Faculty of Engineering

Department of
Mechanical and Automobile Engineering

Syllabus for
B Tech-Automobile Engineering

(Applicable for 2019-2023 batch)

CHRIST (Deemed to be University), Bangalore,
Karnataka, India
www.christuniversity.in

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1. INTRODUCTION

CHRIST (Deemed to be University), formerly Christ College (Autonomous), was born out of the educational vision of St. Kuriakose Elias Chavara, an educationalist and a social reformer of the nineteenth century. He founded the first indigenous congregation, Carmelites of Mary Immaculate (CMI). Established in July 1969, Christ College became the most preferred educational institution in the city of Bengaluru within the first three decades. From 1990 it initiated path-breaking reforms in higher education with the introduction of innovative and modern curricula, insistence on academic discipline, imparting of Holistic Education and the support of creative and dedicated staff. Today CHRIST (Deemed to be University) is rated among the top ten educational institutions of the country. The UGC conferred Autonomy to Christ College (No. F.13-1/2004) on 7 October 2004 and identified it as an Institution with Potential for Excellence in 2006. On 22 July 2008 under Section 3 of the UGC Act, 1956, the Ministry of Human Resources Development of the Union Government of India, vide Notification No. F. 9-34/2007-U.3 (A), declared it a Deemed to be University, in the name and style of CHRIST (Deemed to be University).

COLLABORATION WITH AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA (ARAI), PUNE

CHRIST (Deemed to be University) in its pursuit of excellence collaborates with industries and research institutes across the country and abroad to address the rise in market demand and produce globally competent industry, ready professionals.

As a part of this continuous effort, CHRIST (Deemed to be University) Offers a 4-year bachelor's degree in Automobile Engineering in collaboration with **Automotive Research Association of India (ARAI)** which is a research organisation of the Automotive Industry under The Ministry of Heavy Industries and Public Enterprises, Government of India. ARAI, over five decades, has provided its design and development expertise to the Indian automotive industry, focusing on the testing and evaluation of components and systems to meet national and international standards.

Under this joint industry-academia venture, the program is crafted under the expertise of ARAI and will be pooled with CHRIST (Deemed to be University) to bring out employable Automobile graduates. The program is a joint initiative where CHRIST (Deemed to be University) and ARAI are in close association and consultation with each other about design and conduct of curriculum, practical training and the student placement.

VISION
"EXCELLENCE AND SERVICE"

- CHRIST (Deemed to be University), a premier educational institution, is an academic fraternity of individuals dedicated to the motto of excellence and service. We strive to reach out to the star of perfection through an earnest academic pursuit for excellence and our efforts blossom into 'service' through our creative and empathetic involvement in the society to transform it.
- Education prepares one to face the challenges of life by bringing out the best in him/her. If this is well accepted, education should be relevant to the needs of the time and address the problems of the day. Being inspired by Blessed Kuriakose Elias Chavara, the founder of Carmelites of Mary Immaculate and the pioneer in innovative education, CHRIST (Deemed to be University) was proactive to define and redefine its mission and strategies reading the signs of the time.

MISSION STATEMENT

"CHRIST (Deemed to be University) is a nurturing ground for an individual's holistic development to make effective contribution to the society in a dynamic environment."

CORE VALUES

The values which guide us at CHRIST (Deemed to be University) are:

- **Faith in God**
- **Moral Uprightness**
- **Love of Fellow Beings**
- **Social Responsibility**
- **Pursuit of Excellence**

VISION OF DEPARTMENT

To develop Mechanical and Automobile Engineering graduates to be successful in chosen professional career through innovative academic processes for overall development, upholding integrity and ethics.

MISSION STATEMENT

1. To provide excellent academic facilities and provide quality teaching-learning experience
2. To nurture holistic development of individuals for excellence and service with ethics

PROGRAM EDUCATIONAL OBJECTIVES (PEO'S):

PEO1: Provide students with the fundamental knowledge in basic science and engineering in the streams like Design, Thermal and Production engineering to recognise, analyse and solve problems to succeed in technical profession both in industry and higher studies

PEO 2: Provide students with the necessary instruction and practical experience to work well in a team and multi-disciplinary environments and to be effective in written and oral communicators, both for communicating ideas, mentoring, and for learning from others

PEO 3: Produce graduates who have an understanding of continuous learning, ethical responsibility and service toward their peers, employers, society and follow these precepts in their daily lives

GRADUATE ATTRIBUTES:

1. Engineering Knowledge

2. Problem analysis

3. Design/development of solutions

4. Conduct investigations of complex problems

5. Modern tool usage

6. The Engineer and society

7.Environment and sustainability

8.Ethics

9.Individual and teamwork

10.Communication

11.Project management and finance

12.Life-long learning

PROGRAM OUTCOMES (PO'S)

At the end of graduation, the graduates of the Mechanical and Automobile Engineering program are able to:

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

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

3. 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.

4. 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.

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

6. 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.

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

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

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

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

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

12. 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.

02. PROGRAMS OFFERED

- **Undergraduate Programs (B. Tech)**
  B. Techin-
  - **Automobile Engineering (AE)**
  - Civil Engineering (CIVIL)
  - Computer Science and Engineering (CSE)
  - Electronics and Communication Engineering (ECE)
  - Electrical and Electronics Engineering (EEE)
  - Information Technology (IT)
  - **Mechanical Engineering (ME)**
- **Postgraduate Programs** (M. Tech) (2 Years Program)
  - Master of Technology in Computer Science &Engg.
  - Master of Technology in Communication Systems
  - Master of Technology in Information Technology
  - **Master of Technology in Machine Design**
  - Master of Technology in Power Systems
  - Master of Technology in Structural Engineering
- **Doctoral Programs (PhD)** (Doctor of Philosophy)
  - Doctor of Philosophy (PhD) in Computer Science and Engineering
  - Doctor of Philosophy (PhD) in Electronics and Communication Engg.
  - Doctor of Philosophy (PhD) in Civil Engineering
  - Doctor of Philosophy (PhD) in Electrical and Electronics Engineering
  - **Doctor of Philosophy (PhD) in Mechanical Engineering**
  - Doctor of Philosophy (PhD) in Information Technology

03. ELIGIBILITY CRITERIA

- **B. Tech**
- Pass in PUC (10+2) or equivalent with 50% marks in aggregate in Mathematics, Physics and Chemistry is the minimum eligibility for admission
- Lateral Entry Candidates who have successfully completed 3 years of diploma in Engineering or Bachelor of Science (as approved by AICTE) are eligible to apply for lateral entry into:
  - Automobile Engineering (AE)
  - **B Tech Automobile Engineering, (AE)**
  - BTech Civil Engineering, (CE)
  - **B Tech Mechanical Engineering, (ME)**
  - BTech Computer Science & Engineering, (CSE)
  - BTech Electronics & Communication Engineering, (ECE)
  - BTech Electrical and Electronics Engineering, (EEE)
  - BTech Information Technology, (ITE)

Candidates will be admitted to second year of the program only after appearing the CHRIST (Deemed to be University) selection process for engineering programs.

- **For Postgraduate Programs**:
  - For Master of Technology in Computer Science & Engineering
    - Graduate in B. Tech/B. E or MSc with 55% aggregate.
  - For Master of Technology in Communication Systems
    - Graduate in BTech/B. E or MSc in Electronics and VLSI Design with 55% aggregate.
  - For Master of Technology in Civil Engineering
    - Graduate in BE/BTech or MSc in Civil and VLSI Design with 55% aggregate.
  - **For Master of Technology in Mechanical Engineering**
    - Graduate in BE/B Tech in Mechanical, Automobile and Allied Engineering disciplines with 55% aggregate.
- **For Doctoral Programs (PhD):**
  - A graduate with 55% marks in post-graduation and equivalent in the relevant subject from any recognized university.
  - A research proposal (Maximum 1500 words) has to be submitted along with the application.

4. SELECTION PROCESS

1) Candidates can process the admission based on the Undergraduate Entrance Test and Ranking by COMEDK.
   OR
2) CHRIST (Deemed to be University) Selection Process as given below:

Process	Particulars	Date	Venue/Centre
Entrance Test	CHRIST (Deemed to be University) Entrance test for each candidate	As per the E-Admit Card	As per the E- Admit Card
Personal Interview	Personal interview for 15 minutes for each candidate by an expert panel	As per the E-Admit Card	As per the E- Admit Card
Academic Performance	Assessment of past performance in Class 10, Class 11/12 during the Personal Interview	As per the E-Admit Card	As per the E- Admit Card

5. ADMISSION PROCESS

Candidates will be intimated about the Selection status (Selected/Wait Listed/Not Selected) through the CHRIST (Deemed to be University) Notice Board/on the "Application Status" link on University website. The Selection results will be declared within 24 hours of the Personal Interview session.

The selected candidates must process admission at **Office of Admissions, Central Block, CHRIST (Deemed to be University) within 3 working days of the declaration of Selection Process results/as per the stipulated date and time mentioned by Office of Admissions.**

Selected candidates should collect the Fee Challan from the Office of Admissions and remit the Annual fee at the South Indian Bank, CHRIST (Deemed to be University) Branch. The **Offer of Admission** will stand cancelled, if failing to remit the fee within the stipulated date and time.

Admission will not be processed <u>without the presence of the candidate</u> and the <u>mandatory original documents</u> mentioned below:

1. The Offer of Admission Card (E-Admission Card/Mail)
2. Class 10 Marks Statement
3. Class 11 Marks Statement, if Candidate is pursuing class 12 and appearing for final examination during March-April 2012
4. Class 12 Marks Statement, if candidate has appeared and passed the Class 12 examination

The CHRIST (Deemed to be University) ID card is a smart card, which is both an ID card as well as a South Indian Bank ATM card with a chip containing the student personal details. All transactions within the University campus after commencement of classes, including fees payment will be processed only through this card. It is also an access card for Library and other restricted places. Candidates are advised to collect the South Indian Bank account opening form along with fees challan and process it at the Bank branch within the CHRIST (Deemed to be University) premises.

Candidates who fall under International student category (ISC), If selected, should register with the Foreigner Regional Registration Officer (FRRO/FRO) of the Local Police in Bangalore, India within 14 working days from the date of admission or arriving in Bangalore. All International student category (ISC) candidates if studied in India should obtain a NOC from the previous qualifying institution.

6. GENERAL RULES

- There is a grading scheme for each paper and for all the courses.
- All marks will indicate the marks, percentage obtained, grade and grade point average.
- The grade point average shall be calculated as follows: for each subject, multiply the grade point with the number of credits; divide the sum of product by the total number of credits.
- The CGPA [Cumulative GPA] is calculated by adding the total number of earned points [GP x Cr] for all semesters and dividing by the total number of credit hours for all semesters.

$$\mathbf{GPA=\frac{\sum[GPAxCr]}{\sum Cr}}$$

7. GRADING SCHEME FOR EACH PAPER: Undergraduate Courses

Percentage	Grade	Grade Point	Interpretation	Class
80 and above	A	4.0	Outstanding	First Class with Distinction
73-79	A-	3.67	Excellent	First Class
66-72	B+	3.33	Very Good	
60-65	B	3.0	Good	
55-59	B-	2.67	Average	Second Class
50-54	C+	2.33	Satisfactory	
45-49	C	2.00	Pass	Pass Class
40-44	D	1.0	Pass	
39 and below	F	0	Fails	Fail

8. GRADING SCHEME FOR EACH PAPER: Postgraduate Courses

Percentage	Grade	Grade Point	Interpretation	Class
80 and above	A+	4.0	Excellent	First Class with Distinction
70-79	A	3.5	Very Good	
65-69	B+	3.0	Good	First Class
60-64	B	2.5	Above Average	
55-59	C+	2.0	Average	Second Class
50-54	C	1.5	Satisfactory	
40-49	C-	1.0	Exempted if aggregate is more than 50%	Pass Class
39 and below	F	0	Fails	Fail

9. COURSE OVERVIEW

The Department of Mechanical and Automobile Engineering has well established facilities for carrying out the activities of basic mechanical and automobile engineering. It is equipped to meet the present-day technological advances and to meet the industrial requirements matching with the global standards. The department has the state-of-the-art laboratories to meet the demand for practical knowledge by the present-day industrial applications.

One of the oldest, largest and diversified of all engineering disciplines are mechanical and automobile engineering. Rated as one of the most "evergreen" branches, students of mechanical and automobile engineering can look forward to an exciting and robust study in the field of Thermal, Design, Materials and Manufacturing Engineering. A Holistic blend of both theory and practical hands on exposure ensures that students are ready to face the challenges of the industrial world.

10. COURSE OBJECTIVE

The goal of our program is to prepare our graduates for successful professional practice and advanced studies by providing a broad education in automobile engineering and by offering the opportunity to deepen their technical understanding in a particular concentration area of related technical electives. Following are the course objectives.

1. Join a technically sophisticated workforce as successful, practicing engineers in a wide range of automobile engineering fields.
2. Continuously improve and expand their technical and professional skills through formal means as well as through informal self-study.
3. Pursue advanced degrees in engineering, business, or other professional fields.
4. Advance themselves professionally and personally by accepting responsibilities and pursuing leadership roles.

11. TEACHING PEDAGOGY

Our teaching methodology ensures that students are exposed to a holistic education experience in an active and dynamic learning environment, giving them the opportunity to identify and realize their potential, and to achieve excellence. In order to realize the objectives, a methodology based on the combination of the following will be adopted:

1. Team/Class room teaching.
2. PowerPoint presentations and handouts.
3. Exposure to live automobile, systems, components for a deep insight into their construction, working, maintenance and trouble-shooting.
4. Simulated situations and role-plays in automobile environment.
5. Video films on automobile engineering.
6. Assignments.
7. Case Studies.
8. Exercises are solved hands on.
9. Seminars
10. Industry / Field visits.
11. Exposures to Automobile related advances and technologies such as Hybrid and Electric Vehicle.
12. Project work.
13. Learning Management System.

12. DETAILS OF ASSESSMENT

	Category	Weightage for CIA	Weightage for ESE
1	Courses with theory and practical	70	30
2	Courses with only theory	50	50
3	Courses with only Practical	50	50

COURSES WITH THEORY AND PRACTICAL				
	Component	**Assessed for**	**Minimum marks to pass**	**Maximum marks**
1	Theory CIA	30	-	30
2	Theory ESE	30	12	30
3	Practical CIA	35	14	35
4	Attendance	05	-	05
4	Aggregate	100	40	100

DETAILS OF MARK FOR COURSES WITH THOERY AND PRACTICAL										
THEORY						**PRACTICAL**				
	Component	**Assessed for**	**Scaled down to**	**Minimum marks to pass**	**Maximum marks**	**Component**	**Assessed for**	**Scaled down to**	**Minimum marks to pass**	**Maximum marks**
1	CIA-1	20	**10**	-	**10**	Overall CIA	**50**	**35**	**14**	**35**
2	CIA-2	50	**10**	-	**10**					
3	CIA-3	20	**10**	-	**10**					
4	Attendance	05	**05**	-	**05**	Attendance	**NA**	**NA**	**-**	**-**
5	ESE	100	**30**	12	**30**	ESE	**NA**	**NA**	**-**	**-**
		TOTAL	**65**	-	**65**	TOTAL		**35**	**14**	**35**

- Minimum marks required to pass in practical component is 40%.
- Pass in practical component is eligibility criteria to attend Theory End semester examination for the same course.
- A minimum of 40 % required to pass in ESE -Theory component of a course.
- Overall 40 % aggregate marks in Theory & practical component, is required to pass a course.
- There is no minimum pass marks for the Theory - CIA component.
- Less than 40% in practical componentis declared as FAIL.
- Less than 40% in Theory ESE is declared as fail in the theory component.
- Students who failed in theory ESE have to attend only theory ESE to pass in the course

ASSESSMENT OF COMPREHENSION, INTERNSHIP and **SERVICE LEARNING**

Comprehension

Passing marks 40% min

Do not have ESE and completely evaluated through continuous assessment only,
The evaluation (minimum 2 presentations) shall be based on the

- Topic / report :40%
- Presentation: 40%
- Response to the questions asked during presentation :20%.

Service Learning

Passing marks 40% min

Do not have ESE and completely evaluated through continuous assessment only,
Comprising

- Internal Assessment with components like tests/quiz/written assignments: 25 marks
- Field Work or equivalent assignment as approved by the department panel: 25 marks

Internship
Passing marks 40% min
Do not have ESE and completely evaluated through continuous assessment only
Continuous Internal Assessment *is based upon*

- No of Internship Days : 20 marks
- Type of Industry and Work Carried out : 10 marks
- Report on Internship : 10 marks
- Presentation on Internship : 10 marks

ASSESSMENT OF PROJECT WORK

Project work may be assigned to a single student (with due approval from department) or to a group of students not exceeding 4 per group.

Maximum Marks = 200

- Continuous Assessment 100 and the
- End Semester Examination (project report evaluation and viva-voce): 100 marks.
- The continuous assessment and End Semester Examinations marks for Project Work and the Viva-Voce Examination will be distributed as indicated below.
- There shall be **3** reviews **and t**he student shall make presentation on the progress made before the committee constituted by the Department
- The total marks obtained in the 3 reviews shall be 100 marks.

CIA 100 MARKS						**ESE 100 MARKS**
REVIEW 1		**REVIEW 2**		**REVIEW 3**		
REVIEW COMMITTEE	GUIDE	REVIEW COMMITTEE	GUIDE	REVIEW COMMITTEE	GUIDE	EXAMINERS
20	05	20	10	20	25	**100**
TOTAL	**25**	**TOTAL**	**30**	**TOTAL**	**45**	

ESE 100 MARKS IS EVALUATED AS

- Initial Write up : 15 marks
- Viva Voce : 25 marks
- Demonstration : 35 marks
- Project Report : 25 marks

ASSESSMENT OF ENGINEERING GRAPHICS AND COMPUTER AIDED MACHINE DRAWING

- Continuous Internal Assessment (CIA): 50% (50 marks out of 100 marks)
- End Semester Examination (ESE) : 50% (50 marks out of 100 marks)

Components of the CIA

CIA I : Assignments : 10 marks
CIA II : Mid Semester Examination : 25 marks
CIA III : Assignments : 10 marks
Attendance : 05 marks
Total **: 50 marks**

End Semester Examination
3 hrs. duration for 100 marks

1. ENGINEERING GRAPHICS

- Projections of points, lines and plane surfaces –Manual Drawing : 30 marks
- Projections of Solids- Computer Aided : 40 marks
- Development of surfaces and Isometric Projections - Computer Aided : 30 marks

2. COMPUTER AIDED MACHINE DRAWING

- Part-A –Manual Drawing : 20 marks
- Part-B - Manual Drawing : 20 marks
- Part-C - Computer Aided : 60 marks

13. Industry based Project for Final Year Students

Faculty of engineering brings the academics and tech community together to develop transformative ideas and develop pioneering and technologies for the digital age.

1. Scheme:

CHRIST (Deemed to be University) endeavors to instill the industry culture and to create job opportunities for its students. To facilitate this, the departments under faculty of engineering has taken the initiative to introduce 4-6 months industry-based project intended for the final year UG students of the departments during their 8th semester. The scheme of 'industry-based project' shall be option for the student to complete his/her course curriculum of 8th semester through 'experimental learning'.

S.no	Course Code	Course Name	Marks	Credit
1	XX831	Elective V	100	4
2	XX832	Elective VI	100	4
3	XX833	Elective VII	100	4
4	XX871	Project Work	200	6
5	XX872	Comprehension	50	2
6	BTCY01	Cyber security		2
7	IC	The Constitution of India		1
		Total	550	23

Note: "XX" refers to the subject code of the department respectively.

The scheme shall call for the mandatory core course (Elective I, II, III) of the semester to be completed before the commencement of the project tenure. The student shall follow all the norms of the deliverables under project work and comprehension as indicated in the curriculum.

The scheme shall be effective from the academic year 2017-18 as approved by the Interim Board of Studies of the Faculty of Engineering /Academic Council.

2. Eligibility Criteria:

For a student to be selected for this project, it is essential that he /she scores a minimum of 60% in every semester till the sixth semester of study without any repetition and/or backlog.

3. Selection Process:

a) Students interested to opt for the scheme must submit a written application addressed to the Head of the Department along with an official confirmation of Industry Project offer in the relevant area from any company chosen by the student within the specified time limit as may be announced by the Department. It shall be the responsibility of the student to identify the company which should be well established having fair credentials in the field of engineering.

b) Shortlisted students based on the above said criteria will be required to make a short presentation on their intended project to and will face a Viva-Voice by a select

panel of faculty chosen by the Head of the Department. The following aspects will be considered while interviewing the student.

i. Relevance and duration of the project.

ii. Confidence/knowledge competence of the student in his/her presentation.

iii. Availability of monetary/non-monetary stipendiary benefits as per the offer letter issued by the Company for the Industry project.

iv. Company Credentials.

v. Inclination of the company to follow supervisory guidelines of the Faculty of Engineering.

vi. Opportunity for Placement.

c) The students selected by the Panel of Faculty alone will be permitted under the scheme to take up the Industry Based Project although the student would have obtained. The decision of the panel members taken in consultation with the Head of the Department will be final and binding.

d) Selected students must sign a letter of undertaking to abide by the rules specified.

4. Rules:

The following are the rules to be followed by a student who is selected for 6 months full time Industry Based Project:

i. The course content for the semester will be readjusted to include 70% of direct teaching hours and 30% of self-study modules.

ii. The CIA I and CIA 3 components for these courses should be completed before the commencement of the project as may be guided by the Faculty.

iii. The students who are selected are required to attend the centrally conducted Mid Semester Examination (CIA 2) and the End Semester Examination (ESE) by the University along with the other regular students without fail.

iv. For the selected students, the regular courses of eighth semester shall start immediately after the completion of the End Semester Examination (ESE) of seventh semester, and shall end before December of the particular Academic year.

v. There will be an Internal Faculty Guide as well as an External Company guide under whose guidance and supervision the student shall be required to undertake the project work.

vi. The student shall be bound by administrative rules and regulations of the company during the internship period and will attend to the company as per its working hours.

Vii. The student has to maintain a work record diary (a blue book) which needs to be updated daily with the work carried out by him/her at the selected company.

viii. The work diary needs to be got signed by the External Company Guide every day without fail.

ix. The work diary will be closely monitored by the Internal Guide and be reviewed every 15 days. The Internal Guide shall visit the working place of the student for such assessment.

x. Student performance will be graded independently by the two Guides and the combined grades of External and Internal Guides will be considered for the allotment of the CIA marks for the Project work.

xi. The students once selected into a company/industry project cannot withdraw from the project at any time of its duration for whatever reason. If such an event happens

including for rejection by the company the student will be required to repeat the semester in the succeeding academic year in accordance with applicable University Regulations unless otherwise decided by the Disciplinary Committee.

xii. There shall be a Disciplinary Committee under the Head of the Department with 2 additional members nominated by the Associate Dean to deal with any of the following issues of indiscipline.

a. Non-compliance of the matters stated in the regulation by the student as may be reported by the either of the guides.

b. Irregular attendance by the student.

c. Withdrawal from the project work.

d. Any other matter as may be considered improper by the guides.

e. The committee may also directly take up disciplinary proceedings based on its own opinion.

The Decision of the committee as endorsed by the Associate Dean shall be final and binding on the student.

14. COURSE STRUCTURE:

I SEMESTER – CHEMISTRY CYCLE

Sl. No	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	MA131	Mathematics – I	3	0	0	100	3	0	0	3
2	CH132P	Chemistry	3	0	2	100	3	0	1	4
3	EC133P	Basic Electronics	3	0	2	100	3	0	1	4
4	CS134P	Computer Programming	3	0	2	100	3	0	1	4
5	ME135	Basic Mechanical Engineering and Nanoscience	3	0	0	100	3	0	0	3
6	TE136P	Technical English	1	0	2	100	1	0	1	2
7	ME 151	Workshop Practice Lab	0	0	2	50	0	0	1	1
8	HE171	Holistic Education-I	1	0	0	---	1	0	0	1
		Total				**550**				**22**

I SEMESTER – PHYSICS CYCLE

Sl. No	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	MA131	Mathematics – I	3	0	0	100	3	0	0	3
2	PH132P	Physics	3	0	2	100	3	0	1	4
3	EE133P	Basic Electrical Engineering	3	0	2	100	3	0	1	4
4	CE134P	Basics of Civil Engineering & Engineering Mechanics	3	0	2	100	3	0	1	4
5	EG135P	Engineering Graphics	2	0	2	100	2	0	1	3
6	BS136	Bio Science	2	0	0	100	2	0	0	2
7	HE171	Holistic Education-I	1	0	0	---	1	0	0	1
		Total				**600**				**21**

II SEMESTER – CHEMISTRY CYCLE

Sl. No	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	MA231	Mathematics – II	3	0	0	100	3	0	0	3
2	CH232P	Chemistry	3	0	2	100	3	0	1	4
3	EC233P	Basic Electronics	3	0	2	100	3	0	1	4
4	CS234P	Computer Programming	3	0	2	100	3	0	1	4
5	ME235	Basic Mechanical Engineering and Nanoscience	3	0	0	100	3	0	0	3
6	TE236P	Technical English	1	0	2	100	1	0	1	2
7	ME 251	Workshop Practice Lab	0	0	2	50	0	0	1	1
8	HE271	Holistic Education-II	1	0	0	---	1	0	0	1
		Total				**650**				**22**

II SEMESTER – PHYSICS CYCLE

Sl. No	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	MA231	Mathematics – II	3	0	0	100	3	0	0	3
2	PH232P	Physics	3	0	2	100	3	0	1	4
3	EE233P	Basic Electrical Engineering	3	0	2	100	3	0	1	4
4	CE234P	Basics of Civil Engineering & Engineering Mechanics	3	0	2	100	3	0	1	4
5	EG235P	Engineering Graphics	2	0	2	100	2	0	1	3
6	BS 236	Bio Science	2	0	0	100	2	0	0	2
7	HE271	Holistic Education-II	1	0	0	---	1	0	0	1
		Total				**600**				**21**

III SEMESTER

Sl. No	Type	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	BSC	MA331	Mathematics-III	3	0	0	100	3	0	0	3
2	PCC	ME332	Basic Thermodynamics	2	1	0	100	3	0	0	3
3	PCC	ME333P	Strength of Materials	3	0	2	100	3	0	1	4
4	PCC	AU334P	Automobile Manufacturing Processes	3	0	2	100	3	0	1	4
5	BSC	BS335	Applied Chemistry	2	0	0	50	2	0	2	2
6	BSC	BS351	Bio Science Laboratory	0	0	2	50	0	0	1	1
7	PCC	AU352	Automation Laboratory	0	0	2	50	0	0	1	1
8	HSMC	HE371	Holistic Education-III	1	0	0	---	1	0	0	1
9	MC		Environmental Science	2	0	0	---	0	0	0	--
			Total				**550**				**19**

IV SEMESTER

Sl. No	Type	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	PCC	ME431	Applied Thermodynamics	3	0	0	100	3	0	0	3
2	PCC	AU432P	Automobile Materials Engineering	3	0	2	100	3	0	1	4
3	PCC	ME433P	Fluid Mechanics & Fluid Machines	3	0	2	100	3	0	1	4
4	PCC	AU434P	Automotive Engines	3	0	2	100	3	0	1	4
5	PCC	AU435	Kinematics & Theory of Machines	3	0	0	100	3	0	0	3
6	HSMC	HS435	Professional Ethics	2	0	0	50	2	0	0	2
7	HSMC	HE471	Holistic Education-IV	1	0	0	---	1	0	0	1
8	MC	MC	Cyber Security	2	0	0	---	0	0	0	--
			Total				**550**				**21**

V SEMESTER

Sl. No	Type	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	PCC	AU531	Design of Automotive Components	3	0	0	100	3	0	0	3
2	**PCC**	AU532P	Automotive Engine Systems	3	0	2	100	3	0	1	4
3	BSC	AU533	Automotive Electrical and Electronic Systems	3	0	0	100	3	0	0	3
4	PEC	AU534E	Program Elective – 1	2	0	2	100	2	0	1	3
5	OE		Open Elective - 1	2	0	2	100	2	0	1	3
6	ESC	AU536P	Computer Aided Machine Drawing	2	0	2	100	2	0	1	3
7	PCC	AU551	Advanced Machining Laboratory	0	0	2	50	0	0	1	1
8	MC		Indian Constitution	2	0	0	---	0	0	0	0
			Total				**650**				**20**

VI SEMESTER

Sl. No	Type	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	PCC	AU631P	Alternate Fuels and Energy Systems	3	0	2	100	3	0	1	4
2	PCC	AU632	Automotive Chassis, Vehicle body Engineering & safety	3	0	0	100	3	0	0	3
3	EEC	AU633	Engineering Economics and Automotive Cost Estimation	3	0	0	100	3	0	0	3
4	PEC	AU634E	Program Elective – 2	2	0	2	100	2	0	1	3
5	OE		Open Elective - 2	2	0	2	100	2	0	1	3
6	OE		Open Elective - 3	2	0	2	100	2	0	1	3
7	PCC	AU651	Simulation Laboratory	0	0	2	50	0	0	1	1
8	PCC	AU652	Computational Laboratory	0	0	2	50	0	0	1	1
9	HSMC	HS637	Service Learning	0	0	4	50	0	0	2	2
			Total				**750**				**23**

VII SEMESTER

Sl. No	Type	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	PEC	AU731E	Program Elective – 3	2	0	2	100	2	0	1	3
2	PEC	AU732E	Program Elective – 4	2	0	2	100	2	0	1	3
3	PCC	AU751	Teardown lab	0	0	2	50	0	0	1	1
4	PCC	AU752	Analysis	0	0	2	50	0	0	1	1
5	OE		Open Elective – 4	2	0	2	100	2	0	1	3
6	OE		Open Elective - 5	2	0	2	100	2	0	1	3
7	EEC-PROJ	AU771	Project Stage-I	2	0	2	100	2	0	1	3
8	EEC	AU772	Internship	0	0	4	50	0	0	2	2
			Total				**650**				**19**

VIII SEMESTER

Sl. No	Type	Course No	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	PEC	AU831E	Program Elective – 5	2	0	2	100	2	0	1	3
2	PEC	AU832E	Program Elective – 6	2	0	2	100	2	0	1	3
3	EEC-PROJ	AU871	Project Stage-II	0	0	18	200	0	0	1	9
			Total				**400**				**15**

Sl. No	Program Elective – 1	L	T	P	Hrs/ Week	Credits
1	Automotive Emissions & Control	2	0	2	4	3
2	Turbo Machines	2	0	2	4	3
3	Vehicle Dynamics	2	0	2	4	3
4	Non-Traditional Machining	2	0	2	4	3
5	Operations Research	2	0	2	4	3

Sl. No	Program Elective – 2	L	T	P	Hrs/Week	Credits
1	Automotive Transmission System	2	0	2	4	3
2	Vehicle Dynamics	2	0	2	4	3
3	Automotive Aerodynamics	2	0	2	4	3
4	Trouble Shooting, Servicing and Maintenance of Automobiles	2	0	2	4	3

Sl. No	Program Elective – 3	L	T	P	Hrs/ Week	Credits
1	Organisational Behaviour, Communication and Leadership	2	0	2	4	3
2	Entrepreneurship Development	2	0	2	4	3
3	Hydraulics & Pneumatic Control	2	0	2	4	3
4	Mechanics of Composite Materials	2	0	2	4	3
5	Automotive Heating Ventilation & Air-Conditioning	2	0	2	4	3

Sl. No	Program Elective – 4	L	T	P	Hrs/Week	Credits
1	Hybrid and Electric Vehicles	2	0	2	4	3
2	Total Quality Management	2	0	2	4	3
3	Nanotechnology	2	0	2	4	3
4	Project and Materials Management	2	0	2	4	3
5	Smart Materials	2	0	2	4	3

Sl. No	Program Elective – 5	L	T	P	Hrs/Week	Credits
1	Vehicle Transport Management	2	0	2	4	3
2	Simulation of IC Engine Processes	2	0	2	4	3
3	Two and Three Wheelers	2	0	2	4	3
4	Automotive Testing and Certification	2	0	2	4	3
5	Control Engineering	2	0	2	4	3

Sl. No	Program Elective – 6	L	T	P	Hrs/Week	Credits
1	Rapid Prototyping	2	0	2	4	3
2	Tribology	2	0	2	4	3
3	Fracture Mechanics	2	0	2	4	3
4	Non-Destructive Testing	2	0	2	4	3
5	Research Methodology	2	0	2	4	3

DETAILED SYLLABUS

Course Name: MATHEMATICS I					
Course Code : MA 131					
	L	**T**	**P**	Category	**BSC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: This course is outlined to those who intend to apply the subject at the proper place and time, while keeping him/her aware to the needs of the society where he/she can lend his/her expert service, and also to those who can be useful to the community without even going through the formal process of drilling through rigorous treatment of Mathematics. At the end of this course, students will

- have a solid base of understanding elementary linear algebra as required for further undergraduate work in engineering.
- be able to differentiate a function partially with respect to each of its variables in turn
- be able to utilize methods of integration to compute length of arcs, surface area and volume of solids
- be skilled in using integration to compute problems important in physics and engineering
- learn the meaning and computation of the curl and divergence of a vector field.
- be able to solve first order differential equations that are separable, linear or exact

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	**Linear Algebra**
Fundamental concepts of Matrix, Rank of a Matrix, Consistency and solution of linear simultaneous equations, Eigen values and Eigen Vectors, Diagonalization	**5**
Unit-2	**Differential Calculus – I**
Partial Differentiation: Partial derivatives, Total differential coefficient, differentiation of composite and implicit functions, Jacobians and properties. Leibnitz's Rule of differentiation under integral sign.	**10**
Unit-3	**Integral Calculus – I**
Reduction formulae for the integration of $\sin^n x$, $\cos^n x$, $\sin^m x \cos^n x$ and evaluation of these integrals with standard limits - Problems. Derivative of arc length, Applications of integration to find surfaces of revolution and volumes of solids of revolution.	**10**
Unit-4	**Differential Equation – I**
Solution of first order and first-degree differential equations: Reducible to Homogeneous, Linear and Exact differential equation, Applications of differential equations. orthogonal trajectories.	**10**
Unit-5	**Vector Calculus – I**

Vector differentiation. Velocity, Acceleration of a particle moving on a space curve. Vector point function. directional derivative, Gradient, Divergence, Curl, Laplacian. Solenoidal and Irrotational vectors - Problems. Standard vector identities.	**10**

Self-study : NIL

Site/Industrial Visits : NIL

Course outcomes:

CO1: Checking the consistency of system of linear equations and hence finding solution {Level} {PO}
CO2: Finding the differentiation of multivariable functions using the concept of total derivatives, Jacobian, Evaluating definite integrals by Leibnitz rule of differentiation under integral sign {Level} {PO}
CO3: Evaluation of definite integrals as surface area and volume of solid of revolution using reduction formulae {Level} {PO}
CO4: Solving first order nonlinear differential equations by reducing into homogenous, linear and exact forms {Level} {PO}
CO5: Finding the velocity and acceleration of a moving particle, vector potential, scalar potential {Level} {PO}

Text Books:

T1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, July 2005.
T2. H. K. Das & Rajnish Verma, "Higher Engineering Mathematics", S. Chand & Company Ltd., 2011.

