
27.	18AUL61	Automotive Embedded Systems Laboratory	0	0	2	1	VI	EE

28.	18AUL62	Computer Aided Analysis Laboratory	0	0	2	1	VI	DSN
29.	18AUL63	Vehicle Maintenance and Reconditioning Laboratory	0	0	2	1	VI	AUTO
Total Credits to be earned						**69**		

PROFESSIONAL ELECTIVE (PE)

S. No.	Course Code	Course Name	L	T	P	C	Sem	Domain/ Stream
		Elective – I						
1.	18AUE01	Advanced Theory of IC Engines	3	0	0	3	VI	TF
2.	18AUE02	Off Road Vehicles	3	0	0	3	VI	AUTO
3.	18AUE03	Design Of Automotive Engine Components	3	0	0	3	VI	DSN
4.	18AUE04	Diesel And Electric Locomotives	3	0	0	3	VI	AUTO
5.	18AUE05	Computer Integrated Manufacturing	3	0	0	3	VI	MFG
6.	18AUE06	Design for Manufacture and Assembly	3	0	0	3	VI	MFG
		Elective – II						
7.	18AUE07	Automotive Control System	3	0	0	3	VII	EE
8.	18AUE08	Principles of Farm Machineries	3	0	0	3	VII	DSN
9.	18AUE09	Alternate Fuels	3	0	0	3	VII	TF
10.	18AUE10	Operations Research	3	0	0	3	VII	MFG
11.	18AUE11	Computational Fluid Dynamics	3	0	0	3	VII	TF
12.	18AUE12	CNC and Metrology	3	0	0	3	VII	MFG
		Elective - III						
13.	18AUE13	Hybrid and Electric Vehicles	3	0	0	3	VII	EE
14.	18AUE14	Automotive Pollution Control	3	0	0	3	VII	AUTO
15.	18AUE15	Vehicle Aerodynamics	3	0	0	3	VII	AUTO
16.	18AUE16	Automotive HVAC	3	0	0	3	VII	TF
17.	18AUE17	Automotive Noise, Vibration and Harshness	3	0	0	3	VII	AUTO
18.	18AUE18	Micro Electro Mechanical Systems	3	0	0	3	VII	EE
		Elective – IV						
18.	18AUE19	Vehicle Maintenance And Servicing	3	0	0	3	VII	AUTO
19.	18AUE20	In-Vehicle Networking	3	0	0	3	VII	EE
20.	18AUE21	Mechanics Of Composite Materials	3	0	0	3	VII	DSN
21.	18AUE22	Vehicle Body Engineering	3	0	0	3	VII	AUTO
22.	18AUE23	Engine Testing And Post Processing	3	0	0	3	VII	AUTO

23.	18AUE24	Total Quality Management	3	0	0	3	VII	MFG
24.	18GEE01	Fundamentals of Research	3	0	0	3	VII	GE
		Elective - V						
25.	18MBE49	Entrepreneurship Development	3	0	0	3	VIII	GE
26.	18AUE25	Autonomous Vehicle Technology	3	0	0	3	VIII	EE
27.	18AUE26	Manufacturing of Automotive Components	3	0	0	3	VIII	MFG
28.	18AUE27	Automotive Safety and Control	3	0	0	3	VIII	AUTO
29.	18AUE28	Open Source Embedded Systems	3	0	0	3	VIII	EE
30.	18AUE29	Road Transport Management	3	0	0	3	VIII	AUTO
31.	18AUE30	Non Destructive Evaluation Techniques	3	0	0	3	VIII	MFG
Total Credits to be earned						**15**		

***** Domain/Stream Abbreviations: AUTO - Automobile, DSN - Design, EE – Electrical and Electronics, TF – Thermal and Fluid, MFG- Manufacturing, GE – General Engineering

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18AUO01	Automotive Engineering	3	0	2	4	V
2.	18AUO02	Autonomous Vehicles	3	1	0	4	VI
3.	18AUO03	Alternate Fuels for Automobile	3	0	0	3	VII
4.	18AUO04	Automotive Electronics	3	0	0	3	VIII
5.	18AUO05	Vehicle Maintenance	3	0	0	3	VIII

OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**OFFERED BY**
		SEMESTER V					
6.	18MAO01	Mathematical Foundations of Machine Learning	3	1	0	4	MATHS
7.	18PHO01	Thin film Technology	3	1	0	4	PHYSICS
8.	18CYO01	Corrosion Science and Engineering	3	1	0	4	CHEMISTRY
9.	18CEO01	Remote Sensing and its Applications	3	0	2	4	CIVIL
10.	18MEO01	Renewable Energy Sources	3	0	2	4	MECH
11.	18MTO01	Design of Mechatronics Systems	3	1	0	4	MTS
12.	18ECO01	PCB Design and Fabrication	3	0	2	4	ECE
13.	18ECO02	Neural Networks and Fuzzy Logic for Engineering Applications	3	0	2	4	ECE

14.	18EEO01	Electrical Wiring and Lighting	3	1	0	4	EEE
15.	18EEO02	Solar and Wind Energy Systems	3	1	0	4	EEE
16.	18EIO01	Neural Networks and Deep Learning	3	1	0	4	EIE
17.	18CSO01	Data Structures and its Applications	3	0	2	4	CSE
18.	18CSO02	Formal Languages and Automata Theory	3	1	0	4	CSE
19.	18CSO03	Computational Science for Engineers	3	1	0	4	CSE
20.	18ITO01	Python Programming	3	0	2	4	IT
21.	18ITO02	Advanced Java Programming	3	0	2	4	IT
22.	18CHO01	Polymer Technology	3	1	0	4	CHEM
23.	18CHO02	Introduction to Drugs and Pharmaceuticals Technology	3	1	0	4	CHEM
24.	18FTO01	Food Processing Technology	3	1	0	4	FT
25.	18FTO02	Baking Technology	3	0	2	4	FT
		SEMESTER VI					
26.	18MAO02	Graph Theory and its Applications	3	1	0	4	MATHS
27.	18MAO03	Number Theory and Cryptography	3	1	0	4	MATHS
28.	18CYO02	Instrumental Methods of Analysis	3	1	0	4	CHEMISTRY
29.	18CEO02	Disaster Management	3	1	0	4	CIVIL
30.	18MEO02	Design of Experiments	3	0	2	4	MECH
31.	18MTO02	Factory Automation	3	0	2	4	MTS
32.	18MTO03	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS
33.	18ECO03	Principles of Quantum Computing	3	0	2	4	ECE
34.	18EEO03	Energy Conservation and Management	3	1	0	4	EEE
35.	18EIO02	Digital Image Processing and Its Applications	3	1	0	4	EIE
36.	18EIO03	Industrial Automation	3	1	0	4	EIE
37.	18CSO04	Web Engineering	3	0	2	4	CSE
38.	18CSO05	Foundations of Data Analytics	3	1	0	4	CSE
39.	18CSO06	Nature Inspired Optimization Techniques	3	1	0	4	CSE
40.	18CSO07	Introducing Data Science	3	1	0	4	CSE
41.	18ITO03	Java Programming	3	1	0	4	IT
42.	18ITO04	Next Generation Databases	3	1	0	4	IT
43.	18CHO03	Bio Energy Resources	3	1	0	4	CHEM

44.	18CHO04	Fundamentals of Nanoscience and Nanotechnology	3	1	0	4	CHEM
45.	18FTO03	Processing of Milk and Milk products	3	0	2	4	FT
46.	18FTO04	Processing of Fruits and Vegetables	3	0	2	4	FT
		SEMESTER VII					
47.	18MAO04	Advanced Linear Algebra	3	0	0	3	MATHS
48.	18MAO05	Optimization Techniques	3	0	0	3	MATHS
49.	18PHO02	Structural and Optical Characterization of Materials	3	0	0	3	PHYSICS
50.	18CYO03	Waste and Hazardous Waste Management	3	0	0	3	CHEMISTRY
51.	18CEO03	Introduction to Smart Cities	3	0	0	3	CIVIL
52.	18CEO04	Environmental Health and Safety	3	0	0	3	CIVIL
53.	18MEO03	Fundamentals of Ergonomics	3	0	0	3	MECH
54.	18MEO04	Principles of Management and Industrial Psychology	3	0	0	3	MECH
55.	18MTO04	3D Printing and Design	3	0	0	3	MTS
56.	18MTO05	Drone System Technology	3	0	0	3	MTS
57.	18ECO04	Electronic Hardware and Troubleshooting	2	0	2	3	ECE
58.	18ECO05	Principles of Communication Techniques	3	0	0	3	ECE
59.	18EEO04	Micro Grid and Smart Grid	3	0	0	3	EEE
60.	18EEO05	Electrical Safety	3	0	0	3	EEE
61.	18EIO04	Biomedical Instrumentation and Applications	3	0	0	3	EIE
62.	18EIO05	PLC Programming and its Applications	3	0	0	3	EIE
63.	18CSO08	Artificial Intelligence and its applications	3	0	0	3	CSE
64.	18ITO05	Business Continuity Planning	3	0	0	3	IT
65.	18ITO06	Mobile Application Development	3	0	0	3	IT
66.	18CHO05	Enzyme Engineering	3	0	0	3	CHEM
67.	18CHO06	Nuclear Engineering	3	0	0	3	CHEM
68.	18FTO05	Principles of Food safety	3	0	0	3	FT
69.	18FTO06	Food and Nutrition	3	0	0	3	FT
		SEMESTER VIII					
70.	18CEO05	Infrastructure Planning and Management	3	0	0	3	CIVIL
71.	18CEO06	Environmental Laws and Policy	3	0	0	3	CIVIL
72.	18MEO05	Safety Measures for Engineers	3	0	0	3	MECH

73.	18MEO06	Energy Conservation in Thermal Equipments	3	0	0	3	MECH
74.	18MTO06	Robotics	3	0	0	3	MTS
75.	18MTO07	Virtual and Augment Reality in Industry 4.0	3	0	0	3	MTS
76.	18ECO06	Bioinspired Computing Technologies	2	0	2	3	ECE
77.	18EEO06	Electric Vehicle	3	0	0	3	EEE
78.	18EIO06	Measurements and Instrumentation	3	0	0	3	EIE
79.	18EIO07	Graphical Programming using Virtual Instrumentation	3	0	0	3	EIE
80.	18CSO09	Applied Machine Learning	3	0	0	3	CSE
81.	18CSO10	Fundamentals of Blockchain	3	0	0	3	CSE
82.	18CSO11	Fundamentals of Internet of Things	3	0	0	3	CSE
83.	18ITO07	Essentials of Information Technology	3	0	0	3	IT
84.	18ITO08	Virtual and Augmented Reality Frameworks	3	0	0	3	IT
85.	18CHO07	Fertilizer Technology	3	0	0	3	CHEM
86.	18FTO07	Food Ingredients	3	0	0	3	FT
87.	18FTO08	Fundamentals of Food Packaging and Storage	3	0	0	3	FT
Total credits to be earned						**14**	

GENERAL OPEN ELECTIVE
(Common to All BE/BTech branches)

		GENERAL OPEN ELECTIVE	L	T	P	C	Offering Department	Semester
88.	18GEO01	German Language Level 1	4	0	0	4	ECE	V/ VI/ VII/ VIII
89.	18GEO02	Japanese Language Level 1	4	0	0	4	ECE	V/ VI/ VII/ VIII
90.	18GEO03	Design Thinking for Engineers	3	0	0	3	CSE	VI
91.	18GEO04	Innovation and Business Model Development	3	0	0	3	MTS	VIII
92.	18GEO05	German Language Level 2	4	0	0	4	ECE	V/ VI/ VII/ VIII
93.	18GEO06	German Language Level 3	3	0	0	3	ECE	V/ VI/ VII/ VIII
94.	18GEO07	German Language Level 4	3	0	0	3	ECE	V/ VI/ VII/ VIII
95.	18GEO08	Japanese Language Level 2	4	0	0	4	ECE	V/ VI/ VII / VIII
96.	18GEO09	Japanese Language Level 3	3	0	0	3	ECE	V/ VI/ VII / VIII
97.	18GEO10	Japanese Language Level 4	3	0	0	3	ECE	V/ VI/ VII / VIII
98.	18GEO11	NCC Studies (Army Wing) – I	3	0	2	4	EEE	V/ VI
99.	18GEO12	NCC Studies (Air Wing) – I	3	0	2	4	IT	V / VI

KEC R2018: SCHEDULING OF COURSES – BE (Automobile Engineering) Total Credits: 173

Sem.	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	18EGT11 English for Communi-cation I (3-0-0-3)	18MAC11 Mathematics I (3-1*-2*-4)	18PHC11 Applied Physics (3-0-2*-3.5)	18CYC11 Applied Chemistry (3-0-2*-3.5)	18GET11 Introduction to Engineering (3-0-0-3)	18MEC11 Engineering Drawing (2-0-2-3)	18MEL11 Engineering Practices Laboratory (0-0-2-1)				**21**
II	18EGT21 English for Communi-cation II (3-0-0-3)	18MAC21 Mathematics II (3-1*-2*-4)	18PHC23 Materials Science and Metallurgy (3-0-2*-3.5)	18CYC23 Environmental Chemistry in Automobile (3-0-2*-3.5)	18CSC11 Problem Solving and Programming (2-0-2-3)	18AUC21 Basics of Automobile Engineering (2-0-2-3)	18VEC11 Value Education (2-0-1-1)				**21**
III	18MAC31 Mathematics III (3-1*-2*-4)	18AUT31 Statics and Dynamics (3-1-0-4)	18MTT32 Manufacturing Processes (3-0-0-3)	18AUT32 Mechanics of Fluids and Hydraulic Machines (3-0-0-3)	18AUT33 Thermo dynamics (3-1-0-4)	18AUT34 Automotive Powertrain (3-0-0-3)	18MTL32 Manufacturing Processes Lab (0-0-2-1)	18AUL31 Automotive Powertrain Lab (0-0-2-1)	18AUL32 Computer Aided Machine Drawing Lab (0-0-2-1)		**24**
IV	18MAC41 Statistics and Numerical Methods (3-1*-2*-4)	18AUT41 Mechanics of Deformable Bodies (3-0-0-3)	18AUT42 Thermal Science (3-1-0-4)	18AUT43 Automotive Chassis (3-0-0-3)	18AUT44 Basics of Automotive Electrical and Electronics (3-0-0-3)	18AUT45 Hydraulics and Pneumatics (3-0-0-3)	18AUL41 Mechanics of Deformable Bodies Lab (0-0-2-1)	18AUL42 Automotive Chassis Components Lab (0-0-2-1)	18AUL43 Basics of Automotive Electrical and Electronics Lab (0-0-2-1)	18EGL31 English for Workplace Communica-tion (0-0-2-1)	**24**
V	18AUT51 Automotive Electrical Systems (3-0-0-3)	18AUT52 Automotive Sensors and Controllers (3-0-0-3)	18AUT53 Vehicle Dynamics (3-1-0-4)	18AUT54 Mechanics of Machinery (3-1-0-4)	Open Elective I (3-1/0-0/2-4)	18AUL51 Automotive Electrical Systems Lab (0-0-2-1)	18AUL52 Automotive Sensors and Controllers Lab (0-0-2-1)	18AUL53 Fuels and Lubricants Lab (0-0-2-1)	18GEL51/ 18GEI51 Professional Skills Training I / Industrial Training I (0-0-0-2)	18GET51 Universal Human Values (2-0-0-2)	**25**
VI	18AUT61 Automotive Embedded Systems (3-0-0-3)	18AUT62 Design of Automotive Chassis Components (3-1-0-4)	18AUT63 Finite Element Method (3-1-0-4)	Professional Elective I (3-0-0-3)	Open Elective II (3-1/0-0/2-4)	18AUL61 Automotive Embedded Systems Lab (0-0-2-1)	18AUL62 Computer Aided Analysis Lab (0-0-2-1)	18AUL63 Vehicle Maintenance and Reconditioning Lab (0-0-2-1)	18GEL61/ 18GEI61 Professional Skills Training II / Industrial Training II (0-0-0-2)	18AUP61 Project Work I Phase I (0-0-4-2)	**25**
VII	18MBT71 Engineering Economics and Management (3-0-0-3)	Professional Elective II (3-0-0-3)	Professional Elective III (3-0-0-3)	Professional Elective IV (3-0-0-3)	Open Elective III (3-0-0-3)	18GEP71 Comprehen-sive Test / Viva (0-0-0-2)	18AUP71 Project Work I Phase II (0-0-8-4)				**21**
VIII	Professional Elective V (3-0-0-3)	Open Elective IV (3-0-0-3)	18AUP81 Project Work II (0-0-12-6)								**12**

MAPPING OF COURSES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	18EGT11	English for Communication I						✓			✓	✓	✓	✓		
1	18MAC11	Mathematics I	✓	✓	✓	✓	✓								✓	✓
1	18PHC11	Applied Physics	✓	✓	✓	✓									✓	✓
1	18CYC11	Applied Chemistry	✓	✓	✓	✓									✓	✓
1	18GET11	Introduction to Engineering	✓	✓	✓	✓		✓	✓					✓	✓	✓
1	18MEC11	Engineering Drawing	✓	✓	✓	✓						✓	✓	✓	✓	
1	18MEL11	Engineering Practices Laboratory	✓	✓	✓	✓					✓	✓	✓	✓	✓	
2	18EGT21	English for Communication II						✓			✓	✓	✓	✓		
2	18MAC21	Mathematics II	✓	✓	✓		✓								✓	✓
2	18PHC23	Materials Science and Metallurgy	✓	✓	✓	✓									✓	
2	18CYC23	Environmental Chemistry in Automobile	✓	✓	✓	✓			✓						✓	✓
2	18CSC11	Problem Solving and Programming	✓	✓	✓	✓	✓					✓			✓	✓
2	18AUC21	Basics of Automobile Engineering	✓	✓	✓										✓	
2	18VEC11	Value Education						✓		✓				✓		
3	18MAC31	Mathematics III	✓	✓	✓	✓	✓								✓	✓
3	18AUT31	Statics and Dynamics	✓	✓	✓										✓	
3	18MTT32	Manufacturing Processes	✓	✓	✓	✓								✓	✓	
3	18AUT32	Mechanics of Fluids and Hydraulic Machines	✓	✓	✓	✓									✓	
3	18AUT33	Thermodynamics	✓	✓	✓	✓									✓	
3	18AUT34	Automotive Powertrain	✓	✓	✓	✓									✓	
3	18MTL32	Manufacturing Processes Laboratory	✓	✓	✓	✓					✓	✓		✓	✓	
3	18AUL31	Automotive Power Train Laboratory	✓	✓	✓		✓								✓	
3	18AUL32	Computer Aided Machine Drawing Laboratory	✓	✓	✓		✓								✓	
4	18MAC41	Statistics and Numerical Methods	✓	✓	✓	✓	✓								✓	✓
4	18AUT41	Mechanics of Deformable Bodies	✓	✓	✓										✓	
4	18AUT42	Thermal Science	✓	✓	✓										✓	

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
4	18AUT43	Automotive Chassis	✓	✓	✓										✓	
4	18AUT44	Basics of Automotive Electrical and Electronics	✓	✓	✓											✓
4	18AUT45	Hydraulics and Pneumatics	✓	✓	✓										✓	
4	18AUL41	Mechanics of Deformable Bodies Laboratory	✓	✓			✓								✓	
4	18AUL42	Automotive Chassis Components Laboratory	✓	✓			✓								✓	
4	18AUL43	Basics of Automotive Electrical and Electronics Laboratory	✓	✓			✓									✓
4	18EGL31	English for Workplace Communication									✓	✓		✓		
5	18AUT51	Automotive Electrical Systems	✓	✓	✓									✓		✓
5	18AUT52	Automotive Sensors and Controllers	✓	✓	✓									✓		✓
5	18AUT53	Vehicle Dynamics	✓	✓	✓	✓								✓	✓	
5	18AUT54	Mechanics of Machinery	✓	✓	✓	✓								✓	✓	
5	18AUL51	Automotive Electrical Systems Laboratory	✓	✓	✓	✓	✓				✓	✓		✓		✓
5	18AUL52	Automotive Sensors and Controllers Laboratory	✓	✓	✓		✓				✓	✓		✓		✓
5	18AUL53	Fuels and Lubricants Laboratory	✓	✓	✓		✓				✓	✓		✓	✓	
5	18GEL51/ 18GEI51	Professional Skills Training I / Industrial Training I	✓	✓				✓	✓		✓	✓	✓	✓		
5	18GET51	Universal Human Values: Understanding Harmony						✓		✓						
6	18AUT61	Automotive Embedded Systems	✓	✓	✓									✓		✓
6	18AUT62	Design of Automotive Chassis Components	✓	✓	✓	✓								✓	✓	
6	18AUT63	Finite Element Method	✓	✓	✓	✓								✓	✓	
6	18AUL61	Automotive Embedded Systems Laboratory	✓	✓	✓	✓	✓				✓	✓		✓		✓
6	18AUL62	Computer Aided Analysis Laboratory	✓	✓	✓	✓	✓				✓	✓		✓	✓	
6	18AUL63	Vehicle Maintenance and Reconditioning Lab	✓	✓	✓		✓	✓			✓	✓		✓	✓	
6	18GEL61/ 18GEI61	Professional Skills Training II / Industrial Training II	✓	✓				✓	✓		✓	✓	✓	✓		
6	18AUP61	Project Work I Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	18MBT71	Engineering Economics and Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
7	18GEP71	Comprehensive Test and Viva	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
7	18AUP71	Project Work I Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	18AUP81	Project Work II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		Professional Elective Courses														
6	18AUE01	Advanced Theory of IC Engines	✓	✓	✓	✓									✓	
6	18AUE02	Off Road Vehicles	✓	✓	✓									✓	✓	
6	18AUE03	Design of Automotive Engine Components	✓	✓	✓	✓								✓	✓	
6	18AUE04	Diesel and Electric Locomotives	✓	✓	✓	✓								✓	✓	
6	18AUE05	Computer Integrated Manufacturing	✓	✓	✓	✓								✓	✓	
6	18AUE06	Design for Manufacture and Assembly	✓	✓	✓	✓	✓							✓	✓	
7	18AUE07	Automotive Control System	✓	✓	✓	✓								✓		✓
7	18AUE08	Principles of Farm Machineries	✓	✓	✓									✓	✓	
7	18AUE09	Alternate Fuels	✓	✓	✓	✓								✓	✓	
7	18AUE10	Operations Research	✓	✓	✓	✓	✓						✓	✓	✓	
7	18AUE11	Computational Fluid Dynamics	✓	✓	✓	✓	✓							✓	✓	
7	18AUE12	CNC and Metrology	✓	✓	✓	✓	✓							✓	✓	
7	18AUE13	Hybrid and Electric Vehicles	✓	✓	✓	✓								✓	✓	✓
7	18AUE14	Automotive Pollution Control	✓	✓	✓	✓								✓	✓	
7	18AUE15	Vehicle Aerodynamics	✓	✓	✓	✓								✓	✓	
7	18AUE16	Automotive HVAC	✓	✓	✓	✓								✓	✓	
7	18AUE17	Automotive Noise, Vibration and Harshness	✓	✓	✓	✓								✓	✓	
7	18AUE18	Micro Electro Mechanical Systems	✓	✓	✓	✓	✓							✓	✓	
7	18AUE19	Vehicle Maintenance and Servicing	✓	✓	✓	✓								✓	✓	✓
7	18AUE20	In-vehicle Networking	✓	✓	✓	✓								✓		✓
7	18AUE21	Mechanics of Composite Materials	✓	✓	✓	✓								✓	✓	
7	18AUE22	Vehicle Body Engineering	✓	✓	✓	✓								✓	✓	
7	18AUE23	Engine Testing and Post Processing	✓	✓	✓	✓	✓								✓	✓
7	18AUE24	Total Quality Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
7	18GEE01	Fundamentals of Research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	18MBE49	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	18AUE25	Autonomous Vehicle Technology	✓	✓	✓	✓								✓		✓
8	18AUE26	Manufacturing of Automotive Components	✓	✓	✓	✓								✓	✓	
8	18AUE27	Automotive Safety and Control	✓	✓	✓	✓								✓	✓	✓
8	18AUE28	Open Source Embedded Systems	✓	✓	✓	✓								✓		✓
8	18AUE29	Road Transport Management	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	
8	18AUE30	Non Destructive Evaluation Techniques	✓	✓			✓					✓		✓	✓	
		Open Elective Courses														
5	18MAO01	Mathematical Foundations of Machine Learning	✓	✓	✓	✓	✓									
5	18PHO01	Thin film Technology	✓	✓	✓											
5	18CYO01	Corrosion Science and Engineering	✓	✓	✓	✓										
5	18CEO01	Remote Sensing and its Applications	✓	✓	✓	✓	✓									
5	18MEO01	Renewable Energy Sources	✓	✓	✓	✓			✓			✓		✓		
5	18MTO01	Design of Mechatronics Systems	✓	✓	✓	✓	✓							✓		
5	18ECO01	PCB Design and Fabrication	✓	✓	✓	✓	✓				✓					
5	18ECO02	Neural Networks and Fuzzy Logic for Engineering Applications	✓	✓	✓	✓	✓				✓					
5	18EEO01	Electrical Wiring and Lighting	✓	✓	✓	✓	✓	✓								
5	18EEO02	Solar and Wind Energy Systems	✓	✓	✓	✓										
5	18EIO01	Neural Networks and Deep Learning	✓	✓	✓	✓	✓									
5	18CSO01	Data Structures and its Applications	✓	✓	✓	✓	✓									
5	18CSO02	Formal Languages and Automata Theory	✓	✓	✓	✓										
5	18CSO03	Computational Science for Engineers	✓	✓	✓	✓	✓									
5	18ITO01	Python Programming			✓		✓									
5	18ITO02	Advanced Java Programming			✓		✓									
5	18CHO01	Polymer Technology	✓	✓												
5	18CHO02	Introduction to Drugs and Pharmaceuticals Technology	✓	✓	✓	✓	✓									
5	18FTO01	Food Processing Technology	✓	✓	✓	✓										
5	18FTO02	Baking Technology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	18MAO02	Graph Theory and its Applications	✓	✓	✓											
6	18MAO03	Number Theory and Cryptography	✓	✓	✓		✓									
6	18CYO02	Instrumental Methods of Analysis	✓	✓	✓	✓										
6	18CEO02	Disaster Management	✓	✓	✓			✓	✓					✓		
6	18MEO02	Design of Experiments	✓	✓	✓	✓	✓						✓	✓		
6	18MTO02	Factory Automation	✓	✓	✓	✓	✓	✓			✓	✓		✓		
6	18MTO03	Data Acquisition and Virtual Instrumentation	✓	✓	✓	✓	✓				✓	✓		✓		
6	18ECO03	Principles of Quantum Computing	✓	✓	✓	✓	✓									
6	18EEO03	Energy Conservation and Management	✓	✓	✓		✓									
6	18EIO02	Digital Image Processing and Its Applications	✓	✓	✓	✓	✓									
6	18EIO03	Industrial Automation	✓	✓	✓	✓	✓									
6	18CSO04	Web Engineering	✓	✓	✓	✓										
6	18CSO05	Foundations of Data Analytics	✓	✓	✓											
6	18CSO06	Nature Inspired Optimization Techniques	✓	✓	✓	✓										
6	18CSO07	Introducing Data Science	✓	✓	✓											
6	18ITO03	Java Programming	✓	✓	✓	✓	✓	✓						✓		
6	18ITO04	Next Generation Databases	✓	✓	✓	✓										
6	18CHO03	Bio Energy Resources	✓	✓	✓	✓	✓									
6	18CHO04	Fundamentals of Nanoscience and Nanotechnology	✓	✓	✓	✓	✓									
6	18FTO03	Processing of Milk and Milk products	✓	✓	✓		✓	✓		✓	✓	✓		✓		
6	18FTO04	Processing of Fruits and Vegetables	✓	✓	✓		✓	✓		✓	✓	✓		✓		
7	18MAO04	Advanced Linear Algebra	✓	✓	✓											
7	18MAO05	Optimization Techniques	✓	✓	✓											
7	18PHO02	Structural and Optical Characterization of Materials	✓	✓	✓											
7	18CYO03	Waste and Hazardous Waste Management	✓	✓	✓	✓			✓							
7	18CEO03	Introduction to Smart Cities	✓	✓	✓				✓							
7	18CEO04	Environmental Health and Safety	✓	✓	✓	✓										

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	18MEO03	Fundamentals of Ergonomics	✓	✓	✓	✓		✓	✓			✓		✓		
7	18MEO04	Principles of Management and Industrial Psychology			✓			✓	✓	✓	✓	✓				
7	18MTO04	3D Printing and Design	✓	✓	✓	✓	✓						✓	✓		
7	18MTO05	Drone System Technology	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		
7	18ECO04	Electronic Hardware and Troubleshooting	✓	✓	✓	✓	✓	✓								
7	18ECO05	Principles of Communication Techniques	✓	✓	✓	✓	✓									
7	18EEO04	Micro Grid and Smart Grid	✓	✓	✓	✓	✓									
7	18EEO05	Electrical Safety	✓	✓	✓											
7	18EIO04	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓									
7	18EIO05	PLC Programming and its Applications	✓	✓	✓	✓	✓									
7	18CSO08	Artificial Intelligence and its Applications	✓	✓	✓											
7	18ITO05	Business Continuity Planning	✓	✓	✓	✓										
7	18ITO06	Mobile Application Development	✓	✓	✓	✓										
7	18CHO05	Enzyme Engineering	✓	✓	✓	✓	✓									
7	18CHO06	Nuclear Engineering	✓	✓												
7	18FTO05	Principles of Food Safety	✓	✓	✓		✓	✓	✓	✓				✓		
7	18FTO06	Food and Nutrition	✓	✓	✓	✓								✓		
7	18CEO05	Infrastructure Planning and Management	✓	✓	✓											
8	18CEO06	Environmental Laws and Policy	✓	✓	✓	✓										
8	18MEO05	Safety Measures for Engineers		✓		✓	✓	✓	✓	✓	✓			✓		
8	18MEO06	Energy Conservation in Thermal Equipments	✓	✓	✓			✓	✓			✓	✓	✓		
8	18MTO06	Robotics	✓	✓	✓	✓	✓							✓		
8	18MTO07	Virtual and Augment Reality in Industry 4.0	✓	✓	✓	✓	✓	✓						✓		
8	18ECO06	Bioinspired Computing Technologies	✓	✓	✓	✓										
8	18EEO06	Electric Vehicle	✓	✓	✓	✓	✓									

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	18EIO06	Measurements and Instrumentation	✓	✓	✓	✓	✓									
8	18EIO07	Graphical Programming using Virtual Instrumentation	✓	✓	✓	✓	✓									
8	18CSO09	Applied Machine Learning	✓	✓	✓											
8	18CSO10	Fundamentals of Blockchain	✓	✓	✓	✓										
8	18CSO11	Fundamentals of Internet of Things	✓	✓	✓	✓	✓									
8	18ITO07	Essentials of Information Technology	✓	✓	✓	✓										
8	18ITO08	Virtual and Augmented Reality Frameworks	✓	✓	✓	✓										
8	18CHO07	Fertilizer Technology	✓	✓												
8	18FTO07	Food Ingredients	✓	✓	✓			✓						✓		
8	18FTO08	Fundamentals of Food Packaging and Storage	✓	✓	✓		✓	✓		✓				✓		
		General Open Elective														
5,6,7,8	18GEO01	German Language Level 1								✓	✓	✓		✓		
5,6,7,8	18GEO02	Japanese Language Level 1								✓	✓	✓		✓		
7	18GEO03	Design Thinking for Engineers	✓	✓	✓	✓										
8	18GEO04	Innovation and Business Model Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5,6,7,8	18GEO05	German Language Level 2								✓	✓	✓		✓		
5,6,7,8	18GEO06	German Language Level 3								✓	✓	✓		✓		
5,6,7,8	18GEO07	German Language Level 4								✓	✓	✓		✓		
5,6,7,8	18GEO08	Japanese Language Level 2								✓	✓	✓		✓		
5,6,7,8	18GEO09	Japanese Language Level 3								✓	✓	✓		✓		
5,6,7,8	18GEO10	Japanese Language Level 4								✓	✓	✓		✓		
5,6	18GEO11	NCC Studies (Army Wing) – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
5,6	18GEO12	NCC Studies (Air Wing) – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				

B.E. AUTOMOBILE ENGINEERING CURRICULUM – R2018

SEMESTER – I									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
18EGT11	English for Communication I	3	0	0	3	50	50	100	HS
18MAC11	Mathematics I	3	1*	2*	4	50	50	100	BS
18PHC11	Applied Physics	3	0	2*	3.5	50	50	100	BS
18CYC11	Applied Chemistry	3	0	2*	3.5	50	50	100	BS
18GET11	Introduction to Engineering	3	0	0	3	50	50	100	ES
18MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
Practical / Employability Enhancement									
18MEL11	Engineering Practices Laboratory	0	0	2	1	50	50	100	ES
Total Credits to be earned					**21**				

***Alternate Weeks**

SEMESTER – II									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
18EGT21	English for Communication II	3	0	0	3	50	50	100	HS
18MAC21	Mathematics II	3	1*	2*	4	50	50	100	BS
18PHC23	Materials Science and Metallurgy	3	0	2*	3.5	50	50	100	BS
18CYC23	Environmental Chemistry in Automobile	3	0	2*	3.5	50	50	100	BS
18CSC11	Problem Solving and Programming	2	0	2	3	50	50	100	ES
18AUC21	Basics of Automobile Engineering	2	0	2	3	50	50	100	PC
Practical / Employability Enhancement									
18VEC11	Value Education	2	0	1	1	100	0	100	HS
Total Credits to be earned					**21**				

***Alternate Weeks**

SEMESTER – III									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
18MAC31	Mathematics III	3	1*	2*	4	50	50	100	BS
18AUT31	Statics and Dynamics	3	1	0	4	50	50	100	ES
18MTT32	Manufacturing Processes	3	0	0	3	50	50	100	PC
18AUT32	Mechanics of Fluids and Hydraulic Machines	3	0	0	3	50	50	100	PC
18AUT33	Thermodynamics	3	1	0	4	50	50	100	PC
18AUT34	Automotive Powertrain	3	0	0	3	50	50	100	PC
Practical / Employability Enhancement									
18MTL32	Manufacturing Processes Laboratory	0	0	2	1	100	0	100	PC
18AUL31	Automotive Powertrain Laboratory	0	0	2	1	100	0	100	PC
18AUL32	Computer Aided Machine Drawing Laboratory	0	0	2	1	100	0	100	PC
Total Credits to be earned					**24**				

***Alternate Weeks**

SEMESTER – IV									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
18MAC41	Statistics and Numerical Methods	3	1*	2*	4	50	50	100	BS
18AUT41	Mechanics of Deformable Bodies	3	0	0	3	50	50	100	PC
18AUT42	Thermal Science	3	1	0	4	50	50	100	PC
18AUT43	Automotive Chassis	3	0	0	3	50	50	100	PC
18AUT44	Basics of Automotive Electrical and Electronics	3	0	0	3	50	50	100	PC
18AUT45	Hydraulics and Pneumatics	3	0	0	3	50	50	100	PC
Practical / Employability Enhancement									
18AUL41	Mechanics of Deformable Bodies Laboratory	0	0	2	1	100	0	100	PC
18AUL42	Automotive Chassis Components Laboratory	0	0	2	1	100	0	100	PC
18AUL43	Basics of Automotive Electrical and Electronics Laboratory	0	0	2	1	100	0	100	PC
18EGL31	English for Workplace Communication	0	0	2	1	100	0	100	HS
Total Credits to be earned					**24**				

***Alternate Weeks**

B.E. AUTOMOBILE ENGINEERING CURRICULUM – R2018

SEMESTER – V									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
18AUT51	Automotive Electrical Systems	3	0	0	3	50	50	100	PC
18AUT52	Automotive Sensors and Controllers	3	0	0	3	50	50	100	PC
18AUT53	Vehicle Dynamics	3	1	0	4	50	50	100	PC
18AUT54	Mechanics of Machinery	3	1	0	4	50	50	100	PC
	Open Elective I	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
18AUL51	Automotive Electrical Systems Laboratory	0	0	2	1	100	0	100	PC
18AUL52	Automotive Sensors and Controllers Laboratory	0	0	2	1	100	0	100	PC
18AUL53	Fuels and Lubricants Laboratory	0	0	2	1	100	0	100	PC
18GEL51/ 18GEI51	Professional Skills Training I / Industrial Training I*	--	--	--	2	100	0	100	EC
18GET51	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					**25**				

***80 hours of training**

SEMESTER – VI									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
18AUT61	Automotive Embedded Systems	3	0	0	3	50	50	100	PC
18AUT62	Design of Automotive Chassis Components	3	1	0	4	50	50	100	PC
18AUT63	Finite Element Method	3	1	0	4	50	50	100	PC
	Professional Elective I	3	0	0	3	50	50	100	PE
	Open Elective II	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
18AUL61	Automotive Embedded Systems Laboratory	0	0	2	1	100	0	100	PC
18AUL62	Computer Aided Analysis Laboratory	0	0	2	1	100	0	100	PC
18AUL63	Vehicle Maintenance and Reconditioning Laboratory	0	0	2	1	100	0	100	PC
18GEL61/ 18GEI61	Professional Skills Training II / Industrial Training II*	---	---	---	2	100	0	100	EC
18AUP61	Project Work I Phase I	0	0	4	2	100	0	100	EC
Total Credits to be earned					**25**				

***80 hours of training**

B.E. AUTOMOBILE ENGINEERING CURRICULUM – R2018

SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
18MBT71	Engineering Economics and Management	3	0	0	3	50	50	100	HS
	Professional Elective II	3	0	0	3	50	50	100	PE
	Professional Elective III	3	0	0	3	50	50	100	PE
	Professional Elective IV	3	0	0	3	50	50	100	PE
	Open Elective III	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
18GEP71	Comprehensive Test and Viva	---	---	---	2	100	0	100	EC
18AUP71	Project Work I Phase II	0	0	8	4	50	50	100	EC
Total Credits to be earned					**21**				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Professional Elective V	3	0	0	3	50	50	100	PE
	Open Elective IV	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
18AUP81	Project Work II	---	---	12	6	50	50	100	EC
Total Credits to be earned					**12**				

Total Credits : 173

LIST OF PROFESSIONAL ELECTIVE COURSES (PE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
		Elective – I					
1.	18AUE01	Advanced Theory of IC Engines	3	0	0	3	VI
2.	18AUE02	Off Road Vehicles	3	0	0	3	VI
3.	18AUE03	Design of Automotive Engine Components	3	0	0	3	VI
4.	18AUE04	Diesel and Electric Locomotives	3	0	0	3	VI
5.	18AUE05	Computer Integrated Manufacturing	3	0	0	3	VI
6.	18AUE06	Design for Manufacture and Assembly	3	0	0	3	VI
		Elective – II					
7.	18AUE07	Automotive Control System	3	0	0	3	VII
8.	18AUE08	Principles of Farm Machineries	3	0	0	3	VII
9.	18AUE09	Alternate Fuels	3	0	0	3	VII
10.	18AUE10	Operations Research	3	0	0	3	VII
11.	18AUE11	Computational Fluid Dynamics	3	0	0	3	VII
12.	18AUE12	CNC and Metrology	3	0	0	3	VII
		Elective - III					
13.	18AUE13	Hybrid and Electric Vehicles	3	0	0	3	VII
14.	18AUE14	Automotive Pollution Control	3	0	0	3	VII
15.	18AUE15	Vehicle Aerodynamics	3	0	0	3	VII
16.	18AUE16	Automotive HVAC	3	0	0	3	VII
17.	18AUE17	Automotive Noise, Vibration and Harshness	3	0	0	3	VII
18.	18AUE18	Micro Electro Mechanical Systems	3	0	0	3	VII
		Elective – IV					
18.	18AUE19	Vehicle Maintenance And Servicing	3	0	0	3	VII
19.	18AUE20	In-Vehicle Networking	3	0	0	3	VII
20.	18AUE21	Mechanics of Composite Materials	3	0	0	3	VII
21.	18AUE22	Vehicle Body Engineering	3	0	0	3	VII
22.	18AUE23	Engine Testing and Post Processing	3	0	0	3	VII
23.	18AUE24	Total Quality Management	3	0	0	3	VII
24.	18GEE01	Fundamentals of Research	3	0	0	3	VII

(Contd.)

		Elective - V					
25.	18MBE49	Entrepreneurship Development	3	0	0	3	VIII
26.	18AUE25	Autonomous Vehicle Technology	3	0	0	3	VIII
27.	18AUE26	Manufacturing of Automotive Components	3	0	0	3	VIII
28.	18AUE27	Automotive Safety and Control	3	0	0	3	VIII
29.	18AUE28	Open Source Embedded Systems	3	0	0	3	VIII
30.	18AUE29	Road Transport Management	3	0	0	3	VIII
31.	18AUE30	Non Destructive Evaluation Techniques	3	0	0	3	VIII

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	18AUO01	Automotive Engineering	3	0	2	4	V
2.	18AUO02	Autonomous Vehicles	3	1	0	4	VI
3.	18AUO03	Alternate Fuels for Automobile	3	0	0	3	VII
4.	18AUO04	Automotive Electronics	3	0	0	3	VIII
5.	18AUO05	Vehicle Maintenance	3	0	0	3	VIII

18EGT11 - ENGLISH FOR COMMUNICATION I

(Common to all Engineering and Technology Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	HS	3	0	0	3

Preamble	This course is designed to impart required levels of fluency in using the English Language at B1 level in the Common European Framework (CEFR).	
Unit - I	**Listening, Speaking, Reading and Writing. Activity Based Learning – Phase – I:**	**9**
Listening - People talking about their past experiences - listening to descriptions - Speaking - Exchanging personal information - Talking about cities and transportation - Reading - Life and achievements of a famous personality - Global transport systems - Writing - Childhood experiences - Process Description.		
Unit - II	**Listening, Speaking, Reading and Writing. Activity Based Learning – Phase – II:**	**9**
Listening - Information about hotels and accommodation - Recipes and food items - Speaking - Life style changes and making comparisons - Talking about food - Reading - Habit formation and changing habits - International cuisine - Writing - Personal email - emails about food and recipes.		
Unit - III	**Listening, Speaking, Reading and Writing. Activity Based Learning – Phase – III:**	**9**
Listening - Information about travel - descriptions / conversations about family life - Speaking - Vacations and Holidays - Requests, complaints and offering explanations - Reading - Tourist places and travel experiences - Group behaviour and politeness - Writing - Personal letter about travelling - Writing guidelines and checklists.		
Unit - IV	**Listening, Speaking, Reading and Writing. Activity Based Learning – Phase – IV:**	**9**
Listening - Descriptions about festivals - Presentations on technology - Speaking - About technology - festivals, special events and traditions - Reading - Sports, hobbies and past time - About different cultures - Writing - Product Description - Writing web content.		
Unit - V	**Listening, Speaking, Reading and Writing. Activity Based Learning – Phase – V:**	**9**
Listening - Talking about changes - Job preferences - Speaking - Comparing different periods or phases in life – changes that happen - skills and abilities, Personality Development - Employability Skills – Reading - Reading about life experiences - emotions and feelings – Job preferences – Jobs and Personality – Writing - Writing about one's past, present and future – Researching job options – choosing the right job.		

Total: 45

TEXT BOOK:

1. Jack C. Richards, "Interchange, Student's Book 2", 4th Edition, Cambridge University Press, New York, 2017.

REFERENCES:

1. Jack C. Richards & Theodore Rodgers, "Approaches and Methods in Language Teaching", 3rd Edition, Cambridge University Press, New York, 2014.
2. Penny Ur, "A Course in English Language Teaching", 2nd Edition, Cambridge University Press, New York, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	use language effectively and accurately acquiring vocabulary from real-life context	Applying (K3)
CO2	listen/view and comprehend different spoken discourses / excerpts in different accents	Applying (K3)
CO3	read different genres of texts adopting various reading strategies	Analyzing (K4)
CO4	write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide range of vocabulary, organizing their ideas logically on a topic	Creating (K6)
CO5	speak clearly, confidently, comprehensibly and communicate with others using appropriate communicative strategies	Creating (K6)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			2	3	2	2		
CO2									2	3		1		
CO3						1				3	1	1		
CO4										3		1		
CO5									2	3		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1		3	47	17		33	100
CAT2			37	23		40	100
CAT3		3	47	33		17	100
ESE		2	42	27		29	100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MAC11 - MATHEMATICS I

(Common to All Engineering and Technology Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	1*	2*	4

Preamble	To provide the skills to the students for solving different real time problems by applying matrices, multivariable functions and differential equations.	
Unit - I	**Matrices:**	**9**
Introduction to Matrices in Engineering – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley – Hamilton theorem (Statement and applications only) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation – Applications of Eigen values and Eigen vectors: Electric circuit – Mass string problems.		
Unit - II	**Multivariable Calculus:**	**9**
Functions of two variables – Partial derivatives – Total differential – Taylor's series for functions of two variables – Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method.		
Unit - III	**First Order Ordinary Differential Equations:**	**9**
Solutions of differential equations in variables separable form – Exact differential equations – Linear first order differential equations – Bernoulli's equation – Clairaut's equation.		
Unit - IV	**Ordinary Differential Equations of Higher Order:**	**9**
Linear differential equations of second and higher order with constant coefficients - Particular Integrals for the types: e^{ax} – cosax, sinax – x^n – e^{ax} x^n , e^{ax} sinbx and e^{ax} cosbx – x^n sinax and x^n cosax – Differential Equations with variable coefficients: Euler-Cauchy's equation – Legendre' s equation.		
Unit - V	**Applications of Ordinary Differential Equations:**	**9**
Method of variation of parameters – Simultaneous first order linear equations with constant coefficients – Applications of differential equations: Simple harmonic motion – Electric circuits (Differential equations and associated conditions need to be given).		

List of Exercises / Experiments:

1.	Introduction to MATLAB
2.	Matrix operations : Addition, Multiplication, Transpose and Inverse
3.	Computation of eigen values and eigen vectors
4.	Finding ordinary and partial derivatives
5.	Computing extremes of a single variable function
6.	Plotting and visualizing single variable functions
7.	Solving first and second order ordinary differential equations
8.	Solution of Simultaneous first order ODEs

***Alternate Weeks**

Lecture:45, Theory and Practical:15, Total:60

TEXT BOOK:

1. Grewal B. S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, New Delhi, 2011.

REFERENCES:

1. Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - I", 2nd Edition, Pearson India Education, New Delhi, 2018.
2. Won Y. Yang, Young K. Choi, Jaekwon Kim, Man Cheol Kim, Jin Kim H. and Taeho Im, "Engineering Mathematics with MATLAB", 1st Edition, CRC Press, London, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	solve engineering problems which needs matrix computations	Applying (K3)
CO2	compute extremal values which arise in function of several	Understanding (K2)
CO3	identify the appropriate method for solving first order ordinary differential equations	Applying (K3)
CO4	solve higher order linear differential equations with constant and variable coefficients	Applying (K3)
CO5	apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems	Applying (K3)
CO6	determine eigen values and eigen vectors of a given matrix using MATLAB	Applying (K3), Manipulation (S2)
CO7	compute maxima and minima of a single variable function, plot and visualize single variable function using MATLAB	Applying (K3), Manipulation (S2)
CO8	solve first and second order ordinary differential equations and simultaneous first order ordinary differential equations using MATLAB	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1										
CO2	3	2												
CO3	3	3	1	1										
CO4	3	3	1	1										
CO5	3	3	1											
CO6					3									
CO7					3									
CO8					3									
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	10	70				100
CAT2	20	10	70				100
CAT3	20	10	70				100
ESE	20	10	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18PHC11 - APPLIED PHYSICS

(Common to All Engineering and Technology Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	BS	3	0	2*	3.5

Preamble	This course aims to impart the essential concepts of properties of matter, acoustics, ultrasonics, quantum physics, laser and fibre optics, crystal structure and crystal defects. It also describes the physical phenomena related to the aforementioned concepts and their applications in engineering and provides motivation towards innovations.	
Unit - I	**Properties of Matter:**	**9**
Elasticity: Stress – Strain – Hooke's law – Stress-strain diagram – Poisson's ratio - Modulus of elasticity - Beams – Bending of beams – Expression for bending moment - Cantilever – Depression of the loaded end of a cantilever - Young's modulus by uniform and non-uniform bending methods - I-shaped girders. Viscosity: Viscous force – Viscosity – Co-efficient of viscosity – Importance of viscosity of liquids (qualitative).		
Unit - II	**Acoustics and Ultrasonics:**	**9**
Acoustics: Sound - Reverberation and reverberation time – Growth and decay of sound and Sabine's formula (qualitative) - Absorption coefficient - Factors affecting acoustics of buildings and their remedies. Ultrasonics: Properties of ultrasonic waves - Production of ultrasonic waves - Magnetostrictive generator - Piezoelectric generator - Applications of ultrasonic waves in non destructive testing.		
Unit - III	**Thermal and Quantum Physics:**	**9**
Thermal Physics: Modes of heat transfer - Thermal conductivity - Radial and cylindrical heat flow - Conduction through compound media (series and parallel). Quantum Physics: Matter waves - Schrodinger's time independent and time dependent wave equations – Physical significance of wave function - Particle in a one dimensional box.		
Unit - IV	**Laser, Fibre Optics and Applications:**	**9**
Laser and Applications: Spontaneous emission and stimulated emission - Population inversion - Pumping methods - Einstein's coefficients - Nd:YAG laser - Holography. Fiber Optics and Applications: Principle of propagation of light through optical fibers - Numerical aperture and acceptance angle - Classification of optical fibers based on refractive index, modes and materials - Fiber optical communication links (block diagram).		
Unit - V	**Crystal Physics:**	**9**
Crystal systems - Bravais lattice - Lattice planes - Miller indices - Interplanar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures - Crystal imperfections: line and surface imperfections.		

List of Exercises / Experiments:

1.	Determination of the Young's modulus of the material of a given beam using uniform bending method.
2.	Determination of the viscosity of a given liquid using Poiseuilles' method.
3.	Determination of the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using ultrasonic interferometer.
4.	Determination of the wavelength and the angle of divergence of a semiconductor laser.
5.	Determination of the acceptance angle and the numerical aperture of a given optical fiber.

***Alternate Weeks**

Lecture:45, Practical:15, Total:60

TEXT BOOK:

1. Tamilarasan K. and Prabu K., "Engineering Physics - I", 3rd Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2014.

REFERENCES:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai and Sons, New Delhi, 2009.
2. Mehta and Neeraj, "Applied Physics for Engineers", 1st Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 2011.
3. Tamilarasan K. and Prabu K., "Physics Laboratory Manual", 3rd Edition, SCM Publishers, Erode, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	make use of the concepts of elasticity and bending moment of a beam to a simple structure under simple loading to compute the Young\'s modulus of a material, and to explain the concepts of viscosity of liquids.	Applying (K3)
CO2	apply the concepts of growth and decay of sound energy in a hall to recognize the requirements of acoustically good buildings, and to describe the production of ultrasonic waves and non-destructive testing using ultrasonic waves.	Applying (K3)
CO3	use the concepts of heat flow to explain heat conduction through materials, and to describe the behavior of electrons in a metal by means of quantum physics.	Applying (K3)
CO4	apply the concepts of laser to explain the working and the applications of laser in engineering and technology, and to apply the principle of propagation of light through optical fiber to compute acceptance angle and numerical aperture to comprehend the fiber optic communication link.	Applying (K3)
CO5	explain seven crystal systems, atomic packing factor of the select crystal systems and the types of crystal defects.	Understanding (K2)
CO6	determine the Young\'s modulus of a material using the concepts of elasticity and bending moment of a beam, and to determine the viscosity of a liquid using the concepts of viscosity.	Applying (K3), Precision (S3)
CO7	compute the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using the concepts of propagation of sound through a medium.	Applying (K3), Precision (S3)
CO8	determine the wavelength and the angle of divergence of a semiconductor laser beam using the concepts of propagation of light through a medium, and to compute the acceptance angle and the numerical aperture of an optical fiber using the concept of total internal reflection.	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2												
CO6				3										
CO7				3										
CO8				3										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	45	35				100
CAT3	20	50	30				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18CYC11 - APPLIED CHEMISTRY
(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	BS	3	0	2*	3.5

Preamble	Applied Chemistry course imparts the basic principles and concepts of chemistry in the field of Engineering and Technology. It also imparts knowledge on Water Technology, Electrochemistry, Corrosion and its control, Fuels & Combustion and Polymers.	
Unit - I	**Water Technology:**	**9**
Introduction - Sources of water - Impurities in water - Types of water – Water Quality Standards - Hardness of water - Expression of hardness - Units of hardness - Estimation of hardness of water by EDTA method - Determination of alkalinity - Disadvantages of using hard water - Boiler troubles - Scale and sludge - Softening of water - External treatment method - Demineralization process - Internal treatment process - Carbonate and Calgon conditioning - Desalination by reverse osmosis method.		
Unit - II	**Electrochemistry:**	**9**
Introduction - Cells - Representation of a galvanic cell - Reversible and irreversible cells - Electrode potential - Nernst equation - Reference electrode - Standard hydrogen electrode - Glass electrode - Electrochemical series and its applications - Conductometric titrations - Mixture of weak and strong acid vs strong base.		
Unit - III	**Corrosion and its Control:**	**9**
Introduction - Chemical corrosion - Electrochemical corrosion - Galvanic corrosion - Concentration cell corrosion - Galvanic series - Factors influencing rate of corrosion - Corrosion control methods - Sacrificial anodic method - Protective coatings - Pretreatment of metal surface - Metallic coating - Electroplating - Nonmetallic coating - Phosphate coating - Organic coating - Paints - Constituents and their functions - Special paints - water repellant and luminescent paints.		
Unit - IV	**Fuels and Combustion:**	**9**
Introduction - Classification of fuels - Requirements of a good fuel - Combustion - Principle of combustion - Calorific value - Gross and net calorific values - Explosive range - Spontaneous ignition temperature - Calorific intensity - Solid fuels - Coal and its varieties - Proximate analysis - Significance - Metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel - Refining of petroleum - Manufacture of synthetic petrol - Hydrogenation of coal - Bergius method - Knocking - Octane number - Cetane number - Gaseous fuel - LPG.		
Unit - V	**Polymers:**	**9**
Introduction - Classification of polymers - Functionality - Polymerization - Plastics - Types - Thermo and thermosetting plastics - Individual polymers - Polypropylene, PVC, PET and epoxy resin - Preparation, properties and uses - Compounding of plastics - Fabrication of plastics - Compression, injection, extrusion and blow moulding methods - Foamed plastics.		

List of Exercises / Experiments:

1.	Estimation of total, temporary and permanent hardness of water by EDTA method.
2.	Estimation of Ca2+ and Mg2+ hardness separately by EDTA method.
3.	Estimation of alkalinity of the given water sample.
4.	Conductometric titration - Mixture of acids.
5.	Estimation of hydrochloric acid using pH meter.

***Alternate Weeks**

Lecture:45, Practical:15, Total:60

TEXT BOOK:

1. Palanisamy P.N., Manikandan P., Geetha A. & Manjula Rani K., "Applied Chemistry", 5th Edition, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2018.

REFERENCES:

1. Jain & Jain, "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2016.
2. Sharma B.K., "Industrial Chemistry", Krishna Prakasan Media Pvt. Ltd, Meerut, 2014.
3. Palanisamy P.N., Manikandan P., Geetha A & Manjula Rani K., "Chemistry Laboratory Manual", Rajaganapathy Publishers, Erode, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the suitable water softening methods to avoid boiler troubles	Applying (K3)
CO2	apply the principle of electrochemistry to construct cells and measure the electrode potential	Applying (K3)
CO3	adopt the suitable corrosion control methods for the given practical problems	Applying (K3)
CO4	illustrate the quality of fuels from its characteristics	Understanding (K2)
CO5	explain the types of polymers, plastics and fabrication methods	Understanding (K2)
CO6	estimate the amount of hardness for the given water sample by EDTA method	Applying (K3), Precision (S3)
CO7	estimate the amount of alkalinity for the given water sample	Applying (K3), Precision (S3)
CO8	demonstrate the conductivity meter and pH meter to estimate the amount of the given solution	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2												
CO5	3	2												
CO6	3	2	1	3										
CO7	3	2	1	3										
CO8	3	2	1	3										
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GET11 - INTRODUCTION TO ENGINEERING

(Common to All Engineering and Technology Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	ES	3	0	0	3

Preamble	The objective of this course is to realize the importance of engineering, measurements and the fundamental concepts of common engineering disciplines like Civil, Mechanical, Electrical and Electronics Engineering.	
Unit - I	**Engineering and Measurements**	**9**
Engineering and Measurements: Engineering - Engineer and Engineering Graduate - Graduate attributes - Role of engineer - Professional bodies and their role. Physical Quantities - Dimensions - SI Units, Symbols and Conversions - Mechanical Measuring Instruments - Electrical Measuring Instruments - Accuracy and Precision - Data Acquisition System.		
Unit - II	**Mechanical Engineering**	**9**
Mechanical Engineering: IC Engines - Power Plants - Boilers and Furnaces - Pumps - Refrigeration and Air Conditioner - CAD/CAM - Additive Manufacturing. Hybrid Electric Vehicles, Industry 4.0.		
Unit - III	**Civil Engineering**	**9**
Civil Engineering: Selection of the site for Building - Building approval process - Contract and tenders - Building Materials - Components of Building - Sequence of works for building construction - Prefabricated Structures - Water Management - Rainwater harvesting - Infrastructure - Bridges, Dams and Roads.		
Unit - IV	**Electrical Engineering**	**9**
Electrical Engineering: Terminologies - Current, voltage, potential difference, power, energy - Supply: DC, AC - single phase and three phase - Energy conversion - Utility structure - Single line diagram of power system - Apparatus - Tariff - House wiring. Alternator - Induction motor - Solar and wind energy.		
Unit - V	**Electronics Engineering**	**9**
Electronics Engineering: Resistor, Inductor, capacitor - Diode - LEDs - Rectifier - Power Supply - Transistor - Transistor as an amplifier - MOSFET - Logic Gates - Microprocessor - Micro controller - Radio communication - Internet of Things.		

Total:45

TEXT BOOK:

1. Faculty of Mechanical Engineering, "Introduction to Engineering", McGraw Hill Education India Pvt. Ltd., Chennai.

REFERENCES:

1. Arvid R. Eide, Roland D. Jenison, Steven K. Mickelson and Larry L. Northup. , "Engineering Fundamentals and Problem Solving", 7th Edition, McGraw Hill Education, New York, 2018.
2. Navaneethakrishnan P., Selvakumar P., Rajeshkumar G. and Sangeetha R.K., "Basic Civil and Mechanical Engineering", McGraw Hill Education, New Delhi, 2016.
3. Senthilnathan N., Logeswaran T. and Suresh M., "Basic Electrical and Electronics Engineering", McGraw Hill, New Delhi, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	recognize the roles of engineer, measurement quantities and systems in Engineering	Understanding (K2)
CO2	infer the components and principles of mechanical engineering applications	Applying (K3)
CO3	summarize the process involved in building construction, infrastructure and water conservation	Applying (K3)
CO4	recognize the fundamental terms involved in electrical engineering	Understanding (K2)
CO5	explain the working of basic electronic components and its applications	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1										3		
CO2	3	2	1	1		2	1					3		
CO3	3	2	1	1		2	1					3		
CO4	2	1										3		
CO5	3	2	1	1								3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	50	50					100
CAT2	50	50					100
CAT3	50	50					100
ESE	50	50					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MEC11 - ENGINEERING DRAWING

(Common to all Engineering and Technology Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	1	ES	2	0	2	3

Preamble	The knowledge on engineering drawing is essential in proposing new product through drawings and interpreting data from existing drawings. This course aims to impart knowledge on orthographic, isometric projections, sectional views and development of surfaces by solving different application oriented problems.	
Unit - I	**General Principles of Orthographic Projection**	**9**
General Principles of Orthographic Projection: Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning - Projections of Points, Lines and Planes - General principles of orthographic projection - First angle projection - Layout of views - Projection of points located in all quadrant and straight lines located in the first quadrant - Determination of true lengths and true inclinations and location of traces - Projection of polygonal surface and circular lamina inclined to both reference planes.		
Unit - II	**Projections of Solid**	**9**
Projections of Solid: Projections of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.		
Unit - III	**Sectioning of Solids**	**9**
Sectioning of Solids: Sectioning of solids - prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other - Obtaining true shape of section.		
Unit - IV	**Development of Surfaces**	**9**
Development of Surfaces: Development of lateral surfaces of simple solids like prisms, pyramids, cylinders and cones – development of simple truncated solids involving prisms, pyramids, cylinders and cones.		
Unit - V	**Isometric Projection and Introduction to AutoCAD**	**9**
Isometric Projection and Introduction to AutoCAD: Principles of isometric projection - Isometric scale - Isometric projections of simple and truncated solids like prisms, pyramids, cylinders and cones - Conversion of isometric projection into orthographic projection - Introduction to AutoCAD.		

Total: 45

TEXT BOOK:

1. Venugopal K. and Prabhu Raja V. “Engineering Graphics”, 15th Edition, New Age International Pvt. Ltd., New Delhi, 2018.

REFERENCES:

1. Basant Agrawal, Agrawal C.M. “Engineering Drawing”, 2nd Edition, McGraw Hill Education, 2019.
2. Gopalakrishnana K.R. “Engineering Drawing”, Volume. I & II, Subhas Publications, Bengaluru, 2014.
3. Parthasarathy N.S., Vela Murali. “Engineering Drawing”, 1st Edition, Oxford University Press, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret international standards of drawings and sketch the projections of points, lines and planes.	Understanding(K2)
CO2	draw the projections of 3D primitive objects like prisms, pyramids, cylinders and cones.	Applying (K3)
CO3	construct the various sectional views of solids like prisms, pyramids, cylinders and cones.	Applying (K3)
CO4	develop the lateral surfaces of simple and truncated solids.	Applying (K3)
CO5	sketch the isometric projections of simple and truncated solids and convert isometric drawing in to orthographic projection.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1							1	3	2	2	2	3
CO2	3	2	1	1						3	2	3	2	3
CO3	3	2	1	1					1	3	2	3	2	3
CO4	3	2	1	1						3	2	3	2	3
CO5	3	2	1	1					1	3	2	3	2	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100

18MEL11 - ENGINEERING PRACTICES LABORATORY
(Common to all Engineering and Technology Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	I	ES	0	0	2	1
Preamble	This course is designed to provide a hands-on experience in the field of mechanical engineering and electrical engineering such as fitting, plumbing, wood working, sheet metal work, welding, safety aspects, assembly and testing of electrical and electronic circuits.						

List of Exercises / Experiments:

	PART A – MECHANICAL ENGINEERING
1.	To prepare square or rectangular shaped MS plates using power tools for cutting, polishing and shaping to the required dimensions.
2.	To carryout drilling, tapping and assembly on the given MS plates.
3.	To carryout thread forming on a GI/PVC pipes and prepare water leak proof water line from overhead tank.
4.	To prepare a wood or plywood box/tray/any innovative models using modern power tools like cutting machine, router, jigsaw, power screw driver etc.
5.	To prepare a leak proof sheet metal tray/box/funnel using modern power tools.
6.	Welding practice using welding simulator.
7.	Project: Preparing innovative articles using wood/sheet metal.
	PART B – ELECTRICAL AND ELECTRONICS ENGINEERING
8.	Safety Aspects of Electrical Engineering, Electrical Symbols, Components Identification, Fuse selection and installation, Circuit Breakers selection
9.	Wiring circuit for fluorescent lamp and stair case wiring
10.	Measurement of earth resistance
11.	Soldering of simple circuits and trouble shooting
12.	Implementation of half wave and full wave rectifier using diodes

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Engineering Practices Laboratory Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	plan the sequence of operations for effective completion of the planned models/innovative articles	Creating (K6), Precision (S3)
CO2	identify and use appropriate modern power tools and complete the exercises/models accurately	Applying (K3), Precision (S3)
CO3	select fuses and Circuit breakers	Understanding (K2), Manipulation (S2)
CO4	perform house wiring and realize the importance of earthing	Applying (K3), Manipulation (S2)
CO5	trouble shoot the electrical and electronic circuits	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3				3	3	2	3		
CO2	3	2	1	1					3	2	2	3		
CO3	2	1							3	2	2	3		
CO4	3	2	1	1					3	3	2	3		
CO5	3	2	1	1					3	2	2	3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18EGT21 - ENGLISH FOR COMMUNICATION II

(Common to All Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	2	HS	3	0	0	3

Preamble	This course is designed to impart required levels of fluency in using the English Language at B1 level in the CEFR.	
Unit - I	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VI:**	**9**
Listening – Job and career related descriptions and conversations – requests of different kinds and the responses – Speaking - Career choices and professional skills – making requests and responding to requests – Reading – Using texts about jobs and careers – about different societies and cultural differences – Writing – Resumes, CVs and job oriented advertisements – business and career related emails – Grammar & Vocabulary – Gerunds and elements of comparison – requests and indirect requests.		
Unit - II	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VII:**	**9**
Listening – Expository and narrative descriptions – information about different cultures, nations and societies - Speaking – Narrating and describing – talking about other countries and other cultures – Reading – Using texts about media and information technology – living abroad and experiencing different cultures – Writing – Blog writing – brochures and tourist pamphlets – Grammar & Vocabulary – The past tense forms - noun phrases and relative clauses.		
Unit - III	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VIII:**	**9**
Listening – Consumerism – product description – complaints and redressal – environmental issues – ecology – saving the planet – Speaking – Talking about problems, issues, complaints – solutions and redressal – talking about environmental issues – Reading – Using texts on segregating wastes – recycling and reusing – texts on environmental issues – Writing – Online reviews, articles and writing web content – Grammar & Vocabulary – Phrases and sentences used for describing problems – passives – prepositions and infinitives.		
Unit - IV	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – IX:**	**9**
Listening – Education, learning and the choice of courses – various services needed in daily life – self-improvement for success in life – Speaking - Discussions about educational and career oriented issues – talking about everyday services – giving advice and self improvement – Reading – Reading about learning strategies and learning styles – using texts about personality development – Writing – Writing about hobbies – pastime and individual skills – writing short articles on everyday life and personality development – Grammar & Vocabulary – Using of "would" and certain gerund forms – use of modals, verbs, gerunds, negative questions and infinitives.		
Unit - V	**Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – X:**	**9**
Listening – Historical narratives – biographies and learning about the future – important life events, milestones and happenings of the past – Speaking – Talking about the past, present and the future – talking about important events in life – Reading – Texts about new technologies and future science – using texts about social organization, culture and social practices – Writing – Biographical sketches – historical events – famous personalities, stages of life and getting along with people – Grammar & Vocabulary – Future tense forms – time clauses and certain "if clauses".		

Total:45

TEXT BOOK:

1. Jack C. Richards, "Interchange, Student's Book 3", 4th Edition, Cambridge University Press, New York, 2017.

REFERENCES:

1. Jane Willis, "A Framework for Task Based Learning", Longman, Harlow, 1996.
2. Rod Ellis, "Task Based Language Learning and Teaching", Oxford University Press, London, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	use functional grammar for improving communication skills	Applying (K3)
CO2	listen and comprehend different spoken excerpts critically and infer unspoken and implied meanings.	Applying (K3)
CO3	read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for method of presentation.	Analyzing (K4)
CO4	write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.	Creating (K6)
CO5	speak effectively, to express opinions clearly, initiate and sustain a discussion and also negotiate using appropriate communicative strategies.	Creating (K6)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						2			1	3	1	1		
CO2									2	3		1		
CO3						1				3	1	1		
CO4										3		2		
CO5									2	3		2		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	3	3	30	40		24	100
CAT2	3	3	33	43		18	100
CAT3	3	3	33	43		18	100
ESE	3	3	31	45		18	100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MAC21 - MATHEMATICS II

(Common to All Engineering and Technology Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	BS	3	1*	2*	4

Preamble	To impart the knowledge of evaluation of real and complex integrals, vector calculus and analytic functions to the students for solving the problems related to various engineering disciplines	
Unit - I	**Multiple Integrals:**	**9**
Double integration in cartesian coordinates – Change of order of integration – Application: Area between two curves – Triple integration in cartesian coordinates – Volume as triple integrals.		
Unit - II	**Vector Calculus:**	**9**
Directional derivative – Gradient of a scalar point function – Divergence of a vector point function – Curl of a vector – Solenoidal and Irrotational vectors – Green's and Gauss divergence theorems (without proof) – Verification of the above theorems and evaluation of integrals using them.		
Unit - III	**Beta and Gamma Functions:**	**9**
Definition of beta and gamma Functions – Properties – Relation between beta and gamma functions – Transformations of gamma function – Applications of beta and gamma functions: Evaluation of definite integrals in terms of beta and gamma functions.		
Unit - IV	**Analytic Functions:**	**9**
Functions of a complex variable – Analytic functions – Necessary and sufficient conditions (excluding proof) – Cauchy–Riemann equations (Statement only) – Properties of analytic function (Statement only) – Harmonic function – Construction of analytic function – Conformal mapping: w = z + a, az, 1/z – Bilinear transformation.		
Unit - V	**Complex Integration:**	**9**
Introduction – Cauchy's theorem (without proof) – Cauchy's integral formula – Singularities – Classification – Cauchy's residue theorem (without proof) – Applications: Evaluation of definite integrals involving sine and cosine functions over the circular contour.		

List of Exercises / Experiments :

1.	Evaluating indefinite and definite integrals
2.	Evaluating double and triple integrals
3.	Finding the area between two curves
4.	Computing gradient, divergence and curl
5.	Computation of beta and gamma functions
6.	Applying Milne-Thomson method for constructing analytic function
7.	Determination of Mobius transformation for the given set of points
8.	Finding poles and residues of an analytic function

***Alternate Weeks**

Lecture: 45, Tutorial and Practical:15, Total:60

TEXT BOOK:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, New Delhi, 2014.

REFERENCES:

1. Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - II", 2nd Edition, Pearson India Education, New Delhi, 2018.
2. Won Y. Yang, Young K. Choi, Jaekwon Kim, Man Cheol Kim, Jin Kim H. and Taeho Im, "Engineering Mathematics with MATLAB", 1st Edition, CRC Press, London, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	solve problems involving double and triple integrals	Understanding (K2)
CO2	apply the concept of vectors in engineering problems	Applying (K3)
CO3	use Beta and Gamma functions to improper evaluate integrals	Applying (K3)
CO4	identify, construct and apply analytic functions in electrostatics and fluid flow problems	Applying (K3)
CO5	evaluate complex integrals which is extensively applied in engineering	Applying (K3)
CO6	evaluate line, double and triple integrals and determine area between two curves using MATLAB	Applying (K3), Manipulation (S2)
CO7	compute gradient, curl and divergence of a vector function using MATLAB	Applying (K3), Manipulation (S2)
CO8	construct analytic function, find bilinear transformation and compute poles and residues using MATLAB	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2											
CO2	3	2												
CO3	3	2	1											
CO4	3	1												
CO5	3	2	2											
CO6					3									
CO7					2									
CO8					2									

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	10	70				100
CAT2	20	10	70				100
CAT3	20	10	70				100
ESE	20	10	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18PHC23 - MATERIALS SCIENCE AND METALLURGY
(Common to Mechatronics and Automobile Engineering branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	2	BS	3	0	2*	3.5

Preamble: This course aims to impart the knowledge on the physics of ferrous metals and alloys, metal processing, light weight materials, conductors, semiconductors, dielectrics and smart materials. It also describes the failures and testing of materials and the applications of aforementioned materials in mechatronics and automobile engineering and provides motivation towards innovations.

UNIT – I		**9**

Ferrous Metals and Alloys: Introduction – Iron ore – Pig iron – Cast iron – Effect of impurities on Cast Iron – Types of Cast iron: Grey cast iron – White cast iron – Chilled Cast iron – Mottled cast iron – Malleable cast iron – Ductile cast iron – Alloy cast iron – Wrought iron – Steel: Carbon Steel – Alloy Steels –Tool and Die Steel- Special Steels: High Speed Steel – Stainless Steel – Heat resisting steels – Shock resisting steels.

UNIT – II		**9**

Metal Processing: Heat Treatment: Annealing – Normalizing – Spheroidizing – Tempering – Austempering – Martempering – Hardening – Case hardening – Carburizing – Age hardening – Induction hardening – Flame hardening – Cyaniding – Nitriding – Carbonitriding – Quenching.

UNIT –III		**9**

Light Weight Materials: Introduction – Aluminum and Aluminum alloys: Duralumin, Magnalumin – Copper and Copper Alloys: Brass, Bronze – Magnesium and Magnesium alloys: Magnesium-Manganese, Magnesium-Aluminium – Polymers: Structure of polymers – Classification of polymers – properties and applications of polymers – Introduction to composites and its applications.

UNIT – IV		**9**

Conducting, Semiconducting, Dielectric and Smart Materials: Conductors – Classical free electron theory – Electrical and Thermal conductivities – Semiconductors – Types of Semiconductor – Intrinsic carrier concentration (qualitative) – Dielectrics and its applications – Metallic glasses – Preparation, properties and applications – Introduction to Shape Memory Alloys and Nanomaterials.

UNIT – V		**9**

Failures and Testing of Materials: Failures of materials: Mechanism of plastic deformation, dislocation, slip and twinning – Types of fracture: Ductile, Brittle – Creep- Fatigue. Testing of Mechanical and Physical Properties: Testing of materials under tension, compression and shear loads.

List of Experiments:

1. Determination of the Young's modulus of stainless steel using non-uniform bending method.
2. Determination of the thermal conductivity of a functional material using Lee's disc arrangement.
3. Determination of the thickness of a nano-crystalline thin film using Air-wedge arrangement.
4. Determination of the specific resistance of a metal using Carey Foster's bridge.
5. Determination of the rigidity modulus of a material using torsional pendulum.

***Alternate Weeks**

Lecture:45, Practical: 15, Total: 60

TEXT BOOK:

1. Balasubramaniam R., "Callister's Materials Science and Engineering", 2nd Edition, Wiley India Pvt. Ltd., 2014.

REFERENCES / MANUAL:

1. Askelend D., "Materials Science and Engineering", Brooks /Cole, 2010.
2. Raghavan V., "Physical Metallurgy: Principles and Practice", PHI Learning Pvt. Ltd., New Delhi, 2015.
3. Tamilarasan K. and Prabu K., "Physics Laboratory Manual", SCM Publishers, Erode, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	explain the composition, properties and applications of the select ferrous metals and their alloys (iron and steel)	Understanding (K2)
CO2:	apply the basic concepts of phase rule, cooling curve and binary phase diagram (Fe-C) to describe the select heat treatment processes of metals	Applying (K3)
CO3:	explain the composition, properties and applications of select light weight materials (non-ferrous metals and their alloys: copper – copper alloys, aluminum – aluminum alloys, magnesium – magnesium alloys), polymers and composites	Understanding (K2)
CO4:	apply the concepts of classical free electron theory to compute electrical and thermal conductivity of metals and to explain the select properties and applications of conductors, semiconductors, dielectrics and smart materials (metallic glasses, SMA and nanomaterials)	Applying (K3)
CO5:	make use of the concepts of extensive properties of matter to describe the failures of materials (mechanism of plastic deformation, dislocation, slip and twinning) and types of fracture (ductile, brittle, creep, fatigue), and testing of mechanical and physical properties (under tension, compression and shear loads)	Applying (K3)
CO6:	determine the Young's modulus of stainless steel using the concepts of elasticity and bending moment of a beam	Applying (K3), Precision (S3)
CO7:	determine the thermal conductivity of functional materials using the concept of heat flow through materials, and to determine the thickness of nano-crystalline thin films using the concept of interference of light	Applying (K3), Precision (S3)
CO8:	determine the specific resistance of metals using the concept of electrical conductivity, and to determine the rigidity modulus of materials using the concepts of elasticity	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	2	1											
CO3	3	2												
CO4	3	2	1											
CO5	3	2	1											
CO6				3										
CO7				3										
CO8				3										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	45	25				100
CAT2	30	50	20				100
CAT3	30	40	30				100
ESE	30	40	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18CYC23 - ENVIRONMENTAL CHEMISTRY IN AUTOMOBILE

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Chemistry	2	BS	3	0	2*	3.5

Preamble: Environmental Chemistry aims to realize the nature of environment, pollution analysis and assessment for automobile engineering students. It also aims to know about the applications of energy storing devices and polymeric materials in automobiles.

UNIT - I	9

Environmental Pollution and Analysis: Environmental pollution - pollutants - toxic effects of pollutants (fluoride, arsenic, chromium, cadmium and lead) - sources, effects and control methods of air pollution (with classification of air pollutants), water, soil and noise pollution - role of an individual in prevention of pollution - case studies.

UNIT - II	9

Environmental Impact Assessment and Auditing: Sustainability -three pillars of sustainability- factors affecting environmental sustainability-approaches for sustainable development - Introduction to EIA - objectives of EIA - steps in EIA - participants of EIA - general approach of environmental auditing - audit programmes in India - ISO 14001 certification - environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act.

UNIT - III	9

Cells and Batteries: Introduction - electrode potential, cells – components and representation - batteries - primary batteries**-** lechlanche cell - secondary batteries **-** construction and working of lead acid and nickel-cadmium batteries - reserve batteries - battery specifications for cars and automobiles - nano technology for energy sector.

UNIT - IV	9

Fuel Cells: Importance and classification of fuel cells - description, principle, components, applications and environmental aspects of fuel cells: alkaline fuel cells, phosphoric acid, molten carbonate and direct methanol fuel cells – hydrogen **-** advantages of using hydrogen as alternate fuel.

UNIT - V	9

Chemistry of Polymeric Materials: Introduction - effect of heat on polymers - mechanical properties of polymers – plastics - types and examples – unique properties - disadvantages of plastics over metals-uses of plastics - rubbers (elastomers) - vulcanization of rubber - synthetic rubbers - preparation, properties and uses of styrene rubber, nitrile rubber and neoprene - polymer blends and alloys - applications in automobile engineering.

List of Experiments:

1. Estimation of chloride ion in the given water sample using Argentometric method.
2. Estimation of chromium (Cr^{6+}) in wastewater sample.
3. Determination of dissolved oxygen in the given wastewater sample.
4. Estimation of copper in the given solution by Iodometric method.
5. Estimation of molecular weight of the polymer using viscometer.

***Alternate Weeks**

Lecture:45, Practical:15, Total : 60

TEXT BOOK:

1. Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K., Kowshalya V.N., “Environmental Science”, Pearson Education, New Delhi, Revised Edition 2019.

REFERENCES / MANUALS:

1. Jain and Jain, “Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing, 2016.
2. Charles H. Eccleston, “Environmental Impact Assessment: A Guide to Best Professional Practices”, CRC Press, 2017.
3. Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., “Chemistry Laboratory Manual”, Rajaganapathy Publishers, Erode, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	determine the importance of toxic pollutants on environment and its control methods	Applying (K3)
CO2:	make use of the knowledge of EIA, EA and environmental legislation laws towards sustainability	Applying (K3)
CO3:	apply the concepts of batteries and its applications in automobiles	Applying (K3)
CO4:	utilize the knowledge of fuel cells and its applications in various fields	Applying (K3)
CO5:	utilize the various polymeric materials in automobile engineering	Applying (K3)
CO6:	demonstrate the viscometer to estimate the molecular weight of the polymer	Applying (K3), Precision (S3)
CO7:	determine the amount of chloride and copper in the given solution	Applying (K3), Precision (S3)
CO8:	estimate the amount of chromium and DO in the given wastewater	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1			3							
CO2	3	2	1	1			3							
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										
CO6	3	2	1	3										
CO7	3	2	1	3										
CO8	3	2	1	3										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18CSC11 - PROBLEM SOLVING AND PROGRAMMING

(Common to All BE/BTech Engineering and Technology Branches)

Programme & Branch	B.E.& Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	ES	2	0	2	3

Preamble	This course mainly focuses on the basic concepts of computing, the methodology of problem solving and developing skills in programming using C language.	
Unit - I	**Introduction to Computer and Problem Solving:**	**9**
Overview of computers - Applications of computers - Characteristics of computer - Basic computer Organization - Number System - Problem solving: Planning the computer program – Algorithms - Flowcharts – Pseudocodes - Structuring the logic.		
Unit - II	**Case Study on Problem Solving:**	**9**
Algorithm, Flowchart and Pseudo code for the problems: Exchanging the values of two variables - Finding the biggest number - Counting - Summation of numbers - Factorial computation - Generation of Fibonacci Sequence - Summation of series - Base Conversion - Reversing the digits of an Integer.		
Unit - III	**Introduction to C and Control Statements:**	**9**
Overview of C - Basic structure of a C Program - Executing a C Program - C Character set - Tokens - Keywords and Identifiers - Constants - Variables - Data types - Storage classes - Managing Input and Output operations - Operators and Expressions - Decision making and Branching - Looping - Break and continue statements.		
Unit - IV	**Arrays, Strings and Structures:**	**9**
Arrays - One dimensional and Two dimensional arrays - Handling of character strings: Declaring and initializing string variables - Performing simple string operations - Introduction to structures: Structure definition - Structure declaration - Accessing a structure member - Structure initialization - Unions.		
Unit - V	**Functions:**	**9**
User defined functions: Elements of user defined functions - String handling functions - Library functions (strings and characters manipulation) - Passing arguments to functions – Recursion. Introduction to Pointers: Understanding pointers - Accessing address of a variable - Declaring pointer variables - Initialization of pointer variables - Accessing a variable through its pointer - Parameter passing mechanisms.		

List of Exercises / Experiments :

1.	Writing algorithms and drawing flowcharts using Raptor Tool for problems involving sequential, selective and repetitive structures
2.	Programs for demonstration of working of different types of operators like arithmetic, logical, relational and ternary operators involving sequential structures
3.	Demonstration of programs using decision making statements namely ‘if’, ‘else if’, ‘switch’, conditional and unconditional ‘goto’ (selective structures)
4.	Programs for demonstrating repetitive control statements like ‘for’, ‘while’ and ‘do-while’ (iterative structures)
5.	Demonstration of programs for declaration, initialization and performing operations on one-dimensional and two-dimensional numeric arrays
6.	Demonstration of programs for implementing various string operations like ‘copy’, ‘finding length’, ‘compare’, ‘concatenate’ with and without built-in library functions.
7.	Demonstration of programs for making use of user-defined data types namely structures and unions
8.	Demonstration of modular programming concepts using functions – developing programs using built-in and user-defined functions and parameter passing mechanisms

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1. "Problem Solving and Programming", compiled by Department of CSE, Kongu Engineering College, Internal circulation, 2017.

REFERENCES:

1. Dromey R.G., "How to Solve it by Computer", Pearson Education, 2009.
2. Balagurusamy E., "Fundamentals of Computing and Programming", Tata McGrawHill Education Pvt. Ltd., 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the characteristics, organisation, working principles and applications of computers	Understanding (K2)
CO2	express the solution for the given real world problems in terms of algorithm, flowchart and pseudocode	Applying (K3)
CO3	identify the appropriate looping and control statements in C for providing the solution to the given problems	Understanding (K2)
CO4	demonstrate the usage of arrays, strings and structures to solve the given problems	Understanding (K2)
CO5	apply fundamental modular programming knowledge to solve the given problems and recall the basic concepts of pointers	Understanding (K2)
CO6	demonstrate the execution of flowchart for the given problem using Raptor	Applying (K3), Precision (S3)
CO7	demonstrate the application of control statements using simple C programs	Applying (K3), Precision (S3)
CO8	implement solutions to the given problem using user defined functions and data types	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2	2	2	2		2									
CO3		2	1											
CO4		2	1											
CO5		2	1											
CO6	3	2	1	1	1					1				
CO7	3	2	1	1	1					1				
CO8	3	2	1	1	1					1				

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	50				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	20	30	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUC21 - BASICS OF AUTOMOBILE ENGINEERING

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	2	PC	2	0	2	3

Preamble: This course provides knowledge on anatomy of automobiles in general and the importance of fuels and lubricants.