Reference Books:

R1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, 2005
R2. Thomas and Finney, "Calculus", 9th Edition, Pearson Education, 2004
R3. Peter V. O'Neil, "Advanced Engineering Mathematics", Thomson Publication, Canada, 2007
R4. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw – Hill, 2009.
R5. Michael Artin, "Algebra", 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2002
R6. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2002
R7. George F. Simmons and Steven G. Krantz, "Differential Equation, Theory, Technique and Practice", Tata McGraw – Hill, 2006.
R8. M. D. Raisinghania, "Ordinary and Partial Differential Equation", Chand (S.) & Co. Ltd., India, March 17, 2005.

Online Resources:

NIL

Course Name: CHEMISTRY					
Course Code: CH 132P / CH 232P					
	L	**T**	**P**	Category	**BSC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives: This paper contains five units which are Chemical Energy Sources, Electrochemical Energy Systems, Corrosion Science, Surface Chemistry & Catalysis, Material Characterization Techniques and Water Technology

This paper aims at enabling the students to know various energy sources, corrosion and its control, basics of surface chemistry, their application in catalysis, water technology and material characterization.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 **Chemical Energy Sources**	
Introduction to energy; Fuels - definition, classification, importance of hydrocarbons as fuels; Calorific value -definition, Gross and Net calorific values. Ultimate and proximate analysis of fuel, Determination of calorific value of a solid / liquid fuel using Bomb calorimeter. Cracking – Thermal Catalytic & fluidised cracking. Reformation, Knocking - mechanism, octane number, cetane number, prevention of knocking- anti-knocking agents, unleaded petrol, Power alcohol. synthetic petrol – Bergius process and Fischer Tropsch process. **Solar Energy** : Physical and chemical properties of silicon, production of silicon for photovoltaic cell – Mettalurgical grade, Solar grade. Purification of silicon – Zone refining crystal pulling technique - Photovoltaic cells- Introduction, VB Theory, definition, working of a PV cell, Merits and demerits.	**10**
Unit-2 **Electrochemical Energy Systems**	
Conductance, Ionic conductance, Transport number, Ionic mobility, activity coefficient and mean activity coefficients. Single electrode potential- origin, sign conventions. Derivation of Nernst equation. Standard electrode potential Construction of Galvanic cell–classification - primary, secondary and concentration cells, Concentration cell with and without transference, EMF of a cell, notation and conventions. Reference electrodes –calomel electrode, Ag/AgCl electrode. Measurement of single electrode potential. Numerical problems on electrode potential and EMF. Ion-selective electrode- glass electrode, Determination of pH using glass electrode.	**8**
Unit-3 **Corrosion Science**	
Corrosion - definition, Chemical corrosion and Electro-chemical theory of corrosion, Types of corrosion, Differential metal corrosion, Differential aeration corrosion (pitting and water line corrosion), Stress corrosion. Factors affecting the rate of corrosion**,** Corrosion control: Inorganic coatings – Anodizing and Phosphating, Metal coatings –Galvanization and Tinning, Corrosion Inhibitors, Cathodic and Anodic protection.	**9**
Unit-4 **Surface chemistry & Catalysis**	
Introduction - Terminologies in surface chemistry – Adsorption - Characteristics, Classification, Application , Factors affecting Adsorption – Surface Area, temperature, pressure and nature of gas, desorption Activation Energy life time, Adsorption isotherms- Freudlich, Langmuir, BET	**11**

Catalysis: Introduction, classification- Homogeneous and Heterogeneous, Active Sites-Single & dual- Solid catalysts- Classification- Supported, Unsupported, Metal Organic Frameworks Imprint catalysts, Hybrid catalysts, shape selective catalyst,– terminologies in material preparation- Precursor, calcination, Ageing, agglomeration regeneration	
Unit-5 Material Characterization & Water Technology	
Theory and Applications of X-ray Photo electron Spectroscopy(XPS), Powder Xray diffraction (pXRD) **Water Technology:** Impurities in water,. Biochemical Oxygen Demand and Chemical Oxygen Demand. Numerical problems on BOD and COD. Sewage treatment. Purification of water- Desalination - Flash evaporation- Electro dialysis and Reverse Osmosis.	**7**
List of Experiments (If any):	**Practical Hours**
PART – A	
1. Determination of viscosity coefficient of a given liquid using Ostwald's viscometer.	**2**
2. Determination of copper by spectrophotometric method.	**2**
3. Conductometric estimation of an acid using standard NaOH solution	**2**
4. Determination of pKa value of a weak acid using pH meter.	**2**
5. Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution.	**2**
PART – B	
1. Determination of Total Hardness of a sample of water using disodium salt of EDTA.	**2**
2. Determination of percentage of Copper in brass using standard sodium thiosulphate solution.	**2**
3. Determination of Calcium Oxide (CaO) in the given sample of cement by Rapid EDTA method	**2**
4. Determination of Iron in the given sample of Haematite ore solution using potassium dichromate crystals by external indicator method.	**2**
5. Determination of Chemical Oxygen Demand (COD) of the given industrial waste Water sample.	**2**
Self-study : NIL	
Site/Industrial Visits : NIL	

Course outcomes:

CO1: Students will be able to distinguish between renewable and non-renewable energy sources. {Level} {PO}

CO2: Students will gain an understanding of oxidation and reduction reactions which are relevant to study the concepts of corrosion science and electrochemistry. {Level} {PO}

CO3: Students will be able to explain basics of physical and chemical phenomena taking place at solid surfaces. {Level} {PO}

CO4: Students will be able to describe physiochemical techniques for material characterization. {Level} {PO}

CO5: Students will be able to explain the fundamentals of water and waste water treatment. {Level} {PO}

Text Books:

T1. Dr. B.S. Jai Prakash, "Chemistry for Engineering Students", Subhas Stores, Bangalore, Reprint 2015

T2. M. M. Uppal, *"*Engineering Chemistry*",* Khanna Publishers, Sixth Edition, 2002

T3. Jain and Jain, *"*A text Book of Engineering Chemistry*",* S. Chand & Company Ltd. New Delhi, 2009, Reprint- 2016

Reference Books:

R1. Atkins P.W. "Physical chemistry" ELBS 9 Edition 2009, London

R2. Stanley E. Manahan, *"*Environmental Chemistry*",* Lewis Publishers, Reprint 2009

R3. B. R. Puri, L. R. Sharma & M. S. Pathania, *"*Principles of Physical Chemistry*",* S. Nagin Chand & Co., 33rd Ed., Reprint- 2016

R4. Kuriakose J.C. and Rajaram J. " Chemistry in Engineering and Technology" Vol I & II, Tata Mc Graw – Hill Publications Co Ltd, NewDelhi, First edition Reprint 2010

R5. Ertl, H. Knozinger and J. Weitkamp, "Handbook of Heterogeneous Catalysis" Vol 1-5, Wiley - VCH.

R6. B. Viswanathan, S. Sivasanker , A.V. Ramaswamy, "Catalysis : Principles & Applications" CRC Press, March 2002, Reprint 2011.

R7. D K Chakrabarthy, B. Viswanathan,"Heterogeneous Catalysis" New Age Internatioanl Publishers,2008.

R8. J. Bassett, R.C. Denny, G.H. Jeffery, *"*Vogels text book of quantitative inorganic analysis*",*5^{th} Edition

R9. Sunita and Ratan Practical Engineering Chemistry, S.K. Kataria & Sons, 2013.

Online Resources:

NIL

Course Name: BASIC ELECTRONICS					
Course Code : EC133P / EC233P					
	L	**T**	**P**	Category	ESC
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives: This course aims at imparting knowledge about electronic and digital systems, semiconductor theory and operational amplifiers. This course also includes a practical component which allows the students to recognize the different elements used in electronics and digital systems.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1 **Basic Semiconductor And Pn Junction Theory**	
Atomic Theory – Atom, Electron Orbits and Energy Levels - Conduction in solids – Electron Motion and Hole Transfer, Conventional Current and Electron Flow – Conductors, Insulators and Semiconductors – Energy Band Diagrams – Variation of band gap with temperature. Intrinsic and Extrinsic Semiconductors – Doping, n type and p type material, Majority and minority carriers, Charge Carrier Density, Mass Action Law. Semiconductor Conductivity – Drift Current, Diffusion Current, Charge Carrier Velocity, Condyctivity.The pn Junction – Biased Junctions – Junction Currents and Voltages.VI Characteristics – Static and Dynamic Resistance.Zener diode characteristics, Zener and Avalanche breakdown**.**	9
Unit-2 **Diode Applications**	
Diode Approximations – DC Load Line Analysis - DC voltage applied to diodes (Si and zener diodes only). (Simple analysis using KCL and KVL). Rectifiers – Half Wave rectifier – Full Wave Rectifier – Bridge Rectifier : dc load current and voltage, rms load current and voltage, ripple factor, efficiency, PIV. Simple Capacitor Filter(Analysis not expected) – Simple Shunt Zener Voltage Regulator	9
Unit-3 **Bipolar Junction Transistor**	
Bipolar Junction Transistors: Transistor Construction – Operation – Common Base Configuration – Transistor Amplifying action – Common Collector – Common Emitter. Transistor currents. Common emitter current gain – Common Base Current gain – Relationship. Transistor Biasing : Operating Point – Significance – Fixed Bias and Voltage Divider Bias – Simple analysis.	9
Unit-4 **Introduction To Operational Amplifiers**	
Block diagram, Op-amp transfer characteristics, Basic Op-amp parameters and its value for IC 741- offset voltage and current, input and output impedance, Gain, slew rate, bandwidth, CMRR, Concept of negative feedback, Inverting and Non-inverting amplifiers, Summing Amplifier, Subtractor, Differential Amplifier, integrator, differentiator, Voltage follower, Introduction to Oscillators, the Barkhausen Criterion for Oscillations, Applications of Oscillator	9
Unit-5 **Digital Electronics**	

Sampling theorem, Introduction, decimal system, Binary, Octal and Hexadecimal number systems, addition and subtraction, fractional number, Binary Coded Decimal numbers. Boolean algebra, Logic gates, Two Variable and three variable K – maps - Half-adder, Full-adder, Logic Design based on two and three input variables only.	9
List of Experiments (If any):	**Practical Hours**
1. Use of basic voltage source and measuring instruments (Power supply, function generator, DSO, Digital Multimeter), familiarization of breadboard.Measurement of Voltage and Frequency using DSO	2
2. Study of step down transformer. Measuring the secondary voltage waveform on DSO and determination of peak and rms value	2
3. Identification and testing of electrical/electronic active and passive components	2
4. Color coding of resistors and capacitor coding	2
5. Study of Series and Parallel circuits to verify Kirchoff's Voltage Law and Current Law – using breadboard, DMM and DC power supply.	4
6. Half Wave Rectifier and Full Wave Rectifier : study of waveforms, determination of DC value of rectified wave	4
7. Study of different types of logic gates – NOT, OR, AND, NAND, NOR and Ex-OR	4
8. Verification of output of a logical expression using Basic gates/NAND gates/NOR gates	2
9. Soldering and de-soldering of electronic components on PCB	2
10. Determination of forward and reverse bias characteristics of silicon diode	4
11. Application of Zener diode as a basic voltage regulator	2
Self-study : NIL	
Site/Industrial Visits : NIL	
Course outcomes: At the end of the course, the student will be able to : CO1: Describe the basic semiconductor principles , working of p-n junction diode and transistors [L2] [PO1] CO2: Demonstrate the operation of diodes in rectifiers, voltage regulator and clipper [L3] [PO1] CO3: Explain the operation of bipolar junction transistor including the amplification and biasing [L2] [PO1, PO6] CO4: Explain the operation and applications of Operational Amplifier [L2] [PO1] CO5: Discuss conversions between binary, decimal, octal and hexadecimal number system [L2] [PO1] CO6: Implement digital logic gates and its application as adders. [L3] [PO1, PO6]	
Text Books: T1. David A. Bell, "Electronic Devices and Circuits" – Vth Edition, OUP, 2011 T2. N. P. Deshpande, "Electronic Devices and Circuits – Principles and Applications", TMH, 2017 T3. Robert L Boylestad& Louis Nashelsky, "Electronic Devices and Circuit Theory", 3rd Edition, 2015 T4. Morris Mano, "Digital Logic and Computer Design", PHI, EEE, 2014	
Reference Books: R1. Donald A. Neamen, "Electronic Circuits", 3rd Edition, TMH, 2017 R2. Thomas L. Floyd, "Electronic Devices", Seventh Edition, Pearson Education, 2012 R3. Albert Malvino, David. J. Bates, ―Electronic Principle, 8th Edition, Tata McGraw Hill, 2015	

Online Resources:
NIL

Course Name: COMPUTER PROGRAMMING					
Course Code : CS134P / CS234P					
	L	**T**	**P**	Category	**ESC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives:

● To provide exposure to problem-solving through programming.
● To provide a basic exposition to the goals of programming
● To enable the student to apply these concepts in applications which involve perception, reasoning and learning.

Units	**Teaching Hours**
Unit-1 Algorithms And Flowcharts, Constants, Variables And Datatypes, Operators, Managing Input And Output Operations	
Algorithms and flowcharts: Algorithms, Flowcharts, Examples on algorithms and flowcharts. Basic structure of a C program, C Tokens, Data types. Declaration of variables. Operators: Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment and Decrement operators, Conditional operator, Bitwise operators, Special operators, Arithmetic expressions, Evaluation of expressions, Precedence of Arithmetic operators, Type conversions in expressions, Operator precedence and associatively. Managing input and output operations: Reading a character, writing a character, Formatted Input, Formatted Output	9
Unit-2 Decision Making And Branching, Looping	
Decision making and branching: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statements, The else … if ladder, The switch statement, The ?: operator, The Goto statement Looping: The while statement, The do statement, The for statement, Jumps in Loops	9
Unit-3 Arrays, User Defined Functions	
Arrays: One-dimensional Arrays, Declaration of one-dimensional Arrays, Initialization of one-dimensional Arrays, Two-dimensional Arrays, Initializing two-dimensional Arrays. User-defined functions: Need for User-defined Functions, A multi-function Program, Elements of user - defined Functions, Definition of Functions, Return Values and their types, Function Calls, Function Declaration, Category of Functions, No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Value, recursion –recursive functions, Limitations of recursion.	9
Unit-4 Pointers	

Understanding the pointers, Accessing the Address of a Variable, Declaring Pointer Variables, Initialization of Pointer Variables, Accessing a Variable through its Pointer, Pointer Expressions, Pointer Increments and Scale Factor, Pointers and Arrays, Pointers and Character Strings, Pointers as Function Arguments.	9
Unit-5 Strings, Derived Types, Files	
Strings: String concepts: declaration and initialization, String I/O functions, Array of strings, String manipulation function, Structure: Basic of structures, structures and Functions, Arrays of structures, structure Data types, type definition. Files: Defining, opening and closing of files, Input and output operations, Standard Library Functions for Files	9
List of Experiments :	**Practical Hours**
1. To understand and realize the use of C tokens, Keywords and Identifiers, Variables, Data types, Declaration of variables, using operators, I/O functions.	**4**
2. To understand and implement concepts of Decision making statements.	**4**
3. To understand and implement concepts looping statements.	**6**
4. To understand and implement concepts of Arrays.	**4**
5. To understand and implement concepts of Pointers	**4**
6. To understand and implement concepts of User defined functions.	**4**
7. To understand and implement concepts of Strings and Structures.	**4**
Self-study: NA	
Site/Industrial Visits: NA	
Course outcomes: CO1:Solve problems using flowchart and algorithm. (Applying, PO1, PO3) CO2: Exhibit the concept of looping and decision-making statements to solve problems. (Applying, PO1, PO3) CO3: Demonstrate different Operations on arrays and user defined functions. (Applying, PO1, PO3) CO4: Illustrate the appropriate use of pointers. (Applying, PO1, PO3) CO5: Illustrate the appropriate use of strings, files, structures to solve real time problems. (Applying, PO1, PO3)	
Text Books: T1. Deitel and Deitel, "C How to Program", Prentice Hall 2010 (Reprint). T2. Herbert Schildt, "C++ : The Complete Reference", McGraw - Hill Osborne Media; 3rd edition 2012 (Reprint). T3. YashvantKanetkar, “Let Us C 13E”, BPB Publications – 13th Edition, 2013.	

Reference Books:

R1.Shelly and Junt, “Computers and Commonsense”, 4th edition, Prentice Hall of India, 2010 (Reprint).
R2. Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, “Information Technology: The Breaking wave”, Tata MC GrawHill Companies, 2010 (Reprint).
R3. Peter Norton, “Introduction to Computers”, 2011 (Reprint).

Online Resources:

W1.V. K. Myalapalli, J. K. Myalapalli and P. R. Savarapu, "High performance C programming," 2015 International Conference on Pervasive Computing (ICPC), Pune, 2015, pp. 1-6
W2. https://users.ece.cmu.edu/~eno/coding/CCodingStandard.html
W3. https://www.w3resource.com/c-programming-exercises/

Course Name: BASIC MECHANICAL ENGINEERING AND NANOSCIENCE					
Course Code : ME 135 / ME 235					
	L	**T**	**P**	Category	**ESC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

1. To elucidate and critically demonstrate the Energy sources and basic thermodynamic concepts behind energy transfer.
2. To distinguish and elaborate the different types of prime movers.
3. To describe the functioning of refrigeration and air-conditioning.
4. To evaluate and apply the concepts of nano-science in real engineering applications.
5. To demonstrate and apply the process of machining and metal joining in basic applications.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 Energy Resources, Thermodynamics and Heat transfer	
Energy Resources Conventional Energy resources- Fossil fuel and nuclear fuel, Merits and demerits. Non-conventional energy sources- Solar, Wind, hydraulic, Ocean-thermal, Geo-thermal, Tidal energy and bio mass energy plants working principle. **Thermodynamics** Basic terms: State, path, process (reversible and irreversible), and cycle, System, surroundings and boundary. Closed system, Open system and Isolated Systems. Laws of Thermodynamics (statements and brief description). Heat engine and Heat pump (Definition). **Heat Transfer** Modes of Heat transfer and their basic governing equations. Heat exchangers-types. Fins – types and applications.	12
Unit-2 I.C. Engine and Turbines	
I.C. Engines Classification, I.C. Engines parts and their function, working of 2 Stroke and 4 stroke engines. Basic terms - Indicated power, brake power frictional power, thermal efficiency, mechanical efficiency (simple problems). **Steam Generators** Boilers, fire and water tube boilers (Lancashire and Babcock and Will Cox boiler-working with simple sketches)**.** **Steam turbines** Classifications, Principle of operation of Impulse and reaction turbines. **Gas Turbines** Open cycle and closed cycle gas turbines working principle. **Water Turbines** Classification, working principle of Pelton wheel, Francis turbine and Kaplan turbine**.**	10
Unit-3 Refrigeration and Air-conditioning	
Refrigeration Types of refrigerants and properties of good refrigerant, Refrigerating effect and unit of Refrigeration (definition). Working principle of vapour Compression refrigeration	

and vapour absorption refrigeration (with sketch). Applications areas of refrigeration system. **Air Conditioning** Definition, types, Room air-conditioning working principle (with sketch), Applications.	6
Unit-4 **Introduction to Nanotechnology**	
Introduction to Nanotechnology Introduction to about Nanomaterials, characterization of nanomaterials-SEM, XRD, AFM and Mechanical properties, Advantages, limitations and applications of Nanomaterials.	7
Unit-5 **Machine tools and Metal joining processes**	
Machine tools Lathe Machine-Types, Parts and different operations like-turning, facing, grooving, parting off, taper turning, and threading (simple sketch) Drilling Machine-Types, Parts and different operations like-drilling, reaming, boring, counter boring, counter sinking and tapping (simple sketch). Milling Machine-Up milling, down milling, Plane milling, End milling, Slot milling and gear cutting (sketches only for following operations) **Metal joining** Definitions, classification of soldering, Brazing and welding. Differences between soldering, brazing and Welding. Description of Electric Arc welding and Oxy-Acetylene gas welding (Simple sketch).	10
Self-study: Unit-1: Distillation process of crude oil, Harnessing of Ocean-thermal Energy. Unit-2: 4 Stroke Diesel Engine, 2 Stroke petrol engine, Water turbines. Unit-3: Office air-conditioning systems. Unit-4: TEM, UTM techniques for characterization of Nanomaterials. Unit-5: Trepanning operation, Vertical milling machine, brazing and soldering applications.	
Site/Industrial Visits: 1. Heat Transfer Lab. 2. Fluid mechanics and Machinery Lab. 3. Metal Cutting Lab. 4. I.C. Engine Lab.	
Course outcomes: The students will be able to CO1: Classify the energy resources and state the basic laws of the thermodynamics and illustrate with an example modes of heat transfer. [L1, L2] [PO1, PO2]. CO2: List the types of I.C. Engines and turbines, discuss the working principle of I.C. engines and turbines. [L1, L3] [PO1, PO2, PO3]. CO3: Define the terms refrigeration and air-conditioning, identify their application areas. [L1, L2, L3] [PO1, PO2, PO3]. CO4: Explain the fundamental concept of nanotechnology and describe the characterization methods for nanomaterials. [L1, L2] [PO1, PO2]. CO5: Summarize the operations performed by using machine tools and distinguish between welding soldering and brazing process. [L1, L2, L4] [PO1, PO2, PO3, PO4].	

Text Books:

T1. K.R. Gopalkrishna, "A text Book of Elements of Mechanical Engineering", Subhash Publishers, Bangalore, 2008.

T2. S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", 3rd revised edition, I .K. International Publishing House Pvt. Ltd., New Delhi. 2010.

T3. P.K.Nag, "Engineering Thermodynamics" Tata McGraw-Hill Education, 2005.

T4. B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, "Nano Science and Nano Technology ", University Press IIM, 2002.

Reference Books:

R1. Dr. R. P. Reddy, "Elements of Mechanical Engineering", 1st Edition, Himalaya Publishing House, New Delhi, 2012.

R2. Hajra Choudhury S K, "Elements of Workshop Technology" 13th Edition, Volume 1, Machine Tools, India Book Distributing Company Calcutta, 2010.

R3. Hajra Choudhury S K, "Elements of Workshop Technology" 13th Edition, Volume 2, Machine Tools, India Book Distributing Company Calcutta, 2012.

R4. Charles P. Poole and Frank J. Owens, "Introduction to Nanotechnology", Wiley India Edition, 2012.

Online Resources:

W1. http://www.hds.bme.hu/letoltesek/targyak/BMEGEVGAG01_ENG/ime.pdf

W2. http://www.nptel.ac.in/downloads/112108148.

Course Name: TECHNICAL ENGLISH					
Course Code : TE 136P / TE 236P					
	L	**T**	**P**	Category	**HSMC**
Contact Hrs./Week	**1**	**0**	**2**	CIA Marks	**25**
Contact Hrs./Sem.	**15**	**0**	**30**	ESE Marks	**25**
Credits.	**1**	**0**	**1**	Exam Hours	**2**

Course objectives: Upon Successful completion of this course, the student will have reliably demonstrated the ability to respond effectively, efficiently, and appropriately to writing in ways that demonstrate comprehension and evaluation of its purpose and meaning.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1 **Vocabulary Building**	
Concept of word formation, synonyms , antonyms, homophones, prefixes and suffixes, Misused and confused words.	8
Unit-2 **Basic Writing Skills**	
Sentence structure, parts of speech, Fragments, Run-on errors, Phrases and clauses, Misplaced and Dangling modifiers, Structure of paragraphs Techniques of writing precisely.	8
Unit-3 **Identifying Common Errors In Writing**	
Subject verb agreement(concord), articles, prepositions, Tenses, Redundancies, cliché's , Misused and confused words	9
Unit-4 **Essay Writing (Lang. Lab)**	
ESSAY WRITING (Lang. Lab), Structure of an Academic essay, writing introduction , thesis statement, writing body paragraphs , writing concluding paragraph, unity, support, coherence and sentence skills , Different types of essay.	10
Unit-5 **Oral Communication**	
(Interactive practical sessions in lang. lab), listening comprehensions, pronunciation, intonation, stress and rhythm, interview and formal presentation skills.	10

Self-study: NA

Site/Industrial Visits: NA

Course outcomes:

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

CO1: acquire basic proficiency in all the English language skills: reading , listening comprehension, writing ,and speaking {Level} {PO}

CO2: have a better understanding of the Mechanics of English language {Level} {PO}

CO3: make an organized, and well prepared oral presentation to meet the needs of individuals and small groups. {Level} {PO}

CO4: write good academic essays {Level} {PO}

CO5: take part in group discussions with a better speaking skill. {Level} {PO}

Text Books:

T1. Practical English Usage. Michael Swan. OUP. 1995

T2. Remedial English Grammar. F.T. Wood. Macmillan.2007

Reference Books:

R1 On Writing Well. William Zinsser. Harper Resource Book. 2001

R2. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

R3. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

R4. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Online Resources:

NIL

Course Name: WORKSHOP PRACTICE LAB					
Course Code : ME 151 / ME 251					
	L	**T**	**P**	Category	**ESC**
Contact Hrs./Week	**0**	**0**	**2**	CIA Marks	**25**
Contact Hrs./Sem.	**0**	**0**	**30**	ESE Marks	**25**
Credits.	**0**	**0**	**1**	Exam Hours	**2**

Course objectives: To provide the students with the hands on experience on different trades of engineering like fitting, welding, carpentary & sheet metal.

Units	**Teaching Hours**
List of Experiments (If any):	**Practical Hours**
1. Safety Precautions and description of workshop tools and equipments.	1
2. Study of fitting tools and equipments.	2
3. Demonstrate and make a square fitting model.	4
4. Demonstrate and make a V fitting model.	2
5. Demonstrate and make a dovetail fitting model.	4
6. Study of electric arc welding tools and equipments.	1
7. Demonstrate and make a Butt Joint welding model.	2
8. Demonstrate and make a Lap Joint welding model.	2
9. Demonstrate and make a T-Joint welding model.	2
10. Demonstrate and make a L-Joint welding model.	2
11. Study of sheet metal tools and equipments.	1
12. Demonstrate and make a rectangular tray.	2
13. Study and demonstration of Carpentry tools, joints and operations.	1
14. Study and demonstration of MIG welding.	2
15. Study and demonstration of TIG welding.	2

Self-study: NA

Site/Industrial Visits: NA

Course outcomes:

CO1: Demonstrate an understanding of and comply with workshop safety regulations. {L1,L2} {PO1,PO2, PO7, PO10}

CO2: Select and perform a range of machining operations to produce a given project. { L1,L2,L3} {PO1,PO6,PO7,PO9,PO10}

CO3: Identify and use marking out tools, handtools, measuring equipment and to work to prescribed tolerances. { L1,L2,L3} {PO1,PO2,PO6,PO9,PO10}

CO4: Demonstrate a knowledge of welding process selection and capabilities. { L2,L3} {PO1,PO2,PO7,PO9,PO10}

CO5: Demonstrate a knowledge of welding, joint design and the application of welding. { L2,L3,L4} {PO1,PO2,PO6,PO7,PO9,PO10}

Text Books:

T1. S. K. H. Choudhury, A. K. H. Choudhury, Nirjhar Roy, “The Elements of Workshop Technology”, Vol 1 & 2, Media Propoters and Publishers, Mumbai, 2018.

Reference Books:
R1. P. Kannaiah and K.L. Narayana, “Manual on Workshop Practice”, Scitech Publications, (1999). R2. T Jeyapoovan, “Engineering Practices Lab - Basic Workshop Practice Manual,” ISBN: 81-259-1800-0 R3. H.S.Bawa, “Workshop Practice”, Tata McGraw Hill Publishing Company Limited, (2007)
Online Resources:
W1. https://nptel.ac.in/noc/ W2. http://ecoursesonline.iasri.res.in

Course Name: MATHEMATICS II					
Course Code : MA 231					
	L	**T**	**P**	Category	**BSC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: Mathematics is a necessary avenue to scientific knowledge which opens new vistas of mental activity. A sound knowledge of engineering Mathematics is a 'sine qua non' for the modern engineer to attain new heights in all aspects of engineering practice. This course provides the student with plentiful opportunities to work with and apply the concepts, and to build skills and experience in mathematical reasoning and engineering problem solving. At the end of this course, the students will

- be introduced to the tools of integration of multivariate functions over areas and volumes.
- learn the technique of multidimensional change of variables to transform the coordinates over which integration proceeds by utilizing Jacobian. Specifically, students will learn how to transform between an integral over an area or volume in Cartesian coordinates to polar coordinates.
- be able to solve higher order homogenous/ non-homogenous linear differential equations with constant coefficients
- be able to solve Cauchy's and Legendre's equations.
- learn the fundamental vector calculus integral theorems of Green, Stokes' and Divergence. Students will also learn how these theorems represent conservation principles for physical vector fields important in gravitation and electric fields.
- be able to perform operations with Laplace and inverse Laplace transforms to solve higher order differential equations

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 **Differential Calculus – II**	
Polar curves and angle between Polar curves. Pedal equations of polar curves, Radius of curvature – Cartesian, parametric, polar and pedal forms.	**8**
Unit-2 **Integral Calculus – II**	
Double integrals, Cartesian and polar co – ordinates, change of order of integration, change of variables between cartesian and polar co – ordinates, triple integration, area as a double integral, volume as a triple integral	**14**
Unit-3 **Differential Equations – II**	
Linear differential equations of second and higher order with constant coefficients. Method of variation of parameters. Legendre'a and Cauchy's homogeneous differential equations.	**10**
Unit-4 **Laplace Transforms**	

Definition - Transforms of elementary functions – Properties, Derivatives and integrals of transforms- Problems. Periodic function. Unit step function and unit impulse function Inverse transforms, Solutions of linear differential equations.	**10**
Unit-5	**Vector Calculus – II**
Vector Integration - Green's theorem in a plane, Gauss's divergence theorems, Stoke's, (without proof) and simple application.	**7**
Self-study: NA	
Site/Industrial Visits: NA	
Course outcomes: CO1: Find the angle between the polar curves and radius of curvature by applying differentiation {Level} {PO} CO2: Calculate the area and volume of solids using double and triple integration. {Level} {PO} CO3: Solve linear differential equations of higher order by using inverse differential operator, Method of undetermined coefficients and variation of parameters. {Level} {PO} CO4: Solve initial value problems using Laplace Transforms method {Level} {PO} CO5: Establish the relation between the line and surface integral, surface and volume integral using Green's, Stoke's and Gauss Divergence theorem {Level} {PO}	
Text Books: T1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, July 2005. T2. H. K. Das & Rajnish Verma, "Higher Engineering Mathematics", S. Chand & Company Ltd., 2011.	
Reference Books: R1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, 2005 R2. Thomas and Finney, "Calculus", 9th Edition, Pearson Education, 2004 R3. Peter V. O'Neil, "Advanced Engineering Mathematics", Thomson Publication, Canada, 2007 R4. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw – Hill, 2009. R5. George F. Simmons and Steven G. Krantz, "Differential Equation, Theory, Technique and Practice", Tata McGraw – Hill, 2006. R6. M. D. Raisinghania, "Ordinary and Partial Differential Equation", Chand (S.) & Co. Ltd., India, March 17, 2005. R7. Paras Ram, "Engineering Mathematics through Applications", 1st Edition, CBS Publisher, 2011.	
Online Resources: NIL	

Course Name: APPLIED PHYSICS					
Course Code : PH132P / PH232P					
	L	**T**	**P**	Category	**BSC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**15**	ESE Marks	**50**
Credits.	**3**	**0**	**1**	Exam Hours	**3 hrs**

Course objectives: This paper contains five UNITS which are Modern Physics, Quantum Mechanics, Conductivity in Metals (Electrical and Thermal), Elastic, Dielectric and Optical Properties of Materials, Lasers, Optical Fibers.

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

- Identify the fundamental aspects of modern physics and quantum mechanics.
- Compare classical and quantum free electron theory.
- Outline the salient properties of elastic and dielectric materials.
- Apply the concepts learnt in Laser, Fiber optics in the field of Engineering.
- Apply optical phenomenon in technology.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 **Modern Physics**	
Introduction, Planck's theory - Deduction of Wien's displacement law and Rayleigh Jean's law from Planck's law, Compton effect, de Broglie hypothesis – extension to electron particle. Phase velocity, group velocity, expression for group velocity based on superposition of waves, relation between group velocity and particle velocity. Problems.	**09**
Unit-2 **Quantum Mechanics**	
Heisenberg's uncertainty principle and its physical significance. Application of uncertainty principle (Non-existence of electron in the nucleus). Wave function. Properties and Physical significance of a wave function Schrodinger - Time independent wave equation – Application: Setting up of a one dimensional Schrödinger wave equation of a particle in a potential well of infinite depth : Probability density and Normalization of wave function – Energy Eigen values and Eigen function. Problems.	**09**
Unit-3 **Electrical and Thermal Conductivities of metals**	
Classical free-electron theory. Introduction, assumptions and limitation of classical free-electron theory. Thermal Conductivity. Wiedemann - Franz law, calculation of Lorentz number. **Quantum free-electron theory** – Postulates of quantum fee electron theory, Fermi - Dirac Statistics. Fermi-energy – Fermi factor. Density of states. Carrier concentration in metals. Expression for electrical resistivity/conductivity - Merits of Quantum free electron theory. Problems.	**10**
Unit-4 **Materials Science**	

Elasticity : Introduction - Bending of beams – Single Cantilever – Application of Cantilever in AFM, Young's modulus-Non uniform bending. Problems. **Dielectrics :** Dielectric constant and polarisation of dielectric materials. Types of polarisation. Equation for internal fields in liquids and solids (one dimensional). Clausius – Mossotti equation. Ferro and Piezo – electricity(qualitative). Frequency dependence of dielectric constant. Important applications of dielectric materials. Problems.	**09**
Unit-5 Applied Optics	
Lasers: Principle and production. Einstein's coefficients (expression for energy density). Requisites of a Laser system. Condition for Laser action. Principle, Construction and working of He-Ne and semiconductor diode Laser. Applications of Laser – Laser welding, cutting and drilling. Measurement of atmospheric pollutants. Problems. **Optical Fibers:** Introduction, Principle and Propagation of light in optical fibers. Angle of acceptance. Numerical aperture. Types of optical fibers and modes of propagation. Applications –optical fiber communication system. Problems.	**08**
List of Experiments (If any):	**Practical Hours**
PART – A	
1. Basic Measuring Instruments • Vernier Callipers • Screw Gauge • Travelling Microscope	**02**
2. Verification of Stefan's law	**01**
3. Planck's Constant (Determination of Planck's constant using LED or using the principle of photoelectric effect)	**01**
4. Determination of Fermi energy.	**01**
5. Young's modulus – Non-uniform bending.	**01**
6. Measurement of Dielectric Constant (Charging & discharging of capacitor).	**02**
7. Ultrasonic Interferometer.	**01**
8. Interference at a wedge.	**02**

9. Laser Diffraction (Determination of grating constant and number of rulings per inch using diffraction grating).	**01**
10. Frequency determination – Melde's apparatus	**02**
11. Photo Multiplier Tube – Demonstration only	**01**

Course outcomes:

1. To outline the principles of Classical Physics and Modern Physics.
2. To classify the materials according to the theories of Quantum Physics.
3. To apply the principles of Physics to solve the problems in different relevant topics.
4. To analyze different materials for various scientific applications.
5. To apply the principles of optics in the field of LASERS and Optical Fiber.
6. To evaluate the theories of quantum mechanics in various fields of LASERS, Materials sciences and future engineering applications.

Mapping with Program Outcomes:

Text Books:

T1. M.N.Avadhanulu and P.G. Kshirsagar, "A Text Book of Engineering Physics", S.Chand & Company Ltd, 9th Edition 2012.

T2. John Wiley "Engineering Physics",Wiley India Pvt. Ltd, 1st Edition 2014.

T3. S.O. Pillai, "Solid State Physics", New Age International, 6th Edition 2009.

T4. S.P. Basavaraju, " Engineering Physics", Revised Edition 2009.

T5. Charles Kittel, "Introduction to Solid State Physics" , 8th Edition.

T6. Arthur Beiser, "Concepts of Modern Physics" , Special Indian Edition 2009.

T7. Ajoy Ghatak, "Optics",4th Edition 2009

Reference Books:

R1. R.K. Gaur and S.L. Gupta, "Engineering Physics", Dhanpatrai and Sons, New Delhi, 2001.

R2. Sehgal Chopra Sehgal, " Modern Physics ", Tata McGraw-Hill, 6th Edition, 2005.

R3. Halliday, Resnick and Krane, "Fundamentals of Physics Extended", John Wiley and Sons Inc., New York, 5th Edition, 1997.

R4. P.Mani, "Engineering Physics", Dhanam publishers, Revised Edition 2011.

R5. H.J. Sawant, "Engineering Physics", Technical Publications, 1st Edition, 2010.

R6. V. Rajendran, "Engineering Physics", Tata Mcgraw Hill Publishing Company Limited, 1st Edition, 2009.

R7. K.Eric Drexler, "Nanosystems - Molecular Machinery, Manufacturing and Computation", John Wiely & Sons, 2005.

R8. J David, N Cheeke , "Fundamentals and Applications of Ultrasonic Waves", CRC Press 1st Edition, 2002.

R9. Frederick J Bueche and Eugene Hecht "Schaum Outline of Theory and Problems of College Physics", Tata McGraw-Hill, 11th Edition, 2012.

R10. M. Ali Omar, "Elementary Solid State Physics", Addison-Wesley 1st Edition, 1993.

Online Resources:

W1. https://en.wikipedia.org/wiki/Laser

W2. https://en.wikipedia.org/wiki/Ultrasound

W3. https://en.wikipedia.org/wiki/Optical_fiber

Course Name: BASIC ELECTRICAL ENGINEERING					
Course Code : EE133P /233P					
	L	**T**	**P**	Category	ESC
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**24**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives: This course is aimed to solve and analyse DC and AC networks. It also covers the fundamental principles of alternator, transformer, motors, renewable energy systems and power converters. It also emphasise the concepts in smart grid and electrical vehicles to cope up with current trends in electrical engineering.

Prerequisites: NA

Units	**Teaching Hours**
Unit-1 : DC circuits	
Basic electrical quantities, KCL, KVL, voltage and current division rules, circuit reduction using series, parallel and star-delta transformation of resistors. Superposition theorem, Thevenin's theorem, Source transformations- Electromagnetism- Faraday's laws, comparison of electric and magnetic circuits.	9
Unit-2: AC circuits	
Comparison of DC and AC , Generation of sinusoidal signal, Representation of AC, inductance and capacitance, behaviour of pure R, L and C in AC circuits, RL, RC and RLC series circuits- derivations, phasor diagrams, real power, reactive power, power factor and resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.	9
Unit-3: Power System Components	
Power system components-overview, Alternator-construction, working and generated voltage equation, Transformer – types, construction, working, emf equation, voltage regulation and efficiency, Switchgears (Fuse, MCB, relay), earthing, electric safety, standards and best practices. DC Motor- construction and working, torque and speed equations of shunt motors, Single phase induction motors - construction and working, BLDC motor and its applications in e-mobility.	9
Unit-4: Power Converters and Renewable Energy	
Power supplies and converters, SCR as a switch single phase rectifiers and inverters, DC power supply. Solar standalone system and its characteristics, Solar PV grid tied system description, Wind energy systems- types, types of renewable systems- stand alone, grid tied systems and hybrid and micro-grids.	9

Unit-5: Smart Grid and Electric Vehicles	
Introduction to smart grid, Home automation systems, Application of IoT in electrical systems, smart meters, communication systems in electrical systems, Artificial intelligence in power system. Introduction to electric vehicles- building blocks, charging stations. Different types of batteries and terminologies and BMS applications	9
List of Experiments:	**Practical Hours**
12. Verification of superposition theorem	**2**
13. Wiring practice – multiple switching and two way switching	**2**
14. Phase angle measurement in R, RL and RLC circuits	**2**
15. Energy measurement in single phase circuits – with R and RL loads	**2**
16. Power factor improvement	**2**
17. Regulation and efficiency of single phase transformer.	**2**
18. Speed – torque characteristics of a DC shunt motor	**2**
19. Speed – torque characteristics of single phase induction motor	**2**
20. Characteristics of solar PV modules	**2**
21. Electrical appliances control using Arduino	**2**
22. Variable DC voltage using DC-DC converter (Demonstration)	**2**
23. Power circuit control using relay and a contactor. (Demonstration)	**2**
Self-study : NA	
Site/Industrial Visits : NA	
Course outcomes: CO1: To solve DC networks CO2: To solve AC networks CO3: To understand working modes of alternator, transformer and motors CO4: To understand renewable energy systems and power converters CO5: To illustrate concepts smart grid and electrical vehicles	
Text Books: T 1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010. T 2. V K. Mehta, Vivek Mehta, "Principles of Power System", S. Chand, 2005, reprint 2015. T 3. D. P. Kothari and K C.Singal, "Renewable Energy Sources and Emerging Technologies", PHI, 2011. T 4. James Larminie, John Lowry, 'Electric Vehicle Technology Explained', Wiley , 2015.	

Reference Books:

R 1. Weedy, Cory, Ekanayake, ' Electric Power Systems', John Wiley & Sons; 5th edition, 2012.

R 2. Hina Fathima (Editor), 'Hybrid-Renewable Energy Systems in Microgrids: Integration, Developments and Control', Woodhead Publishing Series in Energy, 2018.

R 3. Nikos Hatziargyriou, 'Microgrids: Architectures and Control', Wiley, 2014

R 4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

Online Resources:

W1. https://nptel.ac.in/courses/108108076/

W2. https://nptel.ac.in/downloads/108105053/

Course Name: BASICS OF CIVIL ENGINEERING AND ENGINEERING MECHANICS					
Course Code : CE134P / CE234P					
	L	**T**	**P**	**Category**	**ESC**
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	**3**

Course objectives:

1. The students will understand the basics of civil engineering and Engineering Mechanics
2. The students will understand the basic principles and laws of forces of nature, measurements, calculations and SI units.
3. The students will understand mechanics that studies the effects of forces and moments acting on rigid bodies that are either at rest or moving with constant velocity along a straight path for static condition only.
4. The students will understand the basic concepts of forces in the member, centroid, moment of inertia and Kinetics of bodies.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	
Introduction To Civil Engineering Scope of different fields of Civil Engineering: Surveying, Building Materials, Construction Technology, Structural Engineering, Geotechnical Engineering, Environmental Engineering, Hydraulics, Water Resources Engineering, Transportation Engineering. Role of Civil Engineers in Infrastructure Development. **Introduction to Engineering Mechanics** Basic idealizations-Particle, Continuum, Rigid body and Point force, Newtons laws of motion. Force, classification of force systems, Principle of Physical Independence of forces, Principle of Superposition of forces and Principle of Transmissibilty of forces, Moment, Couple and its characteristics. Composition and resolution of forces, Paralleologram Law of forces, Polygon law. Resultant of coplanar concurrent force systems.	9
Unit-2	

Composition of Coplanar Concurrent and Non Concurrent Force System. Resultant of coplanar concurrent force systems. Varignon's Theorem, Resultant of coplanar non concurrent force systems. **Equilibrium of force systems** Free body Diagram, Lami's Theorem ,Equations of Equilibrium, Equilibrium of coplanar concurrent forces.	9
Unit-3	
Support Reactions Types of loads and supports, Types of beams, Statically determinate and indeterminate beams, Support Reactions in beams, Numerical Problems on support reactions for statically determinate beams (point load, Uniformly distributed load, Uniformly varying load and moments) .	9
Unit-4	
Centroid and Moment of inertia Definition of centroid and centre of gravity, Centroid of simple plane figures and built up sections. Moment of inertia / Second Moment of area, Parallel axis theorem and Perpendicular axis theorem, Moment of Inertia of composite areas, Polar Moment of inertia and radius of gyration.	9
Unit-5	
Kinematics Definitions, Displacement, Average velocity, Instantaneous Velocity, Speed, Acceleration, Average Acceleration, Variable Acceleration, Acceleration due to gravity.Types of motion-Rectilinear, Curvilinear and Projectile motion. Relative motion and Motion under Gravity, Numerical Problems. Kinetics: D Alemberts Principle and its application in Plane motion.	9
List of Experiments (If any):	**Practical Hours**
1.To determine moisture content of fine Aggregates.	2
2.Sieve Analysis of Fine Aggregates.	2
3.Determination of Compressive Strength of Burnt Clay Bricks.	2
4. Determination of Fineness of Cement.	2
5. Setting out of rectangle in the field.	2
6. Setting out of polygon in the field.	2
7. To Verify the Polygon Law of Forces Using Universal Force Table.	2

8. To Verify Parallelogram Law of Forces Using Grave Sand's Apparatus.	2
9. To Determine Weight of Body Using Grave Sand's Apparatus.	2
10. To Verify Triangular law of Forces using Jib Crane Apparatus.	2
11. To determine the reactions for simply supported beam Using Parallel Force Apparatus.	2
12. To determine the center of gravity Using Parallel Force Apparatus.	2
Self-study: NA	
Site/Industrial Visits : Nil	
Course outcomes: After a successful completion of the course, the student will be able to: **CO1:** Understand basics of Civil Engineering, its scope of study and materials of construction.(L1)(PO1)(PSO1) **CO2**: Comprehend the action of Forces, Moments and other loads on systems of rigid bodies.(L2)(PO1,PO2)(PSO2) **CO3:** Compute the reactive forces and the effects that develop as a result of the external loads.(L3)(PO1)(PSO2) **CO4:** Compute Centroid and Moment of Inertia of regular and built up sections.(L3)(PO1)(PSO1) **CO5:** Express the relationship between the motion of bodies and equipped to pursue studies in allied courses in Mechanics. (L3) (PO1,PO2) (PSO1)	
Text Books: T1. Bhavikatti S.S. *Elements of Civil Engineering*, 4th Edition and *Engineering Mechanics* ,2nd edition, New Delhi, Vikas Publishing House Pvt. Ltd, 2008. T2. Shesh Prakash and Mogaveer, Elements *of Civil Engineering and Engineering Mechanics*, 1st edition, New Delhi , PHI learning Private Limited,2009. T3. Jagadeesh T.R. and Jay Ram, *Elements of Civil Engineering and Engineering Mechanics*, 2nd edition, Bangalore, Sapana Book House, 2008.	
Reference Books: R1. Timoshenko, and Young, Engineering Mechanics, Tata McGraw-Hill, New Delhi, 2013. R2. Meriam J. L, and Kraige, L. G, Engineering Mechanics, 5/E, Volume I, Wiley India Edition, India, Feburary 2018 R3. Irvingh H Shames, Engineering Mechanics, 4/E, PHI learning Private Limited, New Delhi, 2008 R4. Ferdinand P. Beer and E. Russel Johnston Jr., Mechanics for Engineers: Statics, McGraw-Hill Book Company, New Delhi. International Edition 2013 R5. Bansal R. K, Engineering Mechanics, Laxmi Publications (P) Ltd, New Delhi, 2015 Goyal and Raghuvanshi, Engineering Mechanics, New Edition, PHI learning Private Limited, New Delhi. 2011 R6. Rajasekaran, S, Sankarasubramanian, G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2011. R6. Kukreja C.B., Kishore K.Ravi Chawla., Material Testing Laboratory Manual, Standard Publishers & Distributors 1996. R7. Gambhir M.L., Concrete Manual, Dhanpat Rai & Sons, New Delhi, 2014	

Duggal S.K., Surveying, Vol-I, Tata McGraw Hill - Publishing Co. Ltd. New Delhi.
R8. Punmia. B.C., Surveying Vol–1, Laxmi Publications, New Delhi.

Online Resources:

W1.https://nptel.ac.in/courses/112103109/
W2. https://nptel.ac.in/courses/122104015/

Course Name: ENGINEERING GRAPHICS					
Course Code : EG 135P / EG 235P					
	L	**T**	**P**	Category	**ESC**
Contact Hrs./Week	**2**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**30**	**0**	**30**	ESE Marks	**50**
Credits.	**2**	**0**	**1**	Exam Hours	**3**

Course objectives:

- To create an awareness and emphasise the need for Engineering Graphics.
- To teach basic drawing standards and conventions.
- To develop skills in three-dimensional visualization of engineering components.
- To develop an understanding of 2D and 3D drawings using the Solidworks software

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 Introduction to Engineering Drawing& Orthographic Projections	
Introduction to Engineering Drawing Principles of Engineering Graphics and their significance, usage of Drawing instruments, BIS conventions, lettering, Scales – Plain, Diagonal and Vernier Scales. **Orthographic Projections (First Angle Projection Only)** Principles of orthographic projections, introduction to first angle and third angle projection, projections of points, lines (inclined to both planes) and planes. (No application problems)	**14**
Unit-2 Introduction of Computer Aided Engineering Drawing	
Introduction of Computer Aided Engineering Drawing (CAED) Introduction and customization of user interface consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning, orthographic constraints, snap to objects manually and automatically, producing drawings by using various coordinate input entry methods to draw straight lines, applying various ways of drawing circles. Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings, setting up and use of layers, layers to create drawings, create, edit and use customized layers, changing line lengths through modifying existing lines.	**2**
Unit-3 Projections of Regular Solids &Sections of solids	
Projections of Regular Solids Projection of solids inclined to both the Planes, draw simple annotation, dimensioning and scale (both manual and CAD software). **Sections of solids** Sections and sectional views of right angular solids - Prism, Cylinder, Pyramid, Cone– Auxiliary Views; (both manual and CAD software)	**20**
Unit-4 Development of surfaces & Isometric Projections	
Development of surfaces Development of surfaces of right regular solids - prism, pyramid, cylinder and cone; draw the sectional orthographic views of geometrical solids. **Isometric Projections**	**20**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of simple and compound Solids, conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.	
Unit-5 Overview of Computer Graphics & Introduction to Modeling and Assembly	
Overview of Computer Graphics Demonstrating knowledge of the theory of CAD software: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Projection of solids, Isometric of Simple and compound Solids, sections of solids and development of surfaces. **Introduction to Modeling and Assembly** Introduction to Computer aided modeling of solid part and assembly using CAD software Parametric and non-parametric solid and wireframe models, part editing and 2D drafting of assembly.	**20**
Self-study: Three Modeling of Simple Machine Parts	
Site/Industrial Visits : Nil	
Course outcomes: CO1: Understand the importance of BIS standards and scales and be able to use it in Engineering drawings and be Able to graphically construct geometric 2 Dimensional figures with hand tools and solve numericals related to them. {L1,L2}{PO1} CO2: Use the CAD software and be able to create basic 2D computer geometries like points, lines, and planes. {L1,L2}{PO1,PO2} CO3: Understand the concept of projection and sectioning of solids and be able to create the drawings manually. {L1,L2}{PO1,PO2} CO4: To create Drawings of surfaces of regular solids after development Manually. {L1,L2}{PO1,PO2} CO5: To create isometric drawings from Orthographic projections by using isometric scale Manually and using CAD software. {L1,L2}{PO2,PO5} CO6: To create projection of solids, sectioning development of surface using CAD software and be able to draw basic 3D shapes in CAD. {L1,L2}{PO2,PO5}	
Text Books: T1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House T2. N S Parthasarathy and Vela Murali (2015) Engineering Drawing, Oxford University Press T3. Shah, M.B. & Rana B.C. (2009), Engineering Drawing and Computer Graphics, Pearson Education T4. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication	
Reference Books: R1. S. Trymbaka Murthy, *"*Computer Aided Engineering Drawing*",* I.K. International Publishing House Pvt. Ltd., New Delhi. R2. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech R3. K.R. Gopalakrishna, *"*Engineering Graphics*",* 15th Edition, Subash Publishers Bangalore	
Online Resources: Nil	

COURSE NAME: BIOLOGY FOR ENGINEERS					
Course Code : BS 136 / BS 236					
	L	**T**	**P**	**S**	Course Code
Contact Hrs./Week	**3**	**0**	**0**		CIA Marks
Contact Hrs./Sem.	**45**	**0**	**0**		ESE Marks
Total Contact Hrs.	**45**	**0**	**0**		Exam Hours
Credits.	**3**	**0**	**0**		

Course objectives:

Prerequisites: Write course names if any, Otherwise leave blank

- **Fundamental understanding of biological processes.**

Units	**Teaching Hours**
Unit-1 ***Introduction to Cell structure and biomechanism***	
Biological Engineering - Classifications-Taxonomy- Prokaryotes and Eukaryotes- Morphology, NucleusProtein structure and function - Organelles for Protein synthesis and transport- Cell division - mitosis, meiosis- Biochemical pathways - metabolism, energy conversion, TCA cycle, electron transport, ATP, glycolysis, photosynthesis- DNA structure - Replication- Transcription- Translation	9
Unit-2 ***Biosensors***	
General principles - Construction of biosensors, immobilization of receptor components in biosensors- Types –metabolism, semiconductor, optical, piezoelectric, immunosensors - Applications – lab-on-a-chip, food and beverage, defence, environmental applications, Medical instruments	10
Unit-3***Modern Imaging systems***	
X ray, digital radiography – x-ray computed tomography- Nuclear medical imaging systems, Magnetic resonance imaging system, Ultrasonic imaging system, thermal imaging, haemodialysis system, anaesthesia and ventilator systems.	8
Unit-4 ***Biomechanics***	
Key mechanical concepts - 9 fundamentals of biomechanics -Muscle action, Range of motion principle, Force motion principle - Tissue loads -Response of tissue to force -Biomechanics of passive muscle tendon unit- Biomechanics of bone - Biomechanics of ligaments - Mechanical characteristics of muscles- Force time principle - Stretch-shortening cycle	10
Unit-5 ***Materials for organs and devices***	
Materials – polymers, metals, ceramics, hydrogels, degradable biomaterials - Host reaction to biomaterials and their evaluation -Application of biomaterials – heart valves, orthopaedic applications, Cochlear and dental implants, soft tissue replacements, Hard tissue replacements	8

Self-study: Self-study modules can be added**.** Not mandatory

Site/Industrial Visits: If you feel, an industrial visit can bridge the gaps in syllabus or course delivery then a visit can be added. Not mandatory

Course outcomes:

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

- Discuss the hierarchical of life and the classification of species.
- The student would be able to differentiate between single celled and multi-cellular organisms based on their cell structure.
- Explain about structure, types and functioning of key components as proteins, carbohydrates, fats and DNA/RNA.
- The student will be able to elaborate on the different pathways for energy production, cell division, photosynthesis and genetic transfer.
- Discuss about the construction and working of biosensors for various applications.
- Discuss about the architecture and organization of implantable electronics, which are used to sense and monitor different body functions.
- Discuss the fundamental of the common laboratory equipment, its functioning and the electronics associated with it.

Program Outcomes (as per NBA)

Text Books:

- F. Scheller, F. Schubert, (1991) *Biosensors, Volume 11 of Techniques and Instrumentation in Analytical Chemistry*, Elsevier.
- Vinod Kumar Khanna, (2015) *Implantable Medical Electronics: Prosthetics, Drug Delivery, and Health Monitoring*, Springer.
- Khandpur, (2003) *Handbook of Biomedical Instrumentation*, Tata McGraw-Hill Education
- David A. Winter, (2009) *Biomechanics and Motor Control of Human Movement*, John Wiley & Sons.
- Duane Knudson, (2013) *Fundamentals of Biomechanics*, Springer Science & Business Media.
- Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, (2012) *Biomaterials Science: An Introduction to Materials in Medicine*, Academic Press.

Reference Books:

- Bansi Dhar Malhotra, Anthony Turner, (2003) Advances in Biosensors: Perspectives in Biosensors, *Volume 5 of Advances in Biosensors*, Elsevier.

Online Resources:

NPTEL Online courses

SEMESTER III

Course Name: MATHEMATICS III					
Course Code : MA331					
	L	**T**	**P**	Category	**BSC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course Name: BASIC THERMODYNAMICS					
Course Code : ME332					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

- Expose the fundamentals of thermodynamics via real world engineering examples
- Understand the nature and role of the following thermodynamic properties of matter: internal energy, enthalpy, entropy, temperature, pressure and specific volume
- Represent various thermodynamic processes on appropriate thermodynamic diagrams, such as a temperature-entropy or pressure-volume diagram
- Represent a thermodynamic system by a control mass or control volume, distinguish the system from its surroundings, and identify work and/or heat interactions between the system and surroundings;
- Recognize and understand the different forms of energy and restrictions imposed by the first law of thermodynamics on conversion from one form to another
- Be able to apply the first law to a control mass or control volume at an instant of time or over a time interval.