UNIT – I		9

Introduction to Automobile Engineering: History of automobile - Definition - Classification of automobiles - Layout of an automobile - Functions of the automobile components - Manufacturers of motor vehicles in India - Development of I.C. Engines - Classification of I.C. Engines - Application of I.C. Engines.

UNIT – II		9

Two and Three Wheelers: Development and history - Classification - Layouts of two and three wheelers - Technical specification - Selection criteria - Design considerations - Electric bike and Rickshaw - RTO regulations.

UNIT – III		9

Four Wheelers and Special Vehicles: Types of Car bodies - Terminology and various panels. Types of bus body and commercial vehicles - Light commercial vehicle bodies and Heavy commercial vehicle bodies. Electric Cars - Earthmovers - Scrappers - Tractors - Tanks - Gun Carriers - Marine vehicles - Aircrafts - Racing Bikes and Cars.

UNIT – IV		9

Automotive Fuels: Types of Fuels, Liquid and gaseous fuels, Heating value of fuels, Higher and lower heating values, Chemical structure of hydro - Carbon fuels, Volatility characteristics, Desirable characteristics of fuels, Octane and Cetane number, Alternative fuels for SI and CI engines, Biodiesels.

UNIT – V		9

Lubricants: Lubricants - Classification - Components of lubricants - Functions - Selection of lubricating oils - Properties - Nomenclature and specifications - SAE Rating - Synthetic lubricants - Grease - Properties.

List of Experiments:

1. Study of single cylinder petrol engine.
2. Study of multi cylinder diesel engine.
3. Two wheeler body and powertrain system.
4. Three wheeler body and powertrain system.
5. Four wheeler body and powertrain system.
6. ASTM Distillation apparatus.
7. Flash and Fire Point apparatus.
8. Cloud and Four Point apparatus.
9. Penetration test apparatus.
10. Drop point apparatus.

Lecture:30, Practical:30, Total: 60

TEXT BOOK:

1. Ganesan V., “Internal Combustion Engines”, 4th Edition, Tata McGraw Hill, New Delhi, 2013.

REFERENCES:

1. Jain K.K & Asthana R B.,(TTTI Bhopal) “Automobile Engineering”, 4th Edition, Tata McGraw-Hill Education, 2012.
2. Narang G.B.S., “Automobile Engineering”, 10th Reprint, Khanna Publishers, Delhi, 2012.
3. Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	outline history & layout of automobiles, functions of automobile components, manufacturers of automobiles and classification & applications of IC engines.	Understanding (K2)
CO2:	explain history, classification, layout, technical specification and selection criteria of two & three wheelers	Understanding (K2)
CO3:	illustrate parts and construction of vehicle bodies & Off Road vehicles	Understanding (K2)
CO4:	recall and explain properties of various fuels used in automobiles	Understanding (K2)
CO5:	explain functions, properties, SAE grade and nomenclature of various lubricants used in automobiles	Understanding (K2)
CO6:	identify and dismantle various engine components	Understanding (K2), Manipulation (S2)
CO7:	identify and dismantle various transmission components	Understanding (K2), Manipulation (S2)
CO8:	test the properties of various fuels and lubricants	Understanding (K2), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2										2	
CO2	3	3	2										2	
CO3	3	3	2										2	
CO4	3	3	2										2	
CO5	3	3	2										2	
CO6	2	3	3										2	
CO7	2	3	3										2	
CO8	2	3	3										2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	30	40	30				100
ESE	30	40	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18VEC11 - VALUE EDUCATION

(Common to All BE/BTech Engineering and Technology Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	2	HS	2	0	1	1

Preamble	The aim of the course is to make the students to understand the purpose and value of life and to exhibit positive human values.	
Unit - I	**Philosophy of Life Science:**	**4**
Life - Purpose of life (four stages of life) - Philosophy of life (who am I') – Law of nature (cause of the life and body) - Content of the Life (five sheaths) - Goal of life. Five duties in life. Methodology: Life and messages of spiritual and national leaders - The forgotten hero, etc. Project report: Complementing with happiness - Every soul is potentially divine.		
Unit - II	**Human Values - Moral Foundation:**	**4**
Truth, forgiveness, compassion, endurance, humility, non violence,moderate diet, non stealing, self purification, self discipline, self study, content, cleanliness, honesty, and totality in faith - Good habits - Attitude forming for Individual peace. Practical Methods: Personal experience with above characters, Puranic Stories - Self resolve diary maintenance.		
Unit - III	**Social Values:**	**4**
Family - Family System - Greatness of women - World brotherhood (vasudeiva kudumbagam) - Glorious Bharath - Bharathian systems - Past-Present-Future - Team spirit - Goal setting - Economics - Education - Politics - Responsibilities of people - Preserving natural resources. Methodology: Preparing an album on glorious Bharath Past, Present and Future Plans. Goal setting - Management Games.Team Spirit - Yogic Games.		
Unit - IV	**Development of Mental Prosperity:**	**4**
Prosperity of mind - Functions of mind - Obstacles of mind - Practical method to perfect mind is yoga - Types - Uses - Precaution - Contradiction - Kriyas - Asanas - Pranayamas - Meditative techniques. Methodology: Asana - Pranayama - Cyclic meditation - Nada anu sandhana - Meditation - Yogic games for memory. Album on asanas, pranayama and mantra.		
Unit - V	**Maintenance of Physical Health:**	**4**
Human body - Structure - Ten Systems of the body as per modern science.Five elements - Harmonious relationship - Life force - Conserving vitality and health through natural life -Pranic food and its importance - Uses of herbs - Right way of cooking to preserve nutrients - Cause of the disease - Acute and chronic - Disease - Life and death. Methodology: Natural food making, traditional millet dishes. Asanas, pranayamas, cleansing procedures, Quiz on healthy living, Uses of herbs or kitchen garden.		

List of Exercises / Experiments:

1.	List of Loosening Exercises: Neck Movements, Shoulder Joint Movements, Elbow Joint Movement, Wrist Joint Movements, Finger Joint Movements, Rip Joint Movement, Hip Joint Movements, Spinal Cord Movement, Knee Joint Movements, Ankle Joint Movements, Toe Joint Movements.
2.	List of Asanas: Surya Namaskara, Shavasana, Makarasanas, Uttanpadasana, Pawanamuktasana, Sedubandasana, Naukasana, Vipareetakarani, Bhujangasana, Sarpasana, Shalabasana, Dhanurasana, Padmasana,Parvatasana, Vakrasana, Janu Sirashasana, Ustrasana, Yoga Mudra, Meru Tandasana, Tadasana, Katichakrasana, Paadahastasana, Parivarta Trikonasana, Ardha Chakrasana, Viruksasana.
3.	List of Pranayamas: Naadi Sodhana Pranayama, Bhastrika Pranayama, Bhramari Pranayama, Sheetali Pranayama.

Lecture:20, Practical:10, Total:30

TEXT BOOK:

1. Value Education, "Compiled by Vethathiri Maharishi Institute for Spiritual and Intuitional Education", Aliyar, Pollachi, 2018.

REFERENCES:

1. Value Education - Yoga Practical Guide, "Compiled by Padmasoorya Naturopathy and Yoga Foundation", Coimbatore, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the purpose and value of life.	Understanding (K2)
CO2	exhibit positive human values.	Understanding (K2)
CO3	understand social values.	Understanding (K2)
CO4	take steps to develop mental and physical health	Applying (K3), Imitation (S1)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						3		3				3		
CO2						3		3				3		
CO3						3		3				3		
CO4						3		3				3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1							0
CAT2							0
CAT3							0
ESE	25	75					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MAC31 - MATHEMATICS III

(Common to Civil Engineering, Mechanical Engineering, Mechatronics Engineering, Automobile Engineering, Electronics And Communication Engineering, Electrical And Electronics Engineering , Electronics And Instrumentation Engineering, Chemical Engineering & Food Technology Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3	BS	3	1*	2*	4

Preamble	To provide the skills for solving the real time engineering problems involving partial differential equations and impart knowledge in Fourier transform and Z-Transform.	
Unit - I	**Fourier Series:**	**9**
Dirichlet's conditions – General Fourier series – Change of interval – Odd and even functions – Half range Sine series – Half range Cosine series – Harmonic analysis.		
Unit - II	**Partial Differential Equations:**	**9**
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange's linear equation – Solution of homogeneous linear partial differential equations of higher order with constant coefficients.		
Unit - III	**Applications of Partial Differential Equations:**	**9**
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (excluding insulated edges).		
Unit - IV	**Fourier Transform:**	**9**
Fourier Integral theorem (without proof) – Fourier transform pair – Properties (without proof) – Transforms of simple functions – Fourier Sine and Cosine transforms – Properties (without proof) – Convolution theorem and Parseval's identity (Statement and applications only).		
Unit - V	**Z –Transform:**	**9**
Definition – Z-transform of some basic functions – Elementary properties – Inverse Z- transform: Partial fraction method – Residue method – Convolution theorem – Applications of Z-transforms: Solution of difference equations.		

List of Exercises / Experiments :

1.	Expressing given function in terms of Fourier series.
2.	Harmonic Analysis of given data.
3.	Solving second order partial differential equations.
4.	Solution of One dimensional wave equation.
5.	Solution of Two dimensional heat equation.
6.	Determining Fourier and inverse Fourier transform of a given function.
7.	Computing Z- transform of a discrete sequence.
8.	Apply Z- transforms to obtain the solution of difference equations.

***Alternate Weeks**

Lecture:45, Tutorial and Practical:15, Total:60

TEXT BOOK:

1. Veerarajan T., "Transforms and Partial Differential Equations", 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons Ltd., USA, 2019.
2. Duraisamy C., Vengataasalam S., Arun Prakash K. & Suresh M., "Engineering Mathematics – III", 2nd Edition, Pearson India Education, New Delhi, 2018.
3. Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	express given function or data in terms of Fourier series	Applying (K3)
CO2	solve the given standard partial differential equations	Applying (K3)
CO3	apply Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations	Applying (K3)
CO4	use the mathematical principles of Fourier transforms which will provide the ability to formulate and solve some of the physical problems of engineering	Applying (K3)
CO5	apply Z transform techniques for analyzing linear time invariant systems	Applying (K3)
CO6	express the given data in Fourier series using MATLAB	Applying (K3), Manipulation (S2)
CO7	solve partial differential equations using PDE Modeler	Applying (K3), Manipulation (S2)
CO8	find Fourier and Z-Transforms using MATLAB built in functions	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1										
CO2	3	3	1	1										
CO3	3	3	1	1										
CO4	3	3	1	2										
CO5	3	3	1	2										
CO6					3									
CO7					3									
CO8					3									

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	10	70				100
CAT2	20	10	70				100
CAT3	20	10	70				100
ESE	20	10	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT31 - STATICS AND DYNAMICS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mathematics I & II, Applied Physics	3	ES	3	1	0	4

Preamble: This course provides knowledge to represent engineering system as a force system and solve the system for equilibrium under static and dynamic conditions

UNIT – I	9+3

Statics of Particles: Introduction and laws of mechanics - System of forces - Principle of transmissibility, parallelogram and triangular law of forces - Resultant of forces in plane and space - Equilibrium of a particle in plane and space. Applications - Lifting a load by crane, towing a vehicle and resultant force acting on various automotive components.

UNIT – II	9+3

Statics of Rigid Bodies: Moment and couple - Vectorial representation of moment and couple - Varignon's theorem - Types of supports and their reactions - Resultant moment and couple in plane and space - Equilibrium of rigid bodies in plane and space. Applications - Moment about hinges in doors and bonnet, moment about fixed joint in foot rest, location of door locks, overturning of crane while lifting large loads, better position to hold a spanner, selecting appropriate screw driver and steering wheel to reduce effort and best position to mount hydraulic cylinder on a tipper.

UNIT – III	9+3

Friction: Introduction and laws of dry friction - Coefficient of friction - Angle of friction and repose - Sliding friction - ladder friction - wedge friction - belt friction - wheel friction and rolling resistance. Applications - Coefficient of friction required to move a vehicle, horizontal force required to overcome rolling resistance of a vehicle, maximum load a vehicle can pull, tension in V belt and braking torque in disc and drum brakes.

UNIT – IV	9+3

Properties of Surfaces and Solids: First moment of area and centroid of sections - Moment of inertia of plane areas - Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia and product of inertia - Principal moments of inertia of plane areas. Applications - Location of CG in a vehicle and Area moment of Inertia of chassis frame.

UNIT – V	9+3

Dynamics of Particles and Rigid Body: Equations of motion - Rectilinear motion of particles - Curvilinear motion - Projectile motion. Principle of work and energy of particles and rigid body - Impulse - Momentum equations of particles and rigid body - Impact of elastic bodies. Applications - Linear and angular velocity of a vehicle, acceleration and deceleration of a vehicle, force transmitted due to vehicle impact and force exerted by driver on seat belt.

Lecture: 45, Tutorial:15, Total: 60

TEXT BOOK:

1. Beer Ferdinand P., Russel Johnston Jr., David F. Mazure, Philip J. Cornwell, Sanjeev Sanghi, "Vector Mechanics for Engineers: Statics and Dynamics", 11th Edition, McGraw Hill Education, New Delhi, 2017.

REFERENCES:

1. Dubey N.H., "Engineering Mechanics: Statics and Dynamics", 1st Edition, McGraw Hill Education, New Delhi, 2016.
2. Hibbeler R.C., "Engineering Mechanics", 14th Edition, Pearson Education, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	represent the forces in vector components (both 2D and 3D) and apply equilibrium conditions to find the unknown force in automotive systems	Applying (K3)
CO2:	calculate the moment produced by various force systems and solve rigid body problems by applying equilibrium conditions for designing automotive systems	Analyzing (K4)
CO3:	apply the laws of dry friction to calculate frictional force and torque in various automotive systems to analyze a vehicle	Analyzing (K4)
CO4:	calculate the centroid and area moment of inertia for designing automotive chassis frame	Analyzing (K4)
CO5:	analyze the motion of particles and rigid bodies using various principles	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2										3	
CO2	3	3	2										3	
CO3	3	3	2										3	
CO4	3	3	2										3	
CO5	3	3	2										3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	17	16	50	17			100
CAT2	17	16	33	34			100
CAT3	17	16	33	34			100
ESE	6	6	53	35			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MTT32 - MANUFACTURING PROCESSES

(Common to Mechatronics Engineering & Automobile Engineering branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Introduction to Engineering	3	PC	3	0	0	3

Preamble: This course provides an overview of a wide variety of manufacturing processes like foundry technology, metal forming, metal removal, metal joining and metal finishing process to fabricate various machine element parts.

UNIT – I		**9**

Foundry Technology: Introduction to Molding and Casting - Molding sand: types, properties - preparation of green sand molding - Pattern making: Pattern materials, types and allowances - Core making: types of core, core materials, making of cores - Casting methods: Die casting, Centrifugal Castings, Investment Casting and Shell mold Casting - Defects in casting.

UNIT – II		**9**

Metal Forming Processes: Rolling: Introduction, Rolling mills, Rolling operations - Extrusion: Forward and Backward extrusion - Production of seamless tubing and pipes - Cold and Hydrostatic Extrusion - Drawing: Hot and Cold drawing - Deep drawing - Tube and wire drawing - Sheet metal and forging operations.

UNIT – III		**9**

Metal Removal Processes: Lathe: types, main parts and operations - single point cutting tool nomenclature - Drilling Machine: Types, operations, types of drills - twist drill nomenclature - reaming and tapping - Milling Machine: Types, operations - types of milling cutters - Shaper and Planer: types, main parts, operations. (Numerical problems in Lathe, Drilling and Milling operations).

UNIT – IV		**9**

Metal Joining Processes: Classification of Welding Process - Fusion Welding Processes: Arc Welding - Gas Tungsten Arc welding - Gas Metal Arc Welding - Electron Beam Welding - Laser Beam Welding - Solid State Welding: Cold Welding - Ultrasonic Welding - Friction Welding - Resistance Welding - Explosive Welding - Gas welding: Oxy – Acetylene welding process - Weld defects: types, causes and cure - Brazing and soldering: Concepts and applications.

UNIT – V		**9**

Metal Finishing Processes: Grinding Machine: Methods of grinding - Types of grinding machines - Grinding wheel and its selection – Lapping – Honing - super finishing - Broaching Machine: pull type and push type broachers - broaching methods and operations - types of broaching machines.

Total: 45

TEXT BOOK:

1. Kalpakjian S. and Schmid R., "Manufacturing Engineering and Technology", 7th Edition, Pearson Education India Edition, 2013.

REFERENCES:

1. Kaushish J.P., "Manufacturing Processes", 2nd Edition, PHI Learning Pvt. Ltd., 2013.
2. Rao P.N., "Manufacturing Technology, Volume I & II", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	demonstrate the various foundry techniques like pattern making, molding, casting, melting furnaces and inspection	Understanding (K2)
CO2:	categorize various forming processes involving bulk forming and sheet metal operations	Understanding (K2)
CO3:	choose the metal removal processes according to the material and geometrical design	Understanding (K2)
CO4:	select the metal joining processes based on the properties of base metal	Applying (K3)
CO5:	recommend the various metal finishing processes for surface finishing operations	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2								2	2	
CO2	3	3	3	3								2	2	
CO3	3	3	2	2								2	2	
CO4	3	3	1	1								2	2	
CO5	3	1	1	1								2	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	70	10				100
CAT2	20	60	20				100
CAT3	20	70	10				100
ESE	15	65	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT32 - MECHANICS OF FLUIDS AND HYDRAULIC MACHINES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mathematics I & II	3	PC	3	0	0	3
Preamble	This course provides knowledge to apply governing laws of fluid mechanics to design and evaluate engineering systems and hydraulic machines by assessing various parameters						

UNIT – I		**9**
Fluid Properties and Fluid Statics: Fluid definition and classification - Properties of fluids - Density, specific weight, specific volume, specific gravity, viscosity, compressibility, bulk modulus, capillarity and surface tension - Properties of engine oil, gear oil and grease. Fluid static pressure - Pascal's law - Absolute and gauge pressures - Manometers - Types and pressure measurement - Pressure measurement in intake manifold, hydraulic brake lines and fuel lines. Buoyancy and stability.		
UNIT – II		**9**
Fluid Dynamics: Types of flow - Streamlines, Streaklines, Pathlines and Timelines - Continuity equation in two dimensions - Euler's equation along a streamline - Bernoulli's equation - venturimeter, orificemeter and pitot tube - Flow through nozzles - Fuel velocity and discharge for overhead fuel tanks.		
UNIT – III		**9**
Flow through Pipes and Dimensional Analysis: Flow through pipes - minor and major head losses, hydraulic gradient and total energy lines - Flow through pipes in series and parallel - Power transmission through pipes - Power requirement for brake fluid distribution. Dimensionless numbers - Dimensional analysis: Buckingham's π theorem - Modelling a prototype for wind tunnel test.		
UNIT – IV		**9**
Hydraulic Turbines: Definition of turbine - Impulse and Reaction turbines - Working principle, velocity triangle and efficiency - Specific speed and unit quantities - Application of turbines.		
UNIT – V		**9**
Hydraulic Pumps: Positive displacement pumps - classification, working principle and discharge - Oil pump and fuel pump in automobile engines. Centrifugal pump - working principle, velocity triangle and efficiency. Priming, cavitation, net positive suction head and specific speed - Water pump in automobile engines - Pumps in series and parallel.		

Total: 45

TEXT BOOK:

1. Yunus A. Cengel and John M. Cimbala, "Fluid Mechanics", 3rd Edition, McGraw Hill Education India Pvt. Ltd., 2017.

REFERENCES:

1. Bruce R. Munson, "Fluid Mechanics", 7th Edition, Wiley, 2015.
2. Bansal R.K., "Fluid Mechanics and Hydraulics Machines", 10th Edition, Laxmi Publications, New Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	recall types and properties of fluids, calculate fluid static pressure and analyze the stability of floating bodies	Analyzing (K4)
CO2:	solve the problems related to kinematics and dynamics of fluid for designing overhead fuel tanks	Analyzing (K4)
CO3:	solve the problems on flow through pipes and pipe networks for finding power requirement to transmit brake fluid and give dimensions for prototype to conduct wind tunnel test	Analyzing (K4)
CO4:	design and analyze hydraulic turbines for optimum performance	Analyzing (K4)
CO5:	design and analyze pumps for optimum performance in automotive subsystems	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1									3	
CO2	3	3	2	1									3	
CO3	3	3	2	1									3	
CO4	3	3	2	1									3	
CO5	3	3	2	1									3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	40	10			100
CAT2	15	35	30	20			100
CAT3	15	30	40	15			100
ESE	25	25	30	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT33 THERMODYNAMICS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mathematics I & II, Applied Physics	3	PC	3	1	0	4
Preamble	This course provides the knowledge about the basic concepts and laws of thermodynamics and its applications and knowing the properties of pure substance calculations and adequate concepts for the psychrometry charts.						

UNIT – I	9+3

Basic Concepts of Thermodynamics: Basic concepts - concept of continuum, microscopic, macroscopic approach, thermodynamic systems – closed, open and isolated systems. Zeroth Law of Thermodynamics, concept of temperature and heat, Property, state, path, process and quasi-static process. Specific heat capacities, internal energy, enthalpy, work - modes of work.

UNIT – II	9+3

First Law of Thermodynamics: Introduction to first law of thermodynamics, Analysis of closed system. Energy – Property of a system, Specific heat, Enthalpy, Perpetual motion Machine Types. First Law applied to flow processes, Mass and Energy Balance, Steady flow energy equation (SFEE) for various applications.

UNIT – III	9+3

Second Law of Thermodynamics and Concept of Entropy: Second law of thermodynamics – Kelvin–Planck and Clausius statements of second law. Carnot cycle, Heat engine, reversed Carnot cycle – efficiency, Refrigerator, Heat pump - COP. Reversibility and irreversibility. Thermodynamic temperature scale, Inequality of Clausius. Concept of entropy, entropy of ideal gas, principle of increase of entropy – Carnot's theorem, absolute entropy, Basic concepts of availability.

UNIT – IV	9+3

Properties of Pure Substance: Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, p-v, p-T, T-s, h-s diagrams, p-v-T surface. Thermodynamic properties of steam – Steam Table - Mollier Chart. Calculations of work done and heat transfer in non-flow and flow processes.

UNIT – V	9+3

Psychrometry: Properties of atmospheric air, calculations of properties of air - vapour mixtures. Psychrometric charts. Psychrometric processes – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling - Psychrometric Chart - Problems.

Lecture:15, Tutorial:15, Total:60

TEXT BOOK:

1. Nag P.K., "Engineering Thermodynamics", 6th Edition, McGraw Hill Education, New Delhi, 2017.

REFERENCES:

1. Rajput R.K., "Engineering Thermodynamics", 10th Edition, Laxmi Publications, New Delhi, 2018.
2. Yunus A. Cengel, Michael A. Boles, "Thermodynamics: An Engineering Approach", 8th Edition, McGraw Hill Education, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	analyze basic concepts to formulate thermodynamic systems	Analyzing (K4)
CO2:	apply first law of thermodynamics to solve and analyze thermal systems	Analyzing (K4)
CO3:	apply second law of thermodynamics to solve and analyze heat engine, heat pump and refrigerator	Analyzing (K4)
CO4:	solve and analyze problems related to solid, liquid and vapour phases of a pure substance	Analyzing (K4)
CO5:	analyze various methods used in psychrometric processes	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1									3	
CO2	3	3	2	1									3	
CO3	3	3	2	1									3	
CO4	3	3	2	1									3	
CO5	3	3	2	1									3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	15	45	20			100
CAT2	36	10	30	24			100
CAT3	20	15	50	15			100
ESE	10	20	60	10			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT34 - AUTOMOTIVE POWERTRAIN

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automobile Engineering	3	PC	3	0	0	3
Preamble	To explain the construction and working of combustion chamber, fuel supply system, ignition system, cooling system, lubrication system, supercharger, turbocharger in IC engines and design transmission system for a vehicle						

UNIT – I		**9**
SI Engines: Review of SI Engine operation - combustion chamber - stages of combustion in SI Engines - fuel injection systems - Single point injection, MPFI and GDI - carburetor working and its types - Ignition system and its types.		
UNIT – II		**9**
CI Engines: Review of CI Engine operation - combustion chamber - direct and indirect combustion chambers - stages of combustion in CI Engines - Fuel Injection Systems - CRDI fuel injection system - Concept of Supercharging and Turbo charging - Types of cooling and lubricating system.		
UNIT – III		**9**
Engine Testing: Engine performance evaluation - Total Fuel Consumption - Specific Fuel Consumption - Brake Power - Indicated Power - Mechanical Efficiency - Thermal Efficiency - Volumetric Efficiency – Engine Dynamometer and types.		
UNIT – IV		**9**
Hydrodynamic Transmission and Clutches: Fluid Coupling - Principle - Constructional details. Torque capacity. Performance characteristics. Reduction of drag torque in fluid coupling. Torque Converter - Principle -constructional details - Performance characteristics. Role of Clutch - Positive and gradually engaged types - Types of clutches - Single plate clutch - Coil spring type and diaphragm spring type - Multiple Plate Clutch - Centrifugal clutch - Clutch operating mechanisms - Hydraulic - Vacuum - Electromagnetic clutch - Cone clutch.		
UNIT – V		**9**
Gear box: Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchromesh gearboxes - Planetary Gear Boxes **-** Principle of Planetary gear trains - Wilson Gear box, Cotal electromagnetic transmission, Continuously Variable Transmission (CVT), Types, Automatic Manual Transmission (AMT).		

Total: 45

TEXT BOOK:

1. Garrett T.K., Newton K., Steeds W., “The Motor Vehicle”, 13th Edition, Butterworth-Heinemann, Oxford, 2000.

REFERENCES:

1. Ganesan V., “Internal Combustion Engines”, 4th Edition, McGraw Hill Education, 2017.
2. Dr. Kirpal Singh, “Automobile Engineering”, Volume 1 & 2, 13th Edition, Standard Publishers Distributors, New Delhi, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	explain construction and working of combustion chamber, fuel supply system and ignition system and select suitable fuel supply system and ignition system for SI engine	Analyzing (K4)
CO2:	explain construction and working of combustion chamber, fuel supply system, cooling system and lubrication system and select suitable fuel supply system, cooling system and lubrication system for CI engine	Analyzing (K4)
CO3:	calculate and analyze performance of an IC engine through various testing methods	Analyzing (K4)
CO4:	illustrate the construction and working of all types of clutch and select the suitable clutch for transmission system	Analyzing (K4)
CO5:	illustrate the construction and working of transmission systems and select the suitable transmission system for a vehicle	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1									3	
CO2	3	3	2	1									3	
CO3	3	3	2	1									3	
CO4	3	3	2	1									3	
CO5	3	3	2	1									3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	46	35	10	9			100
CAT2	35	45	10	10			100
CAT3	43	40	10	7			100
ESE	45	35	10	10			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MTL32 - MANUFACTURING PROCESSES LABORATORY

(Common to Mechatronics Engineering & Automobile Engineering branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3	PC	0	0	2	1
Preamble	This course provides hands-on training to various manufacturing processes and to produce the machine elements using different machine tools.						

List of Experiments:	
1.	Lathe operations: Step turning, Taper turning and Knurling
2.	Lathe operation: Thread Cutting
3.	Lathe operation: Eccentric turning
4.	Milling machine operation: Spur gear milling / Contour / Key way milling
5.	Shaper / planner machine operation: Key way / Dove tail shape Cutting
6.	Drilling machine operations: Drilling, Reaming and Tapping
7.	Grinding machine operations: Surface grinding and Cylindrical grinding
8.	Preparation of mould for sand casting using single piece / split patterns
9.	Practice a butt / lap joint using the given metal strips by Arc / Gas welding
10.	Practice a butt / lap joint using the given metal strips by TIG / MIG / Spot welding

Total: 30

REFERENCES:

1.	Laboratory Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	develop the various machine elements using centre lathe through single point and multi point cutting tool	Applying (K3), Precision (S3)
CO2:	develop the various machine elements using special machines like milling machine, Shaper and drilling machine	Applying (K3), Precision (S3)
CO3:	develop the surfaces of machining parts with high finishing using surface and cylindrical grinder	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3					2	2		2	2	
CO2	3	3	2	3					2	2		2	2	
CO3	3	3	2	3					2	2		2	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUL31 - AUTOMOTIVE POWERTRAIN LABORATORY

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automobile Engineering	3	PC	0	0	2	1
Preamble	This course provides knowledge to assemble and dismantle various automobile components and conduct various performance tests of engines.						

List of Experiments:

1. Dismantling and assembly of Carburetors.
2. Dismantling and assembly of Petrol and Diesel Fuel injection system.
3. Dismantling and assembly of Cooling system.
4. Dismantling and assembly of Lubricating system.
5. Dismantling and assembly of Turbocharger and Supercharger.
6. Performance test on single cylinder diesel engine by eddy current dynamometer.
7. Heat balance test on diesel engines by eddy current dynamometer.
8. Emission test on diesel and petrol engines using exhaust gas analyzer.
9. Dismantling and Assembly of clutch.
10. Dismantling and Assembly of various type of gear boxes.
11. Dismantling and Assembly of Constant Velocity Joint (Front Axles).
12. Dismantling and assembly of differential gear.

Total: 30

REFERENCES / MANUAL:

1. Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	dismantle and assemble the automobile engine components	Applying (K3), Precision (S3)
CO2:	test the performance of various engines using dynamometers	Analyzing (K4), Manipulation (S2)
CO3:	dismantle and assemble the clutch, gear box and transmission systems	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		2								2	
CO2	3	2	1		2								2	
CO3	3	2	1		2								2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUL32 - COMPUTER AIDED MACHINE DRAWING LABORATORY

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Engineering Drawing	3	PC	0	0	2	1
Preamble	This course provides knowledge to create parts and assemblies of machine elements in CAD packages.						

List of Experiments:

1. Practice for sketching planes, axis, point and coordinate systems with different sketching tools
2. Practice for reading two dimensional (2D) drawings with geometrical tolerances, conversion of two dimensional drawings to three dimensional (3D) models
3. 2D Drafting of automobile components - Cylinder block, Piston and Connecting rod
4. 3D Part modeling options - Extruded boss/base, revolved cut and extruded cut - Flange coupling and Screw jack
5. 3D Part modeling options - Swept boss / base, lofted boss / base, sweep cut and lofted cut - Machine vice and Knuckle joint
6. Features creation with editing operations - Move, pattern, mirror, fillet and chamfer rib - Simple eccentric and Universal joint
7. Model tree with family table and parametric concepts - Bolts and nuts - BIS
8. Assembly from individual parts - Imposing assembly constraints - Disassembly
9. Assembly mass properties and checking of interferences of components
10. Conversion of 3D solid model to 2D drawing - different views, sections, isometric view and drafting

Total: 30

REFERENCES/MANUAL:

1. Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	sketch 2D drawing by using different sketching tools in CAD packages	Applying (K3), Precision (S3)
CO2:	apply principles associated with CAD and common drafting techniques in designing 3D model machine elements	Applying (K3), Precision (S3)
CO3:	apply advanced competences of CAD to create assemblies of machine elements	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		3								2	
CO2	3	2	1		3								2	
CO3	3	2	1		3								2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18MAC41 - STATISTICS AND NUMERICAL METHODS

(Common to all Engineering and Technology Branches except ECE,CSE and IT)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	BS	3	1*	2*	4
Preamble	To impart knowledge in testing of samples, ANOVA and interpolation. Also develop skills to apply numerical algorithms to identify roots of algebraic and transcendental equations and solve linear and ordinary differential equations.						

UNIT – I		**9**
Testing of Hypothesis: Introduction – Critical region and level of significance – Types of Errors – Large sample tests: Z-test for single mean and difference of means – Small sample tests: Student's t-test for significance of means – F-test for comparison of variances – Chi-square test for goodness of fit and independence of attributes		
UNIT – II		**9**
Design of Experiments: Analysis of variance – One way classification: Completely Randomized Design – Two way classification: Randomized Block Design – Three way classification: Latin Square Design.		
UNIT – III		**9**
Solution to Algebraic and Transcendental Equations: Method of false position – Newton-Raphson method – Solution of linear system of equations – Direct methods: Gauss elimination method and Gauss - Jordan method – Iterative methods: Gauss Jacobi and Gauss-Seidel methods.		
UNIT – IV		**9**
Interpolation: Interpolation with equal intervals: Newton's forward and backward difference formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula. **Numerical Differentiation and Integration:** Differentiation using Newton's forward and backward interpolation formulae – Numerical integration: Trapezoidal rule – Simpsons 1/3rd rule.		
UNIT – V		**9**
Numerical Solution of First order Ordinary Differential Equations: Single step methods**:** Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne's predictor corrector method – Adam's Bashforth method.		

List of Exercises:

1. Testing significance of means by student's t - test
2. Testing the independence of attributes by Chi-square test
3. Analyze the difference in means is statistically significant by Completely Randomized Design
4. Finding positive root by Regula – Falsi method
5. Solving simultaneous linear equations by Gauss – Seidel Method
6. Evaluating definite integrals by Trapezoidal and Simpson's rules
7. Solution of ODE by Euler and Modified Euler methods
8. Solution of ODE by Runge-Kutta method

***Alternate Weeks**

Lecture: 45, Tutorial and Practical:15, Total: 60

TEXT BOOK:

1. Veerarajan T. & Ramachandran T. , "Statistics and Numerical Methods ", 1st Edition, Tata McGraw Hill Education, New Delhi, 2018.

REFERENCES:

1. Jay L. Devore. , "Probability and Statistics for Engineering and the Sciences ", 9th Edition, Cengage Learning , USA, 2016.
2. Steven C. Chapra & Raymond P. Canale. , "Numerical Methods for Engineers ", 7th Edition, McGraw-Hill Education, New York, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify large and small samples and apply suitable tests for solving engineering problems	Applying (K3)
CO2	handle experimental data with the knowledge of ANOVA	Applying (K3)
CO3	apply various numerical techniques to solve algebraic and transcendental equations	Applying (K3)
CO4	compute intermediate values of given data, numerical derivatives and integral values	Applying (K3)
CO5	obtain the solution of ordinary differential equations numerically	Applying (K3)
CO6	test whether the given data is significant by hypothesis testing and ANOVA using MATLAB	Applying (K3), Manipulation (S2)
CO7	use MATLAB for determining numerical solutions of algebraic equations and integral values	Applying (K3), Manipulation (S2)
CO8	obtain the numerical solution of ordinary differential equations using MATLAB	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2										
CO2	3	1	2	2										
CO3	3	2	1	1										
CO4	3	1	1	1										
CO5	3	2	1	1										
CO6					3									
CO7					3									
CO8					3									
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT41 - MECHANICS OF DEFORMABLE BODIES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Statics and Dynamics, Mathematics I and II.	4	PC	3	0	0	3
Preamble	This course provides knowledge to evaluate structural performance of engineering structure due to various forms of external loads by analyzing stresses, strains and deformations.						

UNIT – I		9
Stress, Strain, and Deformation of Solids: Introduction to material properties. Stress-strain curve for ductile and brittle materials - Hooke's law - Poisson's ratio - Factor of safety. Elastic constants and their relationship. Stresses and strains due to axial force, shear force, impact force and thermal effect. Application – Piston & door hinges. Stepped and composite bars - uniformly varying cross section. Strain energy.		
UNIT – II		**9**
Analysis of Stresses in Two Dimensions: State of stresses at a point - Normal and shear stresses on inclined planes - Principal planes and stresses - Plane of maximum shear stress - Mohr's circle for biaxial stress with shear stress. Applications - Connecting rod and Crankshaft. Hoop and longitudinal stresses in thin cylindrical and spherical shells - Changes in dimensions and volume. Application - Air cylinders in pneumatic braking system.		
UNIT – III		**9**
Loads and Stresses in Beams: Types of beams - Supports and Loads - Shear force and Bending Moment in beams - Cantilever, simply supported and overhanging beams - Point of contraflexure. Theory of simple bending - bending and shear stress - stress variation along the length and section of the beam - Section modulus. Application - Chassis frame, Foot rest and Handle bar.		
UNIT – IV		**9**
Deflection of Beams and Columns: Slope and Deflection of cantilever, simply supported and overhanging beams - Double integration method and Macaulay's method. Columns - types - Equivalent length - Euler's and Rankine's formulae - Slenderness ratio.		
UNIT – V		**9**
Torsion in Circular Shafts and Coiled Helical Springs: Analysis of torsion of circular solid and hollow shafts - stepped shaft - compound shaft - Shear stress distribution - angle of twist and torsional stiffness. Closed coil helical spring - stresses and deflection under axial load - Maximum shear stress in spring section including Wahl Factor. Application - Axle shaft, propeller shaft & springs used in suspension systems.		

Total:45

TEXT BOOK:

1. Beer F.P and Johnston E.R. , "Mechanics of Materials", 7th Edition, McGraw Hill Education, New Delhi, 2017.

REFERENCES:

1. Hibbeler R.C. , " Mechanics of Materials ", 9th Edition, Pearson Education, New Delhi , 2018.
2. Bansal R.K. , "Strength of Materials", 6th Edition, Lakshmi Publications , New Delhi , 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	predict mechanical behavior of materials under simple tension or compression for varying cross sections	Applying (K3)
CO2	calculate principal stresses & strains to analyze automotive components	Applying (K3)
CO3	apply theory of simple bending to design automotive chassis frame	Applying (K3)
CO4	calculate beam and column strength with help of slope and deflection for various loads	Applying (K3)
CO5	design and analyze shafts and springs based on torsional behavior	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2										2	
CO2	3	3	2										2	
CO3	3	3	2										2	
CO4	3	3	2										2	
CO5	3	3	3										3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	17	33	50				100
CAT2	23	44	33				100
CAT3	17	36	33	14			100
ESE	16	26	43	15			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT42 - THERMAL SCIENCE

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics, Thermodynamics and Mechanics of Fluids & Hydraulic Machines	4	PC	3	1	0	4
Preamble	This course provides knowledge to calculate performance of gas power cycles, air compressors, refrigeration & air conditioning system and to solve problems on various modes of heat transfer.						

UNIT – I		**9+3**
Gas Power Cycles: Air standard cycle - Otto, Diesel, Dual and Brayton cycles - Calculation of mean effective pressure and air standard efficiency - Actual and theoretical p-v diagrams, port and valve timing diagram of engines - Engine performance calculations.		
UNIT – II		**9+3**
Air Compressors: Reciprocating air compressors - Single stage and double stage air compressor - Work required - Effect of clearance volume - Volumetric efficiency - Isothermal efficiency - Free air delivery (FAD) - Introduction of rotary air compressor.		
UNIT – III		**9+3**
Refrigeration Cycles and Air-conditioning Systems: Vapour compression and vapour absorption refrigeration systems (VCRS and VARS) - Carnot cycle for refrigeration system - C.O.P calculations - Air conditioning system - Summer air conditioning system - Hot and dry weather - Hot and wet weather - Winter air conditioning system.		
UNIT – IV		**9+3**
Conductive Heat Transfer: Basic Concepts - Mechanism of heat transfer - Conduction, convection and radiation - General Differential equation of heat conduction - Fourier law of conduction - Cartesian - One Dimensional steady state heat conduction - Conduction through plane Wall, cylinders and spherical systems - Composite systems - Conduction with internal heat Generation - Extended surfaces - Unsteady state heat Conduction - Lumped analysis - Use of Heislers Chart.		
UNIT – V		**9+3**
Convective and Radiation Heat Transfer: Basic Concepts - Convective heat transfer coefficients - Boundary layer concept - Types of convection - Forced convection - Free convection. Basic Concepts, Laws of radiation - Stefan Boltzman Law, Kirchoff Law - Black body radiation - Grey body radiation shape factor algebra - Electrical analogy - Radiation shields - Introduction to Gas Radiation..		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Sachdeva R.C., "Fundamentals of Engineering Heat and Mass Transfer", 5th Edition, New Age International, New Delhi, 2017

REFERENCES:

1. Arora C.P, "Refrigeration and Air Conditioning", 3rd Edition, McGraw Hill Education, New Delhi, 2017.
2. Rajput R.K, "Thermal Engineering", 10th Edition, Lakshmi Publications, New Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	calculate efficiency of various air standard cycles and performance of an engine.	Applying (K3)
CO2	calculate volumetric and isothermal efficiency for single and double stage air compressor and select suitable compressor for automotive applications.	Analyzing (K4)
CO3	solve problems in refrigeration systems to calculate COP and select suitable compressor for Air-Conditioning system in a car	Analyzing (K4)
CO4	solve steady and unsteady states of heat conduction by analytical and numerical methods	Applying (K3)
CO5	solve problems by understanding the physical phenomenon associated with convection heat transfer and explain the physical mechanisms involved in radiation heat transfer.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2										2	
CO2	3	3	3										3	
CO3	3	3	3										3	
CO4	3	3	2										2	
CO5	3	3	2										2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	35	50				100
CAT2	10	65	20	5			100
CAT3	30	30	30	10			100
ESE	15	30	50	5			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT43 - AUTOMOTIVE CHASSIS

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automobile Engineering	4	PC	3	0	0	3
Preamble	This course provides knowledge on construction and working of various automotive chassis components						

UNIT – I		9
Chassis and Frames: Classification of vehicles. Chassis construction - conventional, integral and semi-integral type. Material, types and load acting on chassis frame. Selection of appropriate cross section for chassis frame based on the application. Types of chassis layout based on powertrain location.		
UNIT – II		**9**
Suspension Systems: Purpose of suspension systems. Sprung and unsprung weight. Under damping, critical damping and over damping. Essentiality of critical damping. Construction and working of dependent and independent suspension systems. Shock absorbers - Mono tube, twin tube, twin tube PSD, twin tube ASD and twin tube gas charged. Magnetic Rheological Dampers. Air suspension system. Active and semi active suspension systems.		
UNIT – III		**9**
Steering and Braking Systems: Steering linkages. Reversible and Irreversible steering. Steering gear boxes - Recirculating ball, rack and pinion, worm & nut, worm & roller and worm & sector. Power assisted steering - Hydraulic assist for recirculating ball type, electrical and electronic assist for rack & pinion type. Steering geometry. Importance of wheel alignment and wheel balancing. Need for braking systems. Drum and disc actuation. Construction and working - mechanical, hydraulic, pneumatic, power assisted and servo braking system. Antilock braking system.		
UNIT – IV		**9**
Front and Rear Axle: Front axle - Types and construction. Stub axle. Rear Axle: Loads acting on rear axle. Construction and working of full floating, three quarter floating and semi floating axles. Twist beam rear axle. Multi axle vehicles. Types, construction and working of differential.		
UNIT – V		**9**
Wheels and Tires: Types and construction of wheels & rims. Tire types - Bias ply, radial ply, tubed and tubeless. Effects of over and under inflation on vehicle mileage and tire life. Tire specifications. Nitrogen tire inflation.		

Total:45

TEXT BOOK:

1. Garrett T.K., Newton K. and Steeds W., “The Motor Vehicle”, 13th Edition, Butterworth, London, 2001

REFERENCES:

1. Heinz Heisler., "Advanced Vehicle Technology", 2nd Edition, Butterworth, London, 2011.
2. Dr Kirpal Singh., "Automobile Engineering Volume 1", 13th Edition, Standard Publishers Distributors, New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate construction of chassis and select suitable cross section for chassis frame with respect to application.	Understanding (K2)
CO2	explain construction and working of suspension systems and analyze their performance in a vehicle.	Understanding (K2)
CO3	select and describe suitable braking and steering system for a vehicle.	Applying (K3)
CO4	defend selection of an axle to a vehicle and describe with sketches.	Applying (K3)
CO5	describe construction and working of wheels & tires and analyze their performance with respect to inflation pressure.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2										2	
CO2	3	2	2										2	
CO3	3	1	1										1	
CO4	3	1	1										1	
CO5	3	1	1										1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	30	50	20				100
CAT3	30	50	20				100
ESE	20	60	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT44 - BASICS OF AUTOMOTIVE ELECTRICAL AND ELECTRONICS

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Introduction to Engineering	4	PC	3	0	0	3

UNIT – I		**9**
DC Circuits: Resistance- Resistors in Series and Parallel -Network Reduction -Voltage and Current Division Rule - Ohm's Law – Kirchhoff's Laws -Mesh Analysis of Simple Resistive Networks- Star and Delta Transformation – applications of DC voltage control in automotive.		
UNIT – II		**9**
AC Circuits: Alternating (Sinusoidal) Voltage and Current, R.M.S and Average Value, Power Factor, Form Factor and Peak Factor - AC Series Circuits -RL, RC & RLC. Introduction to three phase Systems (Qualitative only): Line and Phase Voltage/Current - applications of AC voltage control in automotive.		
UNIT – III		**9**
Semi-Conductor Devices: Conductors, Semiconductors and Insulators - Properties of Semiconductors - PN Junction Diode - Rectifiers and Filters - Zener Diode - LEDs - Transistors: Principle of Operation - Static Characteristics - CE Transistor as an Amplifier and Switch - Concept of relay logic diagram for electrical vehicles.		
UNIT – IV		**9**
Digital Electronics: Boolean Algebra - Number systems - Complements - Boolean postulates and laws - De-Morgan's Theorem - Minimization of Boolean expressions - Canonical forms - Karnaugh map - Logic Gates -Implementations of Logic Functions using universal Gates – Door open/close checking with logic gates.		
UNIT – V		**9**
Operational Amplifier: Introduction - Ideal operation amplifier - Inverting amplifier - Non-inverting amplifier - Voltage follower - Differential amplifier - Scale changer - Summer - Instrumentation amplifier.		

Total:45

TEXT BOOK:

1. Bhattacharya S.K., "Basic Electrical and Electronics Engineering", 2nd Edition, Pearson India Education Services Pvt. Ltd., India, 2017.

REFERENCES:

1. Salivahanan S. and Arivazhagan S., "Digital Circuits and Design", 4th Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2018.
2. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th Edition, Pearson Education, India, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	calculate voltage and current measurements in DC Circuits for automotive applications	Applying (K3)
CO2	describe about AC Circuits in automotive applications	Understanding (K2)
CO3	explain the operation of semi-conductor devices and its applications in automobiles	Understanding (K2)
CO4	Illustrate and apply the fundamentals digital electronics in automotive applications	Applying (K3)
CO5	discuss the working of operational amplifier and its types in detail	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2											3
CO2	3	2	1											2
CO3	3	2	1											2
CO4	3	3	2											3
CO5	3	2	1											2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	80					100
CAT3	10	45	45				100
ESE	15	45	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT45 - HYDRAULICS AND PNEUMATICS

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mechanics of Fluids and Hydraulic Machines	4	PC	3	0	0	3
Preamble	To expose the students to the technology that deals with the generation, control and transmission of power using pressurized fluids and to design a setup for low cost Automation in the automobile field.						

UNIT – I		**9**
Hydraulics System Fundamentals and Pumps: Review of Fluid Mechanics - Basics of fluid power system - Advantages and Applications of Fluid Power Systems. Hydraulic pumps: Pumping theory -Gear, Vane, Screw pump, Lobe and Piston pumps, Pump Performance, Characteristics and Selection - Sizing of pumps.		
UNIT – II		**9**
Hydraulic Actuators: Hydraulic cylinders: Single acting and double acting cylinders, Special type cylinders: Rodless, Tandem and Telescopic Cylinders - Calculation of cylinder force - Hydraulic Motors: Gear and vane motors.		
UNIT – III		**9**
Hydraulic Valves: Direction control valves: Three way valve, Four way valve, Check valve and shuttle valve - Actuation mechanisms in DCV - Pressure control valves: Pressure Relief, Pressure Reducing, Counter Balance, Sequencing and Unloading Valves - Flow control valves and its types - Proportional Valves - Servo Valves: Mechanical type and Electro Hydraulic Servo Valves.		
UNIT – IV		**9**
Pneumatic System and Actuators: Review of Gas Laws and Compressor - Fluid Conditioning Elements: Filter Regulator and Lubricator unit, Pneumatic silencers, After coolers, Air dryers - Air control valves - Fluid Power Actuators: Linear and Rotary actuators - Types - Cushioning mechanism in cylinders - Sizing of Actuators.		
UNIT – V		**9**
Industrial Circuits and Maintenance: Construction of Hydraulic Circuits - Counter Balance Circuit - Fail Safe Circuit - Regenerative Circuit - Pressure Intensifier Circuits - Accumulator Circuits. Construction of Pneumatic Circuits: Cascade Method - Sequence Circuit. Electro-Pneumatic Circuit - Basics of Fluidics. Sealing devices: Types and materials - Safety aspects in Fluid Power System, Installation, Maintenance and troubleshooting of Fluid Power Systems.		

Total:45

TEXT BOOK:

1. Anthony Esposito, "Fluid Power with Application", 7th Edition, Pearson Education Ltd, New Delhi, 2013.

REFERENCES:

1. Srinivasan R, "Hydraulic and Pneumatic Controls", 2nd Edition, McGraw-Hill Education Pvt. Ltd. , New Delhi, 2008.
2. Andrew Parr, "Hydraulics and Pneumatics", 7th Edition, Jaico Publishing House , Mumbai, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the working and selection of hydraulic pumps for industrial applications	Understanding (K2)
CO2	exemplify the operation of different hydraulic cylinders and motors	Understanding (K2)
CO3	discuss the working of different types of hydraulic vales and their applications	Understanding (K2)
CO4	illustrate the construction and working principles of different types of compressors and FRL and the valves Involved in pneumatic circuit	Understanding (K2)
CO5	design the hydraulic and pneumatic circuits for various applications using cascade method and explain the significance of fluid power circuit for various applications and maintenance	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											1	
CO2	3	1											1	
CO3	3	1											1	
CO4	3	1											1	
CO5	2	3	2										2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	80					100
CAT3	10	60	30				100
ESE	10	70	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUL41 - MECHANICS OF DEFORMABLE BODIES LABORATORY

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Statics and Dynamics, Mathematics I & II.	4	PC	0	0	2	1
Preamble	This course provides knowledge to evaluate structural performance of engineering structure due to various forms of external loads by analyzing stresses, strains and deformations by conducting experiments						

List of Experiments:	
1.	Tension test on a mild steel rod
2.	Double shear test on Mild steel and Aluminum rods
3.	Torsion test on mild steel rod
4.	Impact test on metal specimen (Izod and Charpy Test)
5.	Deflection test on cantilever beam and simply supported beam (Aluminum, Steel and Wood)
6.	Test on Helical springs (open and closed coil)
7.	Preparation and determination of compressive strength shear strength of green sand and dry sand
8.	Sieve analysis – Determination of AFS fineness number
9.	Rockwell and Brinell hardness measurement for different materials
10.	Microstructure of Grey cast-iron and eutectoid steel

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	analyze the properties and mechanical behavior of structural components	Analyzing (K4), Manipulation (S2)
CO2	demonstrate the preparation and testing of molding sands	Applying (K3), Manipulation (S2)
CO3	examine microstructure and analyze various metals and alloys	Analyzing (K4), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3			1								3	
CO2	3	2			1								1	
CO3	3	1			1								1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUL42 - AUTOMOTIVE CHASSIS COMPONENTS LABORATORY

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automobile Engineering	4	PC	0	0	2	1
Preamble	This course provides knowledge of construction, components, types, working, advantages and limitations of different automotive chassis and its components.						

List of Experiments:

1. Study and Measurement of Light and Heavy Commercial Vehicle Frame
2. Study the layout of steering systems with different Steering gearboxes
3. Dismantling and Assembling of Transfer case
4. Dismantling and Assembling of Constant Velocity Joint(Front Axles)
5. Dismantling and Assembling of Clutch
6. Dismantling and Assembling of Sliding mesh gear box
7. Dismantling and Assembling of Constant mesh gear box
8. Dismantling and Assembling of Synchromesh gear box
9. Dismantling and Assembling of Differential
10. Dismantling and Assembling of Rear Axle
11. Dismantling and Assembling of Braking system
12. Dismantling and Assembling of suspension system
13. Study of Automatic transmission system

Total:30

REFERENCES/MANUAL/SOFTWARE:

1. Tom Denton., "Automotive Technician Training: Theory", 1st Edition, Routledge, London, 2016.
2. Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	dismantle and assemble braking and steering systems in a vehicle	Applying (K3), Manipulation (S2)
CO2	dismantle and assemble transmission and drive line systems in a vehicle	Applying (K3), Manipulation (S2)
CO3	repair and recondition suspension system of a vehicle	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1			1								1	
CO2	2	1			1								1	
CO3	2	1			1								1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUL43 - BASICS OF AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Introduction to Engineering, Engineering Practices Laboratory	4	PC	0	0	2	1
Preamble	This course is intended to acquire practical knowledge about the working of electrical and electronic components.						

List of Experiments:

1. Basic measurements of DC and AC signals for automotive applications
2. Design and implementation of voltage divider circuit for automotive applications
3. Design and execution of two way switch for AC supply in automotive applications
4. Characteristics of PN junction diode
5. Characteristics of Half Wave and Full Wave rectifiers
6. Characteristics of Zener diode
7. Input and output characteristics of transistor under CE configuration
8. Design and implementation of relay logic circuit for automobile application
9. Verification of Boolean theorems using digital logic gates
10. Linear Op-Amp circuits - Inverting and Non inverting Amplifiers

Total:30

REFERENCES/MANUAL/SOFTWARE:

1. Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	analyze the characteristics of electrical and electronic components	Applying (K3), Precision (S3)
CO2	develop and execute the electronic circuits for automobile applications	Applying (K3), Precision (S3)
CO3	design and implement the op-amp circuit for signal conditioning applications	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1			2									3
CO2	3	1			1									3
CO3	3	1			1									3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18EGL31 ENGLISH FOR WORKPLACE COMMUNICATION

(Common to all Engineering and Technology branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	HS	0	0	2	1
Preamble	This course is designed to impart required levels of fluency in using the English Language at B2 level in the CEFR through activities, hands-on training and application.						

Language Practice Domains:	
1. Listening	**6**
Techniques for effective listening - Listening and note taking - Listening activities using listening texts - Listening to discourse samples of native English speakers – Focussed listening for improving pronunciaition - understanding different accents.	
2. Reading	**6**
Developing reading skills - Reading aloud - Group reading activities - Reading with correct word stress and intonation.	
3. Soft Skills	**6**
Attitude - Goal setting - Time Management - Team Work - Telephonic conversation skills.	
4. Writing	**6**
Making preparatory notes, drafts and PPT's for laboratory activities - Word editing features - editing and proof reading.	
5. Speaking	**6**
Verbal and non-verbal communication - Introducing oneself - Introducing others – Mock Interviews - Making presentations on chosen topics - Group Discussion.	

Total:30

REFERENCES/MANUAL/SOFTWARE:

1. Sanjay Kumar & Pushp Lata, "Communication Skills", 2nd Edition, Oxford University Press, New Delhi, 2017.
2. Laboratory Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	acquire effective listening and reading skills	Understanding (K2), Imitation (S1)
CO2	acquire and demonstrate appropriate professional skills for the workplace	Applying (K3), Naturalization (S5)
CO3	speak fluently and write meaningfully in English in the given context	Applying (K3), Articulation (S4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									2	3		3		
CO2									2	2		2		
CO3									2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUT51 - AUTOMOTIVE ELECTRICAL SYSTEMS

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automotive Electrical and Electronics	5	PC	3	0	0	3

Preamble	This course provides knowledge on automobile wiring, charging and starting systems with various control strategies.	
Unit - I	**Electrical Wiring and Components:**	**9**
Introduction – Electrical wiring, terminals and switching devices. Output Devices: Relays – Relay logic diagram – Contactors – OLR – DOL Starter – MCB – Fuses – Timer – Counter -Vehicle interior and exterior lighting systems - horn circuit - wiper circuit - power window circuit and central locking circuit.		
Unit - II	**Charging and Starting System:**	**9**
Requirements of charging system – Charging system principles – Alternators and charging circuits. Starting system circuits – starter motor types – characteristics – drive mechanisms – capacity requirements – servicing and troubleshooting.		
Unit - III	**Ignition System:**	**9**
Magneto coil ignition system - Battery coil ignition system – Electronic – Programmed - Distributor less ignition systems - spark advance and retard mechanisms - Types of spark plugs.		
Unit - IV	**Power Electronic Devices:**	**9**
Concept of Power Electronics – Power electronic systems – Power Semiconductor Devices – Principle of operation – Steady state and switching characteristics of Power diodes - Power BJT - Power MOSFET - IGBT – Firing circuit for Thyristor – Steady state and switching characteristics of SCR – Two transistor model of SCR – DIAC – TRIAC – GTO.		
Unit - V	**Electric Motor Drives:**	**9**
Introduction - DC to DC converters – Boost converter and Buck converter - Single phase and three phase DC to AC convertors - AC induction motor and control - BLDC motor and control - Plug in battery charger design. Stepper Motor and Control - Servo Motor and control - Permanent Magnet Synchronous Motor and control and Switched Reluctance Motors and control.		

Total: 45

TEXT BOOK:

1. Tom Denton, "Automobile Electrical and Electronic Systems", 5th Edition, Routledge, United Kingdom, 2017 for Units I, II, III.
2. Rashid M.H., "Power Electronics: Circuits Devices and Applications", 3rd Edition, Pearson Education, New Delhi, 2014 for Units IV, V.

REFERENCES:

1. Wei Liu, "Introduction to Hybrid Vehicle System Modeling and Control", 1st Edition, Wiley, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the vehicle wiring harness, working of filed devices and circuit diagrams for various sub systems	Understanding (K2)
CO2	illustrate the circuit diagram for starting and charging system with characteristics of starter motor and alternator	Understanding (K2)
CO3	explain the various ignition systems with advance and retard mechanisms	Understanding (K2)
CO4	describe various power electronic devices with characteristics and functions	Understanding (K2)
CO5	discuss types of electric motors with different control strategies	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2									1		3
CO2	3	2	2									1		3
CO3	3	3	2									1		3
CO4	3	3	3									1		3
CO5	3	2	3									1		3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80					100
CAT2	30	70					100
CAT3	30	70					100
ESE	20	80					100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

18AUT52 - AUTOMOTIVE SENSORS AND CONTROLLERS

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automotive Electrical and Electronics	5	PC	3	0	0	3

Preamble	This course provides knowledge on concept and working of various sensors, transducers and microprocessor which finds the extensive application in the field of automobile.	
Unit - I	**Introduction to Measurement Systems:**	**9**
Methods of Measurement - Classification of Instruments - Functional elements of Measurement System - Static and dynamic characteristics - Types of Errors - Classification of transducers - Selection of transducers.		
Unit - II	**Electrical Transducers:**	**9**
Resistive transducers - potentiometer, RTD, thermistor - thermocouple - strain gauge - inductive transducers – LVDT - RVDT - capacitive transducer - applications of electrical transducers in automobile.		
Unit - III	**Sensors and Signal Conditioning:**	**9**
Sensors: piezoelectric sensors - hall effect sensor – proximity sensors – optical sensors - lambda oxygen sensor - humidity sensor – applications. Signal Conditioning: data acquisition system - review of operation amplifiers - wheatstone bridge - multiplexers – ADC - DAC – types.		
Unit - IV	**Microprocessor 8085:**	**9**
Introduction to microprocessor and microcontroller – Automotive applications - Organization of microcomputer - Microprocessor 8085 architecture – pin configuration – registers - Memory Interfacing.		
Unit - V	**Microprocessor programming:**	**9**
Addressing modes - Immediate Addressing - Register Addressing- Direct Addressing - Register Indirect Addressing – Implied / Implicit Addressing - Instruction Sets - Data transfer group - Arithmetic group - Logical Group - Branch Group - Control group - Simple programs.		

Total:45

TEXT BOOK:

1. Sawhney A.K., "A Course in Electrical and Electronic Measurements and Instrumentation", Reprint Edition, Dhanpat Rai & Co. Pvt Ltd., New Delhi, 2015 for Units I, II, III.
2. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Penram International Publishing Pvt Ltd., Mumbai, 2013 for Units IV, V.

REFERENCES:

1. https://nptel.ac.in/courses/108/107/108107029/
2. https://nptel.ac.in/courses/108/105/108105102/

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the fundamentals, static and dynamic characteristics of transducers	Understanding (K2)
CO2	illustrate the working of electronic transducers and its automotive applications	Understanding (K2)
CO3	discuss the operation of automotive sensors and purpose of signal conditioning systems	Understanding (K2)
CO4	describe the architecture of 8085 microprocessor and its pin details	Understanding (K2)
CO5	write simple 8085 microprocessor programs	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2									1		3
CO2	3	2	2									1		3
CO3	3	2	2									1		3
CO4	3	3	3									1		2
CO5	3	3	3									1		3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	70					100
CAT2	20	80					100
CAT3	20	70	10				100
ESE	20	70	10				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT53 - VEHICLE DYNAMICS

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Statics and Dynamics	5	PC	3	1	0	4

Preamble	This course provides knowledge on road vehicle dynamics, stability & handling, relationship between vehicle design variables and vehicle dynamic behavior	
Unit - I	**Acceleration Performance:**	**9+3**
Introduction to Vehicle Dynamics - Fundamental approach to modeling - Vehicle fixed coordinate system - Earth fixed coordinate system - Dynamic and Static axle loads on level roads and grades. Acceleration Performance - Free body diagram of accelerating vehicle, maximum transferable tractive force, acceleration and gradeability.		
Unit - II	**Braking Performance:**	**9+3**
Deceleration Performance - Free body diagram of decelerating vehicle, brake force distribution, maximum decelerating rates, maximum braking force, stopping distance and braking efficiency. Consequence of wheel lock up.		
Unit - III	**Tyre Dynamics:**	**9+3**
Tyre forces and moments - Tyre axis system - Rolling resistance of a tyre - Tyre soil interaction - Conicity and ply steer. Cornering properties of tyres and camber thrust. Tire Models - Brush model, Magic formulae model and introduction to other models. Estimation of various tyre forces using Brush model and Magic formulae model.		
Unit - IV	**Handling Characteristics:**	**9+3**
Low speed cornering and static steering - Ackerman steering geometry. 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.		
Unit - V	**Ride Characteristics:**	**9+3**
Human response to vibration, Ride Models - Quarter car, Half car and Full car model. Semi-active and active suspension. Influence of suspension stiffness, suspension damping, and tyre stiffness. Control law for LQR, H-infinite and skyhook damping.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Wong J.Y, "Theory of Ground Vehicles", 4th Edition, John Wiley & Sons, New Jersey, 2008.

REFERENCES:

1. Thomas D. and Gillespie, "Fundamentals of Vehicle Dynamics", 1st Edition, SAE International, United States, 1992.
2. Hans Pacejka, "Tire and Vehicle Dynamics", 3rd Edition, Butterworth-Heinemann, United Kingdom, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	analyze the acceleration performance of a vehicle	Analyzing (K4)
CO2	analyze the braking performance of a vehicle	Analyzing (K4)
CO3	calculate the forces generated in a tyre by applying different models	Applying (K3)
CO4	assess the handling characteristics of a vehicle	Applying (K3)
CO5	estimate the ride characteristics of a vehicle	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3								1	2	
CO2	3	2	3	3								1	2	
CO3	3	3	2	2								1	2	
CO4	3	2	3	3								1	2	
CO5	3	2	2	3								1	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	13	17	53	17			100
CAT2	17	30	36	17			100
CAT3	20	27	53				100
ESE	7	20	56	17			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT54 - MECHANICS OF MACHINERY

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Statics and Dynamics	5	PC	3	1	0	4

Preamble	This course provides knowledge on kinematics of mechanisms and effect of balancing in different machine elements.	
Unit - I	**Basics of Mechanisms:**	**9+3**
Machine Structure - Kinematic link, pair and chain - Grueblers criteria - Constrained motion - Degrees of freedom - Slider crank and crank rocker mechanisms - Inversions - Applications - Kinematic analysis of simple mechanisms - Velocity and Acceleration of simple four bar and slider crank mechanism using relative velocity method.		
Unit - II	**Design of Cam Profile:**	**9+3**
Types of cams - Types of followers - Radial cam - Terminology of radial cam, Types of follower motions - Uniform motion, simple harmonic motion, constant acceleration / deceleration motion, cycloidal motion. Cam profile for knife edge, roller and flat faced follower - Graphical method.		
Unit - III	**Kinematics of Gear Trains:**	**9+3**
Classification of gear trains - Calculation of Gear ratio - Velocities of gears in gear trains such as Simple, Compound, Reverted and Epicyclic (using tabulation method) gear trains. Geometric progression - Standard step ratio - Ray diagram - Kinematics layout of sliding mesh and constant mesh gear box.		
Unit - IV	**Balancing:**	**9+3**
Static and dynamic balancing - Single and several masses in different planes - Balancing of reciprocating masses - Primary balancing and concepts of secondary balancing - Single and multi-cylinder engines (Inline) - Balancing of radial V engine - Direct and reverse crank method.		
Unit - V	**Vibration:**	**9+3**
Free, forced and damped vibrations of single degree of freedom systems - Force transmitted to supports - Vibration isolation - Vibration absorption - Torsional vibration of shaft - Single and multi-rotor systems - Geared shafts - Critical speed of shaft.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Rattan S.S., "Theory of Machines", 4th Edition, McGraw Hill Education, New Delhi, 2017.

REFERENCES:

1. Norton R.L., "Kinematics and Dynamics of Machinery", Special Indian Edition, McGraw Hill Education, New Delhi, 2017.
2. Shigley J.E., Pennock G.R., Uicker J.J. Cornwell & Sanjeev Sanghi, "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, Oxford, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	calculate the velocity and acceleration of various links of simple mechanisms	Applying (K3)
CO2	design cam profile for different follower motions	Analyzing (K4)
CO3	solve and evaluate the kinematics aspects of gears and gear trains	Analyzing (K4)
CO4	solve and plot the static and dynamic balancing of various mechanical systems	Analyzing (K4)
CO5	evaluate and analyze the free and forced vibrations for different applications	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2								1	3	
CO2	3	3	2	2								1	3	
CO3	3	3	2	2								1	3	
CO4	3	2	1	2								1	3	
CO5	3	3	2	2								1	3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	8	42	50				100
CAT2	10	50	40				100
CAT3	10	24	50	16			100
ESE	8	42	35	15			100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

18AUL51 - AUTOMOTIVE ELECTRICAL SYSTEMS LABORATORY

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automotive Electrical and Electronics Laboratory	5	PC	0	0	2	1
Preamble	This course provides knowledge to understand the operation and working characteristics of automotive electrical components						

List of Exercises / Experiments:

1.	Design and development of lighting circuits
2.	Design and development of horn circuit and tuning
3.	Design and implementation of wiper motor circuit
4.	Hardware implementation of power window and central locking system
5.	Performance test on batteries
6.	Fault identification and characteristic analysis of charging system
7.	Fault finding and characteristic analysis of starting system
8.	Speed control of induction motor
9.	Position control of stepper motor
10.	Performance analysis of BLDC motor

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	design and implement electrical circuits for automotive applications	Applying (K3), Manipulation (S2)
CO2	analyze the characteristics and diagnose the faults in charging and starting systems	Applying (K3), Manipulation (S2)
CO3	carryout the conventional speed control techniques for AC and DC machines	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	3				1	1		1		3
CO2	3	2	1	2	3				1	1		1		3
CO3	3	2	1	2	3				1	1		1		3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUL52 - AUTOMOTIVE SENSORS AND CONTROLLERS LABORATORY

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automotive Electrical and Electronics Laboratory	5	PC	0	0	2	1
Preamble	This course provides knowledge about the characteristics of sensors, transducer and working of microprocessor.						

List of Exercises / Experiments:

1.	Measurement of temperature using Thermistor / RTD.
2.	Measurement of temperature using Thermocouple.
3.	Measurement of displacement using Potentiometer, LVDT and Capacitive transducer.
4.	Torque/ Strain Measurement using Strain Gauge.
5.	Force measurement using Load Cell.
6.	Flow measurement using Orifice Meter.
7.	Level measurement using Capacitive type level Gauge.
8.	Speed measurement using Encoder and Opto-coupler.
9.	8-bit Addition and subtraction of two numbers using 8085 microprocessor.
10.	8-bit Multiplication and division using 8085 microprocessor.

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	evaluate the characteristics of various sensors in the measurement system	Analyzing (K4), Precision (S3)
CO2	analyze the characteristics of various transducers in the measurement system	Analyzing (K4), Precision (S3)
CO3	develop the 8085-microprocessor program for arithmetic operations	Analyzing (K4), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		2				1	1		1		3
CO2	3	2	1		2				1	1		1		3
CO3	3	2	1		2				1	1		1		3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUL53 - FUELS AND LUBRICANTS LABORATORY

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automobile Engineering	5	PC	0	0	2	1
Preamble	This course provides knowledge to analyze and characterize various properties of fuels by conducting experiments.						

List of Exercises / Experiments:

1.	Study of International and National standards for fuels and lubricants
2.	Study of Octane and Cetane number of fuels
3.	Aniline point test of diesel fuel
4.	Calorific value of gaseous fuel
5.	Calorific value of liquid fuel
6.	Reid vapour pressure test
7.	Copper strip corrosion Test
8.	Temperature dependence of viscosity of lubricants and fuels by Redwood Viscometer
9.	Viscosity Index of lubricants and fuels by Saybolt Viscometer
10.	Ash content and Carbon Residue Test

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	characterize the fuels and lubricants used in automobiles	Analyzing (K4), Manipulation (S2)
CO2	measure the properties of fuels and lubricants	Applying (K3), Manipulation (S2)
CO3	perform an in-depth analysis related with any fuel / lubricant	Analyzing (K4), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		3				1	1		1	1	
CO2	3	2	1		2				1	1		1	1	
CO3	3	2	1		2				1	1		1	1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18GEL51 - PROFESSIONAL SKILLS TRAINING I
(Common to all BE/ BTech / MSc /MCA /BSc Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	EC	0	0	80	2

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit - I	**Soft Skills – I:**	**20**
Soft skills and its importance: Pleasure and pains of transition from an academic environment to work environment-Need for change- Fear, stress and competition in the professional world-Importance of positive attitude- Self motivation and continuous knowledge upgradation-Self-confidence. Professional grooming and practices: Basics of corporate culture-Key pillars of business etiquette- Basics of etiquette-Introductions and greetings-Rules of the handshake, earning respect, business manners-Telephone etiquette- Body Language.		
Unit - II	**Quantitative Aptitude & Logical Reasoning – I:**	**30**
Problem solving level I: Number System-LCM &HCF-Divisibility test-Surds and indices-Logarithms- Ratio-proportions and variation-Partnership-Time speed and distance-Data interpretation-data representation. Logical reasoning: Family tree-Deductions-Logical connectives-Binary logic Linear arrangements- Circular and complex arrangement		
Unit - III	**Written Communication & Verbal Aptitude :**	**30**
Writing Skills: Writing strategies and formats – Importance of Résumés – Writing a Cover letter – Writing a fresher's CV / Résumés – Responding to Job Advertisements – Professional e-mail Writing – Responding to e-mails and business letters – Technical Report writing – Interpretation of Technical Data (Transcoding) – Writing One-page Essays. Verbal Aptitude – Synonyms – Antonyms – Homonyms – One word substitution – Idioms and Phrases – Paired words – Analogies – Spelling test – Cloze test – using suitable verb forms – using appropriate articles and prepositions; Spotting Errors – Sentence Correction and Formation – Grammar Based questions (Transformation : Active-Passive & Direct-Indirect); Rearranging Jumbled Sentences & Jumbled paragraphs, Identifying Facts, Inferences and Judgements statements.		

Total: 80

TEXT BOOK:

1	Thorpe, Showick and Edgar Thorpe, "Objective English For Competitive Examination", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1	Bailey Stephen, "Academic Writing: A practical guide for students", Routledge, New York, 2011.
2	Raman, Meenakshi and Sharma, Sangeeta**,** "Technical Communication - Principles and Practice", 3rd Edition, Oxford University Press, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individual and as a team	Applying (K3), Precision (S3)
CO2	solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	apply communication skills effectively to understand and deliver information in various written discourses grammatically with accuracy	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs													
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2				3	3		3		3	2		
CO2	3	2				3	3		3		3	2		
CO3		2				3	3		3	3	3	2		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	50	30				100
CAT2		50	50				100
CAT3		50	50				100
ESE	**NA**						

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GET51 - UNIVERSAL HUMAN VALUES
(Common to all BE/BTech branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	MC	2	0	0	2

Preamble	To make the student to know what they 'really want to be' in their life and profession, understand the meaning of happiness and prosperity for a human being. Also to facilitate the students to understanding of harmony at all the levels of human living, and live accordingly	
Unit - I	**Introduction:**	**9**
Need and Basic Guidelines of Value Education – Content and Process of Value Education – Self Exploration – purpose of self-Exploration – Content and Process of Self exploration – Natural Acceptance – Realization and Understanding – Basic Human Aspirations – Continuous Happiness and Prosperity – Exploring Happiness and Prosperity – Basic Requirement for Fulfillment of Human Aspirations – Relationships – Physical Facilities – Right Understanding.		
Unit - II	**Harmony in the Self and Body:**	**9**
Human Begin and Body – Understanding Myself as Co–existence of Self ('I') and Body, Needs of the Self and Body, Activities in the Self and Body, Self ('I') as the Conscious Entity, the Body as the Material Entity – Exercise – Body as an Instrument– Harmony in the Self ('I) – Understanding Myself – Harmony with Body.		
Unit - III	**Harmony in the Family and Society:**	**9**
Harmony in the Family – Justice – Feelings (Values) in Human Relationships – Relationship from Family to Society – Identification of Human Goal – Five dimensions of Human Endeavour.		
Unit - IV	**Harmony in Nature and Existence:**	**9**
Order of Nature – Interconnectedness – Understanding the Four order – Innateness – Natural Characteristic – Basic Activity – Conformance – Introduction to Space – Co–existence of units of Space – Limited and unlimited – Active and No–activity – Existence is Co–existence.		
Unit - V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics:**	**9**
Values in different dimensions of Human Living – Definitiveness of Ethical Human Conduct –Implications of Value based Living – Identification of Comprehensive Human Goal – Humanistic Education – Universal Human Order – Competence and Issues in Professional Ethics.		

Total: 45

TEXT BOOK:

1. Gaur R.R., Sangal R., Bagaria G.P., "A Foundation Course in Human Values and Professional Ethics", 1st Edition, Excell Books Pvt. Ltd., New Delhi, 2016.

REFERENCES:

1. Ivan Illich, "Energy & Equity", The Trinity Press, USA, 1974.
2. Schumacher E.F., "Small is Beautiful: a study of economics as if people mattered", Britain, 1973.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.	Understanding (K2)
CO2	distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co–existence of Self and Body.	Understanding (K2)
CO3	understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human–human relationships and explore their role in ensuring a harmonious society.	Understanding (K2)
CO4	understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.	Understanding (K2)
CO5	distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1		3						
CO2								2						
CO3						1		3						
CO4								2						
CO5								3						

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					100
CAT2	25	75					100
CAT3	NA						
ESE	NA						

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

18AUT61 - AUTOMOTIVE EMBEDDED SYSTEMS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Sensors and Controllers	6	PC	3	0	0	3

Preamble	This course deals with embedded system concepts, terminologies. Two different 8-bit microcontrollers are introduced with automotive applications.	
Unit - I	**Introduction to Embedded Systems:**	**9**
RISC and CISC machines - 89C51 Microcontroller hardware block diagram - Data and program memory mapping - Register organization - Basic concepts of I/O pins - Interfacing to external memory.		
Unit - II	**Microcontroller Programming:**	**9**
Instruction sets - Addressing modes - Assembly language programming - Addition, subtraction, multiplication and division. I/O port programming: LED - Seven segment display - Switch interfacing - Level triggering - Edge triggering - Timer and counter programming - Simple programs.		
Unit - III	**Communication with Peripherals:**	**9**
Liquid Crystal Display interfacing - Matrix keypad interfacing - Serial data communication - Applications - Interrupt programming - Hardware interrupt - Timer interrupt - External interrupt - Serial interrupt.		
Unit - IV	**Sensor Interfacing:**	**9**
Analog to digital converter - ADC 0808 with LM35 temperature sensor - Signal conditioning. Motor Interfacing: Relay logic - Pulse width modulation - Speed control of DC motor using PWM - Stepper motor interfacing with automotive applications.		
Unit - V	**Intelligent Automotive Systems:**	**9**
Introduction to 8-bit ATmega microcontroller - Simple programs - Serial UART interfacing - Servo motor interfacing with angle control - Object detection on car reverse using ultrasonic sensor - Recent automotive applications.		

Total:45

TEXT BOOK:

1. Muhammad Ali mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C – VTU", 2nd Edition, Pearson Education, New Jersey, 2011 for Units I,II,III,IV.
2. Culkin, Jody, and Eric Hagan, "Make: Learn Electronics with Arduino: An Illustrated Beginner's Guide to Physical Computing", 1st Edition, Maker Media, San Francisco, 2017 for Unit V.

REFERENCES:

1. https://nptel.ac.in/courses/108/105/108105102/
2. https://nptel.ac.in/courses/106/108/106108100/

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	comprehend the concepts of embedded systems	Understanding (K2)
CO2	write assembly language programs for 8051 microcontroller	Applying (K3)
CO3	communicate with various peripheral devices using 8051 microcontroller	Applying (K3)
CO4	interface the input and output devices with 8-bit microcontroller	Applying (K3)
CO5	examine intelligent automotive systems with 8-bit microcontroller	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									1		3
CO2	3	2	1									1		3
CO3	3	2	2									1		3
CO4	3	3	2									1		3
CO5	3	3	3									1		3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	10	40	50				100
CAT3	10	20	70				100
ESE	20	25	55				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT62 - DESIGN OF AUTOMOTIVE CHASSIS COMPONENTS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mechanics of Deformable Bodies	6	PC	3	1	0	4

Preamble	This course provides knowledge to design and analyze the various automotive components	
Unit - I	**Vehicle Frame and Suspension:**	**9+3**
Vehicle loads and chassis operating conditions – Moments and stresses on frame members – Design of frame for passenger and commercial vehicles – Design of leaf springs – coil springs and torsion bar springs.		
Unit - II	**Front Axle and Steering Systems:**	**9+3**
Analysis of loads – Moments and stresses at different sections of front axle – Determination of bearing loads at Kingpin and Wheel spindle bearings – Choice of Bearings – Torque steer components - Optimum design of steering tubes and linkages – Steering geometry errors and rebound – Design of front axle beam.		
Unit - III	**Design of Clutch and Gear Box:**	**9+3**
Torque capacity of clutch – Design of single plate clutch, multi-plate clutch, cone clutch, and centrifugal clutch –Design of clutch components – Gear train calculations – Calculation of gear ratios for acceleration, gradability and drawbar pull – Design of four, five and six-speed gearboxes.		
Unit - IV	**Drive Line and Real Axle:**	**9+3**
Design of propeller shaft – Design details of final drive gearing – Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings and design aspects of final drive.		
Unit - V	**Design of Braking System:**	**9+3**
Fundamentals – Calculations on stopping time and distance, weight transfer during braking - Brake linkages and actuating mechanisms – Design and analysis of brake shoes and friction pads. Optimization of drum and disc brake design – Hand brake types and its mechanism.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Giri N.K., "Automobile Mechanics", 8th Edition, Khanna Publications, New Delhi, 2014.

REFERENCES:

1. Khurmi R.S. & Gupta J.K., "A Text Book of Machine Design", 34th Edition, Eurasia Publishing House Pvt. Ltd., New Delhi, 2005.
2. Dean Averns, "Automobile Chassis Design Book", 2nd Edition, Kotelian Sky Press, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	design of vehicle frames and suspension systems	Applying (K3)
CO2	design and specify the shape the front axle and steering systems	Applying (K3)
CO3	design and analyze the various types of clutches and automotive gear boxes	Analyzing (K4)
CO4	design the rear axles and the drive lines in real time applications	Applying (K3)
CO5	design and analyze the various types of brakes for automotive application	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	2								1	3	
CO2	3	3	2	1								1	3	
CO3	3	2	2	1								1	3	
CO4	3	3	3	2								1	3	
CO5	3	2	3	2								1	3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	30	55				100
CAT2	10	30	60				100
CAT3	10	30	40	20			100
ESE	20	30	30	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUT63 - FINITE ELEMENT METHOD

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mechanics of Deformable Bodies	6	PC	3	1	0	4

Preamble	This course provides knowledge to apply finite element method in solving differential equations of structural and thermal systems	
Unit - I	**Fundamentals of Finite Element Analysis:**	**9+3**
Historical background - Matrix approach – Coordinates. Numerical simulation - Gauss Elimination based Solvers. FEA General procedure - Basic element shapes - Discretization process - Node Numbering Scheme - Interpolation - Weighted residual method - Ritz techniques. Application of FEA.		
Unit - II	**One Dimensional Problem:**	**9+3**
One Dimensional finite element modeling - Element Types - Linear Elements - Linear Element Shape Function - Finite Element Equation – Galerkin's method - Solid Mechanics - Heat transfer - pin fin and composite wall - Beam Element. Applications of Beam and Spring Problems.		
Unit - III	**Two Dimensional Problems:**	**9+3**
Introduction to 2-D Finite element modelling - Constant Strain Triangular - Finite element formulation - Shape Functions - strain displacement and stress strain relationship matrix - Plane Stress and Plane Strain - Temperature Effects. Applications of temperature effects on Piston and cylinder.		
Unit - IV	**Axisymmetric Continuum and Plane truss:**	**9+3**
Axisymmetric formulation - Element stiffness matrix and force vector - Body forces and temperature effects - Stress calculations - Boundary conditions - Applications to cylinders under internal or external pressures - Applications of plane truss. Analysis of a circular piston head using 2D axis symmetric elements.		
Unit - V	**Isoparametric Elements for Two Dimensional Continuum:**	**9+3**
Natural Co-ordinate Systems - Isoparametric elements - The four node quadrilateral - Shape functions - Element stiffness matrix and force vector - Jacobin matrix - Stress calculations - Numerical integration - Gauss Quadrature.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Rao S.S., "The Finite Element Method in Engineering", 6th Edition, Butterworth–Heinemann (An imprint of Elsevier), New Delhi, 2018.

REFERENCES:

1. Tirupathi R. Chandrupatla & Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", 4th Edition, Pearson Education, India, 2015.
2. Reddy J.N., "An Introduction to the Finite Element Method", 3rd Edition, McGraw Hill Education, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate finite element equations and solve engineering problems	Applying (K3)
CO2	solve and analyze 1D structural and heat transfer problems for different applications	Analyzing (K4)
CO3	evaluate and analyze 2D structural problems for different applications	Analyzing (K4)
CO4	solve on axisymmetric and plane truss problems	Applying (K3)
CO5	formulate and analyze isoparametric formulation and numerical integration	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2								1	3	
CO2	3	3	2	2								1	3	
CO3	3	3	2	2								1	3	
CO4	3	3	2	3								1	3	
CO5	3	3	2	3								1	3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	16	17	33	34			100
CAT2	16	17	16	51			100
CAT3	16	17	33	34			100
ESE	4	6	36	54			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUL61 - AUTOMOTIVE EMBEDDED SYSTEMS LABORATORY

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Sensors and Controllers Laboratory	6	PC	0	0	2	1
Preamble	This course provides hands on experience in interfacing of peripherals and programming of microcontrollers.						

List of Exercises / Experiments:

1.	Addition and subtraction using 89C51 microcontroller
2.	Multiplication and division using 89C51 microcontroller
3.	Interfacing of switch and LED with 89C51 microcontroller
4.	Seven segment display interfacing with 89C51 microcontroller
5.	LCD interfacing with 89C51 microcontroller
6.	Interfacing of ADC with 89C51 microcontroller
7.	DC Motor interfacing with 89C51 microcontroller
8.	Stepper motor interfacing with 89C51 microcontroller
9.	Interfacing of switch and LED with Arduino board
10.	Servo motor interfacing with Arduino board

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	write and execute programs for 8-bit microcontroller.	Applying (K3), Precision (S3)
CO2	interface various peripherals with 8-bit microcontroller.	Applying (K3), Precision (S3)
CO3	design microcontroller-based applications.	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2				1	1		1		3
CO2	3	2	2	2	2				1	1		1		3
CO3	3	2	2	2	2				1	1		1		3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUL62 - COMPUTER AIDED ANALYSIS LABORATORY

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mechanics of Deformable Bodies Laboratory	6	PC	0	0	2	1
Preamble	This course provides knowledge to evaluate structural performance of automobile components.						