Prerequisites: Knowledge of Mathematics, Physics

Units	**Teaching Hours**
Unit-1: FUNDAMENTAL CONCEPTS & ZEROTH LAW	
Revision of definition and scope. Microscopic and Macroscopic approaches. System (closed system) and Control Volume (open system);, Thermodynamic properties;, intensive and extensive properties. Definitions of state, path, process and cycle. Quasi-static process. **THERMODYNAMIC EQUILIBRIUM**; **ZEROTH LAW OF THERMODYNAMICS**, Temperature; concepts, scales, measurement. Internal fixed points.	9 Hours
Unit-2: WORK, HEAT AND FIRST LAW OF THERMODYNAMICS FOR NON-FLOW SYSTEMS	
Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. PMM-I. Displacement work; expressions for displacement work in various processes through p-v diagrams. **FIRST LAW OF THERMODYNAMICS**: Joule's experiments, equivalence of heat and work,. Extension of the First law to non –cyclic processes, energy, energy as a property. Applications of first law for various thermodynamics processes.	9 Hours
Unit-3: FIRST LAW OF THERMODYNAMICS	

For flow systems, enthalpy, Specific heat Extension of the First law to control volume; steady state steady flow energy equation, important applications, Application of SFEE for different flow systems. **SECOND LAW OF THERMODYNAMICS:** Devices Thermal reservoir. Direct heat engine; reserved heat engine, heat pump and refrigerator. Kelvin –Planck and Clasius's statement of Second law of Thermodynamic; equivalence of the two statements; PMM II.	9 Hours
Unit-4: ENTROPY	
Reversible and irreversible processes, Factors that make a process irreversible. Carnot cycle and principles. Thermodynamic temperature scale. Clasius's inequality. Entropy; a property, principle of increase of entropy, Calculation of entropy using T.ds relations. **AVAILABLE AND UNAVAILABLE ENERGY:** Maximum Work, maximum useful work for a system and a control volume, availability of a system and a steadily flowing stream, irreversibility. Second law efficiency.	9 Hours
Unit-5: IDEAL GASES	
Ideal Gas Definition Gas Laws: Boyle's law, Charle's law, Avagadro's Law, Equation of State, Ideal Gas, Universal Gas constant, Evaluation of heat transfer, work done, internal energy. Change in entropy, enthalpy for various quasi-static processes. **Ideal gas mixture:** Dalton's law of additive pressures, Amagat's law of additive volumes, evaluation of properties. Analysis of various processes. **REAL GAS:** Introduction; Vander Waal's Equation Van der Waal's constants in terms of critical properties, law of corresponding states, compressibility factor; compressibility)" chart.	9 Hours
Course outcomes: CO1: Express the basic concepts of thermodynamics and zeroth law of thermodynamics on thermal systems to device a thermometer [L1, 2, 4] [PO1, 2, 4] CO2: Develop relation between heat and work for a given thermal system using first principle. [L1, 3, 4] [PO1, 2, 6] CO3: To solve thermal systems using Fist law of thermodynamics and second law of thermodynamics. [L2, 3, 4] [PO1, 2, 4] CO4: Estimate entropy for a given system using the concepts of available and unavailable energy. [L2, 4] [PO1, 3, 4] CO5: Distinguish between ideal and real gases using thermodynamic relations. [L1, 2, 4] [PO1, 2, 4]	
Text Books: 1. "Basic and Applied Thermodynamics" by P.K. Nag, Tata McGraw Hill, 3rd Edi. 2002 2. "Thermodynamics an engineering approach", by Yunus A. Cenegal and Michael A. Boles. Tata McGraw hill Pub. 2002	

Reference Books:

1. Engineering Thermodynamics. By Rajput, Laxmi Publications pvt ltd., 3rd Edi. 2007.
2. Engineering Thermodynamics by J.B. Jones and G.A.Hawkins, John Wiley and Sons.
3. Thermo Dynamics by S.C.Gupta, Pearson Edu. Pvt. Ltd., 1st Ed. 2005.

Course Name: STRENGTH OF MATERIALS					
Course Code : ME333P					
	L	**T**	**P**	Category	PCC
Contact Hrs./Week	**3**	**1**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives:

- To determine the behaviour of the element when it is subjected to stresses and strains
- To study various methods of calculating stresses and strains.
- To study the behaviour under axial and transverse loading.
- Study the principle stresses, Biaxial and triaxial state of stresses.

Units	**Teaching Hours**
Unit-1: SIMPLE STRESS AND STRAIN	
SIMPLE STRESS AND STRAIN: Introduction, Stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation - behaviour in tension for Mild steel, cast iron and nonferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self-weight, Principle of super position. **Stress in Composite Section:** Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars).	9 Hours
Unit-2: COMPOUND STRESSES	
COMPOUND STRESSES: Introduction, Plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress. **ENERGY METHODS**: Work and strain energy, Strain energy in bar/beams, castiglinios theorem, Energy methods. **THICK AND THIN CYLINDER** Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume). Thick cylinders Lame's equation (compound cylinders not included).	9 Hours
Unit-3: BENDING MOMENT AND SHEAR FORCE IN BEAMS	
BENDING MOMENT AND SHEAR FORCE IN BEAMS: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.	9 Hours
Unit-4: BENDING AND SHEAR STRESSES IN BEAMS	

BENDING AND SHEAR STRESSES IN BEAMS: Introduction, Theory of simple bending, assumptions in simple bending. Bending stress equation, relationship between bending stress, radius of curvature, relationship between bending moment and radius of curvature. Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections. (Composite / fletched beams not included).	9 Hours
Unit-5: DEFLECTION OF BEAMS	
DEFLECTION OF BEAMS: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple. Macaulay's method **TORSION OF CIRCULAR SHAFTS AND ELASTIC STABILITY OF COLUMNS**: Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts **COLUMNS:** Euler's theory for axially loaded elastic long columns. Derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.	9 Hours
List of Experiments (If any): **PART – A**	**30 Practical Hours**
1. Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.	2
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of heat-treated samples.	2
3. To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.	2
4. Non-destructive test experiments like, (a). Ultrasonic flaw detection (b). Magnetic crack detection (c). Dye penetration testing. To study the defects of Cast and Welded specimens.	8
PART – B	
1. Tensile, shear and compression tests of metallic and non-metallic specimens using Universal Testing Machine.	4
2. Torsion Test.	2
3. Bending Test on metallic and non-metallic specimens.	4
4. Izod and Charpy Tests on M.S,C.I Specimen.	2
5. Brinell, Rockwell and Vickers's Hardness test.	2
6. Fatigue Test.	2

Course outcomes:

CO1-Understand the fundamental concepts of stress and strain and the relationship between both through the strain-stress equations in order to solve problems for simple tri-dimensional elastic solids.

CO2-Calculate and represent the stress diagrams in bars and simple structures.

CO3-Solve problems relating to pure and non-uniform bending of beams and other simple Structures.

CO4-Solve problems relating to torsional deformation of bars and other simple tri-dimensional structures.

Text Books:

1. "Mechanics of materials", by R.C.hibbeler, printice hall. pearson edu., 2014.
2. "Mechanics of materials", James.m.gere;Stephe Timoshenko, CBS Publishers, Second edition 2016.
3. "Mechanics of materials", Ferdinand P Beer; E. Russel Johnson;John T Dewolf;David F Mazurek; Sanjeev. Sanghi, Tata mcgrawhill- 2013.

Reference Books:

1. S.S. Rattan, "Strength of Materials", Tata McGraw Hill, 2011.
2. S.S.Bhavikatti, "Strength of Materials",Vikas publications House Pvt. Ltd., 2013.
3. " K.V. Rao, G.C. Raju, Mechanics of Materials", First Edition, 2007
4. "Engineering Mechanics of Solids", Egor.P. Popov, Pearson Edu. India, 2008.
5. W.A. Nash, Schaum's Outlines Strength of Materials, Tata Mcgraw-Hill Publishing Company 2010.
6. R.K. Rajput"Strength of Materials" S.Chand & co Ltd. New Delhi, 2015
7. R.KBansal, Strength of Materials, Lakshmi Publication (P) Ltd, New Delhi,2009.

Course Name: AUTOMOBILE MANUFACTURING PROCESSES					
Course Code : AU334P					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**20**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**80**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives:

- To provide a basic knowledge about the casting process casting defects, melting furnaces.
- To gain sound knowledge about welding process and its application in fabrication areas.
- To provide basic knowledge about various machining processes and their applications e.g. Lathe, Drilling, Milling, Grinding etc…
- To study the concepts of metal forming techniques and their applications in metal forming industry.
- To develop the knowledge of the properties of materials and its alloys
- To introduce the modern materials and alloys.
- To develop knowledge in recent trends in manufacturing techniques of automobile components.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
INTRODUCTION TO CASTING PROCESS: Concept of manufacturing process, its importance & classification. Introduction to casting process, steps involved in casting, varieties of components produced by casting process, advantages & limitations of casting process. Casting defects; causes and remedies. Melting Furnaces: Classification of furnaces, Blast furnace, open hearth furnace and cupola furnace. **WELDING PROCESS:** Definition, Principles, Classification, Application, Advantages & limitations of welding. Concept of electrodes, filler rod and fluxes. Arc Welding: Principle, Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding) (SAW) and Atomic Hydrogen Welding processes. (AHW) Special types of welding: Working principle, advantages, limitations and applications of Resistance welding, Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.	10
Unit-2	
Lathe Machine; Types, Parts, specifications and different operations like-turning, facing, knurling, tapering and thread cutting. Cutting	

conditions; cutting speed, depth of cut, feed. Tool life, tool wear, cutting fluids. **Drilling Machine**- Types, Parts, specifications and different operations like drilling, Boring, Counter Boring, counter sinking, tapping, trepanning and Reaming operation. Radial and Sensitive drilling machines (simple sketches) **Milling Machine** –principle of milling; up milling, down milling. Types and important parts of milling machine - column and knee type and vertical milling machine, Milling machine operations. **GRINDING MACHINE:**Types of abrasives, Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types, selection of grinding wheel, grinding process parameters, Dressing and truing of grinding wheels. Types of grinding machines- surface, cylindrical and centerless grinding. **FINISHING PROCESSES**; principle, advantages, limitations and applications ofLapping, Honing, polishing, buffing and super finishing process.	10
Unit-3	
INTRODUCTION TO METAL WORKING PROCESSES:Classification of metal working processes. **FORGING PROCESS;**Introduction to Forging machines & equipment, Advantages, Limitations and applications, defects in forged components and remedies. **ROLLING PROCESS:**Types of rolling mills, Rolling variables,Advantages, Limitations and applications, defects in rolled products and remedies. **SHEET METAL FORMING:**Sheet Metal forming methods, dies & punches, progressive die, compound die, combination die. Open back inclinable press (OBI press), sheet metal forming operations.	8
Unit-4	
Engineering alloys Ferrous alloys-Iron-Iron carbide phase diagram with all phases & critical temperatures-steel,Types of steels-Effect of alloying elements on physical and chemical properties-Automotive applications- cast iron-Types-properties-factors affecting structures of cast iron-Automotive application. Non ferrous alloys- Al, Cu, Tin, Baased alloys, Light metal alloys(mg and Ti) Cylinder block and head-cylinder head and gasket-valves,seats and guides-piston and pin-piston ring and liner-con rod-crankshaft and bearing-turbocharger. Jigs and fixtures.	10
Unit-5	

Surface modification of materials Mechanical surface treatment and coating- case hardening and hard facing-thermal spraying-Vapor deposition-ion implantation-diffusion coating-Electroplating and Electroless plating-Conversion coating-Ceramin and Organic coating-Diamond coating-Laser surface treatment-Selection of coating for Automotive applications Super alloys-super plastic alloys for autobody panels-refractory metals-shape memory alloys-dual phase steels-micro alloyed steels-high strength low alloy steels-smart materials-Composite materials-ceramic –plastics-introduction, overview of processing,their characteristic features, Types and automotive application-Nanomaterials-Introduction and automotive applications.	10
List of Experiments (If any):	**Practical Hours**
PART – A	
1.Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.	
PART – B	
Cutting of V Groove/ dovetail / Rectangular groove using a shaper. Cutting of Gear Teeth using Milling Machine. Surface Grinding	
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Classify the manufacturing processes and identify the basic requirements for the casting process. CO2: Explain the welding techniques and suggest special welding techniques in the relevant areas. CO3: Summarize the various lathe, milling and drilling operations. CO4: Describe the types of Ferrous & Non-Ferrous alloys CO5: Discuss the Mechanical surface treatment and coatings done on materials CO6: Describe the need for modern materials and its alloys.	
Text Books: T1. “Manufacturing Processes” by J. P. Kaushish, Prentice-Hall of India Pvt.Ltd; 2nd edition (August 2010), ISBN-13: 978-8120340824 T2. “Manufacturing Technology: Foundry, Forming and Welding”, 4e (Volume 1) [Kindle Edition], McGraw Hill (14 May 2013), ASIN: B00H1Q21EO. T3. “Metal Cutting Principles”, by Milton C. Shaw. Oxford University Press,2008.	

T4. "Elements of Workshop Technology" Vol 2 Machine Tools, by Choudhury S K, Indian Book, Distributing Company Calcutta, 2010; 13 edition, ISBN-8185099154, 9788185099156

T5. Callister W.D. (2006) "Material Science and Engineering- An introduction", Wiley –Eastern

T6. Flinn R. A. and Trojan P. K., (1999)"Engineering Materials and their Applications", Jaico.

Reference Books:

R1. Manufacturing Engineering and Technology , Steven R Schmid , Serope Kalpakjian, Pearson publication, 2014.

R2. Fundamentals of Metal Machining and Machine Tools, Third Edition by Geoffrey Boothroyd; CRC Press, 1988, ISBN 0824778529, 9780824778521.

R3. Production Technology: Manufacturing Processes, Technology and Automation 17th Edition" by R K Jain, Khanna Publishers, 2012.

R4.KENNETH BUDINSKI – (1988) "Surface Engineering for wear resistance", Prentice Hall.

R5.Avner S.H., (2006) "Introduction to physical metallurgy" –Tata McGraw Hill.

Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990.

R6.Rusinoff, " Forging and Forming of metals ", D.B. Taraporevala Son & Co. Pvt Ltd., Mumbai,1995. . Sabroff.A.M. & Others, " Forging Materials & Processes ", Reinhold Book Corporation, New York,

R7.Upton, " Pressure Die Casting ", pergamon Press, 1985. High Velocity " Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990

Course Name: APPLIED CHEMISTRY					
Course Code : BS335					
	L	**T**	**P**	Category	**BSC**
Contact Hrs./Week	**2**	**0**	**0**	CIA Marks	
Contact Hrs./Sem.	**30**	**0**	**0**	ESE Marks	
Credits.	**2**	**0**	**0**	Exam Hours	

Course Name: BIO SCIENCE LABORATORY					
Course Code : BS351					
	L	**T**	**P**	Category	**BSC**
Contact Hrs./Week	**0**	**0**	**1**	CIA Marks	
Contact Hrs./Sem.	**0**	**0**	**25**	ESE Marks	
Credits.	**0**	**0**	**1**	Exam Hours	

Course Name: AUTOMATION LAB					
Course Code : AU352					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**0**	**0**	**2**	CIA Marks	**25**
Contact Hrs./Sem.	**0**	**0**	**18**	ESE Marks	**25**
Credits.	**0**	**00**	**2**	Exam Hours	**02**

Course objectives:

- To understand the techniques involved in designing an experiment.
- To establish the basic statistical concepts in designing and experiment.
- To obtain the knowledge of taguchi method which is the efficient method of experimental design.

Prerequisites:

List of Experiments (If any):	**Practical Hours**
1. Introduction to Pneumatic and Hydraulic symbols	
2. To Control of a Casting Ladle movement using one-way flow control valve	
3. To Feed a pin continuously using limit switches	
4. To use a pneumatic timer in welding of plastic sheet	
5. To determine the pressure for stamping a badge with uniform press using double acting cylinders	
6. To control a furnace door using manual operated hydraulic valve	
7. To control a surface Grinding machine	
8. To determine the hydraulic pressure for a Drilling machine	
9. To use hydraulic motor and accumulator for an Earth Drill used in construction site	
10. To utilize the pressure sequence valve to handle a garbage box used in solid waste management.	
11. Using directional control flow valves for distributing Billiard Balls	
12. To feed a paper roll for the next stage of process	

Self-study :

Site/Industrial Visits :

Course outcomes:

CO1: Understand the operating principle, performance and selection procedure of hydraulic elements and machines

CO2: Understand the working principle of actuators and evaluate actuator performance and justify selection of actuators for various applications

CO3: Identify different types of control valves and understand their working principle and application.

CO4: Design and analyze hydraulic circuits

Text Books:

1. T1. Anthony Esposito, "Fluid Power with Applications", 7TH edition, Pearson Education, Inc, 2014.
2. T2. Andrew Parr, "Pneumatics and Hydraulics", Jaico Publilishing Co, 2005.

Reference Books:

R1. S. R. Majumdar, "Oil Hydraulic systems Principles and Maintenance", Tata Mc Graw Hill Publishing Company Ltd., 2001.

Online Resources:

SEMESTER IV

Course Name: APPLIED THERMODYNAMICS					
Course Code : ME431					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**2**	**1**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

- To make the students understand thermodynamic principles, in various applications involving machines converting heat in to work and work in to heat. Some of such applications covered in this course are
  a) Steam engines
  b) Gas turbine and jet propulsion
  c) Compressors
  d) Refrigerators and air conditioners
- To quantify the behaviour of power plants based on the Rankine cycle, including the effect of enhancements such as superheat, reheat and regeneration;
- To quantify the performance of power plants based on the Brayton cycle, including the effects of enhancements such as reheat, regeneration and intercooling;
- To quantify the performance of refrigeration and heat pumps

Prerequisites: Knowledge of basic mathematics and physics

Units	**Teaching Hours**
Unit-1	
PROPERTIES OF PURE SUBSTANCES. Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-V, T-S and Mollier diagram for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined). Non-flow and Steady flow vapour processes, Change of properties, Work and heat transfer. **VAPOUR POWER CYCLE** Carnot cycle, Rankine cycle, Comparison of Carnot cycle and Rankine cycle, Efficiency of Rankine cycle, Relative efficiency, Effect of superheat, boiler and condenser pressure on performance of Rankine cycle.	9 Hours
Unit-2	
GAS POWER CYCLE AND GAS TURBINE Classification of Gas Turbines, Analysis of open cycle gas turbine cycle. Advantages and Disadvantages of closed cycle. Work done, condition for maximum work, methods to improve thermal efficiency. **JET PROPULSION:** Introduction to the principles of jet propulsion, Turbojet and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine.	9 Hours
Unit-3	

RECIPROCATING COMPRESSORS: - Operation of a single stage reciprocating compressors. Work input through p-v diagram. Effect of clearance and volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multi-stage compressor, saving in work, optimum intermediate pressure, inter-cooling, minimum work for compression. **ROTARY COMPRESSORS** - Vane compressor, roots blower - Comparison between reciprocating compressors and rotary compressors.	9 Hours
Unit-4	
REFRIGERATION: History and applications, air cycle refrigeration; reversed Carnot cycle, reversed Brayton cycle. Vapour absorption refrigeration system. Steam jet refrigeration. **VAPOUR COMPRESSION REFRIGERATION**; description, analysis, refrigerating effect, capacity, power required, units of refrigeration, COP. Refrigerants and their desirable properties	9 Hours
Unit-5	
PSYCHOMETRICS: **Atmospheric air and psychometric properties**; Dry bulb temperature, wet bulb temperature, dew point temperature; partial pressures, specific and relative humidifies and the relation between the two Enthalpy and adiabatic saturation temperature. Problems without charts only. **AIR CONDITIONINIG** Construction and use of psychometric chart. Analysis of various processes; heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream of moist air. Summer and winter air - conditioning. Problems using charts only.	9 Hours
Course outcomes: CO1:Determine the properties of steam using Mollier chart and steam calorimeters [L1, L2] [PO1, PO2, PO4, PO6] CO2:Explain the principles of vapour power cycles and gas power cycles using first principle [L1, L2, L3] [PO1, PO2, PO4] CO3:Explain jet propulsion system using principles of turboprop and turbojet principles [L1, L2] [PO1, PO2, PO12] CO4:Compare rotary and reciprocating compressors using first principle [L2, L3] [PO1, PO2, PO12] CO5:Evaluate the psychometric properties of refrigerant using psychometric charts [L2, L3, L4] [PO1, PO2, PO4]	
Text Books: 1. Basic and Applied Thermodynamics by P.K.Nag, Tata McGraw Hill Pub. Co., 2002. 2. Fundamental of Classical Thermodynamics by G.J. Van Wylen and R.E.Sonntag, Wiley Eastern.	

Reference Books:
1. Thermodynamics -An Engineering Approach by Yunus, A.Cenegal and Michael A.Boles, Tata McGraw Hill Pub. Co., 2002 2. Applied Thermodynamics by R.K.Hegde and Niranjan Murthy, Sapna Book House, 2005.
Online Resources:
W1. https://nptel.ac.in/courses/112106133/1 W2. https://nptel.ac.in/courses/112106133/2 W3. https://nptel.ac.in/courses/112106133/5 W4. https://nptel.ac.in/courses/112106133/6 W5. https://nptel.ac.in/courses/112106133/12

Course Name: AUTOMOBILE MATERIALS ENGINEERING					
Course Code : AU432P					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives: To familiarize with

The students will possess the knowledge and skills in

- The general concepts and terminologies of Measurement system, Evolution of measurement.
- Concept of measurement and measurand, Flow diagram of measurement, Static and Dynamic characteristics of measurement system.
- Concept of Transducer, Classification and Performance Characteristics of transducers.
- Principles of calibration- definition, traceability, dead beat readings.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
STANDARDS OF MEASUREMENT: Definition and Objectives of metrology, Standards of length-International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Legal Metrology, Care of Measuring Instruments- Reliability. **SYSTEM OF LIMITS, FITS, TOLERANCE AND GAUGING:** Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS919-1963), geometrical tolerance, positional-tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.	10
Unit-2	
COMPARATORS AND ANGULAR MEASUREMENT: Introduction to comparators, characteristics, classification of comparators, mechanical comparators-dial indicator, optical comparators-principles, Zeiss ultra optimeter, electric and electronic comparators-principles, LVDT, pneumatic comparators, back pressure gauges, solex comparators. Angular measurements, bevel protractor, sine principle and use of sine bars, sine centre, use of angle gauges	10

clinometers.Coordinate Measurement Machine- Architecture & Operation, Laser Interferometer, Angle Dekkor **INTERFEROMETER AND SCREW THREAD, GEAR MEASUREMENT:** Interferometer, interferometry, autocollimator. Optical flats. Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear.to., terminology, use of gear tooth vernier caliper, Gleason Gear Testing Machine	
Unit-3	
MEASUREMENTS AND MEASUREMENT SYSTEMS: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysterisis, repeatability, linearity, loading effect, system response-times delay. Errors in measurement, classification of errors, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers. **RECEIVING DEVICES & ADVANCES IN METROLOGY:** Mechanical systems, electronic amplifiers and telemetry. Terminating devices, mechanical, cathode ray oscilloscope, oscillographs, X-Y plotters,Machine tool Metrology,Introduction to atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Nanometrology	10
Unit-4	
MEASUREMENT OF FORCE, TORQUE: Principle, analytical balance,platform balance, proving ring. Torque measurement, Prony brake, hydraulicdynamometer. **PRESSURE MEASUREMENTS:** principle, use of elastic merijbers, Bridgemangauge, Mcloed gauge, Pirani gauge,Surface Finish Metrology	9
Unit-5	
TEMPERATURE MEASUREMENT: Resistance thermometers, thermocouple, law of thermo couple, materials used for construction, pyrometer, optical pyrometer. **STRAIN MEASUREMENTS**: strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement.	8
List of Experiments (If any): Part-A: Mechanical measurements	**Practical Hours**
24. Calibration of Pressure Gauge	
25. Calibration of Thermocouple	
26. Calibration of LVDT	
27. Calibration of Load cell	

28. Determination of modulus of elasticity of a mild steel specimen using strain gauges.	
Part-B: Metrology	
1. Measurements using Optical Projector / Toolmaker Microscope.	
2. Measurement of angle using Sine Center / Sine bar / bevel protractor	
3. Measurement of alignment using Autocollimator / Roller set	
4. Measurement of cutting tool forces using a. Lathe tool Dynamometer b. Drill tool Dynamometer.	
5. Measurement of Screw threads Parameters using Two wire or Three-wire method.	
6. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator	
7. Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer	
8. Calibration of Micrometer using slip gauges	
9. Measurement using Optical Flats	
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Examine the Line standards by slip gauges. CO2: Detect the screw thread parameters and to operate the LVDT equipment. CO3: Interpret the parameters of Cathode ray oscilloscope. CO4: Operate & infer the values of Torque measurement equipment. CO5: Compute the strain from the strain gauge equipment.	
Text Books: T1. Mechanical Measurements (6th Edition)by Thomas G. Beckwith , Roy D. Marangoni , John H. Lienhard V ISBN-13: 9780132295076 ©2007 • Pearson Higher Education T2. Engineering Metrology by R K Jain, 17th Edition, ISBN: 717409024X; ©1999 Khanna Publications Delhi T3. Fundamentals of Dimensional Metrology by Connie L Dotson05th Edition ISBN-13: 978-1418020620 ©2006, Thomson Delmer Learning	

Reference Books:

R1. A Text Book Of Engineering Metrology by I C Gupta, 07th Edition, Dhanpat Rai Publications (P) Ltd.-New Delhi

R2. Industrial Instrumentation by Jerry Faulk, Al Sutko, 01st Edition, ISBN-13: 978-0827361056, Thompson Asia Pvt. Ltd.2002.

R3. Measurement Systems Application by Ernest O. Doebelin, 01st Edition, ISBN-13: 978-0070173385, McGrawHill Book Company.

R4. Mechanical measurementsby R.S.Sirohi, 03rd Edition, ISBN-8102403832, New Age Publications, 1991.

R5. Metrology for Engineers by J.F.W. Galyer, Charles Reginald Shotbolt, 05th Edition, Mc Donald & Co Publications, 2005.

Course Name: FLUID MECHANICS					
Course Code : ME433P					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives:

- Develop an understanding of fluid dynamics in Fluid/aerospace engineering as well as a variety of other fields.
- Learn to use control volume analysis to develop basic equations and to solve problems.
- Understand and use differential equations to determine pressure and velocity variations in internal and external flows.
- Understand the concept of viscosity and where viscosity is important in real flows.
- Learn to use equations in combination with experimental data to determine losses in flow systems.
- Learn to use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity.

Units	**Teaching Hours**
Unit-1: PROPERTIES OF FLUIDS	
Introduction, Properties of fluids, viscosity, Stroke's Theorem, Compressibility, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitation **FLUID STATICS:** Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Total pressure and centre of pressure.	9 Hours
Unit-2: BUOYANCY	
Archimedes's Principle, Buoyancy, centre of buoyancy, metacenter and metacentric height, conditions of equilibrium of floating and submerged bodies, determination of Metacentric height experimentally and theoretically **FLUID KINEMATICS:** Types of fluid flow, continuity equation in 2D and 3D (Cartesian Coordinates only, velocity and acceleration, velocity potential function and stream function, Streamlines, Path lines, Streak lines and Stream tubes, Circulation and Vorticity	9 Hours
Unit-3: FLUID DYNAMICS	
Introduction to Navier-Stoke's equation, Introduction equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation **FLUID FLOW MEASUREMENTS:** Venturimeter, orifice meter, Pitot tube, V-Notch and rectangular notches.	9 Hours

Unit-4: DIMENSIONAL ANALYSIS	
Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham pi theorem, dimensionless numbers, similitude, types of similitudes (Problems only on similitudes) **EXPERIMENTAL FLUID MECHANICS:** Objective of experimental studies, Fluid mechanics measurements, Measuring instruments, Performance terms associated with measurement systems, Direct measurements, Analogue methods, Flow visualization, Components of measuring systems.	9 Hours
Unit-5: INTERNAL AND EXTERNAL FLOWS	
Flow through pipes, Hagen-Poiseuille equation, and Minor losses through pipes. Darcy's and Chezy's equation for loss of head due to friction in pipes, Flow past immersed bodies-Drag, Lift, expression for lift and drag and their coefficients, wake and separation, boundary layer concept, displacement, momentum and energy thickness **INTRODUCTION TO COMPRESSIBLE FLOW:** Velocity of sound in a fluid, Mach number, Mach cone, Mach angle and Mach wave, propagation of pressure waves in a compressible fluid	9 Hours
List of Experiments (If any): **PART – A**	**30 Practical Hours**
4. Determination of coefficient of friction of flow in a pipe.	4
5. Determination of minor losses in flow through pipes.	4
6. Determination of force developed by impact of jets on vanes.	2
4. 4. Calibration of flow measuring Devices like a) Orifice Plate Meter b) Nozzle c) Venturimeter d) V-notch	8
PART – B	
7. Determination of performance of water turbine.	4
8. Determination of performance of centrifugal pump.	4
9. Determination of performance of air compressor.	4
Course outcomes: CO1: To Develop an understanding of fluid dynamics in Fluid/aerospace engineering as well as a variety of other fields. [L1, 2, 3, 4] [PO1, 2, 4, 6] CO2: To Learn to use control volume analysis to develop basic equations and to solve problems. [L1, 2, 3] [PO1, 2, 3] CO3: To Understand and use differential equations to determine pressure and velocity variations in internal and external flows. [L2, 3] [PO1, 3, 4] CO4: To Understand the concept of viscosity and where viscosity is important in real flows. [L2, 3, 4] [PO1, 2, 4,6]	

CO5: To Learn to use equations in combination with experimental data to determine losses in flow systems. [L1, 3] [PO2, 3, 4]

CO6: To Learn to use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity. [L1, 4] [PO1, 2, 4]

Text Books:

1. "Bansal. R.K, "Fluid Mechanics and Hydraulics Machines", 5th edition, Laxmi publications (P) Ltd., New Delhi, Ninth Edition, 2006

Reference Books:

8. White. F.M, "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2003
9. Streeter V.L., Benjamin Wylie, "Fluid Mechanics", Mc Graw Hill Book Co., New Delhi, 1999
10. Robert W. Fax, Philip J. Pritchard, Alan T. McDonald, "Introduction to Fluid Mechanics", Wiley India Edition (Wiley Student Edition Seventh 2011)
11. Modi P.N, & Seth S.M, "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 14thedition, 2002
12. Shiv Kumar, "Fluid Mechanics & Fluid Machines: Basic Concepts & Principles", Ane Books Pvt. Ltd., New Delhi, 2010
13. Yunus A Cengel & John M. Cimbala, Fluid Mechanics, Tata McGraw Hill Edition, New Delhi, 2006

Course Name: AUTOMOTIVE ENGINES					
Course Code : AU434P					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives:

- To make students familiar with engine components.
- To understand about carburetion, and types of petrol injection systems.
- To introduce combustion inside the engine.
- To introduce students to lubrication and cooling systems, supercharging turbocharging and scavenging.

Prerequisites: Internal combustion engines

Units	**Teaching Hours**
Unit-1: ENGINE CONSTRUCTION AND OPERATION	
Thermodynamic cycles; Four stroke SI and CI engines - Working principle - function, materials, constructional details of engine components - Valve timing diagram - Firing order and its significance – relative merits and demerits of SI and CI engines Two stroke engine construction and operation. Comparison of four-stroke and two-stroke engine operation.	9 Hours
Unit-2: FUELS AND COMBUSTION	
Combustion fundamentals, Conversion of gravimetric to volumetric analysis -Determination of theoretical minimum quantity of air for complete combustion -Determination of air fuel ratio for a given fuel. Properties and rating of fuels (petrol and diesel), chemical energy of fuels, reaction equations, combustion temperature, combustion chart. Combustion in premixed and diffusion flames - Combustion process in IC engines.	9 Hours
Unit-3: COMBUSTION IN SI ENGINES	
Stages of combustion in SI engine- Flame propagation - Flame velocity and area of flame front - Rate of pressure rise - Cycle to cycle variation – Abnormal combustion - Theories of detonation - Effect of engine operating variables on combustion. Combustion chambers - types, factors controlling combustion chamber design, Emissions from SI engine, SI emission reduction techniques.	9 Hours
Unit-4: COMBUSTION IN CI ENGINES	
Importance of air motion - Swirl, squish and turbulence - Swirl ratio. Fuel air mixing - Stages of combustion - Delay period - Factors affecting delay period, Knock in CI engines - methods of controlling diesel knock.	9 Hours

CI engine combustion chambers - Combustion chamber design objectives - open and divided. Induction swirl, turbulent combustion chambers. - Air cell chamber - M Combustion chamber. Emissions from CI engine, CI emission reduction techniques	
Unit-5: ENGINE PERFORMANCE	
Measurement and calculation techniques of performance parameters - BP, FP, IP, Torque specific fuel consumption, Specific Energy consumption, volumetric efficiency, thermal efficiency, mechanical efficiency, Engine specific weight, and heat balance, Testing of engines – different methods, Emission measurement techniques, Numerical problems	9 Hours
List of Experiments (If any): **PART – A** **ENGINE COMPONENTS LAB**	**30 Practical Hours**
1. Study of Hand Tools	2
2. Study of Engine Components	2
3. Technical Specifications of Automobile engines	2
4. Trouble Shooting Charts	2
5. Dismantling & Assembly of SI and CI engines	2
6. Compression and Vacuum Test	2
7. Study of Auxiliary Components	2
PART – B **AUTOMOTIVE MAINTENANCE AND SERVICE LAB**	
1. Wheel Balancing	2
2. Wheel Alignment Test	2
3. Automotive Air Conditioning System	2
4. Study of Automotive Chassis Components	2
5. Dismantle and assemble of major systems (clutch system, Gear boxes, Propeller shaft, Differential, Front and Rear axles, brake system, steering system and suspension system) and identifying remedies (like backlash adjustment, brakes adjustment, bleeding of brakes) for the possible problems based on trouble shooting charts.	8
Course outcomes: CO 1 : Understand engine construction based on mechanism of working. [L1, 2, 3] [PO1, 2, 3] CO2 : Summarize stoichiometric air-fuel ratio by using stoichiometric combustion equation for fuels. [L1, 2, 4] [PO1, 3, 4] CO 3 : Understand the stages of combustion in S.I engine to reduce knocking. [L1, 2, 3] [PO1, 2, 6] CO 4 : Explain the importance of air swirl, turbulence and tumble in combustion chamber to increase the rate of combustion. [L2, 3] [PO1, 2, 4]	

CO 5 : Understand and apply formula to know the various engine performance parameters with respect to different engine dimensions. [L2, 4] [PO1, 2, 4, 5]

Text Books:

2. Ganesan V, "*Internal combustion engines*", 4th edition, Tata McGraw Hill Education, 2012
3. Rajput R. K, "*A textbook of Internal Combustion Engines*", 3rd edition, Laxmi Publications (P) Ltd, 2016.

Reference Books:

14. John. B, Heywood, "*Internal Combustion Engine Fundamentals*", McGraw Hill Education; 1 edition (17 August 2011)
15. Ramalingam K. K, "*Internal Combustion Engines*", Second Edition, Scitech Publications.
16. Sharma S. P, Chandramohan, "*Fuels and Combustion*", Tata McGraw Hill Publishing Co, 1987.
17. Mathur and Sharma, "*A course on Internal combustion Engines*", DhanpatRai& Sons, 1998.
18. Edward F, Obert, "*Internal Combustion Engines and Air Pollution*", Intext Education Publishers.
19. Yunus A Cengel & John M. Cimbala, Fluid Mechanics, Tata McGraw Hill Edition, New Delhi, 2006

Course Name: KINEMATICS AND THEORY OF MACHINES					
Course Code : AU435					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

To understand the kinematics and rigid- body dynamics of kinematically driven machine components

To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link

To be able to design some linkage mechanisms and cam systems to generate specified output motion

To understand the kinematics of gear trains

Prerequisites: Engineering Graphics, Engineering Mechanics

Units	**Teaching Hours**
Unit-1	
Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashoff's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms	9
Unit-2	
Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Coriolis component of acceleration- introduction to linkage synthesis-three position graphical synthesis for motion and path generation	9
Unit-3	
Classification of cams and followers- Terminology and definitions- Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers	**9**
Unit-4	

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics	**9**
Unit-5	
Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication-friction clutches- belt and rope drives- friction in brakes	9
List of Experiments (If any):	**Practical Hours**
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: { Summarize the fundamentals of kinematics and Planar mechanisms} {L1} {PO1} CO2: {Analyse velocity and acceleration parameters in various four bar mechanisms using instantaneous centre method and relative velocity method} {L2, L3} {PO2} CO3: {Develop the displacement diagram for a required output and design cam profiles for inline and offset followers}{L4}{PO1,PO2,PO3} CO4: { Explain the fundamentals of gear profiles and extrapolate various parameters of Spur gear teeth.}{L2}{PO1,PO2} CO5: {Design gear trains for power transmission}{L2}{PO1,PO2,PO3}	
Text Books: T1. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988. T2. Ratan.S.S, "Theory of Machines", 4th Edition, Tata McGraw Hill Publishing company Ltd. 2014.	
Reference Books: R1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005. R2. CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005. R3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.	
Online Resources: W1. https://nptel.ac.in/courses/112104121/ W2.	

Course Name: PROFESSIONAL ETHICS					
Course Code : HS436					
	L	**T**	**P**	Category	**HSMC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**100**

Course objectives: This paper deals with the various organizational behaviours like learning, perception, motivation and method of managing stress and conflicts and the basic principles of communication.

Prerequisites:

Units	**Teaching Hours**
Unit-1 : Introduction	
Definition of Organization Behaviour and Historical development, Environmental context (Information Technology and Globalization, Diversity and Ethics, Design and Cultural, Reward Systems). THE INDIVIDUAL: Foundations of individual behaviour, individual differences. Ability. Attitude, Aptitude, interests. Values.	**8**
Unit-2: Learning and Perception	
LEARNING: Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement. PERCEPTION: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect.	**8**
Unit-3 : Motivation & The groups	
MOTIVATION: Maslow's Hierarchy of Needs theory, Mc-Gregor's theory X and Y, Hertzberg's motivation Hygiene theory, David Mc-Clelland's three needs theory, Victor Vroom's expectancy theory of motivation**.** THE GROUPS: Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making.	**8**
Unit-4: Conflict & Stress management	
Definition of conflict, functional and dysfunctional conflict, stages of conflict process. Sources of stress, fatigue and its impact on productivity.Job satisfaction, job rotation, enrichment, job enlargement and reengineering work process.	**10**
Unit-5: Principle of Communication	
Useful definitions, communication principles, communication system, role of communication in management, barriers in communication, how to overcome the barriers, rule of effective communication.	**9**
Self-study :	
Site/Industrial Visits :	

Course outcomes:

CO1: To communicate in an effective manner in an organization. {Level-1, PO-1}
CO2: To motivate the team members in an organization. {Level-3, PO-2}

CO3: To Study the various motivational theories {Level-2, PO-3}
CO4: To study the various methods of learning. {Level-1, PO-2}
CO5: To effectively manage the stress and conflicts in an organization.{Level-1, PO-1}

Text Books:

T1. Organizational Behaviour, Stephen P Robbins, 9th Edition, Pearson Education Publications, ISBN-81-7808-561-5 2002
T2: Organizational Behaviour, Fred Luthans, 9th Edition, Mc Graw Hill International Edition, ISBN-0-07-120412-12002

Reference Books:

R1.Organizational Behaviour, Hellriegel, Srocum and Woodman, Thompson Learning, 9th Edition, Prentice Hall India, 2001

R2. Organizational Behaviour, Aswathappa - Himalaya Publishers. 2001

R3.Organizational Behaviour, VSP Rao and others, Konark Publishers.2002

R4. Organizational Behaviour, (Human behaviour at work) 9th Edition, John Newstron/ Keith Davis. 2002

Online Resources:

W1.
W2.

SEMESTER V

Course Name: DESIGN OF AUTOMOTIVE COMPONENTS					
Course Code : AU531					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**48**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course Name: AUTOMOTIVE ENGINE SYSTEMS					
Course Code : AU532P					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives:

- To make students familiar with the intake and exhaust system components.
- To understand about carburetion, and types of petrol injection systems.
- To introduce students to diesel injection systems and the function of components like pumps, mechanical and pneumatic governors, fuel injectors and injection nozzles.
- To introduce students to lubrication and cooling systems, supercharging turbocharging and scavenging.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
INTAKE AND EXHAUST SYSTEMS Intake system components - Discharge coefficient, Pressure drop - Air filter, intake manifold, Connecting Pipe - Exhaust system components – Exhaust manifold and exhaust pipe - Spark arresters - Exhaust mufflers, Types, operation	09
Unit-2	
CARBURETION AND GASOLINE INJECTION Mixture requirements for steady state and transient operation, Mixture formation studies of volatile fuels, design of elementary carburettor Chokes - Effects of altitude on carburetion - Carburettor for 2-stroke and 4-stroke engines – carburettor systems for emission control. Petrol injection - Open loop and closed loop systems, mono point, multi-point and direct injection systems - Principles and Features, Bosch injection systems.	10
Unit-3	
DIESEL INJECTION Requirements - Air and solid injection - Function of components - Jerk and distributor type pumps- pump calibration .Pressure waves - Injection lag – Unit injector - Mechanical and pneumatic governors - Fuel injector - Types of injection nozzle - Nozzle tests - Spray characteristics - Injection timing - Factors influencing fuel spray atomization, penetration and dispersion of diesel	09
Unit-4	

LUBRICATION AND COOLING Need for cooling system - Types of cooling system - Liquid cooled system: Thermosyphon system, Forced circulation system, pressure cooling system - properties of coolant, additives for coolants Need for lubrication system - Mist lubrication system, wet sump any dry sump lubrication - Properties of lubricants, consumption of oil.	10
Unit-5	
SUPERCHARGING AND SCAVENGING Objectives - Effects on engine performance - engine modification required -Thermodynamics of supercharging and Turbocharging – Turbo lag-Windage losses- Turbo charging methods - Engine exhaust manifold arrangements. Classification of scavenging systems -Mixture control through Reed valve induction - Charging Processes in two-stroke cycle engine - Terminologies -Shankey diagram - perfect displacement, perfect mixing.	10
List of Experiments (If any): PART - A	**Practical Hours**
13. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Martin (closed) / Cleavland (Open Cup) Apparatus.	
14. Determination of Calorific value of solid, liquid and gaseous fuels.	
15. Determination of Viscosity of lubricating oil using Redwoods, Saybolts and Torsion Viscometers.	
16. Valve Timing/port opening diagram of an I.C. engine (4 stroke/2 stroke).	
17. Use of planimeter	
PART - B	
1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, SFC, FP, Heat Balance sheet for : i. Four stroke Diesel Engine ii. Four stroke Petrol Engine iii. Multi Cylinder Diesel/Petrol Engine, (Morse test) iv. Two stroke Petrol Engine v. Variable Compression Ratio I.C. Engine.	
Self-study :	
Site/Industrial Visits :	

Course outcomes:

CO1: Understand how make a perfect Design of Intake manifold for proper air flow and back pressure in exhaust manifold of engines.

CO2: Learns to improve the carburettor design for defining the rich and lean mixture.

CO3: Understand various methods of injection systems for C.I. Engines for improving the combustion process.

CO4: Understand the Heat Exchangers phenomenon to improve cooling method in radiators and other cooling systems.

CO5: Tells the importance of charging method for engines which improves engine efficiency.

Text Books:

T1. Ganesan V, "*Internal combustion engines*", 4th edition, Tata McGraw Hill Education, 2012

T2. Rajput R. K, "*A textbook of Internal Combustion Engines*", 3rd edition, Laxmi Publications (P) Ltd, 2016.

Reference Books:

R1. Ramalingam K. K, "*Internal Combustion Engine*", Scitech Publication (India) Pvt.Ltd. 2000.

R2. Duffy Smith, "*Auto Fuel Systems*", The Good Heart Willcox Company Inc., Publishers, 1987.

R3. Edward F, Obert, "*Internal Combustion Engines and Air Pollution*", Intext Education Publishers, 1980.

Course Name: AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS					
Course Code : AU533					
	L	**T**	**P**	Category	**BSC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

•To make the students understand the working principle of transducers and sensors.

•To understand various types of lighting system and charging system.

•To understand various types of sensors used in engine and application of each sensor.

•To have a broad knowledge about electrical and electronic components in the vehicle.

Prerequisites: Provide knowledge about electronic components in automobile.

Units	**Teaching Hours**
Unit-1	
BATTERIES AND ACCESSORIES Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging.Standard Battery rating for various vehicles, other battery types and overview of battery management system.	09
Unit-2	
STARTING SYSTEM Condition at starting, behaviour of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.	**10**
Unit-3	
CHARGING SYSTEM AND LIGHTING Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cut-out. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, and wiper system, advances in lighting system (adaptive front lighting system – AFLS).	**10**
Unit-4	

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS Current trends in automotive electronic engine management system, electromagnetic interference /electromagnetic compatibility (EMI/EMC), electronic dashboard instruments, on board diagnostic system (OBD), security and warning system.	**10**
Unit-5	
SENSORS AND ACTUATORS Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.Case study of any one of the automotive sensor-based application.	**10**
List of Experiments (If any): PART A Electrical Experiments	**Practical Hours**
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: To explain various electronic systems present in the vehicle. CO2: To do demonstrate on quantity of energy conversion through calculations for actual processes CO4: To explore current trend automotive electronic engine management. CO3: CO5: CO6:	
Text Books: T1. Allan Bonnick, "*Automotive Computer Controlled Systems*", ISBN1138177172 2016. T2. Tom Weather Jr and Cland C.Hunter, "*Automotive Computers and Control System*", Prentice Hall Inc., New Jersey. T3. Young A. P & Griffiths L, "*Automobile Electrical and Electronic Equipments*", English Languages Book Society & New Press, 1990.	
Reference Books: R1. Santini Al, "*Automotive Electricity and Electronics*", Cengage Learning, 2012.. R2. Tom Denton, "*Automotive Electrical and Electronic System*", SAE International, 2004. R3. William B. Ribbens, "*Understanding Automotive Electronics*", 6th Edition, Newnes, 2003. R4. BOSCH, "*Automotive Handbook*", 8th Edition, BENTLEY ROBERT Incorporated, 2011. R5. Norm Chapman, "*Principles of Electricity and electronics for the Automotive Technician*", Delmar Cengage Learning,2nd edition 2009. R6. Judge A.W, "*Modern Electrical Equipment of Automobiles*", Chapman & Hall,	

London, 1992.
Online Resources: W1. W2.

Course Name: COMPUTER AIDED DRAWING					
Course Code :AU536P					
	L	**T**	**P**	Category	**ESC**
Contact Hrs./Week	**2**	**4**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**20**	**50**	**0**	ESE Marks	**50**
Credits.	**2**	**0**	**2**	Exam Hours	**3**

Course objectives:

- To visualize an object and convert it into a drawing.
- To gain knowledge of conventional representation of various machining and mechanical details as per IS.
- To become conversant with 2-D and 3-D drafting.
- Gaining the knowledge of CAD software and its features for effective representation of machine components and their assembly.
- Understand the format and Standards of Machine Drawing.
- Understand the technical information on machine drawings.
- Understanding and drawing of various views and machine components.
- Learning how to assemble and disassemble important parts used in major mechanical engineering applications.

Prerequisites: Gives knowledge on 2d drawing and 3d modeling.

Units	**Teaching Hours**
Unit-1 PART-A	
INTRODUCTION: Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing, Drawing units, grid and snap. **SECTIONS OF SOLIDS:** Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids). True shape of sections. **ORTHOGRAPHIC VIEWS:** Conversion of pictorial views into orthographic projections. of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.	10
Unit-2	
THREAD FORMS: Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread. **FASTENERS:** Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper	08

and split pin for locking, counter sunk head screw, grub screw, Allen screw.	
Unit-3	
KEYS & JOINTS : Parallel key, Taper key, Feather key, Gibhead key and Woodruff key **RIVETED JOINTS:** Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.	08
Unit-4	
COUPLINGS: Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint) **INTRODUCTION TO GD&T:** Introduction to dimensional analysis, GD&T and its tools, Datum's and concepts, manufacturing GD&T and its application, application of GD&T and its Principles.	08
Unit-5 PART – C	
Assembly Drawings **(Part drawings should be given)** 1. Plummer block (Pedestal Bearing) 2. Rams Bottom Safety Valve 3. I.C. Engine connecting rod 4. Screw jack (Bottle type) 5. Tailstock of lathe 6. Machine vice 7. Tool head of the shaper	26
List of Experiments (If any):	**Practical Hours**
18.	
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Will be able to read and understand the machine drawings. CO2: Will be able to prepare machine components drawings. CO3: Will be able to do assembly drawings. CO4: Will be in a position to do drawings and assembly using computer. CO5: CO6:	

Text Books:

T1. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum.

T2. 'Machine Drawing', N.D.Bhat & V.M.Panchal.

Reference Books:

R1. 'A Text Book of Computer Aided Machine Drawing', S. Trymbaka Murthy, CBS
R2. Publishers, New Delhi, 2007

R3. 'Machine Drawing', K.R. Gopala Krishna, Subhash Publication.

R4. 'Machine Drawing with Auto CAD', Goutam Pohit & Goutham Ghosh, 1st Indian print Pearson Education, 2005

R5. 'Auto CAD 2006, for engineers and designers', Sham Tickoo. Dream tech 2005

R6. 'Machine Drawing', N. Siddeshwar, P. Kanniah, V.V.S. Sastri, published by Tata Mc GrawHill,2006

R7. Fundamentals of Geometric Dimension & Tolerancing, by Alex Krulikowski

Online Resources:

W1.

W2.

Course Name: ADVANCE MACHINING LABORATORY					
Course Code : AU551					
	L	**T**	**P**	Category	PCC
Contact Hrs./Week	**1**	**0**	**2**	CIA Marks	**25**
Contact Hrs./Sem.	**30**			ESE Marks	**25**
Credits.	**1**	**0**	**1**	Exam Hours	**2**

List of Experiments (If any):	**30 Practical Hours**
PART – A	
CNC part programming using CAM packages. Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like Master- CAM, or any equivalent software.	12
Practice on 3D printing	5
PART – B	
(Only for Demo/Viva voce) 1. FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components. 2. Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects (2 programs).	5
PART – C	
1. Practice on Special purpose machining- Hands on practice by using Universal (capstan/Turret)	8

Programmable logic controllers (Minimum 3 Experiments)

1. Introduction to Ladder Logic diagram
2. To study various types of sensors
3. To configure the given programmable logic controllers
4. To do logic operation using ladder logic diagrams
5. To start and stop any process using timer modules in PLC
6. To do a ladder logic for the continuous operation & termination of the conveyor belt based on the sensor inputs
7. To start and stop a main motor and an oil pump motor used in lathe operation.
8. Electro pneumatic circuit for Automatic Washing Machine
9. Electro pneumatic circuit for pin feeding device
10. Electro pneumatic circuit for metal stamping device

Text Books:

4. Fundamental Concepts and Analysis, Ghosal A., Robotics, Oxford,2008 (reprint)
5. Introduction to Robotics Analysis, Systems, Applications, Niku, S. B., Pearson Education, 2nd edition, 2010.
6. Automation, Production Systems and Computer Integrated Manufacturing, M. P. Groover Pearson education, 4th Edition, 2015.

7. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India.

Reference Books:

20. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 3rd edition, 2004.
21. Fundamentals of Robotics, Analysis and Control, Schilling R. J., PHI, 2006
22. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
23. Performance Modelling of Automated Manufacturing Systems, Viswanandham, PHI, , 2006 (reprint).
24. Computer Integrated Manufacturing, J. A. Rehg & Henry. W.Kraebber, 3rd edition, 2004.
25. CAD/CAM by Zeid, Tata McGraw H, 2nd edition, 2009.

SEMESTER VI

Course Name: ALTERNATE FUELS AND ENERGY SYSTEMS					
Course Code: AU631P					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives:
The purpose of this course is to impart the importance of the most important renewable energy resources, and the technologies for harnessing these energies

Prerequisites:

Units	**Teaching Hours**
Unit-1	
INTRODUCTION Concept of petroleum fuels, Need for alternate fuel, availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternate energy sources. like EV, hybrid, fuel cell and solar cars.	09
Unit-2	
ALCOHOLS Properties as engine fuel, alcohols and gasoline blends, performance and emission analysis in SI engine, Feasibiity study of alocohols in CI engines, performance and emission analysis in CI engines,modifications required to use in engines, DME, DEE properties performance analysis,, Flex fuel vehicle, reformed alcohol.	10
Unit-3	
NATURAL GAS, LPG, HYDROGEN AND BIOGAS Availability of CNG, LPG, properties, modification required to use in engines, performance and emission characteristics of CNG & LPG in SI & CI engines, Hydrogen; storage and handling, performance and safety aspects, producer gas, bio gas.	10
Unit-4	
VEGETABLE OILS Various vegetable oils for engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics, biodiesel standards.	10
Unit-5	

ELECTRIC, HYBRID, FUEL CELL AND SOLAR CARS Layout of an electric vehicle, advantage and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar powered vehicles	10
List of Experiments (If any): PART - A	**Practical Hours**
19. Determination of Overall Heat Loss Co-efficient, Heat Removal Factor and Efficiency for Flat plate collector for FLATE PLATE COLLECTOR with thermosyphonic mode of flow.	**2**
20. Determination of Overall Heat Loss Co-efficient, Heat Removal Factor and Efficiency for Flat plate collector for FLATE PLATE COLLECTOR with forced mode of flow.	**2**
21. To determine the Performance Overall Heat Loss Co-efficient, Heat Removal Factor and Efficiency of the Parabolic Trough collector with fixed parameters with water and oil as working fluid.	**2**
22. To determine the Performance Overall Heat Loss Co-efficient, Heat Removal Factor and Efficiency of the Parabolic Trough collector with varying Solar Radiation with water and oil as working fluid	**2**
23. Determination of Heat Transfer Coefficient in a Forced Convention Flow through a Pipe.	**2**
PART - B	
1. Evaluation of cut-in speed of wind turbine	**2**
2. Evaluation of Tip Speed Ratio (TSR) at different wind speeds	**2**
3. Evaluation of Coefficient of performance of wind turbine	**2**
4. Characteristics of turbine (power variation) with wind speed	**2**
5. Characteristics of fuel cell with the help of resistive load or DC-DC converter	**2**
6. Output power variation of fuel cell with change in Hydrogen supply	**2**
Self-study :	
Site/Industrial Visits :	

Course outcomes:

CO1: Discuss the use of energy sources with regard to future supply and the environment.

CO2: Discuss solutions to the supply and environmental issues associated with Alcohol as an alternative fuel for IC Engines.

CO3: Give the solutions to the supply and environmental issues associated with Natural Gas, LPG, Hydrogen and Biogas as a fuel for IC Engines.

CO 4: Discuss solutions to the supply and environmental issues associated with Vegetable Oils as a fuel for IC Engines.

Co 5: Discuss solutions to the supply and environmental issues associated with Electric, Hybrid, Fuel Cell and Solar Cars

Text Books:

T1. Richard.L.Bechfold – Alternative Fuels Guide Book - SAE International Warrendale - 1997.

T. Maheswar Dayal - "Energy today & tomorrow"- I & B Horish India - 2012.

Reference Books:

R1. Nagpal - "Power Plant Engineering" - Khanna Publishers, 16th edition, 2015.

R2. "Alcohols as motor fuels progress in technology" - Series No.19 - SAE Publication

USE - 1980.

R3. SAE paper nos. 840367, 841333, 841334, 841156, Transactions, SAE, USA.

Course Name: AUTOMOTIVE CHASSIS, VEHICLE BODY ENGINEERING AND SAFETY					
Course Code : AU632					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

To make students familiar with the constructional details of chassis and body.
To understand about various steering systems, steering linkages and steering gear boxes and power steering.
To study the different components in the drive line and types of final drive.
To introduce students to the rear axles and types of suspension systems.
To introduce students to braking systems, wheels and tyres.
To introduce vehicle body details and types of materials used
To broaden the understanding of vehicle aerodynamics and load distribution
To introduce commercial vehicle body details and driver's seat ergonomics
To understand the importance of safety.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
INTRODUCTION- CHASSIS & BODY Types of chassis layout with reference to power plant locations and drive. Vehicle frames. Various types of frames. Constructional details. **FRONT AXLE AND STEERING SYSTEM** Types of front axle. Construction details. Front wheel geometry viz. Castor, Camber, King pin inclination, Toe-in. Conditions for true rolling motion of wheels during steering. Steering geometry. Ackerman and Davis steering system. Constructional details of steering linkages. Different types of steering gear boxes. Steering linkages and layouts. Power assisted steering and four wheel steering system. **REAR AXLES AND SUSPENSION SYSTEM** Construction of rear axles. Full floating. Three quarter floating and semi floating rear axles. Rear axle housing. Construction of different types of axle housings. Multi axle's vehicles. Construction details of multi drive axle vehicles. Need for suspension system, types of suspension, suspension springs, constructional details and characteristics of leaf, coil and torsion bar springs. Independent suspension, Rubber Suspension, Pneumatic suspension, Shock absorbers.	08
Unit-2	
TRANSMISSION SYSTEM Hotchkiss drive, torque tube drive and radius rods. Clutches, different types of gear boxes, Automatic transmission, Propeller shaft. Universal joints. Constants velocity universal joints. Front wheel drive. Different	10

types of final drive. Differential principles. Construction details of differential unit. Non-slip differential. Differential locks. Differential housings. **BRAKING SYSTEM** Classification of brakes, drum brake & disc brakes. Constructional details-Theory of braking. Mechanical hydraulic and Pneumatic brakes. Servo brake. Power and power assisted brakes-different types of retarders like eddy current and hydraulic retarder. Anti-lock braking systems. Regenerative braking system. **WHEELS AND TYRES** Types of wheels & construction. Tyres designation and specifications, tyre components, Function of tyres. Constructional details of tyres. Tube and tubless tyre, Radial & non-radial tyres, Relative merits and demerits. Effect of tyre pressure.	
Unit-3	
BUS BODY AND CAR BODY Classification of car body and buses type: styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, commercial vehicle types, Vans and Pickups. Terms used in body building construction, Angle of approach, Angle of departure, Ground clearance, Cross bearers, Floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets. **LOAD DISTRIBUTION & VEHICLE STABILITY:** Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion Longitudinal and lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding, Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability	10
Unit-4	
VEHICLE BODY MATERIALS: Aluminium alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention. **INTERIOR ERGONOMICS**: Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods	10

vehicle layout. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms.	
Unit-5	
NOISE AND VIBRATION: Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression. **SAFETY:** Impact protection basics, Physics of impact between deformable bodies, Design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety.	10
Self-study: Material properties of Aluminium, Steel and their alloys	
Site/Industrial Visits: Lab visit to learn about ergonomic and safety aspects in vehicle	

Course outcomes:

CO1: Classify the chassis layout with reference to the power-train location and design of steering system for proper rolling of the tyres.{L1,L2,L3}{PO1,PO2,PO6,PO7}

CO2: Explain the different components in the drive line and understand the details of differential unit.{L1,L2,L3}{PO1,PO2,PO6,PO7}

CO3: Summarise the different types of rear axles and to understand the need for suspension systems and its types.{L1,L2,L3}{PO1,PO2,PO6,PO7}

CO4: Explain the various braking systems and its application based on requirement {L1,L2,L3}{PO1,PO2,PO6,PO7}

CO5: Explain the laws of Newton on vehicle crash methods to improve safety of a vehicle. {L1,L2,L3}{PO1,PO2,PO6,PO7}

CO6: Identify the parameters affecting stability and also the methods to reduce noise and vibration in a vehicle.{L1,L2,L3} {PO1,PO2,PO6,PO7, PO11}

Text Books:

T1. Tim Gilles, "*Automotive Chassis-Brakes, Steering and Suspension*", Thomson Delmer Learning, 2005.

T2. Heldt.P.M, "*Automotive Chassis*", Chilton Co., New York, June 2012.

T3. Sydney F page, "Body Engineering"' Chapman & Hall Ltd, London, 1956

T4. "Giles J Pawlowski", Vehicle body engineering Business books limited, 1989

T5. John Fenton, "Vehicle body layout and analysis", MechanicalEngg. Publication ltd, London.

Reference Books:

R1.JornsenReimpell, Helmut Stoll, "*Automotive Chassis: Engineering Principles*", Elsevier, 2nd edition, 2001.

R2. Newton. Steeds &Garrot, "*Motor Vehicles*", SAE International and Butterworth Heinemann, 2001

R3. Judge.A.W. "*Mechanism of the car*", Chapman and Halls Ltd., London, 1986.

R4. Giles.J.G, "*Steering Suspension and tyres*", Iliffe Book Co., London, 1988.

R5. Crouse.W.H, "*Automotive Chassis and Body*", McGraw Hill New York, 1971.