List of Exercises / Experiments:

1.	Study of different commercial FEA tools used for design and analysis
2.	Design and analysis of piston crown
3.	Stress analysis of crankshaft
4.	Stress analysis of leaf spring
5.	Thermal analysis of cylinder liners
6.	Cam profile analysis
7.	Modal analysis of Aerofoil profile
8.	Design and analysis of torsion bar
9.	Design and analysis of chassis frames
10.	Stress analysis of composite body panels
11.	Design and analysis of connecting rod

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the boundary conditions with respect to FEA for the real physical problem	Analyzing (K4), Precision (S3)
CO2	solve structural, thermal and fluid problems in FEA and FVM using software packages	Analyzing (K4), Precision (S3)
CO3	validate the various FEA and FVM results based on theoretical or simulation results	Analyzing (K4), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3				1	1		1	1	
CO2	2	3	2	3	3				1	1		1	1	
CO3	2	3	2	3	3				1	1		1	1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUL63 - VEHICLE MAINTENANCE AND RECONDITIONING LABORATORY

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Power Train & Automotive Chassis	6	PC	0	0	2	1
Preamble	This course provides knowledge on maintenance and reconditioning of vehicle subsystems.						

List of Exercises / Experiments:

1.	Engine valve reconditioning and valve lapping
2.	Gasoline Engine Tuning: Ignition timing, valve gap, adjustment on carburetor and plugs
3.	Diesel Engine Tuning: Injection pressure, adjustment of injection pump and valves
4.	Engine fault diagnosis using On-board diagnostic (OBD) tool
5.	Compression and vacuum test in single and multi-cylinder engines
6.	Measurement of head illumination
7.	Fault diagnosis of automotive electrical systems
8.	Tyre removal, edge rotation and position rotation
9.	Wheel balance and wheel alignment of a car
10.	Fault diagnosis of transmission and drive line using two post lift
11.	Fault diagnosis of hydraulic braking system
12.	Fault diagnosis of Air Conditioning system

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	overhaul various types of engines	Applying (K3), Manipulation (S2)
CO2	rectify the faults in automotive electrical systems	Applying (K3), Manipulation (S2)
CO3	rectify the faults in automotive chassis components	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2		2	1			2	1		1	3	
CO2	1	1	2		2	1			2	1		1	3	
CO3	1	1	2		2	1			2	1		1	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18GEL61 PROFESSIONAL SKILLS TRAINING II
(Common to all BE/ BTech / MSc /MCA /BSc Branches)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	EC	0	0	80	2

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit - I	**Soft Skills – II**	**20**
Group discussions: Advantages of group discussions-Structured GD- Team work: Value of team work in organizations- Definition of a team, why team-Elements of leadership, disadvantages of a team, stages of team formation- Group development activities. Facing an interview: Foundation in core subject- industry orientation / knowledge about the company- professional personality-Communication skills-Activities before Interview, upon entering interview room, during the interview and at the end Mock interviews.		
Unit - II	**Quantitative Aptitude & Logical Reasoning - II**	**30**
Problem solving level II: Money related problems-Mixtures-Symbol base problem-Clocks and calendars-Simple-linear-quadratic and polynomial equations-Special, equations-Inequalities-Sequence and series-Set theory-Permutations and combinations-Probability-Statistics-Data sufficiency- Geometry-Trigonometry-Heights and distances-Co-ordinate geometry-Mensuration. Logical reasoning: Conditionality and grouping-Sequencing and scheduling- Selections-Networks:-Codes; Cubes-Venn diagram in logical reasoning-Quant based reasoning-Flaw detection- Puzzles-Cryptarithms.		
Unit - III	**Reading & Speaking Skills**	**30**
Reading: Reading comprehension– Effective Reading strategies – Descriptive, Inferential, & Argumentative reading passages – Identifying and locating factual information within a text – global reading/skimming for general understanding – selective comprehension / scanning for specific information – detailed comprehension / intensive reading – understanding the development of an argument – identifying the writer's attitude and opinions – Reading news articles in business magazines, newspapers – Reading notices and book reviews –Interpreting graphic data & Advertisements. Speaking: Mock Interviews –Self-Introduction – Sharing of Real Time Experience; Conversational Practices –Role Play – Short Talks / TED Talks –Extempore; Giving a Presentation on Various Topics – Technical / Non-Technical Topics – Project Review Presentation – Oratory and Effective Public Speaking; Pair Discussion – Group Discussion – The process of Group Discussion – Strategies to be adopted – Skills Assessed – Telephonic Conversations & Skills – Negotiating Skills.		

Total: 80

TEXT BOOK:

1	Thorpe, Showick and Edgar Thorpe, "Objective English For Competitive Examination", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1	Aruna Koneru, "Professional Speaking Skills," Oxford University Press India, 2015.
2	Thorpe, Showick and Edgar Thorpe, "Winning at Interviews," 5th edition, Pearson Education, India, 2013.
3	Rizvi, Ashraf M, "Effective Technical Communication," 2nd Edition, McGraw Hill Education India, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individual and as a team	Applying (K3), Precision (S3)
CO2	solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	apply reading and speaking skills effectively for various academic and professional purposes	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2				3	3		3		3	2		
CO2	3	2				3	3		3		3	2		
CO3		2				3	3		3	3	3	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2		50	50				100
CAT3		50	50				100
ESE	NA						

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUP61 - PROJECT WORK I PHASE I

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	EC	0	0	4	2

Total: 60

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	fulfill team roles assigned	Applying (K3)
CO2	communicate effectively	Applying (K3)
CO3	solve engineering problems involving current issues using modern tools	Applying (K3)
CO4	demonstrate the ability to apply the knowledge gained in the programme	Applying (K3)
CO5	recognize the global, economic and environmental issues associated with the project undertaken and the implications to the society	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO3	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18MBT71 – ENGINEERING ECONOMICS AND MANAGEMENT

(Common to All BE/BTech Engineering and Technology branches except Chemical Engineering)

Programme & Branch	B.E. & Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	HS	3	0	0	3

Preamble	The aim of the course is to create fundamental knowledge on management by introducing concepts like economics, national income, marketing, operations management, accounting principles etc.	
Unit - I	**Micro Economics:**	**9**
Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic activities and Income.		
Unit - II	**Macro Economics, Business Ownership and Management concepts:**	**9**
National Income and its measurement techniques. Inflation - Causes of Inflation – Controlling Inflation – Business Cycle. Forms of business – Ownership types. Management concepts: Taylor and Fayol's Principles – Functions of Management - Managerial Skills - Levels of Management - Roles of manager.		
Unit - III	**Marketing Management:**	**9**
Marketing - Core Concepts of Marketing - Four P's of Marketing - New product development – Intellectual Property rights (IPR), Product Life Cycle - Pricing Strategies and Decisions.		
Unit - IV	**Operations Management:**	**9**
Operations Management - Resources - Types of Production system - Site selection, Plant Layout, Steps in Production Planning and Control - Inventory - EOQ Determination.		
Unit - V	**Financial Management:**	**9**
Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting: Significance –Traditional and discounted cash flow methods.		

Total:45

TEXT BOOK:

1. Compiled by Department of Management Studies, Kongu Engineering College, "Economics and Management for Engineers", 1st Edition, McGraw Hill Education, Noida, 2013.

REFERENCES:

1. Geetika, Piyali Ghosh and Purba Roy Choudhury, "Managerial Economics", 3rd Edition, McGraw-Hill, New Delhi, 2018.
2. William J. Stevenson, "Operations Management", 14th Edition, McGraw-Hill Education, 2021.
3. William G. Nickels, James M. McHugh, Susan M. McHugh, "Understanding Business", 12th Edition, McGraw-Hill Education, New York, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify market equilibrium and interpret national income calculations and inflation issues	Applying (K3)
CO2	choose a suitable business ownership for their enterprise and illustrate managerial functions	Applying (K3)
CO3	infer marketing management decisions	Understanding (K2)
CO4	apply appropriate operation management concept in business situations	Applying (K3)
CO5	interpret financial and accounting statements and evaluate new proposals	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2			3		2	2	2	3	2	1	2
CO2		1	2			2	2	2	2	2	3	2	1	2
CO3	1	2	1			2		2	2	2	3	2	2	2
CO4	1	2	1			2		2	2	2	3	2	1	2
CO5	2	2				2		2	2	2	3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUP71 - PROJECT WORK I PHASE II

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	EC	0	0	8	4

Total: 90

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	fulfill team roles assigned	Applying (K3)
CO2	communicate effectively	Applying (K3)
CO3	solve engineering problems involving current issues using modern tools	Applying (K3)
CO4	demonstrate the ability to apply the knowledge gained in the programme	Applying (K3)
CO5	recognize the global, economic and environmental issues associated with the project undertaken and the implications to the society	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO3	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUP81 - PROJECT WORK II / INTERNSHIP

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	EC	0	0	12	6

Total: 180

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	fulfill team roles assigned	Applying (K3)
CO2	communicate effectively	Applying (K3)
CO3	solve engineering problems involving current issues using modern tools	Applying (K3)
CO4	demonstrate the ability to apply the knowledge gained in the programme	Applying (K3)
CO5	recognize the global, economic and environmental issues associated with the project undertaken and the implications to the society	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO3	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18AUE01 - ADVANCED THEORY OF IC ENGINES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Powertrain	6	PE	3	0	0	3

Preamble	To gather knowledge about recent trends in SI and CI engines, fuel injection systems related to its working components and engine modifications for using alternate fuels.	
Unit - I	**Combustion Principles:**	**9**
Thermodynamics, concepts of combustion – combustion equations, heat of combustion, theoretical flame temperature, chemical equilibrium and dissociation. Theories of combustion, Pre – flame reactions, Reaction rates, Laminar and Turbulent flame propagation in engines.		
Unit - II	**Gasoline and Diesel HCCI Combustion Engines:**	**9**
Conventional Gasoline Combustion, Effects of EGR, Techniques to HCCI operation in gasoline engines, Conventional Diesel Combustion, Overview of diesel HCCI engines, Techniques – Early Injection, Multiple injections, Narrow angle direct injection (NADI) concept.		
Unit - III	**HCCI Fuel Requirements and Combustion with Alternative Fuels:**	**9**
Introduction, Background, Diesel fuel HCCI, HCCI fuel ignition quality, Gasoline HCCI, HCCI fuel Specification, Fundamental fuel factors. Natural gas HCCI engines, CNG HCCI engines, methane/n – butane/air mixtures. DME HCCI engine – chemical reaction model, Combustion completeness, Combustion control system, Method of combining DME and other fuels, 'unmixedness' of DME/air mixture.		
Unit - IV	**Low Temperature and Premixed Combustion:**	**9**
Basic concept, Characteristics of combustion and exhaust emissions, modulated kinetics (MK) combustion – First and Second generation of MK combustion, Emission, performance improvement, RCCI combustion and emission.		
Unit - V	**Engine Modifications for Alternative Fuels:**	**9**
Alcohols, Vegetable Oils and Bio – Diesel, Bio – Gas, Natural Gas, Liquefied Petroleum Gas, Hydrogen, Properties, Suitability. Engine Modifications, Performance, Combustion and Emission Characteristics of SI And CI Engines using the Alternate Fuels.		

Total:45

TEXT BOOK:

1. John B. Heywood, "Internal Combustion Engine Fundamentals", 2nd Edition, McGraw Hill Education, New Delhi, 2017.

REFERENCES:

1. Ganesan V., "Internal Combustion Engines", 4th Edition, McGraw Hill Education, New Delhi, 2017.
2. Patterson D.J. & Henein N.A., "Emissions from combustion engines and their control", Illustrated Edition, Ann Arbor Science Publishers, USA, 1972.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the importance of combustion principles with various characteristics	Applying (K3)
CO2	Illustrate the homogenous charge compression ignition performance with various injection techniques	Applying (K3)
CO3	describe about HCCI fuel with alternate fuels used for novel combustion	Applying (K3)
CO4	exemplify the performance and possible outcomes of low temperature and premixed combustion technology	Applying (K3)
CO5	discuss about the engine modification for alternative fuels	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1									3	
CO2	3	2	1	1									3	
CO3	3	2	1	1									3	
CO4	3	2	1	1									3	
CO5	3	2	2	1									3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	46	40	14				100
CAT2	35	45	20				100
CAT3	43	40	17				100
ESE	45	40	15				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE02 - OFF ROAD VEHICLES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	PE	3	0	0	3

Preamble	This course provides knowledge on various off road vehicles their systems, mechanisms and features.	
Unit - I	**Earth Moving Equipment:**	**9**
Constructional details and features: Dumpers – Types of dumper - Loader – Types of loader – Bulldozers – Excavator – Types of excavator - Bush cutters – Stumpers - Tree dozer – Rippers.		
Unit - II	**Scrappers, Graders, Shovels and Ditchers:**	**9**
Constructional details and features: Scrappers – Types of scrapper – Graders - elevating graders, motor graders - Power shovel - revolving and stripper shovels - Capacity of shovels - Drag lines – Ditchers.		
Unit - III	**Farm Equipment:**	**9**
Classification of tractors - Main components of tractor - Working attachment of tractors - Auxiliary equipment - Trailers and body tipping mechanism - Ploughing - Paddy plantation and harvesting machines, sugarcane harvesting and Power trailers.		
Unit - IV	**Military and Combat Vehicles:**	**9**
Ride and stability characteristics - Power take off - Special Implementations - Special Features and constructional details of tankers - Gun carriers and transport vehicles - Bridge builders - Communication Vehicles.		
Unit - V	**Vehicle Systems and Features:**	**9**
Brake system and actuation - Disc caliper brakes and its types - Body hoist and bucket operational hydraulics - Hydro-pneumatic suspension cylinders - Power steering system - Kinematics for loader and bulldozer operational linkages - Safety features, safe warning system for dumper - Design aspects on dumper body, loader bucket.		

Total:45

TEXT BOOK:

1. Sharma S.C., "Construction Equipment and its Management", 6th Edition, Khanna Publishers, New Delhi, 2008 for Units I, II.
2. Wong J.Y., "Theory of Ground Vehicles", 4th Edition, John Wiley & Sons Inc., New Delhi, 2008 for Units III, IV, V.

REFERENCES:

1. George W. Green, "Special Use Vehicles: An Illustrated History of Unconventional Cars and Trucks Worldwide", McFarland & Company Inc. Publishers, Jefferson, North Carolina, 2003.
2. Nakra C.P., "Farm Machines and Equipments", Dhanpatrai Publishing Company Pvt. Ltd., New Delhi, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the constructional details and features of an earth moving equipment	Understanding (K2)
CO2	illustrate the constructional details and features of construction equipment	Understanding (K2)
CO3	describe the construction and working of farm equipment and harvesting machines	Understanding (K2)
CO4	discuss the construction details and features of military and combat vehicles	Understanding (K2)
CO5	explain the special systems and features involved in off road vehicles	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2									1	3	
CO2	3	2	2									1	3	
CO3	3	2	2									1	3	
CO4	3	2	2									1	3	
CO5	3	2	2									1	3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	70					100
CAT2	35	65					100
CAT3	25	75					100
ESE	30	70					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE03 - DESIGN OF AUTOMOTIVE ENGINE COMPONENTS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mechanics of Deformable Bodies	6	PE	3	0	0	3

Preamble	This course provides knowledge to design and analyze Internal Combustion Engine components	
Unit - I	**Design of Cylinder, Piston:**	**9**
Choice of material for cylinder and piston - Design considerations for cylinder and piston - Design of cylinder, piston, piston pin, piston rings, piston failures - Lubrication of piston assembly.		
Unit - II	**Design of Connecting Rod:**	**9**
Euler's - Rankine's formula for columns - Johnson formula - Material for connecting rod - Design considerations for connecting rod - Determining minimum length of connecting rod - Small end design, shank design, design of big end cap bolts.		
Unit - III	**Design of Crankshaft:**	**9**
Balancing of I.C. engines - Significance of firing order - Material for crankshaft - Design of crankshaft under bending and twisting - Balancing weight calculations - Development of short and long crank arms - Front and rear-end details.		
Unit - IV	**Design of Flywheels:**	**9**
Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. Engine flywheel - Stresses on the rim of the flywheels. Design of hubs and arms of the flywheel, turning moment diagram.		
Unit - V	**Design of Valves and Valve Train:**	**9**
Design aspects of intake and exhaust manifolds, inlet and exhaust valves, valve springs, tappets and valve train - Design of cam and camshaft - Design of rocker arm - Cam profile generation - design of pushrods.		

Total:45

TEXT BOOK:

1. Khurmi R.S. & Gupta J.K., "A Text Book of Machine Design", 14th Edition, Eurasia Publishing House Pvt. Ltd., 2005.

REFERENCES:

1. Giri N.K., "Automobile Mechanics", 1st Edition, Khanna Publications, New Delhi, 2014.
2. Jain R.K., "Machine Design", 2nd Edition, Khanna Publications, New Delhi, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	design engine cylinder and piston components	Applying (K3)
CO2	identify various forces acting on connecting rod and design connecting rod	Applying (K3)
CO3	design and analyze crankshaft for IC engines	Analyzing (K4)
CO4	calculate various parameters for designing flywheel in IC engines	Applying (K3)
CO5	evaluate dimensions of valve and valve train components	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2								1	3	
CO2	3	3	2	1								1	3	
CO3	3	2	2	1								1	3	
CO4	3	3	3	2								1	3	
CO5	3	2	3	2								1	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60				100
CAT2	10	30	50	10			100
CAT3	10	30	50	10			100
ESE	20	30	35	15			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE04 - DIESEL AND ELECTRIC LOCOMOTIVES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Electrical Systems & Vehicle Dynamics	6	PE	3	0	0	3

Preamble	This course provides knowledge on locomotive systems, modelling of traction, train dynamics and signaling & communications in locomotives.	
Unit - I	**Introduction to Locomotives:**	**9**
Types of locomotives – Wagon frames – Suspension elements – Bogies – Wheelsets and bearings – Brake systems – Coupling mechanisms – Standards and acceptance tests. Important parameters of locomotives. Power generation systems – Diesel engine and its systems – Electric power systems.		
Unit - II	**Traction System and Control:**	**9**
Diesel-Electric locomotives with AC and DC traction system. Electric locomotives with AC and DC traction system. Traction generators and alternators. Traction motor operating principles. Control of traction motors – Control strategies for AC, DC, Synchronous and Induction traction motors.		
Unit - III	**Train Dynamics:**	**9**
Train models – Rail load model – Rail connection model – Interaction of longitudinal and vertical train dynamics – Energy considerations – Starting the train – Stopping the train – Topography issues – Traction pinch points – Cycle time.		
Unit - IV	**Traction Control Modelling:**	**9**
Adhesion control strategies and algorithms. Wheelset dynamics – Adhesion force modelling – Traction control modelling. Simplified traction control study – Locomotive and wagon parameters – Simulation scenarios – Constant speed mode and Acceleration mode simulation in MATLAB Simulink.		
Unit - V	**Signalling and Communications:**	**9**
Signalling and interlocking - Speed signalling – Centralizing signal boxes – Solid-state control systems for locomotives - Brown-Boveri System – Radio communications, signalling and control – Automatic warning, control and driving systems on main line railways.		

Total:45

TEXT BOOK:

1. Maksym Spiryagin, Peter Wolfs, Colin Cole, Valentyn Spiryagin, Yan Quan Sun & Tim McSweeney, "Design and Simulation of Heavy Haul Locomotives and Trains", 1st Edition, CRC Press, New Delhi, 2016.

REFERENCES:

1. Brian Solomon, "The American Diesel Locomotives", 1st Edition, Motorbooks International, United States of America, 2000.
2. Duffy M.C., "Electric Railways, 1880-1990", Illustrated Reprint Edition, Institution of Engineering and Technology, Kerala, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	summarize different subsystems and power generation systems in locomotives	Understanding (K2)
CO2	compare and explain various traction control systems with control strategies	Understanding (K2)
CO3	model mathematical equations using fundamental principles by considering train dynamics	Applying (K3)
CO4	model and simulate traction control systems for various scenarios with different control strategies and algorithms	Analyzing (K4)
CO5	outline signalling, communications and control systems in locomotives	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								1	2	
CO2	3	2	1	1								1	2	
CO3	3	2	2	2								1	2	
CO4	3	3	2	2								1	2	
CO5	3	1	1	1								1	1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	17	83					100
CAT2	10	56	34				100
CAT3	10	40	34	16			100
ESE	30	46	16	8			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE05 - COMPUTER INTEGRATED MANUFACTURING

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Manufacturing Processes	6	PE	3	0	0	3

Preamble	This course enables to understand about the manufacturing concepts, process planning, cellular manufacturing, FMS and Computer aided quality control methods.	
Unit - I	**Introduction:**	**9**
Introduction – Manufacturing Planning, Manufacturing control - Concurrent Engineering - CIM concepts – Computerized elements of CIM system –Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems. Basic Elements of an Automated system – Levels of Automation. Lean Production and Just-In-Time Production-Kanban System - Smart Factories, Industrial revolution – history - Features of Industry 4.0.		
Unit - II	**Production Planning & Control and Computerized Process Planning:**	**9**
Process Planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and Master Production Schedule – Material Requirement Planning – Capacity Planning - Control Systems - Shop Floor Control - Inventory Control. Brief on Manufacturing Resource Planning (MRP-II) and Enterprise Resource Planning (ERP) – Supply Chain Management (SCM) – Simple Problems.		
Unit - III	**Cellular Manufacturing:**	**9**
Group Technology(GT), Part Families – Parts Classification and Coding – Simple Problems in Opitz Coding system – Production Flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method – Arranging Machines in a GT cell – Hollier Method – Simple Problems.		
Unit - IV	**Flexible Manufacturing System (FMS) and Automated Guided Vehicle System (AGVS):**	**9**
Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance Technology – Vehicle Management & Safety. Automated Storage systems – Performance –Methods.		
Unit - V	**Computer Aided Quality Control:**	**9**
Computers in QC, Automated Inspection Methods and Principles, Contact Inspection Methods, Non-Contact Inspection Methods, Machine Vision System, Optical Inspection Method, Sensors, Co-ordinate Measuring Machine, Computer Aided Testing, Integration of CAQC with CAD/CAM.		

Total:45

TEXT BOOK:

1. Groover M.P., “Automation, Production System and Computer Integrated Manufacturing”, 4th Edition, Prentice-Hall of India, New Delhi, 2016.

REFERENCES:

1. Koren, Yoram, "Computer control of Manufacturing Systems", McGraw Hill, New Delhi, 2014.
2. Rao P.N., "CAD/CAM: Principles and Applications", 3rd Edition, McGraw Hill, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply CIM concepts in manufacturing industries	Understanding (K2)
CO2	develop a process plan and material requirement plan for a product	Applying (K3)
CO3	identify the parts by using different coding methods	Applying (K3)
CO4	design flexible manufacturing layout for a machine cell	Applying (K3)
CO5	utilize various computer aided quality control techniques and inspection techniques	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2								1	2	
CO2	3	2	1	3								1	2	
CO3	3	2	1	3								1	2	
CO4	3	2	2	2								1	2	
CO5	3	2	2	2								1	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	65	10				100
CAT2	20	60	20				100
CAT3	25	65	10				100
ESE	20	60	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE06 - DESIGN FOR MANUFACTURE AND ASSEMBLY

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PE	3	0	0	3

Preamble	This course explores the basis for concurrent engineering studies which is aimed to reduce manufacturing and assembly costs to quantify the improvements. It appears as an assessment tool to study competitors products to quantify manufacturing and assembly difficulties.	
Unit - I	**Tolerance Analysis:**	**9**
Tolerance Analysis: Geometric tolerances – Tolerance analysis – Worst case method – Assembly limits – Design and manufacturing datum – Conversion of design datum into manufacturing datum – Tolerance stacks – True position theory – Zero true position tolerance – Process capability.		
Unit - II	**Materials Selection and Design for Assembly:**	**9**
Materials Selection and Design for Assembly: Principal materials – Selection of materials and processes –Design – Possible solutions – Evaluation method. General design principles for manufacturability – General design guidelines for manual assembly – Assembly efficiency – Effects of part symmetry – part thickness and weight on handling time – Types of manual assembly methods – Design for high speed automatic assembly and robot assembly.		
Unit - III	**Design for Machining:**	**9**
Design for Machining: Design features to facilities machining – Single point and multipoint cutting tools – Choice and shape of work material – Accuracy and surface finish – Design recommendations for turning and milling operations: Process description – Suitable materials. Guidelines for machining of rotational and non-rotational components – Reduction of machined area – Design for clampability – Design for accessibility.		
Unit – IV	**Design for Injection Molding and Powder Metal Processing:**	**9**
Design for Injection Molding: Injection molding materials – The molding cycle – Molding systems and molds – Cycle time and mold cost estimation – Estimation of optimum number of cavities – Design guidelines for injection molding. Design for powder metal processing: Introduction to powder metal processing – Materials and manufacturing cost – Design guidelines for powder metal parts.		
Unit - V	**Design for Sand and Die Casting:**	**9**
Design for Sand and Die Casting: Sand casting alloys – Sand cores – Design rules for sand castings – Identification of uneconomical design – Modifying the design. Die casting alloys – The die casting cycle – Determination of number of cavities and appropriate machine size in die casting – Design principles for die casting.		

Total: 45

TEXT BOOK:

1. Boothroyd G, Dewhurst P & Knight W. A., "Product Design for Manufacture and Assembly", 3rd Edition, CRC Press, USA, 2013.

REFERENCES:

1. Peck Harry, "Designing for Manufacture", 1st Edition, Pitman Publications, London, 1983.
2. Bralla J.G., "Design for Manufacturability Handbook", 2nd Edition, McGraw Hill Education, New York, 1999.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	analyze the dimensions of components and identify the suitable geometrical tolerances for manufacturing oriented design	Analyzing (K4)
CO2	select suitable materials for components and demonstrate the design considerations for assembly in different applications	Applying (K3)
CO3	provide suitable design recommendations for various machining operations	Understanding (K2)
CO4	analyze the design for injection molded components and demonstrate recommendations for design for powder metal processing	Analyzing (K4)
CO5	identify uneconomical design to modify design for sand and die castings	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1							2	3	
CO2	3	2	1	1								2	3	
CO3	3	2	1	1								2	3	
CO4	3	3	2	2	1							2	3	
CO5	3	3	2	2	1							2	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	20	20			100
CAT2	20	40	20	20			100
CAT3	20	40	20	20			100
ESE	20	40	20	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE07 - AUTOMOTIVE CONTROL SYSTEM

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automotive Electrical And Electronics	7	PE	3	0	0	3

Preamble	This course provides knowledge on various systems modelling and control techniques in automobiles	
Unit - I	**Mathematical Modeling of Systems:**	**9**
Open loop and closed loop systems - Transfer function: Mechanical systems, Electrical systems and Electro mechanical systems - Block diagram reduction techniques -Signal flow graphs.		
Unit - II	**Time Response Analysis:**	**9**
System poles and zeros - First order system - Response for step, ramp and impulse signals. Second order system - Time domain specifications - Steady-state error constants - Position, velocity and acceleration error constants. Root-locus plots - Simple problems.		
Unit - III	**Frequency Response and Stability Analysis:**	**9**
Frequency domain specifications - Peak resonance, resonant frequency, bandwidth and cut-off rate. Stability in the frequency domain - Gain and Phase margins - Bode plot - Control systems design using frequency response. Stability analysis in time domain - Routh-Hurwitz criterion of stability - Lag, Lead and Lag - Lead Compensators design.		
Unit - IV	**State Variable Analysis:**	**9**
Introduction - General state space representation - Converting transfer function to state space and vice versa - Applications - Controllability - Controller design - Observability - Observer design.		
Unit - V	**Automotive Control Techniques:**	**9**
Proportional control - Integral control - Derivative control - PI and PID control actions - Tuning rules - Introduction to optimal control and rule based control techniques - Applications - Fuel Control - Spark - Timing Control - Idle - Speed Control - Cruise Control - Automatic transmission control - ABS control.		

Total:45

TEXT BOOK:

1. Nagrath I.J., & Gopal M., "Control System Engineering", 5th Edition, New Age International, New Delhi, 2009.

REFERENCES:

1. Norman S. Nise, "Control System Engineering", 6th Edition, John Wiley & Sons, 2010.
2. Ogata K., "Modern Control Engineering", 5th Edition, Pearson Education India, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the mathematical models for linear time-invariant systems of different sub systems in automobile engineering	Applying (K3)
CO2	model up a state-feedback controller using pole placement to meet transient response specification	Applying (K3)
CO3	apply the frequency domain analysis techniques to determine the system response and stability	Applying (K3)
CO4	identify the system elements and their representations in state space form	Applying (K3)
CO5	explain about the basics of vehicle control system design	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2								1		3
CO2	3	3	2	2								1		2
CO3	3	3	2	2								1		2
CO4	3	3	2	2								1		3
CO5	3	2	1	1								1		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	17	33	50				100
CAT2	17	50	33				100
CAT3	26	57	17				100
ESE	6	53	41				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE08 – PRINCIPLES OF FARM MACHINERIES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	This course explores the nature of soil conditions and principles of farm equipments	
Unit - I	**Introduction to Farm Machines and Soil:**	**9**
Introduction to Farm Machines: Objectives of Farm Mechanisms - Classification of Farm Machines - Materials for Construction of Farm Machines - Principles of Operation and Selection of Machines for Production of Crops - Field Capacities & Economics. Soil: Nature and Origin of Soil- Soil Forming Rocks and Minerals - Soil Classification and Composition - Soil Forming Processes.		
Unit - II	**Tillage:**	**9**
Tillage: Primary and Secondary Tillage Equipment - Forces Acting on Tillage Tools - Field Operation Patterns - Draft Measurement of Tillage Equipment - Earth Moving Equipment - Construction & Working Principles of Bulldozer - Trencher - Excavators - Sowing - Planting and Transplanting Equipment their Calibration and Adjustments.		
Unit - III	**Fertilizer Application Equipment:**	**9**
Fertilizer Application Equipment: Selection - Calibration - Construction Features - Different Components and Adjustment of Weed Control - Plant Protection Equipment - Sprayers and Dusters.		
Unit - IV	**Principles and Types of Cutting Mechanisms:**	**9**
Principles and Types of Cutting Mechanisms: Construction and Adjustments of Shear and Impact Type Cutting Mechanisms - Crop Harvesting Machinery: Mowers - Windrowers - Reapers - Reaper Binders and Forage Harvesters - Forage Chopping and Handling Equipment - Threshing Mechanics - Types of Threshers - Straw Combines - Grain Combines - Maize Harvesting - Shelling Equipment - Root Crop Harvesting Equipment - Cotton Picking and Sugarcane Harvesting Equipment.		
Unit - V	**Principles of Harvesting Tools and Machines:**	**9**
Principles of Harvesting Tools and Machines: Horticultural Tools and Gadgets - Testing of Farm Machine - Test Codes and Procedure - Interpretation of Test Results - Selection and Management of Farm Machines for Optimum Performance - Workplace Layout for Men and Women.		

Total: 45

TEXT BOOK:

1. Kepner R. A., Bainer Roy and Barger E. L, "Principals of Farm Machinery", 3rd Edition, CBS Publishers and Distributors, New Delhi, 2017.

REFERENCES:

1. Bosoi E.S., "Theory, Construction and Calculation of Agricultural Machines", 1st Edition, Oxonion Press Pvt. Ltd., New Delhi, 1990.
2. Ghosh P.K. and Swain S., "Practical Agricultural Engineering", 1st Edition, NayaProkash, Calcutta, 1993.
3. Donnel Hunt, "Farm Machinery and Management", 10th Edition, Iowa State University Press, Ames, USA, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	describe the nature of soil condition and different types of farming equipments	Understanding (K2)
CO2	illustrate the working of tillage equipments	Applying (K3)
CO3	identify the fertilizer application equipments and explain its working construction	Applying (K3)
CO4	explain the cutting mechanisms for various crops	Applying (K3)
CO5	illustrate the principle of harvesting equipments for various crop	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1									1	2	
CO2	3	2	1									1	2	
CO3	3	2	1									1	2	
CO4	3	2	1									1	2	
CO5	3	2	1									1	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	50	30				100
CAT2	20	45	35				100
CAT3	20	45	35				100
ESE	20	45	35				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE09 - ALTERNATE FUELS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Powertrain	7	PE	3	0	0	3

Preamble	This course deals with various characteristics of alternate fuels and their performance in IC engines.	
Unit - I	**Environmental Issues:**	**9**
Energy scenario and environmental issues in India – Importance of alternate energy sources – Alternate energy sources for SI and CI Engines – Emission standards and measuring techniques.		
Unit - II	**Biodiesel:**	**9**
Biodiesel from edible and non-edible oils – Blending, emulsification, preheating and transesterification – Physical and chemical properties – Effects of biodiesel on performance, emission and combustion characteristics in diesel engines.		
Unit - III	**Alcohols:**	**9**
Production process of alcohol – Properties – Methods of using alcohols in CI and SI engines: Blending, dual fuel operation, fumigation, surface ignition and oxygenated additives – Performance, emission and combustion characteristics.		
Unit - IV	**Gaseous Fuels:**	**9**
Production of Biogas, Natural Gas and Liquefied petroleum Gas – Reactions – Viability – Economics – Physical and chemical properties – Engine modification – Performance and emission characteristics.		
Unit - V	**Hydrogen :**	**9**
Production – Storage – Properties – Safety issues – Engine Modifications – Performance, emission and combustion analysis.		

Total:45

TEXT BOOK:

1. Thipse S.S., "Alternative Fuels: Concepts, Technologies and Developments", Jaico Publishing House, 2010.

REFERENCES:

1. Ganesan V., "Internal Combustion Engines", 4th Edition, McGraw Hill Education, New Delhi, 2017.
2. SAE, "Alternative Fuels: Fuel Cells and Natural Gas", SAE, USA, 2000.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the needs of alternate fuels for automobiles	Understanding (K2)
CO2	infer the properties, combustion characteristics and emission parameters of various biodiesel	Applying (K3)
CO3	compare the performance and emission of engines when alcohol is used as a fuel in various methods	Applying (K3)
CO4	analyze the performance and emission parameters of IC engines for various gaseous fuels	Applying (K3)
CO5	relate the different methods of using hydrogen in IC engines with performance and emission parameters	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1								1	3	
CO2	3	2	2	1								1	3	
CO3	3	2	2	1								1	3	
CO4	3	2	2	1								1	3	
CO5	3	2	2	1								1	3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	35	50	15				100
CAT2	15	45	40				100
CAT3	10	47	43				100
ESE	10	50	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE10 - OPERATIONS RESEARCH

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mathematics I, Mathematics II, Statistics and Numerical Methods	7	PE	3	0	0	3

Preamble	This course promotes the application of scientific methods in decision-making with respect to the production operations for the effective utilization of scarce resources.	
Unit - I	**Linear Models:**	**9**
Linear Models: Introduction - Phases of OR study – Formation of Linear Programming Problem (LPP) - Canonical form of LPP - Solutions to LPP - Graphical Solution - Simplex Algorithm - Artificial Variables Technique - Big M method - Two Phase method.		
Unit - II	**Transportation Problems, Assignment Problems and Sequencing Problems:**	**9**
Transportation problems: Mathematical formulation-Basic Feasible solutions – North-West Corner (NWC) – Least Cost Method (LCM) – Vogels Approximation Method (VAM). Optimality test – Modified Distribution (MODI) technique. Assignment problems: Mathematical formulation –Hungarian Algorithm. Sequencing Problems:1 jobs n machine, n jobs 1 machine, n jobs 2 machine, n jobs 3 machine, n jobs m machine and 2 jobs n machine problems.		
Unit - III	**Network Models and Project Management:**	**9**
Network Models: Shortest route - minimal spanning tree - maximum flow models. Project Management: Construction of networks-activity and event based diagrams - PERT-CPM-problems – Cost analysis and crashing of networks.		
Unit - IV	**Inventory Models:**	**9**
Inventory Models: Types of Inventory – Economic Order Quantity (EOQ) - Deterministic inventory models - Price break problems - stochastic inventory models - multi item deterministic models - selective inventory control techniques.		
Unit - V	**Queuing Models and Replacement Models:**	**9**
Queuing Models: Queuing systems and structures - notations - parameter - single server and multiserver models - Poisson input - exponential service - constant rate service - infinite population. Replacement Models: Replacement of Items due to deterioration with and without time value of Money - Individual and group replacement policy		

Total: 45

TEXT BOOK:

1. Gupta P.K. & Hira D.S., "Operations Research", 7th Edition, S. Chand and Company Ltd., New Delhi, 2014.

REFERENCES:

1. Taha & Hamdy A., "Operation Research: An Introduction", 10th Edition, Pearson Education, Chennai, 2017.
2. Hiller Frederick S. & Lieberman Gerald J., "Introduction to Operations Research", 10th Edition, McGraw-Hill Science, Bengaluru, 2011.
3. Vohra N.D., "Quantitative Techniques in Management", 5th Edition, McGraw Hill Education, Noida, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate and solve linear programming problems	Applying (K3)
CO2	develop solutions to transportation, assignment and sequencing problems	Analyzing (K4)
CO3	construct networks and analyze optimality for various applications	Analyzing (K4)
CO4	identify inventory models and solve for optimality	Analyzing (K4)
CO5	assess queuing characteristics and compute the optimum replacement period for capital equipments and items that fail suddenly	Evaluating (K5)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2						2	2	2	
CO2	3	3	3	2	2						2	2	2	
CO3	3	3	3	2	2						2	2	3	
CO4	3	3	3	2	2						2	2	3	
CO5	3	3	3	2	2						3	3	3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	30	40	20			100
CAT2	10	30	30	30			100
CAT3	15	20	20	25	20		100
ESE	10	20	30	25	15		100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE11 - COMPUTATIONAL FLUID DYNAMICS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mechanics of Fluids and Hydraulic Machines	7	PE	3	0	0	3

Preamble	This course involves on the application of numerical methods to solve fluid flow and heat transfer problems. In addition, the course also provides an introduction into turbulence modeling which enables the application of CFD in vortices and eddies.	
Unit - I	**Governing Equations and Boundary Conditions:**	**9**
Governing Equations and Boundary Conditions: Basics of Computational Fluid Dynamics – Governing Equations – Continuity - Momentum and Energy Equations – General Transport Equation – Physical Boundary Conditions – Discretization – Mathematical Behavior of PDEs on CFD –Elliptic - Parabolic - Hyperbolic Equations.		
Unit - II	**Finite Difference Method:**	**9**
Finite Difference Method: Finite Difference Method – Taylors Series – Forward - Central - Backward Differences – Explicit Method – Implicit Method – Tridiagonal Matrix-Application of the TDMA to Two-Dimensional Problems– ADI Method –Solution Methodology for Parabolic and Elliptic Equations – Errors.		
Unit - III	**Finite Volume Method:**	**9**
Finite Volume Method: Finite Volume Formulation for Steady-State - One - Two and Three - Dimensional Diffusion Problems – Parabolic Equations – Explicit - Implicit Schemes - Unsteady Heat Conduction on Elliptic and Parabolic Equations - Steady State One-Dimensional Convection and Diffusion – Central - Upwind Differencing Schemes- Hybrid - Power-Law - QUICK Schemes – Properties of Discretization Schemes.		
Unit - IV	**Grid:**	**9**
Grid: Types – Grid Generation – Grid Transformation – Calculation of Flow Field Variable –Staggered Grid –Pressure and Velocity Correction – SIMPLE Algorithm – SIMPLER Algorithm-SIMPLEC Algorithm – PISO Algorithm.		
Unit - V	**Turbulence Models:**	**9**
Turbulence Models: Reynolds Stress Equation Model – Algebraic Stress Model - Turbulence – Effect of Turbulence on Time Averaged Navier Stokes Equation – Characteristics of Simple Turbulent Flow – Flat Plate Boundary Layer – Pipe Flow – Turbulence Models – Mixing Length Model –K-ε Models.		

Total: 45

TEXT BOOK:

1. Versteeg H. K. & Malalasekera W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", 2nd Edition, Pearson Education Ltd., UK, 2007.

REFERENCES:

1. Anderson John D., "Computational Fluid Dynamics: Basic with Applications", 1st Edition, Tata McGraw-Hill, India, 2012.
2. Ghoshdastidar P.S., "Computer Simulation of Flow and Heat Transfer", Tata McGraw Hill Publishing Company Ltd., India, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	recognize the governing equations and boundary conditions for fluid dynamics.	Understanding (K2)
CO2	apply various finite difference method to solve the complex problems.	Applying (K3)
CO3	analyze the convection diffusion problems by the finite volume method.	Analyzing (K4)
CO4	identify the grid generation technique for the flow field variables.	Applying (K3)
CO5	recognize and summarize the various turbulence models and its characteristics	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1									2	2	
CO2	3	3	1									2	2	
CO3	3	2	3									2	3	
CO4	3	2	2	1	3							2	3	
CO5	3	2	3	1	3							2	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50				100
CAT2	10	20	35	35			100
CAT3	10	20	35	35			100
ESE	10	20	35	35			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE12 - CNC AND METROLOGY

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Manufacturing Processes	7	PE	3	0	0	3

Preamble	This course provides the concepts of CNC part programming and various measurement techniques	
Unit - I	**Basic Concepts of Metal Cutting and CNC Machines:**	**9**
Introduction – Mechanics of chip formation -Mechanics of oblique cutting - Cutting forces and power- Tool life –Surface finish- Machinability. CNC machines: Classification – Construction details: Structure, Configuration of CNC system – Compensations for Machine accuracy – DNC – Adaptive control CNC systems, Drives and Controls - Drive Mechanism, gearbox, Spindle Drives, Axes drives - Magnetic Levitation and Linear motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re-circulating ball screws – Backlash measurement and compensation, linear motion guide ways.		
Unit - II	**Tooling For CNC Machines:**	**9**
Interchangeable tooling system – Preset and qualified tools – coolant fed tooling system – Modular fixturing – Quick change tooling system – Automatic head changers – Tooling requirements for Turning and Machining centres – Tool holders – Tool assemblies – Tool Magazines – ATC Mechanisms – Automatic Pallet Changer-Tool management. Principles of location, clamping and work holding devices. Economics of CNC Machines and Retrofitting: Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements. Retrofitting.		
Unit - III	**Part Programming of CNC Machines:**	**9**
Part Program Terminology - G and M Codes – Types of interpolation. CNC part programming – Manual part programming (Turning and Milling).		
Unit - IV	**Linear and Angular Measurements:**	**9**
Basic concepts: Legal metrology- Precision- Accuracy- Types of errors – Standards of measurement- Traceability – Interchangeability and selective assembly. Introduction to limits, fits and tolerances, Gauge design- Comparators-Angular measurement: bevel protractor - Angle gauges - Sine bar. Surface Finish and Form Measurement: Measurement of surface finish: Terminology – Geometrical irregularities – Roughness – Waviness. Surface- roughness measurement methods. Screw thread metrology: Terminology- Errors in thread, Gears Terminology- Measurement of various elements of gear.		
Unit - V	**Interferometry and LASER Metrology:**	**9**
Principle of light wave interference – Optical flats -Michelson and NPL flatness interferometer, Laser interferometer. Advances in Metrology: Coordinate Measuring Machine (CMM): Types - Constructional features-Possible causes of errors in CMM - Probing system – Performance and applications of CMM. Machine Vision System: Applications of machine vision in measurement- In process and On line measurement.		