R6.Hand book on vehicle body design – SAE publication

R7. Automotive chassis by P.M. Heldt, Chilton & Co, 1970
R8. Vehicle Safety 2002, Cornwell press, Townbridge, UK, ISBN 1356 -1448.
R9. Redesign of bus bodies – part I & part II – CIRT pune (Report), 1983
R10. Ed W.H. Hucho, Aerodynamics of Road Vehicles, 4th Edition, Butter worth's 1987
R11. Scibor-Rylski A.J, Road Vehicle Aerodynamics, Pentech press, London 2nd Edition 1984
R12. Rae W.H & Pope A, Low Speed Wind Tunnel Testing Wiley & Sons, USA 1984 out of print
R13. Noel W. Murray, "when it comes to the Crunch: The Mechanics of the Car Collisions" (Body work maintenance and repair) by Paul and Browne.

Online Resources:

W1. https://www.youtube.com/watch?v=LZ82iANWBL0
W2. https://www.youtube.com/watch?v=G-p4GFL-F4E&t=468s
W3. https://www.youtube.com/watch?v=J16V2GIg3fg

Course Name: ENGINEERING ECONOMICS AND AUTOMOTIVE COST ESTIMATION					
Course Code : AU633					
	L	**T**	**P**	Category	**EEC**
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**50**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

- Prepare engineering students to analyze cost/revenue data and carry out make economic analyses in the decision making process to justify or reject alternatives/projects on an economic basis.
- Be able to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
- Be able to perform and evaluate payback period and capitalized cost on one or more economic alternatives.
- Be able to carry out and evaluate benefit/cost, life cycle and break even analyses on one or more economic alternatives.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Introduction: Definition of various economic terms such as economic goods, utility, value, price, wealth, Attributes of wealth and its classification, wants and their characteristics, Classification of wants, standard of living, rent and profit, Factors of Production: Land, Lab our, Capital, Organization. **Demand and Supply:** Law of diminishing utility, marginal and total utility, Demand, Demand Schedule, Law of demand, Elasticity of demand, Factors governing the elasticity of demand, Law of substitution and its application, Supply, Law of supply, supply schedule, elasticity of supply, theory of value, equilibrium price, Laws of returns. **Wages:** Nominal and real wages, Factors affecting real wages, Wages, efficiency and standard of living, theory of wages, difference in wages, methods of wage payment **Money and Exchange:** Definition and function of money, Qualities of a good money, classification of money, value of money, index numbers, appreciation and depreciation of money, Gresham's Law and its limitations. Theory of exchange, barter, stock exchange, Speculation	10

Taxation and Insurance: Principle of taxation, characteristics of a good taxation system, kinds of taxes and their merits and demerits, Vehicle Insurance and loss Assessment	
Unit-2	
Interest: Introduction, theory of interest, interest rate, interest rate from lender's and borrower's view point, simple and compound interest, Cash Flow Diagram, Interest formulas (discrete compounding, discrete payments), Nominal and effective interest rates, Numerical problems. **Depreciation:** Need for depreciation, Causes of depreciation, Life and salvage value, Methods of calculating depreciation and their merits and demerits, Numerical problems.	10
Unit-3	
Costs and Cost Accounting: Standard cost, estimated cost, First cost, fixed cost, Variable cost, Incremental cost, Differential cost, Sunk and marginal cost, Breakeven and minimum cost analysis. Objectives of cost accounting, elements of cost: material cost, labor cost, and expenses, allocation of overheads by different methods, Numerical problems. **Basis for Comparison of alternatives:** Present worth, equivalent annual worth, future worth, rate of return, payback period, capitalized cost comparison, and capital recovery with return methods, Numerical problems.	10
Unit-4	
Replacement analysis: Basic reasons for replacement, present asset and its replacement, consideration leading to replacement, installation and removal cost, Numerical problems. **Book Keeping and accounts:** Introduction, Necessity of book keeping, single entry and double entry system, Classification of assets, Journal, Ledger, Trial balance, Final accounts, trading, profit and loss account, Balance sheet, Numerical problems.	10
Unit-5	
Cost Estimation: Introduction, importance, objectives and functions of estimating, principle factors in estimating, Functions and qualities of an estimator, estimating procedure. Estimation of material cost and manufacturing	10

cost of simple automotive components, Estimation of cost of overhauling and servicing of automotive components - cylinder, valves, valve seats, crankshaft, FIP, Brake drum, body building, different types of repairs, Numerical problems.	
List of Experiments (If any)	**Practical Hours**
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Student will be competent to do budget, balance sheet, strategy for industrial needs. CO2: Acquire knowledge to evaluate and explain financial planning. CO3: Will learn strategies to evaluate strategies for running the industry in profit despite adverse financial market CO4: Will be in a position to Carry out work strategy, analyse balance sheet and profit and loss accounts. CO5: CO6:	
Text Books: T1. Engineering Economics, Tara Chand, Nem Chand and Brothers, Roorkee T2. Engineering Economy, Thuesen, G. J. and Fabrycky, W. J., Prentice Hall of India Pvt. Ltd. T3. Mechanical Estimating and Costing, T. R. Banga and S. C. Sharma, Khanna Publishers, Delhi.	
Reference Books: R1. Industrial Organization and Engineering Economics, T. R. Banga and S. C. Sharma, Khanna Publishers, New Delhi R2. Mechanical Estimating and Costing, D. Kannappan et al., Tata McGraw Hill Publishing Company Ltd., New Delhi R3. A Text Book of Mechanical Estimating and Costing, O. P. Khanna, Dhanpat Rai Publications Pvt. Ltd., New Delhi R4. Industrial Engineering and Management, O. P. Khanna, Dhanpat Rai and Sons, New Delhi R5. Financial Management, I. M. Pandey, Vikas Publishing House Pvt. Ltd., New Delhi R6. Engineering Economics, James L. Riggs, David D. Bedworth and Sabah U. Randhawa, Tata McGraw- Hill Publishing Co. Ltd., New Delhi	

R7. Engineering Economy, Paul DeGarmo, Macmillan International Inc., New York
Online Resources: W1. W2.

Course Name: SIMULATION LABORATORY					
Course Code : AU651					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**0**	**0**	**3**	CIA Marks	**25**
Contact Hrs./Sem.	**0**	**0**	**30**	ESE Marks	**25**
Credits.	**0**	**0**	**2**	Exam Hours	**2**

Course objectives:

- MATLAB environment and commands
- Linear Algebra and matrices, fundamental engineering computing
- Save, load, display and print commands
- Communication with Excel & 2D and 3D plotting
- Solutions to systems of linear equations
- Conditional statements & Loops
- MATLAB scripts and functions
- Polynomials, including differentiation and integration
- Using MATLAB for simple engineering problems

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Introduction to MATLAB: Graphical User Interface (GUI) of MATLAB, Use MATLAB as a sophisticated calculator, Syntax,and semantics.	
Unit-2	
Plotting In MATLAB: A technique to draw the graph of functions in a variety of formats by using MATLAB. Plotting in the plane, plotting the graphs of function, graphs defined by parametric and polar equations. 3-space and investigate the nature of curves and surfaces in space. a) One dimensional plot b) Two-dimensional plot c) Three-dimensional plot	
Unit-3	
Matrices and Operations: Define matrices and vectors, extract parts of them and combine them to form new matrices. How to use operators to add, subtract, multiply and divide matrices.	
Unit-4	
Communication with Excel: Linking MATLAB with Excel by means of command in order to export and import data from Excel. **Functions:**	

Breaking the complex problem into smaller, more manageable parts. We will learn how functions let us create reusable software components that can be applied to many different programs. We will learn how the environment inside a function is separated from outside via a well-defined interface through which it communicates with outside world. We will learn how to define a function to allow input to it when it initiates its execution and output from it when it is done.	
Unit-5	
Conditional statements and loops: a) FOR-loop b) IF-loop c) WHILE-loop d) NESTED loops. **Part B** **Engineering Mechanics problems**: Initially, we will discuss theoretical background of the topic. Further, we will learn how to use MATLAB programming for solving engineering mechanics problems.	
List of Experiments (If any):	**Practical Hours**
24.	
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Introduce vectors and matrices in MATLAB, CO2: Apply basic concepts of Linear Algebra for vector and matrix operations, Perform 2D and 3D plotting, CO3: Formulate and solve systems of linear equations by Gaussian elimination, and matrix inversion, CO4: Write conditional statements and loops, CO5: Write Scripts and functions in MATLAB, CO6: Solve some engineering problems using MATLAB, CO7: Apply the fundamental knowledge of mathematics, science & engineering, to solve the real mechanical engineering problems (through case studies). This course is focused on learning programming by using MATLAB to solve mathematical problems. It is divided into two parts.	
Text Books: T1. T2.	

Reference Books:

R1. Chapman, S. J. (2004). *MATLAB programming for engineers.* New Delhi: Cengage Learning,.

R2. Coleman, M. P. (2005). *An introduction to partial differential equations with MATLAB.* Boca Raton: CRC Press.

R3. Datta, K. B. (2009). *Matrix And Linear Algebra Aided with Matlab.* New Delhi: PHI Learning Private Limited.

R4. Yang, W. Y., & Chung., W. C.-S. (2005). *Applied Numerical Methods Using Matlab.* John Wiley & Sons, Inc., .

Course Name: COMPUTATIONAL LAB					
Course Code : AU652					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**0**	**0**	**2**	CIA Marks	**25**
Contact Hrs./Sem.	**0**	**0**	**30**	ESE Marks	**25**
Credits.	**0**	**0**	**1**	Exam Hours	**3**

Course objectives: FEA tools are used vastly by industries to validate the design and improvement of overall product experience. Hence, students will be trained for using FEM by using commercial tools. This will not only improve their knowledge but also will help them to secure better job with in Industry.

Prerequisites: Finite Element Method and Strength of Materials.

List of Experiments (If any):	**Practical Hours**
1. Linear Static Analysis of Cantilever Beam	4
2. Non-linear Analysis of Skew Plate	4
3. Cargo Crane – Critical Load Estimation	4
4. Eigenvalue Buckling of a Square Tube	3
5. Static Post-buckling Analysis: Cargo Crane – Riks Analysis	3
6. Static Post-buckling Analysis: Buckling of a Square Tube with Imperfections	2
7. Damped Static Post-buckling Analysis: Cargo Crane – Stabilized Static Analysis	2
8. Damped Static Post-buckling Analysis: Cargo Crane – Dynamic Analysis	2
9. Introduction to Contact Modeling : Hinge Model	2
10. Introduction to Contact Modeling : Clip and Plate Model	2
11. Bolted Connection Modeling: Pump Model – Bolt Loading	2
12. Bolted Connection Modeling: Beam-Column Connection with Fasteners	2
Self-study: CAD Modelling of parts used for analysis and validation by using analytical method.	

Site/Industrial Visits : N/A

Course outcomes:
CO1: To known the latest vastly used commercial tool {L1,2} {PO1,2,5}
CO2: Virtual testing of product or mechanical components. {L1,2,5} {PO1,2,5}
CO3: Improvement of product/ part design by using FEM tools. {L1,2,5} {PO1,2,5}

Text Books:
T1. Huebner, K. (2001). The finite element method for engineers. New York: John Wiley & Sons.

T2. Ataei, H. and Mamaghani, M. (2017). Finite element analysis. 1st ed. createspace Independent.

Course Name: Service Learning					
Course Code : HS637					
	L	**T**	**P**	Category	**HSMC**
Contact Hrs./Week	**0**	**0**	**4**	CIA Marks	**50**
Contact Hrs./Sem.	**0**	**0**	**30**	ESE Marks	**0**
Credits.	**0**	**0**	**2**	Exam Hours	**-**

Course objectives:

1. To develop a habit of critical reflection for life-long learning in solving societal problems.
2. To work with a community and identify a specific need that can be addressed through
   Involvement and engineering practices.

Prerequisites: All the core and applied engineering courses.

Units	**Teaching Hours**
MODULE – I: Solid waste Management (Theory –6; Field Work -24) **Sources of solid wastes:** Types and Sources of solid wastes. Need for solid waste management. Elements of integrated waste management and roles of stakeholders. Salient features of Indian legislations on management and handling of municipal solid wastes, plastics and fly ash. **Collection & segregation:** Handling and segregation of wastes at source. Storage and collection of municipal solid wastes. Analysis of Collection systems. Need for transfer and transport. Transfer stations Optimizing waste allocation. Compatibility, storage, labelling wastes. **(OR)** **MODULE– II: Managing stagnant Ponds (Theory –6; Field Work - 24)** **Purification of stagnant ponds :**Introduction to Microbiology : Microbial ecology and Growth kinetics; Types of microorganisms ; aerobic vs. anaerobic processes Biological Unit Processes :Aerobic treatment; Suspended growth aerobic treatment processes; Activated sludge process and its modifications; Attached growth aerobic processes; Tricking filters and Rotating biological contactors; Anaerobic treatment; suspended growth, attached growth, fluidized bed and sludge blanket systems; nitrification, denitrification; Phosphorus removal.	**L-6** **T-0** **P-24**

Sludge Treatment: Thickening; Digestion; Dewatering; Sludge drying; Composting
Natural Wastewater Treatment Systems: Ponds systems.

(OR)

MODULE – III: Solar power (Theory – 6; Field Work - 24)

Solar energy: Global and National scenarios, Form and characteristics of renewable energy sources, Solar radiation, its measurements and prediction, Solar thermal collectors, flat plate collectors, concentrating collectors, Basic theory of flat plate collectors, solar heating of buildings, solar still, solar water heaters, solar driers; conversion of heat energy in to mechanical energy, solar thermal power generation systems

Solar photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping, power generation schemes, Basic concepts of Solar power, Solar cells. Applications of Solar-in Hospitals, automobiles, Air cooling, water cooling, Domestic Power generation, Industrial power generation, Traffic signals, Electronic equipments, refrigeration**.**

(OR)

MODULE – IV: Atmospheric pollution (Theory –6; Field Work -24)

Managing atmospheric pollution: Introduction to Atmospheric pollution-sources and causes. Methods of reducing pollution from vehicles, industries, domestic, urban and rural sources. Devising innovative pollution control devices& methods -filters, bags, traps, separators.

Self-study: Based on type of module selected.

Site/Industrial Visits :
Based on type of community problem identified and provide specific engineering solution (Every week wise).

Course outcomes:
The students will be able to

CO1: Integrates the academic work with community service through student involvement. [L1, L2, L3] [PO1, PO2, PO3, PO4, PO12].
CO2: Develop and implement a project designed to respond to that identified community need. [[L1, L2, L3] [PO1, PO2, PO3, PO4, PO12].

CO3: Create an awareness among the students as responsible citizen of the community/society. [L1, L2, L3] [PO1, PO2, PO3, PO4, PO12].

Text Books:

T1. S. P. Sukhatme, "Solar Energy, Principles of Thermal Collection and Storage," 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1990

T2. George Techobanoglous, "Integrated Solid Waste Management" McGraw - Hill, 1993.

T3. R.E.Landrefh and P.A.Rebers," Municipal Solid Wastes-Problems & Solutions", Lewis, 1997.

T4. Michael Allaby, "Fog, Smog and poisoned rain", Facts on File Incorporation, 2002. ISBN:0-8160-4789-8

T5. Arceivala S. J. and Asolekar S. R., Wastewater Treatment for Pollution Control and Reuse. 3rd Edition, Tata McGraw Hill, New Delhi, 2015.

Reference Books:

R1. George Techobanoglous and Thiesen Ellasen, "Solid Waste Engineering Principles and Management", Tata-McGraw – Hill, 1997.

R2. Blide A.D. and Sundaresan, B.B., "Solid Waste Management in Developing Countries", INSDOC, 1993.

R3. Arun Kumar Jain, Ashok Kumar Jain, B.C., Punmia, "Wastewater Engineering (Environmental Engineering-II), (Including Air Pollution)", Laxmi Publications Pvt. Ltd., 2014, ISBN 10: 8131805964, ISBN 13: 9788131805961.

Online Resources:

Based on community problem identified.

SEMESTER VII

Course Name: TEARDOWN LAB					
Course Code : AU751					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**0**	**0**	**2**	CIA Marks	**25**
Contact Hrs./Sem.	**0**	**0**	**30**	ESE Marks	**25**
Credits.	**0**	**0**	**1**	Exam Hours	**03**

Course objectives:

- To make students familiar with engine components.
- To understand about different types of engines systems.
- To introduce students to lubrication and cooling systems.

Prerequisites:

List of Experiments (If any):	**Practical Hours**
1. Study of traffic sign and symbols	**2**
2. Study of Hand Tools	**2**
3. Study of Engine Components	**2**
4. Trouble Shooting Charts	**2**
5. Dismantling & Assembly of SI engines (MARUTHI 800)	**4**
6. Dismantling & Assembly of CI engines (ASHOK LEYLAND ENGINE)	**4**
7. Dismantling & Assembly of CI engines (EICHER ENGINE)	**4**
8. Dismantling & Assembly of SI engines (HERO HONDA SPLENDOR)	**2**
9. Dismantle and assemble of major systems (clutch system, Gear boxes, Propeller shaft, Differential, Front and Rear axles, brake system, steering system and suspension system	**4**
10. Dismantling & Assembly of MBRDI vehicle	**4**

Self-study :

Site/Industrial Visits :

Course outcomes:

CO1: Understand engine construction based on mechanism of working.
CO2: Understand various engine components.
CO3: Able to dismantle and assemble the engine.
CO4: Understand engine working by practical hands on

Text Books:

T1.

Reference Books:

R1.
R2.

Course Name: ANALYSIS LAB					
Course Code : AU752					
	L	**T**	**P**	Category	**PCC**
Contact Hrs./Week	**0**	**0**	**2**	CIA Marks	**25**
Contact Hrs./Sem.	**0**	**0**	**30**	ESE Marks	**25**
Credits.	**0**	**0**	**1**	Exam Hours	**03**

PROGRAM ELECTIVE-1

Course Name: AUTOMOTIVE EMISSIONS AND CONTROL					
Course Code : AU534E1					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives:

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

- To impart the fundamental concepts of Control systems and mathematical modeling of the system
- To study the concept of time response and frequency response of systems
- To teach the basics of stability analysis of the system

Prerequisites: Basic knowledge on Thermodynamics and Automotive Engines

Units	**Teaching Hours**
Unit-1	
EFFECT OF VEHICULAR POLLUTION: Effect of air pollution on Human Health, Effect of air pollution on animals, Effect of air pollution on plants sampling procedures **LAWS AND REGULATIONS:**Historical background, regulatory test procedure and test cycles, Exhaust gas pollutants (European rail road limits), particulate pollutants, European statutory values, inspection of vehicle in circulation (influence of actual traffic conditions and influence of vehicle maintenance)	08
Unit-2	
NITROUS OXIDE: Nitrogen Oxides, formation of nitrogen oxides, kinetics of NO formation, formation of NO_2, NO_x formation in spark ignition engines, NO_x formation in compression ignition engines **CARBON MONOXIDE AND UNBURNED HYDROCARBON EMISSIONS**: Back ground, flame quenching and oxidation fundamentals, HC and CO emissions from spark ignition engines, HC and CO emission mechanisms in diesel engines, Crankcase emissions, piston ring blow by, evaporative emissions **PARTICULATE EMISSIONS**: Characteristics of diesel particulates, particulate formation mechanics, soot formation fundamentals, soot oxidation, Spark ignition GDI engine particulates **INFLUENCE OF FUEL PROPERTIES:** Effect of petrol, Diesel Fuel, Alternative Fuels and lubricants on emissions	08
Unit-3	
Pollution control measures inside SI Engines & lean burn strategies, measures in engines to control Diesel Emissions Pollution control in SI & CI Engines, Design changes, optimization of injection characteristics,	10

Exhaust gas recirculation, fuel additives , Road draught crankcase ventilation system, positive crankcase ventilation system, fuel evaporation control, advanced combustion techniques like PCCI, HCCI, RCCI etc.	
Unit-4	
Available options, physical conditions & exhaust gas compositions before treatment, Catalytic mechanism, Thermal Reactions, Installation of catalyst in exhaust lines, catalyst poisoning, catalyst light-off, NOx treatment in Diesel Engines, particulate traps, Diesel Trap oxidizer, selective catalytic reduction (SCR)	10
Unit-5	
EXHAUST GAS SAMPLING FOR MEASUREMENT, CVS & PARTICULATE SAMPLING: soot particles in a cylinder, soot in exhaust tube, Sampling Methods sedimentations, and filtration, and impinge methods- electrostatic precipitation thermal precipitation, centrifugal methods Determination of mass concentration, analytical methods-volumetric-gravimetric-calorimetric methods, and Particulate number measurement techniques **INSTRUMENTATION FOR POLLUTION MEASUREMENTS:** NDIR analyzers, Gas chromatograph, Thermal conductivity and flame ionization detectors, Analyzers for NOx, Orsat apparatus, Smoke measurement, comparison method, obscuration method, Ringelmann smoke chart, Continuous filter type smoke meter, Bosch smoke meter, Hart ridge smoke meter, correlation between smoke, opacity and PM	09
Self-study: Gravimetric analysis of fuel	
Site/Industrial Visits: Lab visit and pollution measurement of an engine	
Course outcomes: CO1: Summarise the complete emission scenario in the world which includes the laws which were implemented and background reason for it{L1,L2,L3} {PO1,PO2,PO6} CO2: Analyse different blending methods for biodiesel in order to optimize the emissions. {L1,L2,L3} {PO1,PO2,PO6,PO7 } CO3: Understand different after treatment devices used to reduce the emission level. {L1,L2,L3} {PO1,PO2,PO6,PO7 } CO4: Discus the effect of emissions on human health and nature. {L1,L2,L3} {PO1,PO2,PO6,PO7 } CO5: Understand how the emissions are measured using gas analyser devices. {L1,L2,L3} {PO1,PO2,PO6,PO7, PO11}	
Text Books: 1. Fuel and Emissions Control Systems, James D Halderman, 4th edition, 2015. 2. Automobiles and Pollution - Paul Degobert (SAE), 1995. 3. Internal Combustion Engine Fundamentals – John B. Heywood, McGraw Hill Education; 1 edition (2011)	

Reference Books:

1. Air pollution – M.N. Rao, and H. V. Rao
2. Internal combustion engines: V. Ganesan
3. Crouse William, Automotive Emission Control, Gregg Division /McGraw-Hill.
4. Ernest, S., Starkman, Combustion Generated Air Pollutions, Plenum Press.
5. George, Springer and Donald J.Patterson, Engine emissions, Pollutant Formation and Measurement, Plenum press.
7. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational

Online Resources:

W1. https://www.youtube.com/watch?v=iJsEcrIYb7k
W2. https://www.youtube.com/watch?v=qBD2XjejCEI
W3. https://www.youtube.com/watch?v=QoruG4ma210

COURSE NAME: TURBO MACHINES					
Course Code : AU534E2					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: Provides theory of machines that transfer energy between a rotor and a fluid, including both turbines and compressors. While a turbine transfers energy from a fluid to a rotor, a compressor transfers energy from a rotor to a fluid. The two types of machines are governed by the same basic relationships including Newton's second Law of Motion, laws of thermodynamics and Euler's energy equation for compressible fluids.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
Introduction: Definition of turbomachine, parts of turbomachines, Comparison with positive displacement machines, Classification, Static and Stagnation states- Incompressible fluids and perfect gases, Application of first and second laws of thermodynamics to turbomachines, Efficiencies of turbomachines. Problems. **Energy exchange in Turbomachines:** Euler's turbine equation,Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.sheet	07 Hrs
Unit-2	
General Analysis of Turbomachines: Radial flowcompressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems	10 Hrs
Unit-3	
Dimensionless analysis and thermodynamics of fluid flow: Dimensionless parameters and their significance, Effect of Reynold's number, Unit and specific quantities, model studies. Overall isentropic efficiency, stage efficiency (their comparison) and polytrophic efficiency for both compression and expansion processes. Reheat factor for expansion process. **Steam Turbines:** Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of	10 Hrs

compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging. Problems.	
Unit-4	
Hydraulic Turbines: Classification, Different efficiencies, Pelton turbine – velocity triangles, design parameters, Maximum efficiency. Francis turbine - velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. Kaplan and Propeller turbines - velocity triangles, design parameters. Problems.	10 Hrs
Unit-5	
Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Able to compute power output and power required for a power absorbing and power generating turbo machine CO2 Able to compute Degree of reaction, utilisation factor as design inputs for improvising performance and efficiency of Axial/ Radial flow compressor and pump. CO3 Able to assess performance of isentropic, blade and stage efficiencies in compression, expansion and steam turbine. CO4 Able to classify and determine the velocity triangles of pelton turbine, francis turbine and Kaplan turbine for maximum efficiency. CO5: Able to classify and asses the performance of centrifugal pumps, compressor and axial compressors on power developed and stage efficiency. CO6 Able to test performance of Hydraulic Machines like Kaplan Turbine, Francis, pelton wheel, centrifugal pump and reciprocating pump.	
Text Books: 1. An Introduction to Energy Conversion, Volume III, Turbomachinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008. 2. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw Hill Co. Ltd., 2nd edition, 2002	
Reference Books: 1. Principals of Turbomachines, D. G. Shepherd, The Macmillan Company (1964). 2. Fluid Mechanics & Thermodynamics of Turbomachines, S. L. Dixon, Elsevier (2005). 3. Turbomachine, B.K.Venkanna PHI, 2007	

Online Resources: NA

Course Name: VEHICLE DYNAMICS					
Course Code : AU534E3					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This course helps to understand the principle and performance of vehicle in various modes such as longitudinal, vertical and lateral directions. At the end of this course, the student will be able to identify the various forces and loads and performance under acceleration, rides and braking

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	
Introduction Fundamentals of vibration, single degree of freedom, two degree of freedom, multi degree freedom, free, forced and damped vibrations, modeling and simulation studies, model of an automobile, magnification factor, transmissibility, vibration absorber.	09 Hrs
Unit-2	
Stability of Vehicles Load distribution, calculation of acceleration, tractive effort and reactions for different drives, stability of a vehicle on a curved track, slope and a banked road	10 Hrs
Unit-3	
Multi Degree Freedom Systems Closed and far coupled system, Eigen value problems, orthogonality of mode shapes, modal analysis, forced vibration by matrix inversion.	10 Hrs
Unit-4	
Suspension Requirements, sprung mass frequency, wheel hop, wheel wobble, wheel shimmy, choice of suspension spring rate, calculation of effective spring rate, vehicle suspension in fore and aft, roll axis and vehicle under the action of side forces	10 Hrs
Unit-5	
Tyres and Vehicle Handling Tyre, dynamics, ride characteristics power consumed by a tyre. Oversteer, under steer, steady state cornering, effect of braking, driving torques on steering, effect of camber, transient effects in cornering	10 Hrs

List of Experiments (If any): NA		**Practical Hours**
Self-study : NIL		
Site/Industrial Visits : NA		
Course outcomes:	Level	PO
CO 1: Understand vibrating systems and its analysis, modelling and simulation and modal analysis	L1, L2	1,2,8,9
CO 2: Learn about vehicle handling under different steering conditions and directional stability of vehicles	L1, L2	1,2,8,9
CO 3: Understand various Suspension systems, selection of springs and dampers	L1, L2, L3, L5	1,2,3,4,5,8,9
CO 4: Understand the stability of vehicles on curved track and slope, gyroscopic effects and cross wind handling	L1, L2	1, 2
CO 5: understand suspensions and vehicle handling systems.	L1, L2	1,2,3,8,9
Text Books: 1. Rao J.S and Gupta.K "Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd., 2002. 2. Giri N.K –Automotive Mechanics, Khanna Publishers, 8th edition,2008		
Reference Books: 1. Ham B, Pacejka -Tyre and Vehicle Dynamics -SAE Publication -2002. 2. Ellis.J.R -"Vehicle Dynamics"-Business Books Ltd., London-1991 3. Gillespie T.D, "Fundamentals of Vehicle Dynamics", SAE USA 1992 4. Giles.J.G.Steering - "Suspension and Tyres", Illiffe Books Ltd., London - 199		
Online Resources:		

COURSE NAME: NON-TRADITIONAL MACHINING					
Course Code : AU534E4					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This paper describes various processes in which a piece of raw material is cut into a desired final shape and size by a controlled material-removal process. The many processes that have this common theme, controlled material removal, are today collectively known as subtractive manufacturing, in distinction from processes of controlled material addition.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
Introduction: History, Classification, comparison between conventional and Non-conventional machining process selection. **Ultrasonic machining (USM):** Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Effect of parameter: Effect of amplitude and frequency and vibration, Effect of abrasive grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.	07 Hrs
Unit-2	
Abrasive Jet Machining (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean number. Abrasive particles per unit volume of the carrier gas, work material, standoff distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining**:**Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery	10 Hrs
Unit-3	
Electrochemical machining (ECM): Introduction, study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations.	10 Hrs

Chemical Machining (CHM): Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: material removal rate, accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.	
Unit-4	
Electrical discharge machining (EDM): Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design, choice of machining operation, electrode material selection, under sizing and length of electrode, machining time. Flushing; pressure flushing, suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, EDM accessories / applications, electrical discharge grinding, traveling wire EDM.	10 Hrs
Unit-5	
Plasma Arc Machining (PAM): Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations. **Laser Beam Machining (LBM):** Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations. **Electron Beam Machining (EBM):** Principles, equipment, operations, applications, advantages and limitation of EBM.	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Classify the mechanism of Non-Traditional machining processes and process parameters and their effect on the component machined in USM CO2 Summarize the applications of AJM/WJM processes. CO3 Describe the principle of ECM and CHM processes and mechanism of material removal of ECM/CHM. CO4 Differentiate Thermal Metal Removal Processes, characteristics of spark eroded surface, machine tool selection.	

CO5: Able to Relate the generation and control of Plasma arc, electron beam and laser beam for machining and comparison.