Total:45

TEXT BOOK:

1. Narang J.S. & Narang V.D.S., "CNC Machines and Automation", Dhanpat Rai and Co. Pvt. Ltd, New Delhi, 2016 for Units I, II, III.
2. Jain R.K, "Engineering Metrology", Khanna Publishers, New Delhi, 2013 for Units IV, V.

REFERENCES:

1. HMT Limited, "Mechatronics", McGraw-Hill, New Delhi, 2001.
2. Raghavendra N.V. & Krishnamurthy L., "Engineering Metrology and Measurements", Oxford University Press, India, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	estimate the parameters of metal cutting and comprehend the basic components, drives and controls involved in a CNC system	Applying (K3)
CO2	select various tooling systems and fixtures for CNC and identify maintenance features of CNC machines	Understanding (K2)
CO3	develop Part Programming for various machining process	Applying (K3)
CO4	infer linear and angular measurements using various instruments and determine the surface roughness	Applying (K3)
CO5	perform the form and profile measurement using Coordinate Measuring Machine (CMM) with machine vision system	Applying (K3)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2							2	2	
CO2	3	3	3	2	3							3	3	
CO3	3	3	3	3	3							2	3	
CO4	3	3	3	3	3							2	3	
CO5	3	3	3	3	3							2	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE13 - HYBRID AND ELECTRIC VEHICLES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Automotive Electrical and Electronics	7	PE	3	0	0	3

Preamble	This course deals with architecture of electric and hybrid vehicles, extended to modelling and simulation of battery systems, electric vehicles and hybrid vehicles.	
Unit - I	**Electric Vehicles:**	**9**
Electric vehicles architecture and components – Configuration of electric vehicles - Performance of electric vehicles - Traction motor characteristics -Tractive effort - Transmission requirements - Vehicle performance - Energy consumption.		
Unit - II	**Hybrid Vehicles:**	**9**
Architecture of hybrid vehicles: Series hybrid, parallel hybrid and series-parallel hybrid - Components of hybrid vehicles - Power flow analysis in hybrid vehicles - Torque coupling in parallel hybrid-electric drive trains - Speed coupling in hybrid-electric drive trains – Torque and speed coupling in parallel hybrid-electric drive trains.		
Unit - III	**Energy Management :**	**9**
Introduction - Methods to determine Sate of charge - Estimation of battery power availability – Battery life prediction – Cell Balancing - Estimation of cell core temperature - Battery system efficiency - Plug-in charge characteristics, algorithm and impact on power distribution systems.		
Unit - IV	**Electric Vehicle Modelling:**	**9**
Tractive effort - Modelling electric vehicle acceleration - Modelling electric vehicle range - Design considerations - Design of ancillary systems .		
Unit - V	**Hybrid Vehicle Modelling:**	**9**
System modelling - Hybrid vehicle control: Engine control, Dumping control through electric motor, High-Voltage Bus spike control – Thermal control of battery system – HEV/EV traction control - Performance analysis.		

Total:45

TEXT BOOK:

1. James Larminie and John Lowry., “Electric Vehicle Technology Explained”, 2nd Edition, Wiley India Pvt Ltd, New Delhi, 2018 for Units I, IV.
2. Wei Liu., “Introduction to Hybrid Vehicle System Modeling and Control”, Wiley India Pvt Ltd, New Delhi, 2015 for Units II, III, V.

REFERENCES:

1. Mehrdad Ehsani, Uimin Gao and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design", 2nd Edition, CRC Press, New Delhi, 2010.
2. Iqbal Husain, "Electric and Hybrid Vehicles", 2nd Edition, CRC Press, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize about the layout and sub systems of electric vehicles	Understanding (K2)
CO2	explain the architecture of various types of hybrid Vehicles	Understanding (K2)
CO3	illustrate in detail about battery management system and charging charatceristics	Understanding (K2)
CO4	model and simulate electric vehicles for various scenarios	Applying (K3)
CO5	model and simulate hybrid vehicles for performance analysis	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1								1	2	3
CO2	3	2	2	1								1	2	3
CO3	3	2	3	2								1	2	3
CO4	3	2	3	2								1	2	3
CO5	3	3	3	3								1	2	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80					100
CAT2	30	70					100
CAT3	20	50	30				100
ESE	10	60	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE14 - AUTOMOTIVE POLLUTION CONTROL

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Powertrain	7	PE	3	0	0	3

Preamble	This course provides knowledge on emission standards, formation, measurement and control techniques.	
Unit - I	**Emissions and Standards:**	**9**
Atmospheric pollution from automotive engines - Global warming – Green-house effect and effects of engine pollution on environment and human health. Emission Standards and Driving Cycles.		
Unit - II	**Emissions Formation in SI Engines:**	**9**
Mechanism of HC, CO, Evaporative Emission and NO_X formation in SI Engines. Effects of Engine Design and operating Variables on Emission Formation in SI engine.		
Unit - III	**Emissions Formation in CI Engines:**	**9**
Basic of diesel combustion - HC, CO, Smoke, Particulate maters, oxides of nitrogen and aldehyde emission. Effects of Design and Operating Variables on Emission Formation.		
Unit - IV	**Emissions Measurements Techniques:**	**9**
Co and CO2 NDIR Analyzers – Flame Ionization Detector - Chemiluminescence Analyzer –Smoke meters – Constant Volume Sampler – particulate Emission measurement and Dilution tunnel.		
Unit - V	**Emissions Control Techniques:**	**9**
Engine Design modifications - Fuel modification - Evaporative emission control – EGR - Air injection - Thermal reactors-Water Injection-Catalytic converters. Particulate traps - SCR systems – Closed loop Lambda.		

Total:45

TEXT BOOK:

1. Ganesan V., "Internal Combustion Engines", 1st Edition, Tata McGraw Hill Education, Noida, India, 2013.

REFERENCES:

1. John Heywood, "Internal Combustion Engine Fundamentals", 1st Edition, McGraw Hill Education, New Delhi, 2017.
2. Pundir B.P., "IC Engines Combustion and Emission", 1st Edition, Narosa Publishing House, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the current scenario of Automobile Emissions and to create an awareness on the various environmental pollution aspects and issues and standards.	Understanding (K2)
CO2	illustrate the formation of Emissions from SI Engines.	Applying (K3)
CO3	describe the emission formation from CI Engines.	Applying (K3)
CO4	explain the various emission measurement techniques for vehicle pollution	Understanding (K2)
CO5	discuss the various emission control techniques for automotive engines	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1								1	3	
CO2	3	2	2	1								1	3	
CO3	3	2	2	1								1	3	
CO4	3	2	2	1								1	3	
CO5	3	2	2	1								1	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	23	77					100
CAT2	23	44	33				100
CAT3	43	57					100
ESE	25	50	25				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE15 - VEHICLE AERODYNAMICS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mechanics of Fluids and Hydraulic Machines	7	PE	3	0	0	3

Preamble	This course provides knowledge to apply governing laws of fluid mechanics to design a vehicle with better aerodynamic performance.	
Unit - I	**Introduction:**	**9**
Review of fluid mechanics - Importance of vehicle aerodynamics - External and internal flow problems - Resistances 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	**Aerodynamic Drag:**	**9**
Vehicle as a bluff body - Flow field around car - Boundary layer – Bernoulli's equation - Drag force and its types - Analysis of aerodynamic drag - Drag coefficient. Strategies for aerodynamic development - low drag profiles – Vehicle front and rear end optimization techniques.		
Unit - III	**Commercial Vehicle Aerodynamics:**	**9**
Commercial vehicles design – Tractive resistance, drag reduction and fuel consumption – Drag coefficients for various commercial vehicles – Advantages of aerodynamic effects – Vehicle soiling – Front end design techniques.		
Unit - IV	**Vehicle Handling:**	**9**
Origin of forces and moments on vehicle - Lateral stability problems - Methods to calculate forces and moments and their characteristics. Vehicle dynamics under side wind forces and its effects - Dirt accumulation on the vehicle - Wind noise.		
Unit - V	**Wind Tunnels for Automotive Aerodynamics:**	**9**
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

TEXTBOOK:

1. Yomi Obidi, "Theory and Applications of Aerodynamics for Ground Vehicles", 1st Edition, SAE International, Warrendale, Pennsylvania, 2014.

REFERENCES:

1. Wolf Heinrich Hucho, "Aerodynamics for Road Vehicles", 1st Edition, Butterworth Heinemann Ltd., London, 1987.
2. Thomas Christian Schuetz, "Aerodynamics of Road Vehicles", 5th Edition, SAE International, 1994.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	describe fluid mechanics relationship with vehicles	Understanding (K2)
CO2	solve the various aerodynamic drags and their coefficients for vehicles	Applying (K3)
CO3	explain the aerodynamic performance of commercial vehicles	Understanding (K2)
CO4	calculate the side wind relationship with vehicle handling	Applying (K3)
CO5	illustrate the various measurement and testing using wind tunnels	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1								1	2	
CO2	3	2	2	1								1	2	
CO3	3	2	2	1								1	2	
CO4	3	2	2	1								1	2	
CO5	3	2	2	1								1	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	60	20				100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	30	70					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE16 - AUTOMOTIVE HVAC

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Thermal Science	7	PE	3	0	0	3

Preamble	This course provides knowledge on automotive air-conditioning components, controls, fault diagnostics, servicing and repairing.	
Unit - I	**Air-conditioning Fundamentals:**	**9**
Heating and ventilation system – Basic theory of cooling – Vapour compression refrigeration – Alternative cycles – Air conditioning system – Expansion valve system – Fixed orifice valve system – Dual air conditioning.		
Unit - II	**Air Conditioning Components:**	**9**
Compressor – Types of compressor – Condenser – Types of condenser - Receiver drier and accumulator – Expansion valve and fixed orifice valve – Evaporator – Anti-frosting devices – Basic control switches.		
Unit - III	**Electrical and Electronics control**:	**9**
Electrical principles – Sensors and actuators – Testing sensors and actuators – Oscilloscope waveform sampling – Multiplex wiring systems – On Board Diagnostics.		
Unit - IV	**Diagnostics and Troubleshooting:**	**9**
Intial vehicle inspection – Temperature measurements – Pressure gauge reading – Cycle testing – Air-conditioning system leak testing – Sight glass.		
Unit - V	**Air Conditioning Service and Repair:**	**9**
Servicing precautions – Refrigerant: recovery, recycle and charging - System oil – System flushing – Odour removal – Retrofitting – Replacement and adjustment of compressor components – Fixed orifice valve remove and replace.		

Total:45

TEXT BOOK:

1. Steven Daly, "Automotive Air Conditioning and Climate Control Systems", 1st Edition, Butterworth-Heinemann, India, 2006.

REFERENCES:

1. Norman C. Harris, "Modern Air-Conditioning Practice", 3rd Edition, McGraw Hill Education, New Delhi, 1984.
2. Dossat R.J., "Principles of Refrigeration", 5th Edition, Prentice Hall, New Jersey, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic principles of heating, ventilation and air-conditioning system.	Understanding (K2)
CO2	illustrate the basic components of an Air conditioning systems.	Understanding (K2)
CO3	outline the electrical and electronic components present in air-conditioning system.	Understanding (K2)
CO4	describe the diagnostic and troubleshooting procedure of air-conditioning system.	Understanding (K2)
CO5	explain the air-conditioning service and repairing procedure.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1								1	2	
CO2	3	2	1	1								1	2	
CO3	3	2	1	1								1	2	
CO4	3	2	1	1								1	2	
CO5	3	2	1	1								1	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	27	73					100
CAT2	27	73					100
CAT3	27	73					100
ESE	27	73					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE17 - AUTOMOTIVE NOISE, VIBRATION AND HARSHNESS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mathematics III	7	PE	3	0	0	3

Preamble	This course provides knowledge to understand and control vehicle noise, vibration & harshness	
Unit - I	**Introduction to Automotive NVH:**	**9**
Basics of sound propagation - Quantification of sound - Noise sources - Pass-by and stationary noise limits -Automotive NVH sources - Interior noise of vehicles - Sound quality - Ride comfort - Noise and vibration control in vehicles.		
Unit - II	**Transducers and Measurement:**	**9**
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 - III	**Noise Source Identification:**	**9**
Frequency and order domain analysis - Sound intensity and sound power mapping. Introduction to array techniques - Acoustic holography and beam forming - Standard methods for evaluating sound absorption coefficient and transmission loss - Types of sound absorbers - Prediction of transmission loss and flanking transmission - Damping materials and their applications.		
Unit - IV	**Passive Noise Treatments:**	**9**
Ducts and Mufflers - Types of mufflers -Performance parameters - Acoustics and backpressure - Reactive and absorptive silencers - Overall design considerations - Acoustic material characterization - Sound transmission - Absorption and damping - Behaviour of acoustic material with respect to sound absorption and transmission.		
Unit - V	**Interior Noise and Modal Analysis:**	**9**
Interior noise sources - Structure borne noise - Airborne noise, Refinement techniques and sound insulation - Definition of modal properties - Modal analysis theory - FEM and experimental modal analysis - Applications of modal analysis.		

Total:45

TEXT BOOK:

1. Xu Wang, "Vehicle Noise and Vibration Refinement", 1st Edition, Woodhead Publishing, Cambridge, United Kingdom, 2016.

REFERENCES:

1. Harrison M., "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles", Society of Automotive Engineers, 2004.
2. De Silva C.W., "Vibration Monitoring, Testing, and Instrumentation", 1st Edition, CRC Press, United States, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain basics of noise and vibration and their limits	Understanding (K2)
CO2	illustrate and analyze sound & vibration	Applying (K3)
CO3	analyze and Evaluate various sound identification techniques	Analyzing (K4)
CO4	analyze and Evaluate various noise treatment techniques	Analyzing (K4)
CO5	outline modal analysis theory and its applications	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2								1	2	
CO2	3	2	3	2								1	1	
CO3	3	3	3	2								1	2	
CO4	3	3	2	2								1	2	
CO5	3	2	2	2								1	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	60	20				100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE18 - MICRO ELECTRO MECHANICAL SYSTEMS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	7	PE	3	0	0	3

Preamble	This course provides introduction to the basic concepts of sensors, actuators and scaling laws of micro system. It introduces the phenomenon of fabrication, manufacturing and packaging of Micro System. It familiarizes students to design and develop a micro product for various applications.	
Unit - I	**Microsystems:**	**9**
Overview-Microsystems - Working principle of Microsystems - Scaling laws - Scaling in geometry - Scaling in rigid body dynamics - Scaling in electrostatic forces - Scaling in electromagnetic forces - Scaling in electricity - Scaling in fluid mechanics - Scaling in heat transfer.		
Unit - II	**Microsensors and Actuators:**	**9**
Micro sensors - Micro actuation techniques - Micropump – Micromotors – Microvalves – Microgrippers - Micro accelerometers.		
Unit - III	**Micro System Fabrication:**	**9**
Substrates - Single crystal silicon wafer formation - MEMS materials - Photolithography - Ion implantation - Diffusion - Oxidation - CVD - Physical Vapor Deposition - Deposition by epitaxy – Etching process.		
Unit - IV	**Micro System Manufacturing and Design:**	**9**
Bulk Micro manufacturing - Surface Micromachining – LIGA – SLIGA. Micro system packaging – Materials - Die level - Device level - System level - Packaging techniques - Surface bonding - Wire bonding – Sealing - Design considerations.		
Unit - V	**Micro System Applications:**	**9**
Applications of micro system in – Automotive - Bio medical – Aerospace – Telecommunications field. Basic exposure to software for MEMS design – Micro system Design using CAD tool.		

Total:45

TEXT BOOK:

1. Tai-Ran Hsu, "MEMS And Microsystems: Design And Manufacture", 2nd Edition, John Wiley and Sons, New York, 2017.

REFERENCES:

1. Marc Madou, "Fundamentals of Microfabrication", 2nd Edition, CRC Press, New York, 2011.
2. Zhang, Dan, Wei & Bin (Eds.), "Advanced Mechatronics and MEMS Devices II", Springer, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	express Scaling laws of micro system	Applying (K3)
CO2	interpret the concepts of micro sensors and micro actuators	Understanding (K2)
CO3	choose the fabrication process of microsystem	Applying (K3)
CO4	identify the micro machining process and packaging	Applying (K3)
CO5	design and develop the micro system for various applications	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								2	3	
CO2	3	3	2	1								2	2	
CO3	3	3	3	2	3							2	3	
CO4	3	3	3	2	3							2	2	
CO5	3	3	3	2	3							2	1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	30	10			100
CAT2	20	40	30	10			100
CAT3	10	40	30	20			100
ESE	20	30	30	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE19 - VEHICLE MAINTENANCE AND SERVICING

Programme& Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Powertrain & Automotive Chassis	7	PE	3	0	0	3

Preamble	This course provides knowledge on maintenance and servicing of various systems in automobiles.	
Unit - I	**Maintenance Procedure and Tools:**	**9**
Maintenance need, policies – Classification of maintenance – Service intervals - Automotive service procedures – Workshop operations, vehicle insurance -Towing and recovering - Safety – Personnel, equipment and vehicles. Fire safety - First aid - Shop hand tools – Measuring instruments.		
Unit - II	**Engine Maintenance:**	**9**
General Engine service- Dismantling of Engine components- Engine repair - Working on the underside, front, and top of engine, Condition checking of seals, gaskets, and sealants in engine- Cooling system service, lubrication system service, Fuel system service - Electronic fuel injection and engine management service. Fault diagnosis using Scan tools, On and Off Board Diagnostics. Exhaust system - Servicing for parts of emission control systems.		
Unit - III	**Driveline Maintenance:**	**9**
Clutch - General checks, adjustment and service. Transmission and transaxle - Dismantling, identifying, checking and reassembling. Removing and replacing propeller shaft. Servicing of yokes, cross of universal joint and constant velocity joints. Rear axle service - Removing axle shafts, bearings. Servicing of differential assembly.		
Unit - IV	**Chassis Maintenance:**	**9**
Maintenance of suspension systems -Macpherson strut, coil spring, leaf spring and shock absorbers. Maintenance of steering systems- Rack and pinion steering, Recirculating ball type steering, Worm type steering and Power steering. Maintenance of Brake systems- Bleeding of brakes. Maintenance of wheel**-** Tyre wear, tyre rotation, Tyre change, Wheel balance and Wheel alignment.		
Unit - V	**Electrical and HVAC Maintenance:**	**9**
Electrical: Maintenance of battery, starting, charging and lighting systems. HVAC Maintenance: Maintenance of A/C system parts-compressor, condenser, expansion valve and evaporator. Replacement of A/C hoses- Leak detection- AC Charging.		

Total:45

TEXT BOOK:

1. William H. Crouse and Donald l. Anglin, "Automotive Mechanics", 10th Edition, McGraw Hill Education, New Delhi, 2017.

REFERENCES:

1. Ed May & Les Simpson, "Automotive Mechanics" Volume I and II", 8th Edition, McGraw Hill Education, New Delhi, 2009.
2. Jigar A. Doshi, Dhruv U. Panchal & Jayesh P. Maniar, "Vehicle Maintenance and Garage Practice", PHI Learning Pvt. Ltd., New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss the importance of maintenance, workshop practices, tools and safety requirements for automobiles	Understanding (K2)
CO2	explain the maintenance procedure of engine and its sub-systems	Understanding (K2)
CO3	illustrate the maintenance related issues with transmission and drive line	Understanding (K2)
CO4	identify the service practices in the steering, brake, suspension and wheel	Understanding (K2)
CO5	explain the maintenance in auto electrical and air-conditioning systems	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1								1	3	
CO2	3	2	2	1								1	3	
CO3	3	2	2	1								1	3	
CO4	3	2	2	1								1	3	
CO5	3	2	2	1								1	1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	33	67					100
CAT2	33	67					100
CAT3	33	67					100
ESE	33	67					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE20 - IN-VEHICLE NETWORKING

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Embedded Systems	7	PE	3	0	0	3

Preamble	This course provides a knowledge on data communication and networking, automotive communication and diagnostic protocols and their working.	
Unit - I	**Controller Area Network:**	**9**
CAN Bus - protocol - ISO/OSI layers –Properties of CAN - CAN 2.0A standard frame - Message transfer - CAN bit - NRZ coding - bit stuffing - data frame - Errors - Error detection - The rest of the frame -CAN 2.0B – frame format - Compatibility of CAN 2.0A and CAN 2.0 B.		
Unit - II	**CAN Physical Layer:**	**9**
Introduction - CAN bit - Nominal bit time - CAN and signal propagation – Network type, topology and structure - Propagation time - Estimating the value - Precise - Corollaries: relations between the medium, bit rate and length of the network - Bit synchronization - Bit resynchronization -Network speed –Bit rate - Latency.		
Unit - III	**Time-triggered Protocols:**	**9**
Time-triggered communication on CAN – high-speed - X-by-Wire and redundant systems – FlexRay - Protocol handling - Communication frame - Architecture of a FlexRay node - Electronic components for FlexRay - Line driver -Bus guardian.		
Unit - IV	**Multiplexed Bus Concepts:**	**9**
wired – wireless - vehicle infrastructure - internal use within a vehicle - Basic concept of the LIN 2.0 protocol - Operating principle - data link layer - Conformity of LIN - fail-safe SBC approach- Safe-by-Wire Plus - Audio–Video Buses - I2C Bus - MOST Bus.		
Unit - V	**Wireless Communication:**	**9**
Radio-Frequency Communication – Internal - External - control of opening parts -passive keyless entryand passive go - Wireless Networks – GSM - Bluetooth -IEEE 802.11x – NFC.		

Total:45

TEXT BOOK:

1. Dominique Paret, "Multiplexed Networks for Embedded Systems: CAN, LIN, Flexray, Safe-by-Wire", 1st Edition, John Wiley & Sons Ltd., England, 2007.

REFERENCES:

1. Ingolf Karls & Markus Mueck, "Networking Vehicles to Everything", 1st Edition, De|G Press, Germany, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	infer about the basics of in-vehicle networks and CAN protocol	Understanding (K2)
CO2	illustrate about the CAN physical layer	Understanding (K2)
CO3	classify the time-triggered and flexray protocols for vehicle networking	Understanding (K2)
CO4	explain and relate the multiplexed bus concepts for automotive networking	Understanding (K2)
CO5	outline the importance of wireless systems in automobiles	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1								1		3
CO2	3	2	2	1								1		2
CO3	3	2	2	1								1		2
CO4	3	2	2	1								1		2
CO5	3	2	2	1								1		3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	70					100
CAT2	30	70					100
CAT3	30	70					100
ESE	30	70					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE21 - MECHANICS OF COMPOSITE MATERIALS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Mechanics of Deformable Bodies	7	PE	3	0	0	3

Preamble	This course involves the basic concept, manufacturing, characterization and design of composite materials for various static and dynamic applications.	
Unit - I	**Basics of Fibers, Matrices and Composites:**	**9**
Basics of Fibers, Matrices and Composites: Definition – Need – General Characteristics and Applications. Fibers: Glass- Carbon-Ceramic-Aramid-Polymer and Natural Fibers. Matrices: Polymer- Ceramic and Metal Matrices – Characteristics of Fibers And Matrices- Fiber Surface Treatments- Fillers And Additives.		
Unit - II	**Composite Manufacturing:**	**9**
Composite Manufacturing: Hand Layup – Spray up - Bag Molding – Compression Molding – Pultrusion – Filament Winding –Resin Film Infusion - Elastic Reservoir Molding - Tube Rolling – Quality Inspection Methods- Processing of Metal Matrix Composites (MMC) – Diffusion Bonding – Stir Casting – Squeeze Casting and Powder Metallurgy Technique.		
Unit - III	**Composite Performance and Analysis:**	**9**
Composite Performance and Analysis: Static Mechanical Properties – Dynamics Mechanical Analysis–Thermogravimetric Analysis-Fatigue and Impact Properties – Environmental Effects – Long Term Properties -Service Life Predication- Fracture Behavior and Damage Tolerance.		
Unit - IV	**Composite Mechanics:**	**9**
Composite Mechanics: Fiber Content - Density and Void Content- Rule of Mixture -Volume and Mass Fractions - Evaluation of Four Elastic Moduli Based on Strength of Materials Approach and Semi-Empirical Model-Longitudinal Young's Modulus-Transverse Young's Modulus–Major Poisson's Ratio-in-Plane Shear Modulus- Ultimate Strengths of a Unidirectional Lamina- Characteristics of Fiber-Reinforced Lamina–Laminates–Lamination Theory.		
Unit - V	**Design of Composites:**	**9**
Design of Composites: Failure Predictions - Theories of Failure - Laminate Design Consideration - Design Criteria - Design Allowable - Design Guidelines - Joint Design-Bolted and Bonded Joints - Design Examples-Design of a Tension Member – Design of a Compression Member –Design of a Beam-Design of a Torsional Member - Application of Finite Element Method (FEM) for Design and Analysis of Laminated Composites.		

Total: 45

TEXT BOOK:

1. Mallick P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", 3rd Edition, CRC Press Taylor and Francis, New York, 2007.

REFERENCES:

1. Autar K. Kaw, "Mechanics of Composite Materials", 2nd Edition, CRC Press, New York, 2006.
2. Bhagwan D. Agarwal, Lawrence J. Broutman & Chandrashekhar K., "Analysis and Performance of Fiber Composites", 4th Edition, John Wiley & Sons, New York, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the fundamentals of fibers - matrices - additives and composites	Analyzing (K4)
CO2	portray the various manufacturing processes involved in the fabrication of composite material.	Analyzing (K4)
CO3	gain knowledge to analyze the performance of composite materials.	Analyzing (K4)
CO4	analyze and solve problems concerning the mechanics of composite materials.	Analyzing (K4)
CO5	perform design calculations for the development of fiber reinforced matrices.	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1									2	3	
CO2	3	1	1									2	3	
CO3	3	3	1									2	3	
CO4	3	3	3	2								2	3	
CO5	3	3	3	2								2	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	15	40	30			100
CAT2	15	15	40	30			100
CAT3	15	15	30	40			100
ESE	10	10	45	35			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE22 - VEHICLE BODY ENGINEERING

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Chassis	7	PE	3	0	0	3

Preamble	This course provides knowledge on automotive vehicle body construction, mechanism and repairs.	
Unit - I	**Car Body Construction:**	**9**
Importance of vehicle body - Types of car bodies – Visibility: Driver's visibility, Improvement, regulations and tests - Driver seat design - Safety aspects in design and its classification - Active safety: driving, conditional, perceptibility and operational safety - Passive safety: interior and exterior safety - Bumper front and rear end - Safety systems: Air bag - Collapsible Steering column.		
Unit - II	**Bus Body Construction:**	**9**
Types of bus bodies: based on capacity, distance travel and construction - Bus body layout for various constructions - Types of metal sections – Design regulations – Constructional details: Conventional and integral - Sequence of bus building constructions - Driver seat design - RTO regulations.		
Unit - III	**Commercial Vehicle Body Construction:**	**9**
Types of commercial vehicle bodies - Light commercial vehicle bodies - Construction details of heavy vehicle bodies - Flat platform body, Trailer, Tipper body and Tanker body – Design of driver's cab and seat – Commercial vehicle Design based on load capacity - Force exerted on controls by driver - Regulations.		
Unit - IV	**Vehicle Aerodynamics:**	**9**
Introduction - Vehicle drag and its types - Various forces and moments exerted and their effects - Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation and types - Wind tunnel testing: Flow visualization techniques - Airflow management test – Measurement of various forces and moments.		
Unit - V	**Body Materials, Mechanisms and Body Repair:**	**9**
Types of body materials: construction and their properties. Body trim and mechanisms. Body repair - tools and panels - repair of sheet metal and plastics components - body fillers - passenger compartment service. Corrosion: Anticorrosion methods - Modern painting sequence - Painting problems.		

Total:45

TEXT BOOK:

1. James E. Duffy., "Body Repair Technology for 4-Wheelers", Cengage Learning, New Delhi, 2009.

REFERENCES:

1. Powloski J., "Vehicle Body Engineering", Business Books Ltd., 1998.
2. David A. Crolla, "Automotive Engineering: Power train, Chassis System and Vehicle Body", Butterworth-Heinemann Publications, India, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	describe the different types, constructions and safety aspects of car bodies	Understanding (K2)
CO2	explain the different types, construction and design aspects of bus bodies	Understanding (K2)
CO3	exemplify the different types, construction and design aspects of commercial vehicle bodies	Understanding (K2)
CO4	illustrate the role of various aerodynamic forces, moments and measuring techniques	Understanding (K2)
CO5	discuss the materials used in body building and body repairs	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1								1	2	
CO2	3	2	2	1								1	2	
CO3	3	2	2	1								1	2	
CO4	3	2	2	1								1	2	
CO5	3	2	2	1								1	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	30	70					100
CAT3	30	70					100
ESE	30	70					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE23 - ENGINE TESTING AND POST PROCESSING

Programme& Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Powertrain	7	PE	3	0	0	3

Preamble	This course provides knowledge on automotive engine testing and post processing techniques.	
Unit - I	**Vibration and Noise:**	**9**
Vibration: Sources of vibration - Design of engine mountings and test-bed foundations – Factors affecting the design of engine and test-bed mountings - Massive foundations and air-sprung bedplates. Noise: Sound intensity - Noise measurements – Noise levels of workplace - External noise to test facility and planning regulations - Noise reverberation in the test cell.		
Unit - II	**Dynamometers:**	**9**
Types and working of dynamometer, measurement of torque, speed and dynamometer characteristics curves - Torque/Speed and Power/Speed curves - Limits of performance. Water brakes – Absorption of power, Calculation of water requirement – Selection of dynamometer.		
Unit - III	**Combustion Process and Analysis:**	**9**
Fundamental factors influencing combustion - Total and instantaneous energy release - Cyclic energy release, mean effective pressure – Role of combustion analysis in IC engines of hybrid vehicles - Integration of combustion analysis equipment in test cell – Calculations involved in combustion analysis, test results. Thermal efficiency - Measurement of Heat - Mechanical losses.		
Unit - IV	**Data Acquisition System:**	**9**
Machinery and control System. Safety: Stopping, starting, and controlling in test cell - Open and Closed-Loop control of engine in dynamometer - Test control software and sequence editing - Data Acquisition and Transducer chain.		
Unit - V	**Data Collection and Post Processing:**	**9**
Data Collection and transmission - Management of data - Post-Acquisition data processing, statistics, and data mining - Data analysis tools for the test engineer - Physical security of data		

Total:45

TEXT BOOK:

1. Martyr A.J and Plint M.A., “Engine Testing”, 4th Edition, Butterworth-Heinemann, UK, 2012.

REFERENCES:

1. William Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Butterworth Heinemann Publications, Oxford, United Kingdom, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the importance of vibration and noise in engine testing	Understanding (K2)
CO2	classify the various types of dynamometer used in engine testing	Understanding (K2)
CO3	analyze the combustion process and its effects.	Analyzing (K4)
CO4	explain the data acquisition system and its control software	Understanding (K2)
CO5	illustrate the data collection and post processing of combustion analysis	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	1								3	
CO2	3	2	2	1	1								2	3
CO3	3	2	2	1	1								3	
CO4	3	2	2	1	1								3	
CO5	3	2	2	1	1								3	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20				100
CAT2	40	40	20				100
CAT3	40	40	20				100
ESE	40	40	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE24 - TOTAL QUALITY MANAGEMENT

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	This course deals with Quality concepts and TQM principles focusing on process quality to assure product quality to the customers. It also deals with the Basic and modern Quality management tools including ISO standards	
Unit - I	**Quality Concepts and Principles:**	**9**
Quality Concepts and Principles: Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Basic concepts of Total Quality Management - Historical Review. Principles of TQM - Leadership –Concepts - Quality Council - Quality Statements - Strategic Planning - Deming Philosophy - Barriers to TQM Implementation.		
Unit - II	**Total Quality Management-Principles and Strategies:**	**9**
Total Quality Management-Principles and Strategies: Customer satisfaction –Customer Perception of Quality - Customer Complaints - Customer Retention - Employee Involvement –Motivation - Empowerment - Teams - Recognition and Reward - Performance Appraisal - Benefits. Continuous Process Improvement –Juran Trilogy - PDSA Cycle - 5S - Kaizen - Supplier Partnership –Partnering - sourcing - Supplier Selection - Supplier Rating - Relationship Development - Performance Measures		
Unit - III	**Control Charts for Process Control:**	**9**
Control Charts for Process Control: The seven tools of quality - Statistical Fundamentals –Measures of central Tendency and Dispersion - Population and Sample - Normal Curve - Control Charts for variables and attributes - Process capability - Concept of six sigma.		
Unit - IV	**TQM-Modern Tools:**	**9**
TQM-Modern Tools: The new seven tools of quality - Benchmarking-Need - Types and process; Quality Function Deployment-HOQ construction - case studies; Taguchi's Robust design-Quality loss function - DOE; Total Productive Maintenance-uptime enhancement; Failure Mode and Effect Analysis-Risk Priority Number - Process - case studies.		
Unit - V	**Quality Systems:**	**9**
Quality Systems: Need for ISO 9000 and Other Quality Systems - ISO 9000 : 2015 Quality System –Elements - Implementation of Quality System - Documentation - Quality Auditing - Introduction to TS 16949 - QS 9000 - ISO 14000 - ISO 18000 - ISO 20000 - ISO 22000. Process of implementing ISO - Barriers in TQM implementation.		

Total: 45

TEXT BOOK:

1. Dale H. Besterfield, "Total Quality Management", 3rd Edition, Pearson Education, New Delhi, 2011.

REFERENCES:

1. Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill, New Delhi, 2008.
2. Feigenbaum A.V., "Total Quality Management", 4th Edition, Tata McGraw Hill , New Delhi, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the need, history and principles of quality and TQM	Applying (K3)
CO2	illustrate the principles and strategies of TQM	Applying (K3)
CO3	make use of various tools and techniques of quality management	Analyzing (K4)
CO4	apply various quality tools and techniques in both manufacturing and service industry	Applying (K3)
CO5	explain the concepts of quality management system and ISO.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1				2	2	3	2	2	1	1		
CO2	1	1				3	2	3	3	3	1	1	2	
CO3	3	2	2	2	2	2		1	2	2	1	1	1	
CO4	2	2	2	2	2	2		1	2	2	1	1	2	
CO5						3	3	2	3	2	1	1		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	45	30				100
CAT2	20	30	30	20			100
CAT3	25	45	30				100
ESE	20	30	35	15			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEE01 - FUNDAMENTALS OF RESEARCH

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	This course familiarize the fundamental concepts/techniques adopted in research, problem formulation and also disseminate the process involved in collection, consolidation of published literature and rewriting them in a presentable form using latest tools.	
Unit - I	**Introduction to Research**	**9**
Introduction to Research: Types and Process of Research - Outcome of Research - Sources of Research Problem - Characteristics of a Good Research Problem - Errors in Selecting a Research Problem - Importance of Keywords.		
Unit - II	**Literature Review**	**9**
Literature Review: Literature Collection - Methods - Analysis - Citation Study - Gap Analysis - Problem Formulation Techniques.		
Unit - III	**Research Methodology**	**9**
Research Methodology: Appropriate Choice of Algorithms/Methodologies/Methods - Measurement and Result Analysis - Investigation of Solutions for Research Problem - Interpretation - Research Limitations.		
Unit - IV	**Journals and Papers:**	**9**
Journals and Papers: Journals in Science/Engineering - Indexing and Impact factor of Journals. Plagiarism and Research Ethics. Types of Research Papers - Original Article/Review Paper/Short Communication/Case Study.		
Unit - V	**Reports and Presentations**	**9**
Reports and Presentations: How to Write a Report - Language and Style - Format of Project Report - Title Page - Abstract - Table of Contents - Headings and Sub-Headings - Footnotes - Tables and Figures - Appendix - Bibliography etc - Different Reference Formats. Presentation using PPTs. Research Tools.		

Total: 45

TEXT BOOK:

1. Walliman, Nicholas. “Research Methods: The basics”. Routledge, 2017.

REFERENCES:

1. Melville S, Goddard W. “Research Methodology: An Introduction For Science and Engineering Students”. Kenwyn: Juta & Co Ltd., 1996.
2. Kumar, Ranjit. “Research Methodology: A step-by-step guide for beginners”. SAGE Publications Limited, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	list the various stages in research and categorize the quality of journals.	Analyzing (K4)
CO2	formulate a research problem from published literature/journal papers	Evaluating (K5)
CO3	write, present a journal paper/ project report in proper format	Creating (K6)
CO4	select suitable journal and submit a research paper.	Applying (K3)
CO5	compile a research report and the presentation	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1		3	3	3	2	2	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1		40	35	25			100
CAT2		30	40	30			100
CAT3				50	50		100
ESE		25	25	25	25		100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MBE49 - ENTREPRENEURSHIP DEVELOPMENT

(Common to All BE/BTech Engineering and Technology Branches)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	Engineering Economics and Management	8	EC	3	0	0	3

Preamble	The purpose of this course to create entrepreneurial awareness among engineering students.	
Unit - I	**Entrepreneurship Concepts:**	**9**
Entrepreneurship & Entrepreneur- Role in Economic Development - Factors affecting Entrepreneurship- Creativity and Innovation - Entrepreneurship vs Intrapreneurship- Entrepreneurial Motivation factors – Types of Entrepreneurship &Entrepreneurs - Characteristics of Entrepreneurs -Entrepreneurship Development in India		
Unit - II	**Entrepreneurial Ventures and Opportunity Assessment:**	**9**
New venture creation – Bootstrapping,Minipreneurship, Start-ups, Acquiring, Franchising & Social venturing - Venture development stages - Models of market opportunity- Opportunity assessment: Critical Factors In Opportunity Assessment, Idea vs Opportunity, Evaluation process, Global opportunities for entrepreneurs.		
Unit - III	**Business Plan:**	**9**
Designing Business Model- Business Model Canvas- Objectives of a Business Plan - Business Planning Process – Structure of a Business Plan – Technical, Marketing, Financial Feasibility assessment - Competitive analysis - Common errors in Business Plan formulation - Presentation of the Business Plan: The 'Pitch'- case studies		
Unit - IV	**Financing and Accounting:**	**9**
Forms of entrepreneurial capital – Sources of Financial capital: debt financing- Commercial banks and other sources, equity financing: Initial Public offering (IPO), Private placement - Venture capitalists - Angel investors-New forms of financing: Impact investors, Micro-financing, Peer-to-Peer Lending, Crowd funding - Natural capital. Preparing Financial Budget, Break even analysis, Taxation-Direct and indirect taxes, Insolvency and Bankruptcy.		
Unit - V	**Small Business Management:**	**9**
Definition of Small Scale Industries: Strengths and Weaknesses, Sickness in Small Enterprises: Symptoms -Causes and remedies-Indian Startup Ecosystem – Institutions supporting small business enterprises, Business Incubators – Government Policy for Small Scale Enterprises - Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger, FDI and Sub-Contracting		

Total:45

TEXT BOOK:

1. Donald F. Kuratko, "Entrepreneurship: Theory, Process, Practice", 11th Edition, Cengage Learning, Boston, 2020.

REFERENCES:

1. Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, Sabyasachi Sinha, "Entrepreneurship", 11th Edition, McGraw Hill, Noida, 2020.
2. Charantimath Poornima M., "Entrepreneurship Development and Small Business Enterprises", 3rd Edition, Pearson Education, Noida, 2018.
3. Gordon E. & Natarajan K., "Entrepreneurship Development", 6th Edition, Himalaya Publishing House, Mumbai, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the importance of entrepreneurship and demonstrate the traits of an entrepreneur	Applying (K3)
CO2	identify suitable entrepreneurial ventures and business opportunity	Applying (K3)
CO3	assess the components of business plan	Analyzing (K4)
CO4	appraise the sources of finance and interpret accounting statements	Applying (K3)
CO5	interpret the causes of sickness of small scale enterprises and its remedies	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2	1	1		3	2		1
CO2	1	2	2	2		2	2	1	1		3	2		2
CO3	2	2	2	2	2	2	2	2	2	2	3	2		1
CO4	1	1	2	1		2	1	1	1	2	3	2		1
CO5	1	1	2	1		2	1	1	1	2	3	2		1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	30	30	20			100
CAT3	30	30	40				100
ESE	20	30	40	10			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE25 - AUTONOMOUS VEHICLE TECHNOLOGY

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	PE	3	0	0	3

Preamble	This course deals about the principles of automated driving, advanced driver assistance systems, sensors, artificial intelligence and few case studies of autonomous vehicle.	
Unit - I	**Automated Driving:**	**9**
Introduction to ADV - Safety - Vehicle and its occupants –External people and property - Service and repair - IMI TechSafe.		
Unit - II	**Advanced Driver Assistance Systems:**	**9**
Introduction to ADAS - Example systems - Adaptive cruise control - Obstacle avoidance radar - Basic reversing aid – Radar - Stereo video camera - Rear radar - Functional safety and risk.		
Unit - III	**Automated Driving Technologies:**	**9**
The road to autonomy – Perception - Lidar operation - Sensor positioning - Automated driving system – Mapping - Other technologies – Connectivity.		
Unit - IV	**Artificial Intelligence:**	**9**
History of AI - Top-down and bottom-up AI - Deep learning - End to end machine learning - Object recognition simplified example - Social and human issues: Public reaction to Connected and autonomous vehicle – Insurance - Mobility.		
Unit - V	**Case Studies:**	**9**
Nvidia – Bosch - Google (Waymo) - Tesla Autopilot – Audi - Jaguar Land Rover - Toyota Guardian – FLIR - First sensor AG.		

Total:45

TEXT BOOK:

1. Tom Denton, "Automated Driving and Driver Assistance Systems", 1st Edition, Routledge, Taylor & Francis Group, UK, 2020.

REFERENCES:

1. http://moralmachine.mit.edu/
2. https://swayam.gov.in/nd1_noc20_cs42/preview

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	summarize about introduction to automated driving vehicles with safety systems	Understanding (K2)
CO2	explain about the advanced driver assistance systems	Understanding (K2)
CO3	illustrate automated driving technologies with sensor positioning	Understanding (K2)
CO4	illustrate about the artificial intelligence	Understanding (K2)
CO5	analyze the performance of autonomous vehicles for various automotive manufactures	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1										2
CO2	3	3	2	1										3
CO3	3	3	2	1										2
CO4	3	3	2	1										3
CO5	3	3	2	1										3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80					100
CAT2	20	80					100
CAT3	20	50	30				100
ESE	10	70	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE26 - MANUFACTURING OF AUTOMOTIVE COMPONENTS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Manufacturing Processes	8	PE	3	0	0	3

Preamble	This course provides knowledge on various material forming, removing and joining techniques employed in production of automotive components	
Unit - I	**Review of Manufacturing Process:**	**9**
Overview of vehicle manufacturing - Stamping and metal forming processes - Stamping presses and dies - Advances in metal forming process - Automotive joining process - Automotive manufacturing processes: Static and operational aspects.		
Unit - II	**Manufacturing of Engine Components:**	**9**
Material selection and Manufacturing methods: Piston - Piston rings and pin - Cylinder block - Wet and dry liners - Engine head - Crank shaft - Connecting rod - Cam shaft - Pushrod - Rocker arm – Tappets - Spark plug - Thermal barrier coating of Engine head and valves.		
Unit - III	**Manufacturing of Transmission Components:**	**9**
Material selection and Manufacturing methods: Clutch - Clutch lining - Gear Box - Gear - Propeller Shaft - Differential - Axle Shaft - Bearings - Fasteners - Methods of Gear manufacture - Gear hobbing and gear shaping machines - gear generation - gear finishing and shaving.		
Unit - IV	**Manufacturing of Chassis Components:**	**9**
Material selection and manufacturing methods: Chassis - Dead axle - Leaf spring - Coil spring and shock absorbers - Steering system - Wheel housing - Brake shoes - Wheel rim - Tyres.		
Unit - V	**Recent Developments:**	**9**
Surface treatment - Plastics in Automobile vehicles - Interior Dashboard - Processing of plastics - Hydro forming of exhaust manifold and lamp housing - Stretch forming of Auto body panels - MMC liners - Advanced materials for Auto components - Robots in Body welding.		

Total:45

TEXT BOOK:

1. Serope Kalpakjian & Steven Schmid, "Manufacturing Processes for Engineering Materials", 6th Edition, Pearson Education India, New Delhi, 2016.

REFERENCES:

1. Kaushish J.P., "Manufacturing Processes", 2nd Edition, PHI Learning Pvt. Ltd., 2013.
2. Rao P.N., "Manufacturing Technology, Volume I & II", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
3. Mohammed A. Omar, “The Automotive Body Manufacturing Systems and Processes”, 1st Edition, John Wiley & Sons Ltd., 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	describe the various vehicle manufacturing processes and their aspects	Understanding (K2)
CO2	discuss the material selection and manufacturing engine components	Understanding (K2)
CO3	exemplify the material selection and manufacturing of transmission system components	Understanding (K2)
CO4	explain the materials, methods and manufacturing of vehicle chassis components	Understanding (K2)
CO5	outline the recent developments in manufacturing process for automotive components	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1								1	2	
CO2	3	2	1	1								1	3	
CO3	3	2	2	1								1	3	
CO4	3	2	1	1								1	2	
CO5	3	2	1	1								1	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	40	60					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE27 - AUTOMOTIVE SAFETY AND CONTROL

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	PE	3	0	0	3

Preamble	This course provides knowledge to understand the various safety systems in automobile	
Unit - I	**Basic Concepts of Vehicle Safety:**	**9**
Underlying principles - Fail-safe - Alternative design - Redundancy and derating - Fault tolerance - Safety factors - Warnings and instructions – Shielding – Interlocks - System engineering - Survivability and injury reduction - Design by and for test - Design for manufacturing and assembly – Design for maintenance, repair, recycling, and disposal - Recall and liability avoidance.		
Unit - II	**Risk Evaluation and Human Error Control:**	**9**
Risk Evaluation: The basic trilogy - Decision models - Balancing risks - Combining risks - Biological risk assessments. Human Error Control: Basic approaches for human error analysis - Illustrative errors - Acceptable error - Preventive measures - Risk communication – Imagery, Urgency, Magnitude of the risk, Readability.		
Unit - III	**Universal Design and Biokinetics:**	**9**
Universal Design: Idiosyncratic risks – Adjustability - Injury levels - Zero tolerance - Affirmative action - Costs of universal design - Contractual compliance. Biokinetics: Proper use of head restraints – Airbags - Problems less amenable.		
Unit - IV	**Testing and Validation:**	**9**
Human simulation - Crash testing - Human testing, Crashworthiness, Compliance testing, Component testing, Competitive race testing, Proving-ground testing, In-field testing - Accident reconstruction - The initial investigation, The search-and-marshal effort, Analysis and reconstruction, Reports and graphics.		
Unit - V	**Special Design Problems and Future Vehicle Safety:**	**9**
Special Design Problems: Age restrictions – Entrapment - Ladders, steps, and platforms – Batteries - Highway safety - The bulletproof office-on-wheels – Pedestrians. Future Vehicle Safety: Advanced features in future vehicles		

Total:45

TEXT BOOK:

1. George A. Peters and Barbara J. Peters, "Automotive Vehicle Safety", 1st Edition, CRC Press, London, 2002.

REFERENCES:

1. Mark Gonter and Ulrich Seiffert, "Integrated Automotive Safety Handbook", 1st Edition, SAE Publication, Warrendale, Pennsylvania, USA, 2014.
2. Robert Bosch GmbH, "Automotive Hand Book", 9th Edition, Wiley, Germany, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic concepts of vehicle safety.	Understanding (K2)
CO2	illustrate about the risk evaluation and human error control during the vehicle operation	Understanding (K2)
CO3	explain the purpose of universal design and biokinetcs for safety test	Understanding (K2)
CO4	describe about the various testing and validation techniques in vehicle safety	Understanding (K2)
CO5	discuss the future safety techniques and problems in special designed vehicles	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1								1	2	
CO2	3	2	1	1								1	2	1
CO3	3	2	1	1								1	2	1
CO4	3	2	2	1								1	2	1
CO5	3	2	2	1								1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	34	66					100
CAT2	34	66					100
CAT3	34	66					100
ESE	34	66					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE28 - OPEN SOURCE EMBEDDED SYSTEMS

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Automotive Embedded Systems	8	PE	3	0	0	3

Preamble	This course provides an in-depth knowledge on open source embedded systems, concepts of preemptive, highly portable, and scalable real-time kernels which are key component of the Micro C/OS real-time operating system	
Unit - I	**Introduction to embedded RTOS:**	**9**
µC/OS-III Features – RTOS Concepts: Foreground/Background systems – Real time kernels. Critical Sections: disabling Interrupts – locking the schedular. Task management: Assigning task priorities - Size of stack - Detecting task stack overflows - Task management services - Task management internals - Internal tasks - Applications of real-time embedded systems in automobile field.		
Unit - II	**Scheduling:**	**9**
Preemptive scheduling – Scheduling points - Round robin scheduling – Scheduling Internals - Interrupts management: CPU interrupts – Typical ISR – Short ISR – Direct and deferred post methods – Clock Tick.		
Unit - III	**Time Management and Resource Management:**	**9**
Time Management: One-Shot Timers – Periodic – Timer management internals – Timer states – Timer task – Resource Management: Disable/enable interrupts - Lock/unlock- Semaphores- Mutex Semaphore – Deadlock.		
Unit - IV	**Synchronization and Message Passing:**	**9**
Synchronization: Semaphore – Task Semaphore – Event Flags -Synchronizing multiple tasks. Message Passing: Messages – Messages Queues – Task Message Queue – Bilateral rendezvous – Flow control – Clients and servers – Message queue Internals.		
Unit - V	**Memory Management:**	**9**
Creating a memory Partition- Getting Memory Block – Returning Memory Block - Memory partitions - Porting µC/OS-III - Board support Package - Case study of an embedded system for an adaptive cruise control (ACC) system in a car.		

Total:45

TEXT BOOK:

1. Jean J. Labrosse, "µC/OS - III The Real Time Kernel User's Manual", 1st Edition, Micrium Press, USA, 2011.

REFERENCES:

1. Raj Kamal, "Embedded Systems: Architecture, Programming and Design", 2nd Edition, Tata McGraw Hill Education, India, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the characteristics of real time systems and task management	Understanding (K2)
CO2	relate the concepts of scheduling and interrupt management in RTOS	Understanding (K2)
CO3	explain the timer and resource management services provided by µC/OS – III	Understanding (K2)
CO4	illustrate semaphore, mutex, and message queue services in a task	Understanding (K2)
CO5	describe about the memory partitions and allocations techniques used in RTOS and porting µC/OS - III to a different architecture	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1								1		3
CO2	3	2	1	1								1		3
CO3	3	2	1	1								1		3
CO4	3	2	2	1								1		3
CO5	3	2	2	1								1		3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	30	70					100
CAT3	20	80					100
ESE	20	80					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE29 - ROAD TRANSPORT MANAGEMENT

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	PE	3	0	0	3

Preamble	This course provides knowledge on motor vehicle act, vehicle taxation, vehicle insurance and transport operation structure	
Unit - I	**Introduction:**	**9**
Personnel management - Objectives and functions – Psychology -Sociology and their relevance to organization. Drivers and conductors: Job description -Employment tests – Interviewing - Training procedure and psychological tests.		
Unit - II	**Motor Vehicle Act:**	**9**
Short titles and definitions - Laws governing to use of motor vehicle & vehicle transport - Traffic rules and signs - Licensing of drivers & conductors - Responsibility of driver. Accidents - Causes & analysis. Rules regarding construction of motor vehicles - Registration of vehicle - State and interstate permits - Liabilities and preventive measures - Offenses and penalties - Different types of forms - Government motor vehicle administration structure.		
Unit - III	**Taxation and Insurance:**	**9**
Objectives, structure and methods of levying taxation - Onetime tax - Tax exemption - Tax renewal and online tax payment. Insurance: Insurance types - Significance and renewal- Furnishing particulars of vehicles involved in an accident - Duty of driver in case of an accident -Hit and Run case -Surveyor and loss assessor - surveyor's report -Motor Accident Claims Tribunal -Solatium Fund.		
Unit - IV	**Transport Operation:**	**9**
Structure of passenger transport organizations - Depot layouts and requirements -Route planning - Scheduling of passenger transport vehicles - Preparation of timetable and fare structure - Methods of fare collection - Structure of goods transport organizations - Scheduling of goods transport vehicles - Management Information System (MIS) in goods transport operation - Storage & transportation of petroleum products -Operation cost, revenues and records.		
Unit - V	**Maintenance Management:**	**9**
Service advisor - Roles and Responsibilities - Job card and service record preparation - Trial run to understand customer complaints - Time and cost analysis for repair works - Precautions before carrying out repair works -Training procedure for mechanic - Inventory control in stores - Customer longue requirements - Customer feedback systems - Workshop Maintenance software.		

Total:45

TEXT BOOK:

1. "Motor Vehicle Act", Govt. of India Publications.

REFERENCES:

1. Santosh Sharma, "Productivity in Road Transport", 2nd Edition, Association of State Road Transport Undertakings, New Delhi.
2. Patankar P.G., "Road Passenger Transport in India", CIRT, Pune.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate interviewing and training procedures for drivers and conductors	Understanding (K2)
CO2	exemplify public & vehicle issues with help of motor vehicle act	Understanding (K2)
CO3	identify appropriate tax and insurance policies for their own vehicle	Applying (K3)
CO4	analyze operation cost and revenues of transport operation	Applying (K3)
CO5	explain the management principles involved in maintenance	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1				3	3	2	2	1	3	1	1	
CO2	1	1				3	3	2	2	1		1	1	
CO3	1	1				3	3	2	2	1		1	1	
CO4	1	1				3	3	2	2	1	2	1	1	
CO5	1	1				3	3	2	2	1	3	1	1	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	40	60					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUE30 - NON DESTRUCTIVE EVALUATION TECHNIQUES

Programme & Branch	B.E. – Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	PE	3	0	0	3

Preamble	This course provides an introduction to non-destructive evaluation testing, in-depth studies on different types of non-destructive testing equipment's along and appropriate selection of testing techniques based on the nature of defect.	
Unit - I	**Introduction and Liquid Penetrant Testing:**	**9**
Introduction and Liquid Penetrant Testing: Non-Destructive Testing (NDT) and its importance - NDT vs Destructive Testing - Preparation of test materials - Visual Examination - Basic Principles - Optical aids used and Applications. Liquid Penetrant - Principles - Procedure for Penetrant testing - Light sources and special lighting - Calibration - Penetrant testing methods - Post emulsification - Developers - Properties of liquid penetrant - Sensitivity - Applications and Limitations - Standards.		
Unit - II	**Magnetic Particle Testing:**	**9**
Magnetic Particle Testing: Principles - Theory of magnetism - Characteristics of magnetic fields - Magnetizing techniques - Circular and longitudinal magnetization techniques - Procedures - Equipment calibration - Sensitivity - Principles and methods of demagnetization - Residual magnetism - Applications and Limitations - Standards - Case studies.		
Unit - III	**Ultrasonic Testing:**	**9**
Ultrasonic Testing: Properties of sound beam - Transducers - Inspection methods - Techniques for normal and angle beam inspection - Flaw characterization - Equipment - Methods of display - A Scan - B Scan - C Scan - Immersion testing - Calibration - Advanced Ultrasonic Testing Methods - Phased Array Ultrasonic Testing (PAUT) & Time of Fight Diffraction (TOFD) - Standards - Application - Advantages and Limitations.		
Unit - IV	**Radiography:**	**9**
Radiography: Electromagnetic radiation sources - X-ray production & Gamma ray sources - Properties - Radiation - Attenuation and Effects in film - Exposure charts - Radiographic imaging - Inspection techniques - Image Quality Indicators (IQI) - Applications and Limitations - Safety in industrial radiography -Neuron radiography - Standards - Case studies.		
Unit - V	**Eddy Current and Selection of NDT Methods:**	**9**
Eddy Current and Selection of NDT Methods: Eddy Current: Principles - Instrumentation - Techniques - Probe - Sensitivity - Advanced Test Methods - Applications & Limitations - Standards - Other Techniques - Acoustic Emission Testing - Principle - Techniques - Instrumentations - Applications and Standards - Homography Thermography - Principles - Equipments - Techniques - Applications and Standards - Leak testing methods - Detection and Standards. Selection of NDT Methods: Defects in material - Selection of NDT method and Instrumentation - Some case studies.		

Total:45

TEXT BOOK:

1. Baldev Raj, Jayakumar T. & Thavasimuthu M., "Practical Non Destructive Testing", 3rd Edition, Narosa Publishing House, New Delhi, 2019.

REFERENCES:

1. Hull Barry & John Vernon, "Non Destructive Testing", 3rd Edition, Macmillan, London, 2015.
2. Hellier C., "Handbook of Non-Destructive Evaluation", 2nd Edition, McGraw-Hill Professional, New Delhi, 2012.
3. Shull Peter J. , "Non Destructive Evaluation: Theory -Techniques and Applications", Marcel Dekkar Inc., New York, 2002.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	depict the importance of non-destructive testing methods and impart knowledge on liquid penetrant and visual inspection methods.	Understanding (K2)
CO2	explain liquid penetrant and magnetic particle testing methods	Understanding (K2)
CO3	illustrate the principle of ultrasonic testing and its modern methods	Understanding (K2)
CO4	demonstrate Radiographic principles and testing of defects.	Understanding (K2)
CO5	discuss on other non-destructive testing techniques and select appropriate method for defect identification	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2			2					1		1	2	
CO2	3	2			2					1		1	2	
CO3	3	3			3					1		1	2	
CO4	3	3			3					1		1	2	
CO5	3	2			3					1		1	2	
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	40	45				100
CAT2	15	40	45				100
CAT3	20	25	30	25			100
ESE	20	25	35	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUO01 - AUTOMOTIVE ENGINEERING
(Offered by Department of Automobile Engineering)

Programme& Branch	All BE/BTech Branches except Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	0	2	4

Preamble	This course provides the knowledge on working principle of automotive components and various alternative fuel resources recommended for automotive engines.	
Unit - I	**Engines and Exhaust systems:**	**9**
Engine components: Cylinder block - Cylinder head - Sump - Manifolds - Gaskets - Cylinder - Piston - Rings - Connecting rod - Piston pins - Crank shaft - Bearings - Valves - Mufflers. Simple Carburetor - Port and Valve Timing diagram - Engine cooling and Lubrication systems - MPFI and CRDI - Exhaust systems - SCR - EGR - Catalytic converter - DeNox Trap - Emission standards in India		
Unit - II	**Transmission Systems:**	**9**
Clutch - Types and Construction - Clutch operation - Electromagnetic - Mechanical - Hydraulic - Vacuum. Gear Boxes: Manual and Automatic - Simple Floor Mounted Shift Mechanism - CVT - Dual Clutch transmission - Over Drives - Transfer Box - Fluid flywheel - Torque converter - Propeller shaft - Slip Joint - Universal Joints - Differential and Rear Axle.		
Unit - III	**Steering, Brakes and Suspension:**	**9**
Wheels and Tyres - Wheel Alignment Parameters. Steering: Steering Geometry - Types of steering gear box - Davis and Ackermann steering mechanism - Power Steering - Electronic Steering - Types of Front Axle. Suspension systems: Types of suspension springs - Shock absorbers. Braking Systems: Types and Construction - Hydraulic brakes - Air brakes - Antilock Braking System.		
Unit - IV	**Chassis Frame, Battery and Lighting System:**	**9**
Chassis construction - Truck chassis - Four wheel drive chassis - Body on frame - Semi integral and integral type - Loads acting on frame. Types of batteries - Construction, Operation and Maintenance. Electrical systems: Lighting - Wiring circuit.		
Unit - V	**Automotive Accessories and Alternate Energy Sources:**	**9**
Head lights - Switches - Indicating lights. Accessories: Direction indicators - Windscreen wiper - Horn - Speedometer - Heaters - Air conditioner. Use of Natural Gas, LPG, CNG, LPG, Bio diesel, Shale gas, Liquid nitrogen, Ethanol and Hydrogen in Automobiles - Fuel Cells.		

List of Exercises / Experiments:

1.	Dismantling and Assembling of Two stroke Petrol Engine
2.	Dismantling and Assembling of Four Stroke Petrol Engine
3.	Dismantling and Assembling of Four Stroke Diesel Engine
4.	Dismantling and Assembling of Constant Mesh Gear Box
5.	Dismantling and Assembling of Synchromesh Gear Box
6.	Dismantling and Assembling of Differential and Live Axles
7.	Dismantling and Assembling of Hydraulic and Pneumatic Braking Systems
8.	Dismantling and Assembling of Recirculating Ball and Rack & Pinion Steering Systems
9.	Fault diagnosis in Automotive Electrical Wiring Circuit
10.	Dismantling and Assembling of Horn, Wiper and Starter Motor

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Kirpal Singh, "Automobile Engineering Volume I & II", 13th Edition, Standard Publishers, New Delhi, 2017.

REFERENCES:

1.	Tom Denton, "Automobile Electrical and Electronics Systems", 4th Edition, Edward Arnold Publishers, 2013.
2.	Ganesan V., "Internal Combustion Engines", 4th Edition, Tata McGraw-Hill, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify the IC engine components and exhaust system along with its function	Understanding (K2)
CO2	categorize the types of transmission system	Applying (K3)
CO3	select appropriate suspension, brake and steering systems for automobile applications	Applying (K3)
CO4	illustrate the types of chassis and circuit for automotive electrical systems	Understanding (K2)
CO5	analyze the use of automotive accessories and alternate fuel sources recommended for automobiles	Analyzing (K4)
CO6	identify the components and working principle of petrol and diesel engines	Applying (K3), Manipulation (S2)
CO7	understand the working principle of transmission and steering systems	Applying (K3), Manipulation (S2)
CO8	identify the wiring fault in a vehicle and understand the working principle of horn, wiper and starter motor	Applying (K3), Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											
CO2	3	3	2											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	3	2											
CO6	1	2	1		3									
CO7	1	1	1		3									
CO8	1	1	1		3									

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
CAT3	40	60					100
ESE	40	60					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUO02 - AUTONOMOUS VEHICLES

(Offered by Department of Automobile Engineering)

Programme& Branch	All BE/BTech Branches except Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	1	0	4

Preamble	To explain about the principles of automated driving, advanced driver assistance systems, sensors, artificial intelligence and few case studies of autonomous vehicle.	
Unit - I	**Automated Driving:**	**9+3**
Introduction to ADV - Safety - Vehicle and its occupants – External people and property - Service and repair - IMI TechSafe.		
Unit - II	**Advanced Driver Assistance Systems:**	**9+3**
Introduction to ADAS - example systems - adaptive cruise control - obstacle avoidance radar - basic reversing aid – radar - stereo video camera - rear radar - functional safety and risk.		
Unit - III	**Automated Driving Technologies:**	**9+3**
Introduction - road to autonomy – perception - lidar operation - sensor positioning - automated driving system – mapping - other technologies – connectivity - artificial intelligence - Top-down and bottom-up AI - Deep learning - End to end machine learning.		
Unit - IV	**Social and Human Issues:**	**9+3**
Introduction - Public reaction to CAVs – Insurance - Mobility as a service - global overview - UK - European union – US - japan and china.		
Unit - V	**Case Studies:**	**9+3**
Nvidia – Bosch - Google (Waymo) - Tesla Autopilot – Audi - Jaguar Land Rover - Toyota Guardian – FLIR - First sensor AG.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Tom Denton, "Automated Driving and Driver Assistance Systems", 1st Edition, Routledge, Taylor & Francis Group, United Kingdom, 2020.

REFERENCES:

1. http://moralmachine.mit.edu/

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	summarize about introduction to automated driving vehicles with safety systems	Understanding (K2)
CO2	illustrate about the advanced driver assistance systems	Understanding (K2)
CO3	explain automated driving technologies with artificial intelligence	Understanding (K2)
CO4	describe about the social and human issues with global review	Understanding (K2)
CO5	explore autonomous vehicles with different case studies	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	3	2											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	80					100
CAT2	20	80					100
CAT3	20	50	30				100
ESE	10	70	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUO03 - ALTERNATE FUELS FOR AUTOMOBILE

(Offered by Department of Automobile Engineering)

Programme& Branch	All BE/BTech Branches except Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	OE	3	0	0	3

Preamble	To gather knowledge about recent trends in SI and CI engines, fuel injection systems related to its working components and engine modifications for using alternate fuels.	
Unit - I	**Introduction:**	**9**
Energy scenario in India – Energy and Environment Overview – Importance of Alternate Energy sources – Availability of Alternate Energy Sources for SI and CI.		
Unit - II	**Biodiesel:**	**9**
Availability of vegetable oils – Non-edible oils as biodiesel – Blending, Emulsification, Preheating and transesterification – Effect of vegetable oils physical and chemical characteristics on biodiesel properties – Estimation of Physical and chemical properties.		
Unit - III	**Alcohols as Fuel:**	**9**
Production methods of alcohols – Production of alcohol from biomass – Properties of alcohols as fuels – Methods of using alcohols in CI and SI engines – Blending, dual fuel operation, fumigation, surface ignition and oxygenated additives.		
Unit - IV	**Gaseous Fuels:**	**9**
Production methods of Biogas, NG, CNG and LPG – Biogas Digester – Reactions – Viability – Economics – Physical and chemical properties – Modification required in SI and CI Engines.		
Unit - V	**Hydrogen as Fuel:**	**9**
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.		

Total:45

TEXT BOOK:

1. Thipse S.S., "Alternative Fuels: Concepts, Technologies and Developments", Jaico Publishing House, Mumbai, 2010.

REFERENCES:

1. Ganesan.V., "Internal Combustion Engines", 4th Edition, McGraw Hill Education, New Delhi, 2017.
2. SAE, "Alternative Fuels: Fuel Cells and Natural Gas, SAE, USA, 2000.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss the needs of alternate fuels for automobiles	Understanding (K2)
CO2	explain the properties, combustion characteristics and emission parameters of various biodiesel	Understanding (K2)
CO3	illustrate the performance and emission of engines when alcohol is used as a fuel in various methods	Understanding (K2)
CO4	describe the performance and emission parameters of IC engines for various gaseous fuels	Understanding (K2)
CO5	exemplify the different methods of using hydrogen in IC engines with performance and emission parameters	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2											
CO2	3	2	2											
CO3	3	2	2											
CO4	3	2	2											
CO5	3	2	2											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	46	40	14				100
CAT2	35	45	20				100
CAT3	43	40	17				100
ESE	45	40	15				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUO04 - AUTOMOTIVE ELECTRONICS

(Offered by Department of Automobile Engineering)

Programme& Branch	All BE/BTech Branches except Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	OE	3	0	0	3

Preamble	To acquire knowledge on basic automotive electrical and electronics systems for main functions in vehicles like charging, starting, ignition, fuel control and engine management	
Unit - I	**Charging Systems:**	**9**
Introduction - requirements of the charging system - charging system principles – alternators - smart charging - advanced charging system technology - alternator developments		
Unit - II	**Starting Systems:**	**9**
requirements of the starting system - starter motors and circuits - types of starter motor - advanced starting system technology - electronic starter motor control and stop-start system		
Unit - III	**Ignition Systems:**	**9**
ignition system fundamentals - electronic ignition - electronic spark advance - distributor less ignition - coil on plug (COP) ignition - spark plugs		
Unit - IV	**Fuel Control:**	**9**
combustion - engine fuelling and exhaust emissions - emissions and driving cycles - fuel injection - double fuel injectors - diesel fuel injection - electronic control of diesel injection - rotary pump system - common rail system - electronic unit injection (EUI) - diesel lambda sensor - air–fuel ratio		
Unit - V	**Engine Management:**	**9**
combined ignition and fuel introduction - exhaust emission control - Engine design - Catalytic converters - Closed loop lambda control - engine management systems - other aspects of engine management		

Total:45

TEXT BOOK:

1.	Tom Denton, "Automobile Electrical and Electronic Systems", 5th Edition, Routledge, Taylor & Francis Group, UK, 2018.

REFERENCES:

1.	https://swayam.gov.in/nd1_noc20_de06/preview

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain about charging systems used in automobile	Understanding (K2)
CO2	illustrate the working of starting systems used in automobile	Understanding (K2)
CO3	describe the layout and types of ignition system used in automobile	Understanding (K2)
CO4	outline the controlling of fuel usage in automobile	Understanding (K2)
CO5	design the control system for ECU used in engine management system	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1											
CO2	3	2	2											
CO3	3	2	2											
CO4	3	3	3											
CO5	3	3	3											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	30	70					100
CAT3	20	60	20				100
ESE	20	60	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18AUO05 - VEHICLE MAINTENANCE

(Offered by Department of Automobile Engineering)

Programme& Branch	All BE/BTech Branches except Automobile Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	OE	3	0	0	3

Preamble	This course provides knowledge on maintenance and servicing of various systems in automobiles.	
Unit - I	**Maintenance, Workshop Practices, Safety and Tools:**	**9**
Maintenance: Maintenance - Need, policies - maintenance services – Service intervals, Classification of maintenance work Workshop Practices: Vehicle insurance -Towing and recovering, workshop operations. Safety: Safety – Personnel, machines, equipments and vehicles. Tools: Basic tools – Special service tools – Measuring instruments.		
Unit - II	**Engine and Engine Subsystem Maintenance:**	**9**
Engine: General Engine service- Dismantling of Engine components- Engine repair - Working on the underside, front, top of engine, ancillaries - Service for basic parts of engine systems. Engine Subsystem Maintenance: Cooling, lubrication, Fuel, Intake, Exhaust systems.		
Unit - III	**Transmission and Driveline Maintenance:**	**9**
Transmission: Clutch - General checks, adjustment and service. Transmission and transaxle - Dismantling, identifying, checking and reassembling. Driveline Maintenance: Removing and replacing propeller shaft, universal joint and constant velocity joints. Rear axle service - Removing axle shafts, bearings. Servicing of differential assembly.		
Unit - IV	**Brake, Suspension, Wheel and Steering Maintenance:**	**9**
Brake: Brakes - Inspection, Maintenance and Service - Bleeding of brakes. Suspension: Inspection, Maintenance and Service of suspension system-Macpherson strut and shock absorbers. Wheel: Wheel balance and alignment. Steering Maintenance: Inspection, Maintenance and Service of steering systems- Rack and pinion steering, Recirculating ball type steering, and Power steering.		
Unit - V	**Auto Electrical and HVAC Maintenance:**	**9**
Auto Electrical: Fault diagnosis and Maintenance of battery, components of starting, charging and lighting systems. HVAC Maintenance: Fault diagnosis and Maintenance of A/Csystem parts- compressor, condenser, expansion valve and evaporator. Replacement of A/C hoses- Leak detection- AC Charging.		

Total:45

TEXT BOOK:

1. William H. Crouse, "Automotive Mechanics", 10th Edition, McGraw Hill Education, New Delhi, 2017.

REFERENCES:

1. Ed May and Les Simpson, "Automotive Mechanics Volume I and II", 8th Edition, McGraw Hill Education, New Delhi, 2009.
2. Jigar A. Doshi, Dhruv U. Panchal and Jayesh P. Maniar, "Vehicle Maintenance and Garage Practice", PHI Learning Pvt. Ltd., New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the importance of maintenance, workshop practices, tools and safety requirements for automobiles	Remembering (K1)
CO2	discuss the maintenance procedure for engine and engine sub-systems	Understanding (K2)
CO3	solve the problems related with transmission and drive line systems	Applying (K3)
CO4	service the steering, brake, suspension and wheel	Applying (K3)
CO5	diagnose the problems in auto electrical and air-conditioning systems	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2			1								
CO2	3	2	2			1								
CO3	3	2	2			1								
CO4	3	3	2			1								
CO5	3	2	2			1								

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	50	20				100
CAT2	24	44	32				100
CAT3	24	44	32				100
ESE	30	50	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MAO01 - MATHEMATICAL FOUNDATIONS OF MACHINE LEARNING

(Offered by Department of Mathematics)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	To impart the basic knowledge in linear algebra, decomposition of matrices, continuous optimization, linear regression and support vector machines which provide the foundations for machine learning and deep learning.	
Unit - I	**Vector Spaces:**	**9+3**
Definition – Subspaces – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity		
Unit - II	**Linear Transformations:**	**9+3**
Introduction – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity.		
Unit - III	**Inner Product Spaces:**	**9+3**
Norms – Inner products – Length and Distance – Angle and Orthogonality – Orthonormal Basis – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Rotations.		
Unit - IV	**Matrix Decomposition And Continuous Optimization:**	**9+3**
Cholesky decomposition – Singular Value Decomposition, Continuous Optimization: Introduction – Unconstrained Optimization – Gradient Descent method – Constrained Optimization – Lagrange Multipliers method – Convex Optimization		
Unit - V	**Linear Regression And Support Vector Machines:**	**9+3**
Parameter Estimation – Maximum Likelihood estimation – Bayesian linear regression – Bayesian parameter estimation of Gaussian distribution, Support Vector Machines: Introduction – Margin and support vectors – Kernels – Primal support vector machine – Dual support vector machine.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", 9th Edition, John Wiley and Sons, New Delhi, 2011 for Units I, II, III.
2. Deisenroth M.P., Faisal A.A. and Ong C.S., "Mathematics for Machine Learning", 1st Edition, Cambridge University Press, 2019 for Units IV, V.

REFERENCES:

1. David C. Lay, Steven R. Lay and Judith McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education, New Delhi, 2016.
2. Ethem Alpaydin, "Introduction to Machine Learning(Adaptive Computation and Machine Learning series)", 4th Edition, MIT Press, USA, 2020.
3. Duda R.O., Hart E. and Stork D.G., "Pattern Classification", 2nd Edition, John Wiley and Sons, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the concepts of vector spaces.	Understanding (K2)
CO2	apply the concepts of linear mappings in machine learning.	Applying (K3)
CO3	use the concept of inner product space and decompose the given matrix by means of orthonormal vectors.	Applying (K3)
CO4	apply the knowledge of factorisation of matrices and optimization techniques in clustering and classification of data.	Applying (K3)
CO5	describe the concepts of parameter estimation and support vector machine.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1												
CO2	3	1												
CO3	3	2												
CO4	3	3	1	1	1									
CO5	3	2	2	2	1									
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	50	40				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	5	25	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MAO02 - GRAPH THEORY AND ITS APPLICATIONS

(Offered by Department of Mathematics)

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	1	0	4

Preamble	To develop rigorous logical thinking and analytical skills by graph theoretic concepts which helps for solving real time engineering problems in networks, computer architecture, compiling techniques, model checking, artificial intelligence, software engineering, expert systems, software/hardware correctness problem.	
Unit - I	**Graphs:**	**9+3**
Introduction – Definition – Types of graphs – Degree of vertex – Walk, path and cycle – Isomorphism – Connected graph – Hamiltonian graph – Euler graph – Digraph – Representations of graphs: Adjacency matrix – Incidence matrix.		
Unit - II	**Trees:**	**9+3**
Introduction – Properties of trees – Pendant vertices in a tree – Distances and centers in a tree – Rooted and binary trees – Spanning tree – Construction of spanning tree: BFS algorithm – DFS algorithm – Tree traversal.		
Unit - III	**Graph Coloring:**	**9+3**
Vertex coloring – Chromatic number – Chromatic partitioning – Independent sets – Chromatic polynomial – Matching – Covering – Four color problem (statement only) – Simple applications.		
Unit - IV	**Basic Algorithms:**	**9+3**
Shortest paths – Shortest path algorithms: Dijkstra's algorithm – Warshall's algorithm – Minimum Spanning tree – Minimal spanning tree algorithms: Prim's algorithm – Krushkal's algorithm – Optimal assignment – Kuhn and Munkres algorithm – Travelling salesman problem: Two optimal algorithm – Closest Insertion Algorithm.		
Unit - V	**Network Flows and Applications:**	**9+3**
Flows and cuts in networks - Max-flow Min-cut Theorem – Algorithms: Flow Augmenting Path – Ford-Fulkerson Algorithm for Maximum Flow – Edmonds and Karp algorithm.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, New Delhi, 2010.

REFERENCES:

1. Douglas B.West, "Graph Theory", 2nd Edition, Prentice Hall, New Delhi, 2017.
2. Jonathan L. Gross & Jay Yellen, "Graph Theory and its Applications", 2nd Edition, CRC Press, New York, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the types of graphs and illustrate isomorphism on graphs.	Understanding (K2)
CO2	use the concepts and properties of different types of trees in data structures.	Applying (K3)
CO3	estimate the chromatic partition, chromatic polynomial and matching of a given graph.	Applying (K3)
CO4	apply various graph theoretic algorithms to communication and network problems.	Applying (K3)
CO5	identify the maximal flow in network by means of algorithms.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1											
CO2	3	1												
CO3	3	1												
CO4	3	2	1											
CO5	3	2	1											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	50	40				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	30	60				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MAO03 - NUMBER THEORY AND CRYPTOGRAPHY

(Offered by Department of Mathematics)

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	1	0	4

Preamble	To provide the skills for applying various number theoretic algorithms, congruences, primality tests in cryptography and network security and impart knowledge of basic cryptographic techniques.	
Unit - I	**Divisibility Theory and Canonical Decompositions:**	**9+3**
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 - II	**Theory of Congruences:**	**9+3**
Basic concepts – Properties of congruences – Linear congruences – Solution of congruences – Fermat's Little theorem – Euler's theorem – Chinese remainder theorem.		
Unit - III	**Number Theoretic Functions:**	**9+3**
Introduction – Functions τ and σ– Mobius function – Greatest integer function – Euler's Phi function – Euler's theorem – Properties of Euler's function – Applications to Cryptography.		
Unit - IV	**Primality Testing and Factorization:**	**9+3**
Primality testing: Fermat's pseudo primality test – Solvay-Strassen test – Miller-Rabin test – Fibonacci test – Lucas test – Integer factorization: Trial division – Pollard's Rho method – Quadratic sieve method.		
Unit - V	**Classical Cryptographic Techniques:**	**9+3**
Introduction – Substitution techniques – Transposition techniques – Encryption and decryption – Symmetric and asymmetric key cryptography – Steganography.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Thomas Koshy, "Elementary Number Theory with Applications", 2nd Edition, Academic Press, Elsevier, USA, 2007 for Units I, II, III.
2. William Stallings, "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson Education, New Delhi, 2019 for Units IV, V.

REFERENCES:

1. Ivan Niven, Herbert S. Zukerman & Hugh L. Montgomery, "An Introduction to the Theory of Numbers", Reprint Edition, John Wiley & Sons, New Delhi, 2008.
2. Bernard Menezes, "Cryptography and Network Security", 1st Edition, Cengage Learning India, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand various the concepts of divisibility and canonical decompositions.	Understanding (K2)
CO2	obtain knowledge in theory of congruences and solution of linear congruences.	Applying (K3)
CO3	use different number theoretic function suitably in cryptography.	Applying (K3)
CO4	apply various Primality test and factorisation algorithms to network security problems.	Applying (K3)
CO5	identify the suitable cryptographic techniques to handle real time security issues.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2												
CO2	3	1												
CO3	3	1												
CO4	3	2	1		2									
CO5	3	2	1		2									
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	30	60				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MAO04 - ADVANCED LINEAR ALGEBRA

(Offered by Department of Mathematics)

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	OE	3	0	0	3

Preamble	To provide the skills for applying linear equations, decomposition of matrices and linear transformations in real time engineering problems and impart knowledge of vector spaces.	
Unit - I	**Linear Equations:**	**9**
System of linear equations – Row reduction and echelon forms – Vector equations – Matrix equations – Solution sets of linear systems – Applications of Linear systems: Matrix operations – inverse of a matrix, Matrix factorization – Applications to computer graphics.		
Unit - II	**Vector Spaces:**	**9**
Definition – Subspaces – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity.		
Unit - III	**Inner Product Space:**	**9**
Inner products – Angle and Orthogonality in inner product spaces – Orthonormal Bases – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Least square technique.		
Unit - IV	**Linear Transformations:**	**9**
General linear transformation – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity.		
Unit - V	**Eigenvalues and Eigenvectors:**	**9**
Definition – Orthogonal Diagonalization – Quadratic forms – Quadratic surfaces – Singular value decomposition – Applications.		

Total: 45

TEXT BOOK:

1. Howard Anton & Chris Rorres, "Elementary Linear Algebra", 11th Edition, John Wiley & Sons, USA, 2014.

REFERENCES:

1. David C. Lay, Steven R. Lay & Judith McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education, New Delhi, 2016.
2. Gareth Williams, "Linear Algebra with Applications", 8th Edition, Jones & Barlett Learning, USA, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	use the concepts of matrices and vectors in the solution of a system of linear equations.	Applying (K3)
CO2	understand the concepts of vector spaces.	Understanding (K2)
CO3	understand the concept of inner product space and decompose the given matrix by means of orthonormal vectors.	Understanding (K2)
CO4	transform the system from one dimension to another and represent the pertinent linear transformation in matrix form.	Applying (K3)
CO5	apply the knowledge of quadratic forms and techniques of singular value decomposition for problems arising in power/control system analysis, signals and systems.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1											
CO2	3	1												
CO3	3	1	1											
CO4	3	2	1											
CO5	3	2	2											
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	20	70				100
CAT2	10	30	60				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18MAO05 - OPTIMIZATION TECHNIQUES

(Offered by Department of Mathematics)

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	OE	3	0	0	3

Preamble	To provide the skills for solving the real time engineering problems involving linear, non-linear, transportation and assignment problems and also impart knowledge in project management and game theoretic concepts.	
Unit - I	**Linear Programming:**	**9**
Introduction – Formulation of Linear Programming Problem – Advantages of Linear Programming methods – Limitations of Linear Programming models – Standard form of LPP – Graphical Method – Simplex Method – Artificial variable techniques – Big M Method.		
Unit - II	**Transportation Problem:**	**9**
Mathematical Formulation of Transportation Problem – Initial basic feasible solution – North West Corner Method – Least Cost Method – Vogel's approximation method – Optimal solution – MODI Method – Degeneracy – Unbalanced transportation problem – Maximization transportation problem.		
Unit - III	**Assignment Problem and Theory of Games:**	**9**
Assignment Problem: Mathematical model of Assignment problem – Hungarian Method – Unbalanced assignment problem. Theory of Games: Two-person zero-sum game – Pure strategies - Game with mixed strategies – Rules of Dominance – Solution methods: Algebraic method – Matrix method – Graphical method.		
Unit - IV	**Project Management:**	**9**
Basic Concept of network Scheduling – Construction of network diagram – Critical path method – Programme evaluation and review technique – Project crashing – Time-cost trade-off procedure.		
Unit - V	**Non-Linear Programming:**	**9**
Formulation of non–linear programming problem – Constrained optimization with equality constraints – Kuhn-Tucker conditions – Constrained optimization with inequality constraints.		