Text Books:

1. Modern machining process, Pandey and Shan, Tata McGraw Hill 2000
2. New Technology, Bhattacharya 2000

Reference Books:

1. Production Technology, HMT Tata McGraw Hill. 2001
2. Modern Machining Process, Aditya. 2002
3. Non-Conventional Machining, P.K.Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House – 2005.
4. Metals Handbook: Machining Volume 16, Joseph R. Davis (Editor), American Society of Metals (ASM)

Online Resources: NA

COURSE NAME: OPERATIONS RESEARCH					
Course Code : AU534E5					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: Operations research helps in solving problems in different environments that needs decisions. The module covers topics that include: linear programming, Transportation, Assignment, and CPM/ MSPT techniques. Analytic techniques and computer packages will be used to solve problems facing business managers in decision environments.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
INTRODUCTION: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method. **SOLUTION OF Linear Programming PROBLEMS**: The simplex method-canonical and standard form of an LP problem, slack, surplus and artificial variables, big M method and concept of duality, dual simplex method.	08 Hrs
Unit-2	
TRANSPORTATION PROBLEM: Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases. Assignment Problem-formulation, types, application to maximization cases and travelling salesman problem.	10 Hrs
Unit-3	
PERT-CPM TECHNIQUES: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.	10 Hrs
Unit-4	

QUEUING THEORY: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis.	10 Hrs
Unit-5	
GAME THEORY: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games. **SEQUENCING:** Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 To compute and solve the linear programming method by Simplex and Big M method. CO2 To calculate the transportation parameters by MODI method CO3 To determine the critical path by using CPM and PERT method. CO4 To detect the empirical values of queuing systems. CO5: To arrange the jobs in multiple machines.	
Text Books: 1. Operations Research, P K Gupta and D S Hira, Chand Publications, New Delhi - 2007 2. Operations Research, Taha H A, Pearson Education	
Reference Books: 1. Operations Research, A P Verma, S K Kataria &Sons, 2008 2. Operations Research, Paneerselvan, PHI 3. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005 4. Introduction to Operations Research, Hiller and Liberman, McGraw Hill 5. Operations Research S.D. Sharma, Ledarnath Ramanath & Co, 2002	
Online Resources: NA	

PROGRAM ELECTIVE-2

COURSE NAME: AUTOMOTIVE TRANSMISSION SYSTEM					
Course Code : AU735E1					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**03**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**48**	**0**	**0**	ESE Marks	**50**
Credits.	**03**	**0**	**0**	Exam Hours	**3**
Course objectives: The course aims to impart basic skills and understanding of automobile transmission systems basic components their working principle, classification and performance characteristics.					
Prerequisites: NIL					

Units	**Teaching Hours**
Unit-1	
Clutch and Gear Box Role of Clutch in driving system - Requirements of transmission system – Design aspects - Construction and working principle of different types of clutches - Designing the torque capacity, axial force of single plate clutch and typical problems involving the above principles. Objective of the Gear Box - Setting top, bottom and intermediate gear ratios, Problems involving these derivations - Performance characteristics at different speeds - Construction and operations of Sliding-mesh gear box - Constant-mesh gear box - Synchro-mesh gear box - Planetary gear box - Problems on above aspects	08 Hrs
Unit-2	
Fluid coupling - Principle of operation - Construction details - Torque capacity - Performance characteristics - Problems on design - Reduction of drag torque Torque converter - Principle of operation - Constructional details – Performance characteristics, Converter coupling – Construction - Free wheel – Characteristic performance	10 Hrs
Unit-3	
Multi-stage hydro-kinetic torque converter - Poly-phase hydro-kinetic torque converter - Construction, working and performance	10 Hrs
Unit-4	

Principle of working of epi-cyclic gear train - Construction and working principle of Ford-T model gear box - Wilson gear box- construction, working and derivation of gear ratios - Cotal electromagnetic transmission - Automatic over-drive - Hydraulic control system for automatic transmission. Chevrolet automatic transmission - Turbo glide transmission - Power glide transmission - Toyota "ECT-i" [Automatic transmission with intelligent electronic control systems] - Mercedes Benz automatic transmission - Hydraulic clutch actuation system for automatic transmission	10 Hrs
Unit-5	
Hydrostatic drive – principle, types, advantages, limitations - Comparison of hydrostatic drive with hydrodynamic drive - Construction and working of typical Janny hydrostatic drive. Lay-out of elective drive - Principle of early and modified ward Leonard control systems – advantages, limitations, performance characteristics	10Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Have an understanding about the clutch, gearbox, hydrodynamic drives, automatic transmission, hydrostatic drive and electric drive in automobiles, their principle of operation and performance. Problem solving on above aspects L1,L2,PO1,PO2,PO8 CO2 Problem solving on above aspects L1,L2,L3,L4,L5,PO1,PO2,PO3,PO4,PO5,PO8,PO9	
Text Books: 1. *"Automotive Transmissions: Fundamentals, Selection, Design and Application"*, 2nd Edition, Springer, 2011.	
Reference Books: 1. Heldt P. M, *"Torque converters"*, Chilton Book Co., 1992. 2. Newton Steeds & Garrot, *"Motor Vehicles"*, SAE International and Butterworth Heinemann, 2001. 3. CDX Automotive, *"Fundamentals of Automotive Technology: Principles and Practice"*, Jones & Bartlett Publishers, 2013. 4. Judge A.W, *"Modern Transmission Systems"*, Chapman and Hall Ltd., 1990. 5. SAE Transactions 900550 & 930910. 6. Crouse W.H, Anglin D.L, *"Automotive Transmission and Power Trains construction"*, McGraw Hill, 1976.	

Online Resources: NA

Course Name: VEHICLE DYNAMICS					
Course Code : AU634E2					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This course helps to understand the principle and performance of vehicle in various modes such as longitudinal, vertical and lateral directions. At the end of this course, the student will be able to identify the various forces and loads and performance under acceleration, rides and braking

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	
Introduction Fundamentals of vibration, single degree of freedom, two degree of freedom, multi degree freedom, free, forced and damped vibrations, modeling and simulation studies, model of an automobile, magnification factor, transmissibility, vibration absorber.	09 Hrs
Unit-2	
Stability of Vehicles Load distribution, calculation of acceleration, tractive effort and reactions for different drives, stability of a vehicle on a curved track, slope and a banked road	10 Hrs
Unit-3	
Multi Degree Freedom Systems Closed and far coupled system, Eigen value problems, orthogonality of mode shapes, modal analysis, forced vibration by matrix inversion.	10 Hrs
Unit-4	
Suspension Requirements, sprung mass frequency, wheel hop, wheel wobble, wheel shimmy, choice of suspension spring rate, calculation of effective spring rate, vehicle suspension in fore and aft, roll axis and vehicle under the action of side forces	10 Hrs
Unit-5	
Tyres and Vehicle Handling Tyre, dynamics, ride characteristics power consumed by a tyre. Oversteer, under steer, steady state cornering, effect of braking, driving torques on steering, effect of camber, transient effects in cornering	10 Hrs

List of Experiments (If any): NA		Practical Hours
Self-study : NIL		
Site/Industrial Visits : NA		
Course outcomes:	Level	PO
CO 1: Understand vibrating systems and its analysis, modelling and simulation and modal analysis	L1, L2	1,2,8,9
CO 2: Learn about vehicle handling under different steering conditions and directional stability of vehicles	L1, L2	1,2,8,9
CO 3: Understand various Suspension systems, selection of springs and dampers	L1, L2, L3, L5	1,2,3,4,5,8,9
CO 4: Understand the stability of vehicles on curved track and slope, gyroscopic effects and cross wind handling	L1, L2	1, 2
CO 5: understand suspensions and vehicle handling systems.	L1, L2	1,2,3,8,9
Text Books: 1. Rao J.S and Gupta.K "Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd., 2002. 2. Giri N.K –Automotive Mechanics, Khanna Publishers, 8th edition,2008		
Reference Books: 1. Ham B, Pacejka -Tyre and Vehicle Dynamics -SAE Publication -2002. 2. Ellis.J.R -"Vehicle Dynamics"-Business Books Ltd., London-1991 3. Gillespie T.D, "Fundamentals of Vehicle Dynamics", SAE USA 1992 4. Giles.J.G.Steering - "Suspension and Tyres", Illiffe Books Ltd., London - 199		
Online Resources:		

Course Name: AUTOMOTIVE AERODYNAMICS					
Course Code : AU634E3					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This course provides the basic knowledge about types of aerodynamic drag and the optimization techniques for minimum drag on automotive bodies. On completion of this course, the students are exposed to understand the concept of shape optimization and vehicle handling to minimize different types of aerodynamic drag.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	
INTRODUCTION Scope – Historical development trends – Fundamentals of fluid mechanics – Flow phenomenon related to vehicles Types of aerodynamic drag. Forces and moments influencing drag. Effects of forces and moments. Various body optimization techniques for minimum drag. – External & Internal flow problems. Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics.	08 Hrs
Unit-2	
AERODYNAMIC DRAG OF CABS Car as a bluff body – Flow field around car – drag force – types of drag force – analysis of aerodynamic drag – drag coefficient of cars – strategies for aerodynamic development – low drag profiles.	10 Hrs
Unit-3	
SHAPE OPTIMIZATION OF CABS Front and modification – front and rear wind shield angle – Boat tailing – Hatch back, fast back and square back – Dust flow patterns at the rear – Effect of gap configuration – effect of fasteners	10 Hrs
Unit-4	
VEHICLE HANDLING The origin of force and moments on a vehicle – side wind problems – methods to calculate forces and moments – vehicle dynamics under side winds – the effects of forces and moments – Characteristics of forces and moments – Dirt accumulation on the vehicle – wind noise – drag reduction in commercial vehicles.	10 Hrs
Unit-5	

WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 10 Hours Introduction – Principles of wind tunnel technology Flow visualization techniques. Testing with wind tunnel balance (scale models).– Limitation of simulation – Stress with scale models – full scale wind tunnels – measurement techniques – Equipment and transducers – road testing methods – Numerical methods	10 Hrs

Self-study : NIL

Site/Industrial Visits :

Course outcomes:	Level	PO
CO 1: Discuss aerodynamics drag and its effect on a vehicle at different conditions of operation.	L1, L2	1,2,8,9
CO2: Describe strategies to reduce aerodynamic drag	L1, L2	1,2,8,9
CO3: Analyse cabs for better aerodynamics	L1, L2, L3, L5	1,2,3,4,5,8,9
CO4: Analyse of vehicle body considering the forces and moments caused by the aerodynamics of a car.	L1, L2, L3, L5	1, 2, 3,4,5,8,9
CO5: Discuss wind tunnel and its application for simulating aerodynamics in a real time scenario	L1, L2	1,2,3,8,9

Text Books:

1. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 2013.
2. Pope,A., Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York.
3. Aerodynamics by AJ Clancy

Reference Books:

. Automotive Aerodynamics: Update SP-706, SAE, 1987.
2. Vehicle Aerodynamics, SP-1145, SAE, 1996.
3. Aircraft Flight by AC Kermode.

Online Resources:

COURSE NAME: : TROUBLE SHOOTING, SERVICING, MAINTENANCE OF AUTOMOBILES					
Course Code : AU634E4					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: The course content is taught and implemented with the aim to develop different types of skills leading to the achievement of the following competency:
Remedy engine troubles based on diagnosis and testing using suitable instruments and tools.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
MAINTENANCE OF WORKSHOP, ITS SCHEDULE AND RECORDS Importance of maintenance - schedule and unscheduled maintenance - scope of maintenance - vehicle down time - vehicle inspection, reports, log books, trip sheet	10 Hrs
Unit-2	
ENGINE REPAIR AND OVERHAULING Dismantling of SI & CI engines and its components - Cleaning methods - inspection and checking - repair and reconditioning methods for all engine components - Maintenance of ignition system - fuel injection system – cooling system, lubrication system - Design trouble shooting chart for MPFI & CRDI Engines.	10 Hrs
Unit-3	
MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS Maintenance - servicing and repair of clutch, fluid coupling, gear box, torque converter, propeller shaft - Maintenance of front axle, rear axle, brakes, steering systems, tyre.	10 Hrs
Unit-4	
MAINTENANCE AND REPAIR OF VEHICLE BODY Body panel tools for repairing - Tinkering and painting - Use of soldering, metalloid paste.	10 Hrs
Unit-5	
MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS AND FLEET **MAINTENANCE MANAGEMENT**	10 Hrs

Service, maintenance, testing and troubleshooting of battery, starter motor, alternator rectifier and transistorized regulator. Fleet maintenance requirement - investment and costs, types of work shop layout, tools and equipment - spare parts and lubricants stocking, manpower, training, workshop management, warranty, replacement policy.	
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Identify and diagnose the causes of malfunctioning of an engine. L1,L2,PO1,PO2,PO8,PO9 CO2 Rectify engine troubles based on symptoms and causes.L1,L2 ,PO1,PO2,PO8,PO9 CO3 Use the suitable instrument and tools for diagnosis and testing of automotive engine systems.. L1,L2,L4,L5,PO1,PO2,PO3,PO4,PO5,PO8,PO9 CO4 Remove engine from automobile, disassemble and rectify faults. L1,L2,PO1,PO2 CO5 Develop an attitude of relying on systematic method of working using standard trouble shooting procedure rather than taking ad-hoc decisions L1,L2,L3,L4,L5,PO1,PO2,PO3,PO4,PO5,PO8,PO9	
Text Books: 1. Martin W. Stockel, Martin T. Stockel, Chris Johanson, "Auto Service & Repair: Servicing,Troubleshooting, and Repairing Modern Automobiles: Applicable to All Makes and Models", Goodheart-Willcox Publisher, 1996. 2. Automotive Service by Tim Gilles, Thomson Delmar Learning, 4th edition, 2012 3. Engine Repair by Tim Gilles, Delmar Cengage Learning, 3rd edition, 2010 4. Basic Automotive Service and Maintainance by Don Knowels,Thomson Delmar Learning, 2005	
Reference Books: 1. James D. Halderman, "Chase D. Mitchell, "Automotive steering, suspension, and alignment", Prentice Hall, 2000. 2. Martin T. Stockel, Chris Johanson, "Auto Diagnosis, Service, and Repair", Goodheart- Willcox Publisher, 2003. 3. Vaughn D. Martin, "Automotive Electrical Systems: Troubleshooting and Repair Basics", Prompt Publications, 1999 1. Crouse W., "Everyday Automobile Repair", Intl. student edition, TMH, New Delhi, 1986. 5. BOSCH, "Automotive Handbook", 8th Edition, BENTLEY ROBERT Incorporated, 2011. 195 AM-Engg&Tech- SRM-2013 6. John Doice, "Fleet maintenance", Mcgraw Hill, New York, 1984.	

7. Maleev V.L., "Diesel Engine Operation and Maintenance, McGraw Hill Book Co., New
York, 1995.
8. Vehicle servicing manuals. 5. BOSCH, "Automotive Handbook", 8th Edition, BENTLEY ROBERT Incorporated, 2011.
195 AM-Engg&Tech- SRM-2013
6. John Doice, "Fleet maintenance", Mcgraw Hill, New York, 1984.
7. Maleev V.L., "Diesel Engine Operation and Maintenance, McGraw Hill Book Co., New
York, 1995.
2. 8. Vehicle servicing manuals.

Online Resources: NA

PROGRAM ELECTIVE-3

Course Name: ORGANIZATIONAL BEHAVIOR, COMMUNICATION AND LEADERSHIP					
Course Code : AU731E1					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3 hrs**

a) **Course objectives:** Developing the behavioral skills you need to be a successful leader of yourself and others, including working in teams.
b) Understanding the main ideas relating to organizational behavior and their impact on creating a high-performing organization.
c) Understanding what leadership means and what is involved in becoming a successful leader in today's business organizations.
d) Appreciating leadership skills as an essential complement to the technical skills you are learning in other courses.
e) Learning concepts and approaches that will enable you to analyze organizational problems and develop appropriate solutions.

Prerequisites:Nil

Units	**Teaching Hours**
Unit-1 Teaching hours -14	
Ch 1: Introduction: Definition of Organization Behavior and Historical Development, Environmental Context -Information Technology and Globalization, Diversity and Ethics, Cultural, Reward Systems)., Importance & Limitations of OB, Continuing challenges. **Ch2: UNDERSTANDING AND MANAGING INDIVIDUAL BEHAVIOUR** a). **Individual differences and work behaviour** - Why individual differences are important, The basis for understanding Work Behaviour, Individual differences influencing Work Behaviour b). **Personality & values**- Sources of personality differences, Personality structure , Personality and Behaviour, Measuring Personality c) **Attitudes** - The nature of Employee Attitudes, Effects of Employee Attitudes, Studying Job satisfaction, Changing Employee Attitudes. d) **Perceptions & decision making-Attributions and Emotions** - The perceptual process, Perceptual grouping, Impression management, Emotions, Emotional Intelligence. e) **Motivation** - Concept of Motivation, Content approaches, Process approaches, Motivation and psychological contract. f) Emotions and moods	**5** **9**

Unit-2 Teaching Hours:14	
Ch1: LEARNING : Definition, theories of learning, individual decision making, classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement **Ch2: Job Design, Work and Motivation** Job design and quality of work life, A conceptual model of job design, Job performance outcomes, Job analysis, Job designs: the result of job analysis, The way people perceive their jobs, Designing Job range: Job satisfaction, job rotation, job enlargement and re engineering work process , Designing Job depth : Job enrichment, Total quality management and job design. **Evaluation, Feedback and Rewards** - Evaluation of Performance, Performance Evaluation feedback, Reinforcement theory A model of Individual rewards, Rewards Affect Organizational concerns, Innovative reward system.	**7** **7**
Unit-3 Teaching Hours:12	
Ch1: MOTIVATION Malsow's Hierarchy of Needs theory, McGregor's theory X and Y, Hertzberg's motivation hygiene theory, David McClelland's three needs theory, Victor Vroom's expectancy theory of motivation **Ch2: THE GROUPS:** Definition and classification of groups, factors affecting group formation, stages of group development, norms, Hawthorne studies, group processes, group tasks, group decision making	**6** **6**
Unit-4 Teaching Hours:10	
Ch1: CONFLICT AND STRESS MANAGEMENT Definition of conflict, functional and dysfunctional conflict, stages of conflict process, sources of stress, fatigue and it's impact on productivity, **Ch2: GROUP BEHAVIOUR AND INTERPERSONAL INFLUENCE** a) **Informal and Formal Groups** - Group Dynamics, The nature of informal Organizations, Formal groups. b) **Teams and Team Building** - Organizational context for teams, Teamwork, Team building. c) **Managing Conflict and Negotiation** - Conflict in Organizations, A contemporary perspective on intergroup conflict, What causes intergroup conflict, The causes of dysfunctional intergroup conflict, Managing intergroup conflict through Resolution, Stimulating Constructive intergroup	**4** **6**

conflict, Negotiations, Negotiation tactics, Increasing negotiation effectiveness. d) **Power and Politics** - The concept of power, Sources of power, Interdepartmental power, Illusion of power, Political strategies and tactics, Ethics, power and politics, Using power to manage effectively e) **Empowerment and Participation** - The nature of empowerment and participation, How participation works, Programs for participation, Important considerations in participation. f) **Assertive Behaviour** - Interpersonal Orientations, g) Facilitating smooth relations	
Unit-5 Teaching	
a) **Communication** - The importance of communication, The communication process, Communicating within organizations, Information richness, How technology affects communication, Interpersonal communication, Multicultural communication, Barriers to effective communication, Improving Communication in organizations, Promoting ethical communications. b) **Decision Making** - Types of decisions, A Rational Decision-making Process, Alternatives to Rational Decision making, Behavioural influences on decision making, Group decision making, Creativity on group decision making. **Ch2: Leadership** - What is leadership, Trait approaches, Behavioural approaches, Situational approaches, Other perspectives, concepts and issues of leadership, Multicultural leadership, Emerging approaches to leadership.	**10**
Self-study:	
Site/Industrial Visits:	
Course outcomes: After taking this course , students should be able to: CO1: Explain the effect of personality, attitudes, perceptions and attributions on their own and other's behaviors in team and organizational settings. CO2 Describe and apply motivation theories to team and organizational scenarios in order to achieve a team's or an organization's goals and objectives CO3: Explain types of teams and apply team development, team effectiveness, and group decision-making models and techniques. CO4: and apply leadership theories and better understand their own leadership style CO5: Analyze bases of power and influence tactics and their impact on achieving their own personal career goals and the organization's objectives CO6. Identify and apply tactics for resolving conflict and handling interpersonal communication in work groups.	

Text Books:

T1. Organizational Behavior Paperback – 13 or 15 or 16th Edition by Stephen P. Robbins (Author), Timothy A. Judge (Author), Neharika Vohra (Author) , Pearson

T2. Organizational Behaviour, Hellriegel, Srocum and Woodman, Thompson Learning, 9th Edition, Prentice Hall India, 2001

Reference Books:

R1. Organizational Behaviour, Aswathappa - Himalaya Publishers. 2011

R2. Organizational Behaviour, VSP Rao and others, Konark Publishers.2002

R3. Organizational Behaviour, (Human behaviour at work) 9th Edition, John Newstron/ Keith Davis. 2002

R4.O rganisational Behaviour: Text, Cases & Games 11/E Paperback – 2013 by Aswathappa K

Online Resources:

W1.NPTEL Organizational Behaviour

W2.

COURSE NAME: ENTREPRENEURSHIP DEVELOPMENT					
Course Code : AU731E2					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This course help to leverage the competitive market scenario, where the demand for managerial skills is high and supply of skilled and experienced workforce is less. The core subject are aimed to developing knowledge and skills of fundamental management disciple

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
ENTREPRENEURSHIP Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Entrepreneur – Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth	10 Hrs
Unit-2	
MOTIVATION Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self-Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives	10 Hrs
Unit-3	
BUSINESS Small Enterprises – Definition, Classification – Characteristics, Ownership Structures –Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies	10 Hrs
Unit-4	
FINANCING AND ACCOUNTING Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/CPM – Taxation – Income Tax, Excise Duty – Sales Tax.	10 Hrs
Unit-5	

SUPPORT TO ENTREPRENEURS Sickness in small Business – Concept, Magnitude, causes and consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.	
Text Books: 1. B.B. Goel-Project Management-Deep and Deep Publications, New Delhi, 2004 2. Choudhury-S. Project Management –Tata Mc Grew –Hill- Publishing Company Limited, New Delhi,2005 3. Datta.A.K. Integrated Material Management 4. Gopalakrishnan.P. And Sthuram. M. Material management-An integral Approach 5. M.V.Varma –Material Management	
Reference Books: 1. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002. 2. Mathew J Manimala," Enterprenuership theory at cross roads: paradigms and praxis" Dream tech 2nd edition 2006. 3. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998. 4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development" Institute of India, Ahmadabad, 1986	
Online Resources: NA	

COURSE NAME: HYDRAULICS & PNEUMATIC CONTROL					
Course Code : AU731E3					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This course provides the student with a comprehensive grounding in the basic principles; construction and operation of hydraulic and pneumatic equipment as used in shipboard applications such as controllable pitch propellers, mooring winches, start air systems, etc.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law. **The source of Hydraulic Power: Pumps** Classification pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps. **Hydraulic Actuators and Motors:** Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).	10 Hrs
Unit-2	
Control Components in Hydraulic Systems: Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves - compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation. **Hydraulic Circuit Design And Analysis:** Control of Single and Double Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder	10 Hrs

reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Hydraulic circuit for force multiplication, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.	
Unit-3	
Maintenance of Hydraulic System: Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid -particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting. **Introduction to Pneumatic Control:** Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit. **Pneumatic Actuators:** Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols.	10 Hrs
Unit-4	
Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. 3Hrs Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling. **Signal Processing Elements:** Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Time dependent controls principle. Construction, practical applications.	10 Hrs
Unit-5	
Multi- Cylinder Application: Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves). **Electro- Pneumatic Control:** Principles - signal input and output, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application.	10 Hrs

Compressed Air: Production of compressed air- Compressors Preparation of compressed air-Driers, Filters, Regulators, Lubricators, Distribution of compressed air Piping layout.	
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Will be in position to device various circuit for hydraulic and pneumatic applications. CO2 Will be in position to develop various hydraulic and pneumatic devices. CO3 To understand and illustrate the working of various types of pumps. CO4 To understand and illustrate the working of various hydraulic and pneumatic devices.	
Text Books: 1. "Fluid Power with Applications", Anthony Esposito, Sixth edition, Pearson Education, Inc., 2000. 2. 'Pneumatics and Hydraulics', Andrew Parr, Jaico Publishing Co	
Reference Books: 1. 'Oil Hydraulic systems', Principles and Maintenance S. R. Majurr, Tata Mc Graw Hill Publishing Company Ltd. - 2001 2. 'Industrial Hydraulics', Pippenger, Hicks" McGraw Hill, New York 3. 'Hydraulic & Pneumatic Power for Production', Harry L. Stewart 4. 'Pneumatic Systems', S. R. Majumdar, Tata Mc Graw Hill Publish 1995 5. Power Hydraulics' Michael J Pinches & John G Ashby, Prentice Hall	
Online Resources: NA	

COURSE NAME: MECHANICS OF COMPOSITE MATERIALS					
Course Code : AU731E4					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**02**	Exam Hours	**3**

Course objectives: : This paper deals with the basics of composite materials and the study of various laminar structures and the fabrication of Metal Matrix composites and its analysis.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
INTRODUCTION TO COMPOSITE MATERIALS: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. **APPLICATIONS:** Automobile, Aircrafts. Missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites. **FIBER REINFORCED PLASTIC PROCESSING:** Layup and curing, fabricating process, open and closed mold process, hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.	08 Hrs
Unit-2	
Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems. **Macro Mechanics of a Lamina:** Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix.	10 Hrs
Unit-3	
Macro Mechanics of a Lamina Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems. **Biaxial Strength Theories:** Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.	10 Hrs
Unit-4	
Macro Mechanical Analysis of Laminate: Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation), Special cases of laminates, Numerical problems **METAL MATRIX COMPOSITES:** Reinforcement materials, types, characteristics and selection base metals selection. Need for production	10 Hrs

MMC's and its application.**FABRICATION PROCESS FOR MMC'S:** Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques	
Unit-5	
STUDY PROPERTIES OF MMC'S: Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Define Composite materials, manufacturing processes, and applications of composite materials. CO2 Distinguish between different types of composite materials. CO3 Analyze problems on macro-mechanical behaviour of lamina in FRP Composites. CO4 Analyze problems on micro-mechanical behaviour of lamina in FRP Composites. CO5: Identify the physical , mechanical and wear properties of the Metal matrix composites.	
Text Books: 1. Composite Science and Engineering, K. K. Chawla Springer Verlag 1998. 2. Mechanics of composite materials, Autar K. Kaw CRC Press New York.	
Reference Books: 1. Fiber Reinforced Composites, P. K. Mallick, Marcel Dekker,Inc 2. Mechanics of Composite Materials, Robert M. Jones, McGraw Hill Kogakusha Ltd.1998 3. Composite materials hand book, Meing Schwaitz," McGraw Hill book company.1984 4. Principles of composite Material mechanics, Ronald F. Gibron. McGraw Hill international, 1994. 5. Mechanics of Composite Materials and Structures, Madhujit Mukhopadhyay , University Press 2009	
Online Resources: NA	

Course Name: AUTOMOTIVE HEATING VENTILATION & AIR-CONDITIONING					
Course Code : AU731E5					
	L	**T**	**P**	Category	
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives:

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

1. To extend the understanding of air conditioning systems and its components
2. To familiarize air conditioner heating systems and protection of engine
3. To widen the understanding of refrigerants and its handling
4. To present and explain air routing and temperature control
5. To emphasize the importance of maintenance and service of air conditioning systems.

Prerequisites: Basic knowledge on Thermodynamics, Heat & Mass Transfer

Units	**Teaching Hours**
Unit-1	
Basic air conditioning system - location of air conditioning components in a car, schematic layout of a refrigeration system, compressor components, condenser and high pressure service ports, thermostatic expansion valve, expansion valve calibration, controlling evaporator temperature, evaporator pressure regulator, evaporator temperature regulator.	08
Unit-2	
Automotive heaters, manually controlled air conditioner, heater system, automatically controlled air conditioner and heater systems, automatic temperature control, air conditioning protection, engine protection.	08
Unit-3	
Containers handling refrigerants, tapping into the refrigerant container, refrigeration system diagnosis, diagnostic procedure, ambient conditions affecting system pressures.	10
Unit-4	
Objectives, evaporator airflow through the recirculating unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control and handling systems.	10
Unit-5	
Air conditioner maintenance and service, servicing heater system removing and replacing components, trouble shooting of air controlling system, compressor service.	09

Self-study: Changing trends in compressor and its service

Site/Industrial Visits: Case study on different types of AC system used in cars

Course outcomes:
CO1. Trace of the components of air conditioning systems in a car
CO2. Design of air conditioner and heater systems
CO3. Trouble shooting of air conditioning systems
CO4. Categorize air routing systems
CO5. Handling of refrigerants and temperature control

Text Books:
1. William H. Crouse and Donald I. Anglin - "Automotive Air conditioning" - McGraw Hill
Inc. - 1990.
2. Boyce H.DWiggins -"Automotive Air Conditioning" - Delmar – 2002

Reference Books:
1. Mitchell information Services, Inc - "Mitchell Automatic Heating and Air Conditioning
Systems" - Prentice Hall Ind. - 1989.
2. Paul Weiser - "Automotive Air Conditioning" - Reston Publishing Co., Inc., - 1990.
3. MacDonald, K.I., - "Automotive Air Conditioning" - Theodore Audel series - 1978
4. Goings.L.F. – "Automotive Air Conditioning" - American Technical services - 1974.

Online Resources:
W1. https://www.youtube.com/watch?v=BFOAhE2BcVs
W2. https://nptel.ac.in/courses/112105129/
W2. https://nptel.ac.in/courses/112105128/

PROGRAM ELECTIVE-4

Course Name: HYBRID AND ELECTRIC VEHICLES					
Course Code : AU732E1					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**2**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives:
To understand working of different configurations of electric vehicles, and its components, hybrid vehicle configuration and performance analysis.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Introduction **Fundamental Concepts and Definitions:** Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and Environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. **Hybrid Vehicles:** Performance characteristics of road vehicles; calculation of road load- predicting fuel Economy - grid connected hybrids. **Fuel cell:** Fuel cell characteristics- fuel cell types – alkaline fuel cell- proton exchange Membrane; direct methanol fuel cell- phosphoric acid fuel cell- molten carbonate fuel cell- solid oxide fuel cell- hydrogen storage systems- reformers- fuel cell EV- super and ultra-capacitors- flywheels.	09
Unit-2	
Drive Train Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	09
Unit-3	
Hybrid Architecture and Hybrid Power Plant Specifications	

Hybrid architecture: Series configuration locomotive drives- series parallel switching- load tracking architecture. Pre transmission parallel and combined configurations Mild hybrid- power assist- dual mode power split- power split with shift- Continuously Variable transmission (CVT)- wheel motors. **Hybrid power plant specifications:** Grade and cruise targets- launching and boosting- braking and energy recuperation- drive cycle implications- engine fraction engine downsizing and range and performance- usage requirements.	09
Unit-4	
Energy Storage & Sizing the drive system **Energy Storage**: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. **Sizing the drive system:** Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems **Energy storage technology:** Battery basics; lead acid battery; different types of batteries; battery parameters.	09
Unit-5	
Energy Management Strategies Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.	09
List of Experiments : NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: CO1: Differentiate the type of hybrid architectures used in a hybrid vehicle by comparing the advantages and disadvantages of each hybrid architectures. CO2: Compare the advantages and disadvantages of various motors that could be used in hybrid electric vehicle CO3: Explain the various modes of operation used in hybrid vehicle based on the condition of operation of the vehicle. CO4: Selection of motor, power electronics and batteries based on the design of hybrid vehicle. CO5: Explain fuel cell characteristics and the working principle of different types of fuel cell.	