Total: 45

TEXT BOOK:

1. Kanti Swarup, Gupta P.K. & Man Mohan, "Operation Research", 14th Edition, Sultan Chand & Sons, New Delhi, 2014.

REFERENCES:

1. Sharma J.K., "Operations Research – Theory and Applications", 4th Edition, Macmillan Publishers India Ltd., New Delhi, 2009.
2. Gupta P.K. & Hira D.S., "Operations Research: An Introduction", 6th Edition, S.Chand and Co. Ltd, New Delhi, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	formulate and solve linear programming problems.	Applying (K3)
CO2	apply transportation algorithms in engineering problems.	Applying (K3)
CO3	use assignment and game theory concepts in practical situations.	Applying (K3)
CO4	handle the problems of Project Management using CPM and PERT.	Applying (K3)
CO5	solve various types of Non-linear Programming problems.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1											
CO2	3	1	1											
CO3	3	1												
CO4	3	2	1											
CO5	3	2	1											
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	5	10	85				100
CAT2	5	10	85				100
CAT3	5	10	85				100
ESE	5	10	85				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18PHO01 - THIN FILM TECHNOLOGY
(Offered by Department of Physics)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	This course aims to impart the essential knowledge on deposition, characterization and application of thin films in various engineering fields, and also provides motivation towards innovations.	
Unit - I	**Theories and models of thin film growth:**	**9+3**
Introduction - Theories of thin film nucleation: Impingement, Adsorption and Thermal accommodation - The capillarity model - The atomistic models - Structural consequences of thin film nucleation - The four stages of film Growth - The incorporation of defects during growth.		
Unit - II	**Vacuum technology:**	**9+3**
Principle and working of vacuum pumps: Roots pump, Rotary pump, Diffusion pump, Turbo molecular pump, Cryogenic-pump, Ion pump, Ti-sublimation pump - Measurement of Pressure: Bayet-Albert gauge, Pirani and Penning gauge - Cold cathode and hot cathode ionization gauges - Pressure controlling system (qualitative).		
Unit - III	**Deposition of thin films - Physical methods:**	**9+3**
Thermal evaporation – Electron beam evaporation – Pulsed laser deposition – Ion plating – DC sputtering – RF sputtering – Magnetron sputtering – Reactive sputtering - Molecular beam epitaxy - Demonstration of deposition of thin films by RF sputtering.		
Unit - IV	**Deposition of thin films – Chemical methods:**	**9+3**
Chemical vapor deposition – Sol-gel method - Chemical bath deposition - Hydro thermal methods – Electroplating deposition - Electroless deposition - Spray Pyrolysis - Spin coating.		
Unit - V	**Characterization and Applications of thin films:**	**9+3**
Characterization: X-ray diffraction, Energy dispersive X-ray analysis, Atomic probe microscopy, UV-vis spectroscopy, Four probe resistivity – Applications (qualitative): Thin film resistors, Thin film capacitors, Thin film diodes, Thin film transistors, Thin film solar cells, Thin film gas sensors, Thin films for information storage and Optical coatings.		

Lecture:45, Tutorial:15,Total:60

TEXT BOOK:

1. Maissel L.I. and Glang R., "Hand book of Thin Film Technology", McGraw Hill Inc., 1970 for Units I,II,III, IV.
2. Zhang S., Li L. and Kumar A., "Materials Characterization Techniques", CRC Press, 2009 for Unit V.

REFERENCES:

1. Ohring M., "Material Science of Thin Films", Academic Press, 1992.
2. Goswami A., "Thin Film Fundamentals", New Age International Pvt. Ltd., 2003.
3. Chopra K.L., "Thin Film Phenomena", McGraw Hill Inc., 1969.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	utilize the appropriate theory and models to comprehend the thin film growth process.	Applying (K3)
CO2	apply the principle of vacuum pump to explain select methods to create vacuum and to make use of the principle of vacuum gauge to explain the measurement of vacuum by select methods.	Applying (K3)
CO3	describe the deposition of thin films by select physical methods using the principle of working of respective methods.	Applying (K3)
CO4	explain the deposition of thin films by select chemical methods using the principle of working of respective methods.	Applying (K3)
CO5	make use of select characterization techniques to comprehend the properties of thin films and also to illustrate the various device applications of thin films.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	35	40				100
CAT2	20	40	40				100
CAT3	20	35	45				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18PHO02 - STRUCTURAL AND OPTICAL CHARACTERIZATION OF MATERIALS

(Offered by Department of Physics)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	OE	3	0	0	3

Preamble	This course aims to impart the essential knowledge on the characterization of materials using X-ray diffraction, Raman spectroscopy, UV-visible spectroscopy, Electron microscopy and Scanning tunneling microscopy and their application in various engineering fields, and also provides motivation towards innovations.	
Unit - I	**Introduction to Characterization Techniques and X-Ray Diffraction:**	**9**
Importance of materials characterization - Classification of characterization techniques - Destructive and non-destructive techniques - Crystalline materials - Reciprocal lattice - Theory of X-ray diffraction - Powder and Single crystal X-ray diffraction: Instrumentation, XRD pattern, Systematic procedure for structure determination, Particle size determination, Strain calculation - Applications of X ray diffraction measurements.		
Unit - II	**Raman Spectroscopy:**	**9**
Introduction – Pure rotational Raman spectra – Vibrational Raman spectra – Polarization of light and Raman effect – Structure determination – Instrumentation – Near-Infra-Red FT Raman Spectroscopy.		
Unit - III	**Electron Microscopy:**	**9**
Need of Electron Microscopy - Electron Specimen interaction: Emission of secondary electrons, Backscattered electrons, Characteristic X-rays, Transmitted electrons, Specimen interaction volume - Resolution - Scanning electron microscope and Transmission electron microscope: Schematic diagram, Short details of each component and working - Field Emission Gun - Field Emission Scanning electron microscope - Merits of Transmission electron microscope.		
Unit - IV	**Scanning Tunneling Microscopy:**	**9**
Introduction to quantum mechanical tunneling - Basic principles of scanning tunneling microscopy - Two modes of scanning - Interpreting scanning tunneling microscopic images -Applications of scanning tunneling microscopy.		
Unit - V	**Ultra Violet and Visible Spectroscopy:**	**9**
Regions of UV-Visible radiation - Colour and light absorption - The chromophore concept - Beer's and Lambert's laws – Theory of electronic transition - Frank Condon principle – Instrumentation and Working of UV vis spectrometer - Applications of UV visible spectroscopy.		

Total:45

TEXT BOOK:

1. Cullity B.D. and Stock S.R., "Elements of X-ray diffraction ", 3rd Edition, Pearson Education, India, 2003 for Units I,II,III,IV.
2. Banwell C.N., "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill Publications, New Delhi, 2007 for Unit V.

REFERENCES:

1. Holt D.B. and Joy D.C., "SEM micro characterization of semiconductors", Academic Press, New Delhi, 1989.
2. Willard H.H., Merritt L.L., John A. Dean and Settle F.A., "Instrumental Methods of Analysis", 7th Edition, CBS Publishers and Distributors, New Delhi.
3. Elton N. Kaufman, "Characterization of Materials (Volume1&2)", Wiley-Interscience, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the concept of X-ray diffraction to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO2	make use of the concept of Raman effect and Raman spectroscopy to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO3	determine the micro-structural parameters of materials and to perform surface analysis of materials using the concept of matter waves and electron microscopy.	Applying (K3)
CO4	utilize the concept and phenomenon of quantum mechanical tunneling to interpret the surface image at the atomic level recorded using scanning tunneling microscopy.	Applying (K3)
CO5	apply the theory of UV-Vis spectroscopy to comprehend the working of UV-Vis spectrophotometer.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	35	45				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18CYO01 - CORROSION SCIENCE AND ENGINEERING

(Offered by Department of Chemistry)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	Corrosion science and engineering aims to equip the students to have wide range knowledge of corrosion and prevention methods in order to meet the industrial needs.	
Unit - I	**Corrosion and its units:**	**9+3**
Importance of corrosion prevention in various industries: direct and indirect effects of corrosion –free energy and oxidation potential criterion of uniform corrosion –Pilling Bedworth ratio and it consequences –units corrosion rate – mdd (milligrams per square decimeter per day) and mpy (Mils per year) –importance of pitting factor – Pourbaix diagrams of Mg, Al and Fe – and their limitations.		
Unit - II	**Mechanism of Corrosion:**	**9+3**
Localized corrosion: electro chemical mechanism Vs. chemical mechanism – Galvanic corrosion – Area effect in anodic and cathodic metal coatings, Organic coatings of bimetallic systems – prediction using emf Series and Galvanic series – Crevice corrosion – Mechanism of differential oxygenation corrosion – Auto catalytic mechanism of pitting due to crevice or differential oxygenation corrosion – Principles and procedures of cathodic protection: Sacrificial anodes and external cathodic current impression – stray current corrosion.		
Unit - III	**Types of Corrosion:**	**9+3**
Inter-granular corrosion: Stainless steels – cause and mechanism (Cr- Depletion theory) – Weld decay and knife line attack – Stress corrosion and fatigue corrosion – Theory of critical corrosion rate in corrosion fatigue. Cavitation damage – Fretting damage – Atmospheric corrosion – Bacterial corrosion – Marine corrosion –High temperature oxidation of metals – Ionic diffusion through protective oxides.		
Unit - IV	**Kinetics of Corrosion:**	**9+3**
Kinetic aspects of corrosion: Over potential activation and concentration over potentials – Exchange current density – Mixed potential theory – corrosion rates of Fe and Zn in air – free acid – effect of oxidizing agents – Phenomenon of passivation – Theories – effect of oxidizing agents and velocity of flow on passivating metals – effect of galvanic coupling of Fe and Ti respectively with Platinum – Noble metal alloying – anodic protection.		
Unit - V	**Prevention of Corrosion:**	**9+3**
Corrosion in inhibition: Inhibitors of corrosion – passivators, adsorbing inhibitors, V.P. inhibitors. Prevention of galvanic crevice, inter granular, Stress and fatigue corrosion at the design stage and in service conditions – control of catastrophic oxidation and Hydrogen disease -control of Bacterial corrosion – Langelier saturation Index and its uses. Corrosion prevention by Coatings – Surface pre- treatment – Hot dip, diffusion and cladded coatings – Phosphating and its uses.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Winston R. & Uhlig H.H., "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, A John Wiley & Sons Inc. Publication, New Jersey, 2008.

REFERENCES:

1. McCafferty E., "Introduction to Corrosion Science", Springer, New York, 2010.
2. Fontanna, "Corrosion Engineering (Materials Science and Metallurgy Series)", McGraw Hill International Education, Singapore, 2005.
3. Pietro Pedeferri, "Corrosion Science and Engineering", Springer Nature Switzerland AG, Switzerland, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate the importance of direct and indirect corrosion to familiarize for industrial needs.	Understanding (K2)
CO2	demonstrate the mechanism of different types of corrosion with respect to the environment.	Applying (K3)
CO3	organize the various types and theory of corrosion to understand the corrosion problems.	Applying (K3)
CO4	utilize the theories and kinetics of corrosion to interpret with the real time applications.	Applying (K3)
CO5	summarize the corrosion prevention methods to avoid corrosion related issues.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18CYO02 - INSTRUMENTAL METHODS OF ANALYSIS

(Offered by Department of Chemistry)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	BS	3	1	0	4

Preamble	Instrumental methods of analysis aim to prepare the students to have all-encompassing knowledge of spectral methods in order to identify the molecules and reaction mechanism for the process to enhance application towards the industries.	
Unit - I	**Absorption and Emission Spectroscopy:**	**9+3**
Basic concepts of Absorption and emission spectroscopy – representation of spectra – basic elements of practical spectroscopy – signal to noise ratio - techniques for signal to noise enhancement – resolving power – Fourier transform spectroscopy – evaluation of results – basic principles, instrumentation and applications of atomic absorption, atomic fluorescence and atomic emission spectroscopy.		
Unit - II	**IR, Raman and NMR Spectroscopy:**	**9+3**
Infrared spectroscopy – correlation of IR Spectra with molecular structure, instrumentation, samplings technique and quantitative analysis. Raman Spectroscopy – Classical and Quantum theory instrumentation, Structural analysis and quantitative analysis. Nuclear magnetic resonance spectroscopy – basic principles – pulsed Fourier transform NMR spectrometer – elucidation of NMR spectra and quantitative analysis.		
Unit - III	**Surface Studies:**	**9+3**
Surface study – x-ray emission spectroscopy (XES), electron spectroscopy for chemical analysis (ESCA) - UV photo electron spectroscopy (UPS)- X- ray photo electron spectroscopy (XPS) - Auger emission Spectroscopy (AES) - Transmission Electron microscopy (TEM) - Scanning Electron microscopy (SEM) - Surface tunneling microscopy (STEM) - Atomic force microscopy (AFM).		
Unit - IV	**Mass Spectroscopy:**	**9+3**
Mass spectroscopy – Ionization methods in mass spectroscopy – mass analyzer – ion collection systems - correlation of molecular spectra with molecular structure. Instrumentation design and application of Fourier transform mass spectroscopy (FT-MS)- Inductively coupled plasma mass spectroscopy (ICP-MS) - Secondary Ion Mass Spectroscopy (SIMS) and Ion microprobe mass analyzer (IMMA).		
Unit - V	**Thermal Analysis:**	**9+3**
Thermal analysis: principles and instrumentations and applications of thermogravimetry (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), evolved gas detection, thermo mechanical analysis and Thermometric titrimetry.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Willard H.H., Merritt L.L., Dean J.A & Settle F.A., "Instrumental Methods of Analysis", 7th Edition, CBS Publishers & Distributors, New Delhi, 2012.

REFERENCES:

1. Chatwal G.R. & Anand Sham K., "Instrumental Methods of Chemical Analysis", 5th Edition, Himalaya Publishing House, Girgaon, Mumbai, 2019.
2. Srivastava A.K. & Jain P.C., "Instrumental Approach to Chemical Analysis", 4th Edition, S Chand and Company Ltd, New Delhi, 2012.
3. Sharma B.K., "Instrumental Method of Chemical Analysis", Krishna Prakashan Media Pvt. Ltd., Meerut, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate the basics of spectroscopy to understand the instrumentation of various spectral techniques.	Understanding (K2)
CO2	apply the IR, Raman and NMR for quantitative analysis of the sample.	Applying (K3)
CO3	apply the various techniques for the better understanding of surface morphology.	Applying (K3)
CO4	explain the principle, instrumentation of mass spectroscopy for the analysis of organic sample.	Understanding (K2)
CO5	illustrate the thermal analysis for the identification of thermal stability of the compounds.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	1												
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18CYO03 - WASTE AND HAZARDOUS WASTE MANAGEMENT

(Offered by Department of Chemistry)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	BS	3	0	0	3

Preamble	Waste and Hazardous waste management aims to equip the students to have a wide-range knowledge on waste management	
Unit – I	**Solid Waste Management:**	**9**
Solid wastes: Definition, types, sources, classification and composition of solid waste- Solid waste management system – Factors affecting solid waste management system – Solid waste processing technologies – incineration, combustion, stabilization, solidification, chemical fixation, encapsulation, composting, vermicomposting – Energy from waste –Biogasification –Anaerobic digestion, pyrolysis, refuse derived fuels; Landfill leachate and gas management, Landfill bioreactors – Recycling of household and commercial waste, recycling of paper, recycling of tire, recycling of plastics – Health and Environmental effects of Solid Waste – SWM: Indian scenario –Characteristics and quantity of various wastes.		
Unit – II	**Hazardous Waste Management:**	**9**
Hazardous waste Management: Identification and sources – characteristics and categorization – collection, segregation, packaging, labelling, transportation, processing (3R) – risk assessment and waste management treatment and disposal – storage and leak detection – site selection criteria, manifest system and records – Indian scenario – Responsibilities of various authorities. Radioactive Waste Management: Definition, sources, classification, collection, segregation, treatment and disposal.		
Unit – III	**E-Waste and Biomedical Waste Management:**	**9**
E-Waste Management: Definition, sources, classification, collection, segregation, treatment and disposal. Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste – categories and classification of biomedical waste – hazard of biomedical waste – need for disposal of biomedical waste – waste minimization – waste segregation and labelling – waste handling and collection- Treatment – autoclaving, Incineration, Chemical Disinfection – Disposal – Infection control Practices-status in India.		
Unit – IV	**Pollution from Major Industries and Management:**	**9**
Introduction- sources and characteristics – waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts.		
Unit – V	**Solid Waste Management Legislation:**	**9**
Solid waste management plan – Solid Waste (Management and Handling) Rules, 2000, 2016 and amendments if any – Biomedical Waste (Management and Handling) Rules, 2016; Notification of Ash utilization 1999, 2003, 2009, 2015 and amendments if any – Plastic Waste Management Rules, 2016 – E-Waste Management Rules, 2016 – Bio-Medical Waste Management Rules, 2016 – Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 – Construction and Demolition Waste Management Rules, 2016.		

Total:45

TEXT BOOK:

1. John Pichtel, “Waste Management Practices: Municipal, Hazardous, and Industrial”, 2nd Edition, CRC Press, Boca Raton, Florida, 2014 for Unit II, III.
2. Sharma U.C. & Neetu Singh, “Environmental Science and Engineering, Volume 5: Solid Waste Management”, 2nd Edition, Studium Press, United State of America, 2017 for Unit I,IV,V.

REFERENCES:

1. VanGuilder & Cliff, "Hazardous Waste Management: An Introduction", Har Cdr Edition, Mercury Learning & Information, Herndon, VA, 2011.
2. Karen Hardt, "Solid Waste Management", 1st Edition, Callisto Reference, Germany, 2018.
3. Majeti Narasimha Vara Prasad, Meththika Vithanage & Anwesha Borthakur, "Handbook of Electronic Waste Management: International Best Practices and Case Studies", 1st Edition, Butterworth-Heinemann, United Kingdom, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the technical points that are required to set up a solid waste management system.	Applying (K3)
CO2	select the various disposal methods of hazardous wastes like radioactive wastes.	Understanding (K2)
CO3	organize the appropriate method for managing e-waste and biomedical wastes.	Applying (K3)
CO4	identify to plan minimization of industrial wastes.	Applying (K3)
CO5	relate the legal legislation to solid waste management.	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1			3							
CO2	2	1					3							
CO3	3	2	1	1			3							
CO4	3	2	1	1			3							
CO5	2	1					3							
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	35	40				100
CAT2	25	35	40				100
CAT3	25	35	40				100
ESE	25	35	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO01 – GERMAN LANGUAGE LEVEL 1

(Offered by Department of Electronics and Communication Engineering)

Programme& Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Language	5,6,7,8	HS	4	0	0	4

Preamble	To acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations.	
Unit - I	**Contacts (Kontakte):**	**12**
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.		
Unit - II	**Accommodation (Die Wohnung):**	**12**
Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative		
Unit - III	**Working Environment Communication (ArbeitenSie):**	**12**
Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speaking about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*.		
Unit - IV	**Clothes and Style (Kleidung und mode) :**	**12**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative.		
Unit - V	**Health and Vacation (Gesundheit und Urlaub):**	**12**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nichtdürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, ZumSchl*		

Total:60

TEXT BOOK:

1. "Stefanie Dengler, Paul Rusch, Helen Schmitz, TanjaSieber, "Netzwerk Deutsch alsFremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015.

REFERENCES:

1. https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware
   Refer: German 1 for undergraduate students
2. https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understanding letters and simple texts	Remembering (K1)
CO2	assimilating vocabulary on accommodation and invitation	Understanding (K2)
CO3	comprehend concept of time, telephonic conversation and job-related information	Understanding (K2)
CO4	understanding how to do shopping in a German store	Understanding (K2)
CO5	understanding body parts and how to plan personal travel	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO02 – JAPANESE LANGUAGE LEVEL 1

(Offered by Department of Electronics and Communication Engineering)

Programme& Branch	All BE/BTech Engineering & Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Language	5,6,7,8	HS	4	0	0	4

Preamble	To understand the basics of Japanese language which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form	
Unit - I	**Introduction to groups of verbs:**	**12**
tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions		
Unit - II	**Introduction to Casual Form:**	**12**
nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style		
Unit - III	**Express opinions and thoughts:**	**12**
Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications		
Unit - IV	**Introduction to If clause and Kanjis:**	**12**
If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-110 Kanjis		
Unit - V	**Introduction to Counters:**	**12**
How to use numbers-How to use quantifiers-Past form of adjectives and Nouns-Way to say preference-Way of expression degrees of an action-Other necessary particles-How to use numbers-How to use quantifiers-Past form of adjectives		

Total:60

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. MargheritaPezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2. Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and understand typical expression in Hiragana and Katakana	Remembering (K1)
CO2	understand Polite form and Casual form of Japanese	Understanding (K2)
CO3	comprehend personal communication and express greetings	Understanding (K2)
CO4	understand the Kanjis in Japanese Script	Understanding (K2)
CO5	comprehend concept of time, counters and job-related information	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO03 - DESIGN THINKING FOR ENGINEERS

(Offered by Department of Computer Science and Engineering)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Problem Solving and Programming	7	OE	3	0	0	3

Preamble	In this course, systematic process of thinking which empowers even the most traditional thinker to develop new, innovative solutions to the problem at handare studied with an emphasis on bringing ideas to life based on how real users think, feel and behave.	
Unit - I	**Introduction::**	**9**
Introduction – Need for design thinking – Design and Business – The Design Process – Design Brief –Visualization – Four Questions, Ten Tools – Explore – STEEP Analysis – Strategic Priorities – Activity System – Stakeholder Mapping – Opportunity Framing.		
Unit - II	**Visualization:**	**9**
Introduction – Visualization – Journey Mapping – Value Chain Analysis – Mind Mapping – Empathize –Observations – Need Finding – User Personas.		
Unit - III	**Brainstorming:**	**9**
Introduction – Brainstorming – Concept Development – Experiment – Ideation – Prototyping – Idea Refinement.		
Unit - IV	**Assumption Testing:**	**9**
Introduction – Assumption Testing – Rapid Prototyping – Engage – Storyboarding.		
Unit - V	**Customer Co-Creation Learning Launch:**	**9**
Introduction – Customer Co-Creation Learning Launch – Leading Growth and Innovation – Evolve– Concept Synthesis – Strategic Requirements – Evolved Activity Systems – Quick Wins.		

Total:45

TEXT BOOK:

1. Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011.

REFERENCES:

1. Lee Chong Hwa, "Design Thinking The Guidebook", Design Thinking Master Trainers of Bhutan, 2017.
2. Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth FieldBook: A Step-by-Step Project Guide", Columbia University Press, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the basic concepts of design thinking	Understanding (K2)
CO2	make use of the mind mapping process for designing any system	Applying (K3)
CO3	develop many creative ideas through structured brainstorming sessions.	Applying (K3)
CO4	develop rapid prototypes to bring the ideas into reality	Applying (K3)
CO5	plan the implementation of the any system considering the real time feedback	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1										
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	70	20				100
CAT2	10	30	60				100
CAT3	10	20	70				100
ESE	10	20	70				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO04 - INNOVATION AND BUSINESS MODEL DEVELOPMENT

(Offered by Department of Mechatronics Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	OE	3	0	0	3

Preamble	This course will inspire the students to think innovation concepts and ideas for business model developments.	
Unit - I	**Innovation and Design Thinking:**	**9**
Innovation and Creativity– Types of innovation – challenges in innovation- steps in innovation management- 7 concerns of design. Design Thinking and Entrepreneurship – Design Thinking Stages: Empathize – Define – Ideate – Prototype – Test. Design thinking tools: Analogies – Brainstorming – Mind mapping		
Unit - II	**User Study and Contextual Enquiry:**	**9**
Explanatory research – primary and secondary data – classification of secondary data – sources of secondary data – qualitative research – focus groups – depth interviews – analysis of qualitative data – survey methods – observations- Process of identifying customer needs –organize needs into a hierarchy –establish relative importance of the needs- Establish target specifications		
Unit - III	**Product Design:**	**9**
Techniques and tools for concept generation, concept evaluation – Product architecture –Minimum Viable Product (MVP)- Product prototyping – tools and techniques– overview of processes and materials – evaluation tools and techniques for user-product interaction		
Unit - IV	**Business Model Canvas (BMC):**	**9**
Lean Canvas and BMC - difference and building blocks- BMC: Patterns – Design – Strategy – Process–Business model failures: Reasons and remedies		
Unit - V	**IPR and Commercialization:**	**9**
Need for Intellectual Property- Basic concepts - Different Types of IPs: Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design– Patent Licensing - Technology Commercialization – Innovation Marketing		

Total:45

TEXT BOOK:

1. Rishikesha T.Krishnan, “8 Steps To Innovation: Going From Jugaad To Excellence”, Collins India, 2013.

REFERENCES:

1. Peter Drucker, “Innovation and Entrepreneurship”, Routledge CRC Press, London, 2014.
2. Eppinger, S.D. and Ulrich, K.T. “Product design and development”, 7th Edition, McGraw-Hill Higher Education, 2020.
3. Alexander Osterwalder, “Business model generation: A handbook for visionaries, game changers, and challengers”, 1st Edition, John Wiley and Sons; 2010.
4. Indian Innovators Association, “Patent IPR Licensing – Technology Commercialization – Innovation Marketing: Guide Book for Researchers, Innovators”, Notion Press, Chennai, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand innovation need and design thinking phases	Understanding (K2)
CO2	identify, screen and analyse ideas for new products based on customer needs	Analysing (K4)
CO3	develop and analyse the product concepts based on the customer needs and presents the overall architecture of the product.	Analysing (K4)
CO4	predict a structured business model for MVP	Applying (K3)
CO5	practice the procedures for protection of their ideas' IPR	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			2			2						3	2	2
CO2	3	3	3	3	2	2	2	2	3	3	3	3	2	2
CO3	2	2	3	3	3	3	3	3	3	3	3	3	2	2
CO4				3	2	2	2	3	3	3	3	3	2	2
CO5				3	2	2		3	2	3	3	3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	40	10			100
CAT2	20	30	40	20			100
CAT3	30	30	40				100
ESE	20	30	30	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO05 - GERMAN LANGUAGE LEVEL 2

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	German Language Level 1	5/6/7/8	HS	4	0	0	4

Preamble	This course aims to help the learner to acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations.	
Unit - I	**Contacts(Kontakte):**	**12**
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.		
Unit - II	**Accomodation(Die Wohnung):**	**12**
Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative		
Unit - III	**Are you Working?(Arbeiten Sie):**	**12**
Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speakin about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*.		
Unit - IV	**Clothes and Style(Kleidung und mode):**	**12**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative		
Unit - V	**Health and Vacation(Gesundheit und Urlaub):**	**12**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nicht dürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, Zum Schl*		

Total: 60

TEXT BOOK:

1	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, “Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs”, Goyal Publishers, Delhi, 2015.

REFERENCES:

1	https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware
2	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany’s International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand letters and simple texts	Remembering (K1)
CO2	assimilate vocabulary on Accommodation and invitation	Understanding (K2)
CO3	comprehend concept of time, telephonic conversation and job-related information	Understanding (K2)
CO4	understand how to do shopping in a German store	Understanding (K2)
CO5	understand body parts and how to plan personal travel	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1								1	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO06 - GERMAN LANGUAGE LEVEL 3

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	German Language Level 2	**5/6/7/8**	**HS**	**3**	**0**	**0**	**3**

Preamble	This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations.	
Unit - I	**All about food (Rund Ums Essen):**	**9**
Understand information about person, Speak about food, Introduce self and others, Understand and explain a picture base story, To justify something, To speak about feelings, To express opinions, To answer questions on a text, To describe a restaurant. Grammar: Possessive Articles in Dative, Yes/No questions, Reflexive verbs, Sentence with 'weil'		
Unit - II	**School days (Nach der Schulzeit):**	**9**
Understand School reports, Speak and write comments about schooldays, To speak about habits, Understand and provide City-Tipps, To Understand School types in Germany and speak about it. Grammar: Modal verbs in Past tense, Positional Verbs, Two-way prepositions in Dativ and Akkusativ.		
Unit - III	**Media in everyday life (Medien in Alltag):**	**9**
To speak about advantages and disadvantages of Media, formulate comparisons, Express your own opinion, Talk about Movies, Understand and Write Movie reviews. Grammar: Comparative degree, Comparative Sentences with 'Als' and 'Wie', Subordinate clause with 'dass', Superlative degree.		
Unit - IV	**Feelings and expressions (Gefühle):**	**9**
Express thanks and congratulations, Talk about feelings, To understand information about festivals and speak about it, To describe a city, Express joy and regrets, Understand and write Blog entries, Write appropriate heading. Grammar: Subordinate Clause with 'Wenn', Adjectives to be used along with definite articles.		
Unit - V	**Profession and Travel (Beruf und Reisen):**	**9**
To have a conversation at ticket counter, To talk about leisure activities, To gather information from Texts, Introduce people, Express career preferences, Ideate the dream job, To prepare and make telephone calls, To understand text about Workplace. Ask for information, Express uncertainty, Understand and give directions, Understand a newspaper article, Say your own opinion, Talk about the way to work, Describe a statistic, Understand information about a trip, Talk about travel. Grammar: Adjective to be used along with indefinite articles, Prepositions, verb – 'werden', Subordinate clause – indirect questions, All units will include elements for reading, writing, speaking and listening.		

Total: 45

TEXT BOOK:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015.

REFERENCES:

1. Rosa-Maria Dallapiazza , Eduard von Jan, Till Schonherr, "Tangram 2 (German)" , Goyal Publishers, Delhi, 2011.
2. https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand German food style, restaurant and be able express oneself.	Remembering (K1)
CO2	understand German school system and discuss about habits and provide City-Tipps.	Understanding (K2)
CO3	analyze and compare media in everyday life.	Understanding (K2)
CO4	express feelings, describe a city and write blog entries.	Understanding (K2)
CO5	seek and provide information in a professional setup, give directions to others and talk about travel.	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1								1	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO07 - GERMAN LANGUAGE LEVEL 4

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	German Language Level 3	5/6/7/8	HS	3	0	0	3

Preamble	This course imparts knowledge about interacting with external world, understanding various cultural aspects, behaviour and addressing relationships in personal and professional front. It helps one to understand reports from various media and at work. Enhance learner's grammatical exposure and cover the core basic grammatical concepts which would lay the foundation to have a better hold of the language. With focused learning one should be able to read and respond to reports, write simple formal and informal letters and text messages and be able to engage in simple conversations in known situations.	
Unit - I	**Learning (Lernen):**	**9**
Understanding and describing learning problems, Understanding and giving advice, Giving reasons, Understanding reports about everyday work life, Talking about everyday working life, Understanding a radio report, Understanding and making a mini-presentation. Grammar: Conjunctions- denn,weil, Konjuntiv II: Sollte(suggestions), Genitive, Temporal prepositions – bis, über + Akkusativ,ab+dativ		
Unit - II	**Athletic (Sportlich):**	**9**
Expressing enthusiasm, hope, disappointment, Understanding and writing fan comments, Formulating follow-ups, Making suggestions and reacting, Making an appointment, Understanding a report about an excursion, Understanding difficult texts, Introducing a tourist attraction. Grammar: Conjunctions – deshalb, trotzdem, Verbs with Dativ and Akkusativ		
Unit - III	**Living Together (Zusammen Leben):**	**9**
To complain, apologize & give in, As for something, Understand experience reports, Report on the past, Talk about pets, Respond to information, Write and correct a story. Grammatik: Konjunctiv II- könnte, Subordinate clauses – als and Wenn.		
Unit – IV	**Good Entertainment (Gute Unterhaltung):**	**9**
Talk about music style, Buy concert tickets, Introduce a musician / band, Understand newspaper reports, Give more detailed information about a person, Understand information about painting, Understand description of a picture, Describe a picture. Grammatik: Interrogative Articles: Was fuer eine? , Pronouns – man/jemand/niemand and alles/etwas/nichts , Relative sentences in Nominativ.		
Unit - V	**Passage of time and Culture (Zeitablauf & Kultur):**	**9**
Talk about wishes, Express wishes, Give Suggestions, Understand a conversation, Plan something together, To ask others something, Understand a text, Exchange information, Talk about proverbs, write a story. Understand information about other cultures, Discuss about behavior, Express intentions, Use the appropriate salutation, Understand tips in a text, Talk about forms of addressing others, Give more information, Discuss about clichés and write about them. All units will include elements for reading, writing, speaking and listening. Grammatik: Konjunctiv II (Wishes, Suggestions), Verbs with prepositions, W- questions with prepositions, Relative sentences in Akkusativ, Subordinate clauses with damit and Um…Zu.		

Total: 45

TEXT BOOK:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch", Goyal Publishers, Delhi, 2015.

REFERENCES:

1. Rosa-Maria Dallapiazza, Eduard von Jan, Till Schonherr, "Tangram 2 (German)", Goyal Publishers, Delhi, 2011.
2. https://www.dw.com/en/learn-german - Deutsche Welle, Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	leverage learning in Workplace, understanding reports and make presentation.	Remembering (K1)
CO2	reciprocate to different situations, make appointment and understand texts.	Understanding (K2)
CO3	handle relationships and respond appropriately to exchange information	Understanding (K2)
CO4	familiarize to various channels of entertainment	Understanding (K2)
CO5	know about various cultural aspects, usage of proverbs and cliches.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO08 - JAPANESE LANGUAGE LEVEL 2

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Japanese Language Level 1	5/6/7/8	HS	4	0	0	4

Preamble	The basic level of Japanese which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form	
Unit - I	**Introduction to groups of verbs:**	**12**
tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions		
Unit - II	**Introduction to Casual Form:**	**12**
nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style		
Unit - III	**Express opinions and thoughts:**	**12**
Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications		
Unit - IV	**Introduction to If clause and remaining Kanjis:**	**12**
If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-50 Kanjis		
Unit - V	**Introduction to giving and receiving with te form and "when, even if" usages:**	**12**
Providing to and getting from differences - Understanding of situations and framing sentences using when and even if..etc.		

Total: 60

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2. Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	differentiate groups of verbs and its forms	Remembering (K1)
CO2	understand Polite form and Casual form of Japanese	Understanding (K2)
CO3	comprehend personal communication and express greetings	Understanding (K2)
CO4	understand the Kanjis in Japanese Script and If clause	Understanding (K2)
CO5	comprehend concept of “even if”, “when” and job-related information	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO09 - JAPANESE LANGUAGE LEVEL 3

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Japanese Language Level 2	5/6/7/8	HS	3	0	0	3

Preamble	The intermediate level of Japanese which provides understanding of all forms ofverbs, adverbs, conjunctions, etc. which includes 150 Kanji's and provides the ability to comprehend conversations encountered in daily life	
Unit - I	**Introduction to Potential verbs:**	**9**
Causes and Reasons-Favouring Expressions-Expressing a State-Potential Verb Sentences-Simultaneous actions-Verb Groups-te Form-Customary Actions-Nouns-Basic Questions and Kanji's.		
Unit - II	**Introduction to Transitive and Intransitive verbs:**	**9**
Consequence of verbs- Embarrassment about Facts- Consequence of Verbs with an Intentions-Affirmative Sentences-Conjunctions-Basic Questions and kanji's.		
Unit - III	**Introduction to Volitional forms:**	**9**
Expressions of Speakers Intention-Expressing Suggestion or Advice-Usage of Adverbs and Quantifiers-Basic Questions and kanji's.		
Unit - IV	**Introduction to Imperative and Prohibitive verbs:**	**9**
Commanding person- Interrogatives-Expressions of Third Person-Actions and its Occurrence - Possibilities of an Action-Changing of States Basic Questions and Kanji's.		
Unit - V	**Introduction to Conditional form and Passive verbs:**	**9**
Description of Requirement and Speaker's Judgement, HabitualActions, Directions and suggestions-Passive forms of Verbs-Basic Questions and Kanji's.		

Total: 45

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2. Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and understand BasicVocabularies.	Remembering (K1)
CO2	understand Conversations used in daily life.	Understanding (K2)
CO3	comprehend personal communication and express greetings.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Coherent conversations in everyday situations.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO10 - JAPANESE LANGUAGE LEVEL 4

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Japanese Language Level 3	5/6/7/8	HS	3	0	0	3

Preamble	The intermediate level of Japanese provides understanding of expressions of verbs, its pattern, Relationships which also includes 150 Kanji's and also provides the ability to understand relationship among the people.	
Unit - I	**Introduction to Reasoning:**	**9**
Causes and Sequences-Causes and Effects-Interrogative Patterns-Adjective as a Noun -Basic Questions and Kanji's.		
Unit - II	**Introduction to Exchanging of things:**	**9**
Expressions for Giving and Receiving of Things-Polite Expression of Request-Indicating a Purpose of Actions-Basic Quantifiers-Basic Questions and kanji's.		
Unit - III	**Introduction to States of an Action:**	**9**
Sentence Pattern to Indicate Appearance-Degree of Action and State-Adjectives as Adverbs- Convey information -Basic Questions and kanji's.		
Unit - IV	**Introduction to Causative Verbs:**	**9**
Causative Forms of Verbs-Asking Opportunity to do something-Hypothetical Questions-Judgement and Course of an actions-Basic Questions and Kanji's.		
Unit - V	**Introduction to Relationship in Social Status:**	**9**
Honorific expressions- Respectful expressions- Humble expressions-Polite expressions-Basic Questions and Kanji's.		

Total: 45

TEXT BOOK:

1. "MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2. Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and Understand Relationship of a Person.	Remembering (K1)
CO2	understand Conversations Used in Everyday Activities.	Understanding (K2)
CO3	comprehend Contents at Near Natural Speed.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Orally Presented Materials.	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1								1	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	2	3		3		
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

18GEO11 - NCC Studies(Army Wing) – I

(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5 / 6	OE	3	0	2	4

Preamble	This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training.	
Unit - I	**NCC Organisation and National Integration:**	**9**
NCC Organisation – History of NCC- NCC Organisation- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honours and Awards – Incentives for NCC cadets by central and state govt. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.		
Unit - II	**Basic physical Training and Drill:**	**9**
Basic physical Training – various exercises for fitness(with Demonstration)-Food – Hygiene and Cleanliness. Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION)		
Unit - III	**Weapon Training:**	**9**
Main Parts of a Rifle- Characteristics of 5.56mm INSAS rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing(WITH PRACTICE SESSION) - Characteristics of 7.62mm SLR- LMG- carbine machine gun.		
Unit - IV	**Social Awareness and Community Development:**	**9**
Aims of Social service-Various Means and ways of social services- family planning – HIV and AIDS- Cancer its causes and preventive measures- NGO and their activities- Drug trafficking- Rural development programmes - MGNREGA-SGSY-JGSY-NSAP-PMGSY-Terrorism and counter terrorism- Corruption – female foeticide -dowry –child abuse-RTI Act- RTE Act- Protection of children from sexual offences act- civic sense and responsibility		
Unit - V	**Specialized Subject (ARMY):**	**9**
Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews-Fieldcraft and Battlecraft-Basics of Map reading including practical.		

Lecture :45, Practical:30, Total:75

TEXT BOOK:

1. "National Cadet Corps- A Concise handbook of NCC Cadets", Ramesh Publishing House, New Delhi, 2014.

REFERENCES:

1. "Cadets Handbook – Common Subjects SD/SW", published by DG NCC, New Delhi.
2. "Cadets Handbook- Specialized Subjects SD/SW", published by DG NCC, New Delhi.
3. "NCC OTA Precise", published by DG NCC, New Delhi.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders..	Applying (K3)
CO3	basic knowledge of weapons and their use and handling.	Applying (K3)
CO4	understanding about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils	Applying (K3)
CO5	acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	3	3	3	3				
CO2					3									
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
ESE	The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks.						

18GEO12 - NCC STUDIES (AIR WING) – I

(Offered by Department of Information Technology)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5 / 6	OE	3	0	2	4

Preamble	This course is designed especially for NCC Cadets. This course will help develop character , camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, honing qualities such as self-discipline, self-confidence, self-reliance and dignity of labour in the cadets.	
Unit – I	**NCC Organization and National Integration:**	**9**
NCC Organization – History of NCC- NCC Organization- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honors' and Awards – Incentives for NCC cadets by central and state govt. History and Organization of IAF-Indo-Pak War-1971-Operation Safed Sagar. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.		
Unit – II	**Drill and Weapon Training:**	**9**
Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION). Main Parts of a Rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing (WITH PRACTICE SESSION).		
Unit – III	**Principles of Flight:**	**9**
Laws of motion-Forces acting on aircraft–Bernoulli's theorem-Stalling-Primary control surfaces – secondary control surfaces-Aircraft recognition.		
Unit - IV	**Aero Engines:**	**9**
Introduction of Aero engine-Types of engine-piston engine-jet engines-Turboprop engines-Basic Flight Instruments-Modern trends.		
Unit – V	**Aero Modeling:**	**9**
History of aero modeling-Materials used in Aero-modeling-Types of Aero-models – Static Models-Gliders-Control line models-Radio Control Models-Building and Flying of Aero-models.		

Lecture :45, Practical30, Total:75

TEXT BOOK:

1	"National Cadet Corps- A Concise handbook of NCC Cadets" by Ramesh Publishing House, New Delhi,2014.

REFERENCES:

1	"Cadets Handbook – Common Subjects SD/SW" by DG NCC, New Delhi.
2	"Cadets Handbook – Specialised Subjects SD/SW" by DG NCC, New Delhi.
3	"NCC OTA Precise" by DGNCC, New Delhi.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate the sense of discipline with smartness and have basic knowledge of weapons and their use and handling	Applying (K3)
CO3	illustrate various forces and moments acting on aircraft	Applying (K3)
CO4	outline the concepts of aircraft engine and rocket propulsion	Applying (K3)
CO5	design, build and fly chuck gliders/model airplanes and display static models.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						3	3	3	3	3				
CO2					3									
CO3	3	2	1	1										
CO4	3	2	1	1										
CO5	3	2	1	1										
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
ESE	The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks.						