Text Books: T1. Electric and hybrid vehicles: Design fundamentals – Iqbal Hussain, CRC press, 2013 T2. The Electric Car: Development & Future of Battery – Hybrid & fuel cell cars – Mike Westbrook – M H Westbrook- British Library cataloguing in Publication data
Reference Books: R1. Handbook of electric motors – Hamid A Toliyat – Gerald B Kilman – Marcel Decker

Course Name: TOTAL QUALITY MANAGEMENT					
Course Code : AU732E2					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**2**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**03**

Course objectives:

- Summarize the philosophy and core values of Total Quality Management (TQM).
- Recognize the voice of the customer and the impact of quality on economic performance and long-term business success of an organization.
- Analyze best practices for the attainment of total quality.
- To create process improvement teams trained to use the various quality tools for identifying appropriate process improvements.
- Construct a strategy for implementing TQM in an organization.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Principles and Practice: Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM. **Leadership:** Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making.	09
Unit-2	
Customer Satisfaction and Customer Involvement: Customer Satisfaction: customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, Case studies. Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, performance appraisal, unions and employee.	09
Unit-3	
Continuous Process Improvement: process, the Juran trilogy, improvement strategies, types of problems, the PDSA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies. **Tools and Techniques:** Benching marking, information technology, quality management systems, environmental management system, and quality function deployment, quality by design, failure mode and effect analysis, product liability, total productive maintenance.	09
Unit-4	

Quality Management Tools : Why Why, forced filed analysis, nominal group technique, affinity diagram, interrelationship digraph, tree diagram, matrix diagram, prioritization matrices, process decision program chart, activity network diagram. **Statistical Process Control :** Pareto diagram, process flow diagram, cause-and-effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.	09
Unit-5	
Building and Sustaining Performance Excellence in Organizations : Making the commitment to total quality, organizational culture and total quality, change management, sustaining the quality organization, self-assessment processes, implementing ISO 9000, Baldrige, and sis sigma, a view toward the future**s** **Design for Six Sigma**: Tools for concept development, tools for design development, tools for design optimization, tools for design verification, problems.	09
List of Experiments: NA	**Practical Hours**
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Identify the importance of quality in product and service to sustain in global market by TQM frame work. CO2: Assess the voice of customer, employee suggestion for improving the quality of the product and service with help Kano model, TEBOUL model, Maslow hierarchy, Herzberg two factors methods. CO3: Explain problem solving methods to identify the obstacle on the way of implantation of total quality tools to improve quality of product and service and how to resolve it. CO4: Evaluate the given market situation using quality management tool and statistical process control tools namely tree diagram, matrix diagram, pareto diagram, histogram, cause and effective diagram CO5: Develop a strategy for implementing TQM in an Organization by self-assessment, ISO Concept and Six Sigma.	
Text Books: T1. Total Quality Management: Dale H. Bester field, Publisher - Pearson Education India, ISBN: 8109702506, Edition 03/e Paperback (Special Indian Edition) T2. Total Quality Management for Engineers: M. Zairi, ISBN: 1855730243, Publisher: Wood head Publishing	

Reference Books:

R1. A New American TQM, four revolutions in management, Shoji Shiba, Alan Graham, David Walden, Productivity press, Oregon, 1990
R2. 100 Methods for Total Quality Management: Gopal K. Kanji and Mike Asher, ISBN: 0803977476, Publisher: Sage Publications, Inc.; Edition – 1
R3. Organisational Excellence through TQM, H. Lal, New age pub, 2008

Course Name: NANOTECHNOLOGY					
Course Code : AU732E3					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**2**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**03**

Course objectives:

- To provide a broad technical picture of nanotechnology to engineering students from various engineering disciplines.
- Describe the structure, properties, manufacturing, and applications of silicon and carbon materials.
- Explain the fabrication methods in nanotechnology (top down & bottom up).
- Categorize the characterization methods in nanotechnology (optical, electrical, AFM, SEM, TEM, and nano-indentation)

Prerequisites:

Units	**Teaching Hours**
Unit-1	
An overview of Nanoscience & Nanotechnology – historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications. **Experimental Techniques and Methods** for investigating and manipulating materials in the Nano scale – electron microscope – scanning probe microscope – optical and other microscopes – light scattering – x-ray diffraction.	09
Unit-2	
Fullerenes – discovery, synthesis and purification – chemistry of fullerenes in the condensed phase – orientation ordering – pressure effects – conductivity and superconductivity – ferromagnetism – optical properties. **Carbon Nanotubes** – synthesis and purification – filling of nanotubes – mechanism of growth – electronic structure – transport properties – mechanical and physical properties – applications.	09
Unit-3	
Self-assembled Monolayers – monolayers on gold – growth process – phase transitions – patterning monolayers – mixed monolayers – applications. **Gas Phase Clusters** – history of cluster science – formation and growth – detection and analysis – type and properties of clusters – bonding in clusters.	09

Semiconductor Quantum Dots – synthesis – electronic structure of nanocrystals – how quantum dots are studied – correlation of properties with size – uses.	
Unit-4	
Monolayer-protected Metal Nanoparticles – method of preparation– characterization – functionalized metal nanoparticles – applications – superlattices. **Core-shell Nanoparticles** – types – characterization – properties – applications. **Nano shells** – types – characterization – properties – applications.	09
Unit-5	
Nano biology – interaction between biomolecules and nanoparticle surfaces – materials used for synthesis of hybrid Nano-bio assemblies – biological applications – Nano probes for analytical applications – Nano biotechnology – future perspectives. **Nano sensors** – what make them possible – nanoscale organization for sensors – characterization – Nano sensors based on optical properties – Nano sensors based on quantum size effects – electrochemical sensors – sensors based on physical properties – Nano biosensors – sensors of the future. **Nanomedicines** – approach to development – nanotechnology in diagnostic and therapeutic applications.	09
List of Experiments (If any):	**Practical Hours**
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Apply engineering and physical concepts to the nano-scale and non-continuum domain. CO2: Demonstrate a comprehensive understanding of state-of-the-art nano-fabrication methods. CO3: Evaluate processing conditions to engineer functional nanomaterials. CO4: Apply and transfer interdisciplinary systems engineering approaches to the field of bio- and nanotechnology projects. CO5: Describe state of the art characterization methods for nano materials.	
Text Books: T1. NANO: The Essentials – Understanding Nanoscience and Nanotechnology; T Pradeep (Professor, IIT Madras); Tata McGraw-Hill India (2007) T2. Nanotechnology**:** Richard Booker & Earl Boysen; Wiley (2005).	
Reference Books: R1. Introduction to Nanoscale Science and Technology [Series: Nanostructure Science and Technology], Di Ventra, et al (Ed); Springer (2004) R2. Nanotechnology Demystified, Linda Williams & Wade Adams; McGraw-Hill (2007)	

R3.Introduction to Nanotechnology, Charles P Poole Jr, Frank J Owens, Wiley India Pvt. Ltd., New Delhi, 2007.

Course Name: PROJECT AND MATERIALS MANAGEMENT					
Course Code : AU732E4					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**2**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**03**

Course objectives:
The basic objective of this course is to provide to the country a steady stream of competent young men & women with the necessary knowledge, skills and foundations for acquiring a wide range of rewarding careers into the rapidly expanding world of Materials and Logistics Management.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
PROJECT MANAGEMENT Concept of project-Categories of projects-Project life cycle - Concept of project management -Tools and techniques for project management-The project manager-Roles and responsibilities of project manager- Project formulation- Formulation of stages-Bottlenecks-Feasibility Report-Financing arrangements- Finalization of project-Implementation of project.	09
Unit-2	
PROJECT EXECUTION AND CONTRACT Administrative agencies for project approval- Ministry of finance-Bureau of public enterprises –Planning commission- Public Investment Board. Organizing human resources and contracting-Delegation of project manager's authority- Project organization-Accountability in project execution-Contracts- 'R' of contracting-Tendering and selection of contractors-Team building	09
Unit-3	
SYSTEMS AND PROCEDURES: Organizing and working of systems-Design of systems-Project work system design work breakdown structure-project execution plan-project procedure-manual project control system- planning, scheduling, monitoring and controlling-monitoring contracts and project diary. Project implementation-stages of project direction- communication in a project-coordination guidelines for effective implementation-Reporting in project management-project evaluation and its objectives, types, and methods.	09
Unit-4	

MATERIAL MANAGEMENT Concept and importance of Material Management-organization of Material management purchase methods-Dynamic purchasing-Purchasing decisions (quality, quantity, suppliers, time, price) - Purchasing function-Selection of Materials and vendors purchasing organization-concept of value analysis-import substitution-vendor rating vendor development.	09
Unit-5	
INVENTORY MANAGEMENT Material requirement planning, forecasting and Inventory management-inventory control- factors affecting inventory control policy –Inventory costs, Basic EOQ model-order level-ABC analysis-statistical methods in inventory control-inventory classification methods. Store keeping and warehouse management-objectives-functions-store keeper-duties responsibilities-location of store-stores ledger. Cost control& cost reduction programmers.	09
List of Experiments (If any):	**Practical Hours**
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Describe how a project should be managed and also the legal procedure for a project approval. CO2: Describe project planning CO3: Discuss about project handling and managing materials. CO4: Summarize about work system design along with method study and time study. CO5: Discuss logistics management and purchase	
Text Books: T1.B.B. Goel-Project Management-Deep and Deep Publications, New Delhi, 2004 T2. Choudhury-S. Project Management –Tata Mc Grew –Hill- Publishing Company Limited, New Delhi,2005 T3. Datta.A.K. Integrated Material Management T4. Gopalakrishnan.P. And Sthuram. M. Material management-An integral Approach T5. M.V.Varma –Material Management	
Reference Books: R1. Mattin.C.C. Project Management-American Management Association, New York,1976 R2. Denis Lock-Project Management-Coles Publishing company, 1980	

Course Name: SMART MATERIALS					
Course Code : AU732E5					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**2**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**03**

Course objectives:

- To differentiate smart materials and categorize their applications in various disciplines.
- To interpret the physical principles and the multi-physics coupling effects occurring in smart materials.
- To provide an insight into the latest developments regarding smart materials and their use in structures.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Introduction: Characteristics of composites and ceramics materials, Dynamics and controls, concepts, Electro-magnetic materials and shape memory alloys-processing and characteristics	09
Unit-2	
Sensing and Actuation: Principals of electromagnetic, acoustics, chemical and mechanical sensing and actuation, Types of sensors and their applications, their compatibility writer conventional and advanced materials, signal processing, principals and characterization.	09
Unit-3	
Control Design: Design of shape memory alloys, Types of MR fluids, Characteristics and application, principals of MR fluid value designs, Magnetic circuit design, MR Dampers, Design issues. **Optics and Electromagnetic:** Principals of optical fiber technology, characteristics of active and adaptive optical system and components, design and manufacturing principles.	09
Unit-4	
Structures: Principles of drag and turbulence control through smart skins, applications in environment such as aerospace and transportation vehicles, manufacturing, repair and maintainability aspects. **Controls:** Principles of structural acoustic control, distributed, amalog and digital feedback controls, Dimensional implications for structural control.	09
Unit-5	

Principles of Vibration and Modal Analysis: PZT Actuators, MEMS, Magnetic shape Memory Alloys, Characteristics and Applications. **Information Processing:** Neural Network, Data Processing, Data Visualization and Reliability – Principals and Application domains.	09
List of Experiments: NA	**Practical Hours**
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Describe the concept of structure-property relations. CO2: Define the properties of smart materials in various domains. CO3: Explain the process of synthesis of smart systems and smart materials. CO4: Analyze the smart systems for various engineering applications. CO5: Describe the concept of intelligent processing of semiconductors and metals.	
Text Books: T1. Analysis and Design', A. V. Srinivasan, 'Smart Structures –Cambridge University Press, New York, 2001, (ISBN : 0521650267) T2. 'Smart Materials and Structures', M V Gandhi and B S Thompson Chapmen & Hall, London, 1992 (ISBN : 0410370107)	
Reference Books: R1. 'Smart Materials and Structures', Banks HT, RC Smith, Y Wang, Massow S A, Paris 1996 R2. G P Gibss'Adaptive Structures', Clark R L, W R Saunolers, John Wiles and Sons, New York, 1998 R3. An introduction for scientists and Engineers', Esic Udd, Optic Sensors : Jhon Wiley & Sons, New York, 1991 (ISBN : 0471830070)	

PROGRAM ELECTIVE-5

Course Name: VEHICLE TRANSPORT MANAGEMENT					
Course Code : AU831E1					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks:	50
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks:	50
Credits.	**02**	**0**	**01**	Exam Hours:	3

Course objectives: Subject will cover various transport management aspects and motor vehicle laws after studying this subject the students will be able to manage a transport fleet and their related activities for minimizing operational cost.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	
Introduction: Historical background, the growth of a network, trams, trolley buses, buses, private cars, subsidies. Motor vehicle act 1988. **The Infrastructure:** Road, Highway network, traffic control, Bus priorities, pedestrianization, out town shopping centers, Bus-stops, shelters, Bus stations-drive through type, head on type, facilities for passengers, bus garages, requirement, layout of premises, size, function, ,location, design, equipment, use of machinery, garage organization, large scale overhaul conveyance of staff, requirement of facilities at depot., legal provisions for depot. Layouts. Maintenance - preventive, breakdown, overhauling - major, minor, repair schedules & workshop, facilities, documentation, analysis & corrective maintenance schedules	09 Hrs
Unit-2	
Organization and Management: Forms of ownership, municipal undertaking, company undertaking, traffic, secretarial and engineering departments, management, principle of transport, - internal organization-centralized control, de-centralized control, staff administration: industrial relation, administration, recruitment and training, drivers and conductors duties, training of drivers and conductors, factors affecting punctuality, welfare, health and safety. **Route planning:**	10 Hrs

Source of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule test runs, elimination of hazards, factors affecting frequency, direction of traffic flow, community of interest, estimating, traffic volume, probable weekday travelers, passengers during various periods of the day, estimated number of passengers, estimated traffic, possibility of single verses double deck and frequency Timing, Bus working and Schedules: Time table layout, uses of flat graph method of presentation, preparation of vehicle and crew schedule preparation of the duty roster, co-operation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements.	
Unit-3	
Fare collections & Fare structure: Need, Principles of collection, tickets, the way bill, stage by stage, bell punch system, bell graphic system, reduced ticket stocks will brew system, mechanical ticket machines, T.I.M and straight machines, Vero meter, one-man operation, two stream boarding, pre-paid tickets, lenson parson coach tickets exchanges, the fare box, electronic ticket machines, box system personal and common stock flat fare platform control. Fare structure: Basis of fares, historical background, effects of competition and control, calculating average zone system, concession fares, straight and tapered scale elastic and inelastic demand co-ordination of fares concessions fares changes for workman, standard layout of fare table, anomalies double booking inter availability through booking and summation, private hire charges.	10 Hrs
Unit-4	
Operating cost and types of vehicles: Classification of costs, average speed, running costs, supplementary costs, depreciation obsolescence, life of vehicles, sinking fund, factor affecting cost per vehicles mile incidence of wages and overheads, 100 seats miles basis, average seating capacity, vehicles size and spread overs, types of vehicle economic considerations authorization of trolley, bus services, statuary procedure taxes and hire car.	10 Hrs
Unit-5	

Public relations divisions: Dissemination of information, maintaining goodwill-handling complaints, traffic advisory committees- local contractors co-operation with the press news and articles-facilities for visitors- forms of publicity – importance of quality - inter departmental liaison advertisements, sings, notice and directions general appearance of premises, specialized publicity. Prevention of accidents: Emphasis of safe driving, annual awards, bonus encouragement, vehicle design, platform layout, location of stops, scheduled speed, route hazards, records, elimination of accident prone drivers. **Vehicle design:** Buses & coaches, types & capacities, basic features, entrances & exits, comfort & capacity, steps & staircases, miscellaneous arrangements & fitments, articulated buses, standardization. The future: a projection from the past, future demand, environmental and social issues, the energy situation, new technology, hybrid, battery/trolley bus, other types of hybrid, lead acid battery bus, advanced battery bus.	10 Hrs

List of Experiments : NA		**Practical Hours**
Self-study : NIL		
Site/Industrial Visits :		
Course outcomes:	Level	PO
1. Understand and have knowledge about different aspects related to transport system and will be able to manage.	L1, L2	1,2,8,9
2. Understand various Features of scheduling, fixing the fares	L1, L2	1,2,8,9
3. Understand various types of insurance and taxation policies.	L1, L2, L3, L5	1,2
4. Know about the motor vehicle act and laws related to PUC Norms	L1, L2	1, 2

Text Books:

1. S.L. Bhandarkar, "Vehicle Transport Management", DhanpatRai& Co. (Pvt.) Ltd., 2006
2. Motor Vehicle Act and Transport Management,V.S.KhileryDr.Satpal Sharma, Er. Shaman Gupta, 2016.
3. Bus operation - L.D.Kitchen, Iliffe& Sons, London
4. Bus & coach operation - Rex W. Faulks, Butterworth Version Of 1987, London

Reference Books:

1. Compendium of transport terms - Cirt, Pune
2. M.V. Act 1988 - Central Law Agency, Allahabad
3. Automobile engineering-R B Gupta, satyaprakashan, New Delhi, 2015, Publishers.
4. Goods vehicle operation - C.S. Dubbar, 1953.
5. Road transport law - L.D. Kitchen, 6th edition, 1949.
6. Automobile engineering-G B S Narang, Khanna Publications, 5thedition, 2003.

Online Resources: NA

Course Name: SIMULATION OF IC ENGINE PROCESSES					
Course Code : AU831E2					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**03**	**0**	**0**	Exam Hours	**3**

Course objectives: To impart knowledge in simulating IC engine processes. The detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation of SI engine will be taught to the students.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	
Introduction Principle of computer modelling and simulation, Monte Carlo simulation, Nature of computer modelling and simulation, Limitations of simulation, areas of application **System and Environment** Components of system-discrete and continuous systems, Models of a system-a variety of modelling approaches	10 Hrs
Unit-2	
Design and Evaluation of Simulation Experiments Variance reduction techniques, Antithetic variables, Variables verification and validation of simulation models	10 Hrs
Unit-3	
Combustion Process – General Heat of reaction, adiabatic flame temperature, Temperature change due to fuel vaporization **Combustion and Heat Transfer in Engines** Combustion in diesel engines, Heat transfer in engines, Heat Transfer correlations	10 Hrs
Unit-4	
C.I. and S.I. Engine Simulation Simulation of Otto cycles under full load and part load and supercharged conditions. Progressive combustion, Exhaust and intake process analysis	10 Hrs
Unit-5	

Two Stroke Engine Simulation Engine and porting geometry, gas flow, Scavenging **Simulation exercises** Simulation exercises using computers- MATLAB Simulink, ProE / ICEM, CFD Analysis, FE Analysis and Validation of models	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study: NIL	
Site/Industrial Visits : NA	

Course outcomes:	Level	PO
CO 1: Understand the conventional and non-conventional fuels for IC engines and effects of emission formation of IC engines, its effects and the legislation standards.	L1, L2	1,2,8
CO2: Evaluate experiments on IC engine simulation	L1, L2, L5	1,2,3,4,5,8,9
CO 3: Simulate the different engine processes.	L1, L2, L3, L4, L5	1,2,3,4,5,8,9
CO 4: Simulate the process of combustion	L1, L2, L5	1,2,8

Text Books:

1. ComputerSimulation of Spark Ignition Engine Processes by V Ganesan, Universities
Press,1995.
2. V.Ganesan, Computer Simulation of Spark Ignition Engine Processes, Universities
Press, 2000.
3. NARS1NGH DEO, "System Simulation with digital Computer, 1st edition, prentice Hall of India,2009.
4. Flow and Combustion in Piston Engines by C926+/Arcoumanis, Take Kamimoto, Springer, 1st edition, 2010

Reference Books:

1. Ashley S. Campbell, Thermodynamic Analysis of Combustion Engines, Krieger Pub Co, June 1985
2. J.N.Mattavi and C. A. Amann. Combustion Modelingin Reciprocating Engines &Plenum
Press, 1980.
3. Horlockan and lWlnterbone," The Thermodynamics and Gas Dynamics of Internal
Combustion Engines, Vol.II;, Clarendon Press, 1987.
4. Gordon P. Blair, The Basic Design of two-Stroke engines, SAE Publications, 1996.
. J.I.Ramos, "Internal Combustion Engine Modeling ,1st edition, CRC Press, 1989

Online Resources: NA

Course Name: TWO AND THREE-WHEELER					
Course Code : AU831E3					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**
Course objectives: To impart knowledge in basic engine working, chassis design, brakes, wheels and tyres. Specific case studies of two and three-wheeler vehicle are explained.					
Prerequisites: Nil					
Units					**Teaching Hours**
Unit-1					
POWER UNIT Two stroke SI engine, four stroke SI engine; merits and demerits. Symmetrical and unsymmetrical port timing diagrams. Types of scavenging processes; merits and demerits, scavenging pumps. Rotary valve engine. Fuel system. Lubrication system. Magneto coil and battery coil spark ignition system, electronic ignition system. Starting system; kick starter system.					10 Hrs
Unit-2					
CHASSIS AND SUB-SYSTEMS Mainframe and its types. Chassis and shaft drive, Single, multiple plates and centrifugal clutches. Gear box and gear controls. Front and rear suspension systems. Shock absorbers. Panel meters and controls on handle bar					10 Hrs
Unit-3					
BRAKES, WHEELS AND TYRES Drum brakes, disc brakes, front and rear brake links, layouts. Spoked wheel, cast wheel, disc wheel, disc types. Tyres and tubes.					10 Hrs
Unit-4					

TWO WHEELERS Case study of major Indian models of motorcycles, scooters and mopeds. TVS mopeds and motorcycles, Hero Honda motorcycles, Bajaj scooters and motorcycles, Yamaha, Enfield motorcycles. Servicing and maintenance.	10 Hrs
Unit-5	
THREE WHEELERS Case study of Indian models. Auto rickshaws, pickup van, delivery van and trailer. Maintenance: & Fault tracing	10 Hrs
List of Experiments : NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits :	

Course outcomes:	Level	PO
CO 1: Explain the working of IC engine.	L1, L2	1,2,8
CO 2: Explain different types of chassis and its design	L1, L2	1,2,
CO 3: Understand the working of drum and disk brake.	L1, L2	1,2
CO4: differentiate all the parts of two and three wheeler	L1, L2	1,2,8

Text Books:

1. Two and three wheeler technology, Dhruv U Panchal, 2015.
2. A textbook of automobile engineering, R K Rajput, 2007.

Reference Books:

3. Irving.P.E. - Motor Cycle Engineering - Temple Press Book, London.
4. Encyclopedia of Motorcycling - 20 volume Marshall, Cavensih, UK.
5. BrayantR.V,Vespa - Maintenance and Repair Series – S.Chand& Co., New Delhi.
6. Raymond Broad Lambretta - A Practical Guide to maintenance and repair – S.Chand&amp Co, New Delhi - 1987.

Online Resources: NA

Course Name: AUTOMOTIVE TESTING AND CERTIFICATION					
Course Code : AU831E4					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives:

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

1. To broaden the knowledge of role of safety systems in automobiles
2. To familiarize with the vehicle structural crashworthiness and crash testing.
3. To widen the significance of ergonomics in automotive safety and human response to impact
4. To introduce pedestrian safety
5. To underline the importance of vehicle safety systems.

Prerequisites: Basic knowledge on Automotive Chassis, Vehicle Body Engineering

Units	**Teaching Hours**
Unit-1	
Introduction Specification & Classification of Vehicles (including M, N and O layout), Homologation & its Types, Regulations overview (EEC, ECE, FMVSS, AIS, CMVR), Type approval Scheme, Homologation for export, Conformity of Production, various Parameters, Instruments and Types of test tracks.	08
Unit-2	
Static Testing of Vehicle Photographs, CMVR physical verification, Tyre Tread Depth Test, Vehicle Weightment, Horn installation, Rear view mirror installation, Tell Tales, External Projection, Wheel Guard, Arrangement Of Foot Controls For M1 Vehicle, Angle & Dimensions Measurement of Vehicle, The Requirement Of Temporary Cabin For Drive – Away - Chassis	08
Unit-3	
Dynamics Testing of Vehicle Hood Latch, Gradeability, Pass-by Noise, Interior Noise, Turning Circle Diameter & Turning Clearance Circle Diameter, Steering Effort, Constant Speed Fuel Consumption, Cooling Performance, Speedo-meter Calibration, Range Test, Maximum Speed, Acceleration Test, Coast-down test, Brakes Performance ABS Test, Broad band / Narrow band EMI Test. Engine power test (petrol & diesel), Indian driving cycle, Vehicle mass emission, Evaporative emission (petrol vehicles)	10
Unit-4	

Vehicle Component Testing Horn Testing, Safety Glasses Test: Windscreen laminated and toughened safety glass, Rear View Mirror Test, Hydraulic Brakes Hoses Fuel Tank Test: Metallic & Plastic, Hinges and Latches Test, Tyre & Wheel Rim Test, Bumper Impact Test, Side Door Intrusion, Crash test with dummies, Demist test, Defrost Test, Interior Fittings, Steering Impact test (GVW<1500 kg), Body block test, Head form test, Driver Field Of Vision, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints test, Airbag Test, Accelerator Control System.	10
Unit-5	
Vehicle Lighting Testing Installation requirement for lighting, signaling & reflective devices Installation, Conspicuity & Reflective Marking, Photometry Test: Performance requirement for lighting, signaling and reflective devices - Head lamp, Front lamp, direction indicator lamp, signaling lamp and Warning triangles.	09
Self-study: NVH testing	
Site/Industrial Visits: An activity related to various tests done in cars	
Course outcomes: CO1. Identify different safety systems and its role in automobiles CO 2. Determine vehicle structural crashworthiness CO 3. Analyze and simulate vehicle in barrier impacts CO 4. Determine injury thresholds and apply trauma for analysis of crash injuries CO 5. Analyze pedestrian safety by use of pedestrian simulator CO 6. Design vehicle safety systems	
Text Books: 1. "Vehicle Inspection Handbook", American Association of Motor Vehicle Administrators 2. Michael Plint& Anthony Martyr, "Engine Testing & Practice", Butterworth Heinmenn, 3rd edition, 2007	
Reference Books: 1. Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010 at ARAI PUNE 2. Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007	
Online Resources: W1. https://nptel.ac.in/courses/112106225/ W2. https://nptel.ac.in/courses/107106080/	

Course Name: CONTROL ENGINEERING					
Course Code : ME831E5					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives:

- To impart the fundamental concepts of Control systems and mathematical modeling of the system
- To study the concept of time response and frequency response of systems
- To teach the basics of stability analysis of the system

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Introduction: Concept of automatic controls, Open loop and closed loop systems, Concepts of feedback, requirements of an ideal control system, Types of controllers- Proportional, Integral Proportional Integral, Proportional Integral Differential controllers. **Mathematical Models:** Transfer function models, models of mechanical systems, models of electrical circuits, DC and AC motors in control systems, models of thermal systems, models of hydraulic systems, pneumatic system, Analogous systems: Force voltage, Force current.	08
Unit-2	
Block Diagrams and Signal Flow Graphs: Transfer Functions definition, function, block representation of systems elements, reduction of block diagrams, Signal flow graphs: Mason's gain formula. **Transient and Steady State Response Analysis:** Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. System stability: Routh's-Hurwitz Criterion.	10
Unit-3	
Frequency Response Analysis: Polar plots, Nyquist stability criterion, Stability analysis, Relative stability concepts, Gain margin and phase margin, M&N circles.**Frequency Response Analysis Using Bode Plots:** Bode attenuation diagrams, Stability analysis using Bode plots, Simplified Bode Diagrams.	10
Unit-4	
Root Locus Plots: Definition of root loci, General rules for constructing root loci, Analysis using root locus plots.	10
Unit-5	

System Compensation and State Variable Characteristics of Linear Systems: Series and feedback compensation, Introduction to state concepts, state equation of linear continuous data system. Matrix representation of state equations, controllability and observability, Kalman and Gilberts test.	10
List of Experiments (If any): NA	**Practical Hours**
1. Mathematical Modeling of Mechanical Systems To model a given translational/ rotational mechanical system in MATLAB.	
Time response of First Order Systems a. Unit Impulse Response b. Unit Step Response c. Unit Ramp Response To find the unit impulse unit step and unit ramp response of a first order system and to study the effect of time constant on the response.	**2**
2. Time Response of Second Order Systems [Undamped, Underdamped, Critically Damped, Overdamped] a. Unit Impulse Response b. Unit Step Response c. Unit Ramp Response To find the unit impulse unit step and unit ramp response of a second order system and to study the effect of damping constant on the response. The dependence of damping on the location of poles can also be studied.	**2**
3. System Stability [Location of poles Vs Stability] To find and plot the pole and zeros of the system. To study the effect of the location of poles on the stability of a system by finding and plotting the impulse response of systems	**2**
4. Study of Controllers. To study the effect of basic controllers. {P, D, I, PI and PID}	**2**
5. Root Locus To draw the root locus of a system and to design proportional controllers for a given damping from the root locus	**2**
6. Bode Plot To draw the Bode Plot of a system and to find the phase margin and gain margin State Space Modelling of Mechanical Systems To model a given translational/ rotational mechanical system in state space. Eg: Suspension of Car. [Quarter Car Model]	**2**
7. Response of a system modeled in state space To find the natural response and total response of the system modeled in state space.	**2**

8. Controllability and Observability To check the controllability and observability of the given system.	**2**
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: Represent the mathematical model of a system{L1,L2,L3,L4}{PO1,PO2,PO3,PO6,PO7} CO2: Determine the response of different order systems for various step inputs{L1,L2,L3,L4}{PO1,PO2,PO3,PO6,PO7} CO3: Analyse the stability of the system{L1,L2,L3,L4}{PO1,PO2,PO3,PO6,PO7} CO4: To learn the basics of stability analysis of the system {L1,L2,L3,L4}{PO1,PO2,PO3,PO6,PO7} CO5: To impart the conceptual knowledge of Control systems and mathematical modelling of the system{L1,L2,L3,L4}{PO1,PO2,PO3,PO6,PO7} CO6: To study the concept of time response and frequency response of systems{L1,L2,L3,L4}{PO1,PO2,PO3,PO6,PO7}	
Text Books: T1. Modern Control Engineering, Katsuhiko Ogatta, Pearson Education, 2004. T2. Control Systems Principles and Design, M.Gopal, TMH, 2000.	
Reference Books: R1. Modern Control Systems, Richard.C.Dorf and Robert.H.Bishop, Addison Wesley,1999 R2. System dynamics & control, Eronini-Umez, Thomson Asia pte Ltd. Singapore, 2002. R3. Feedback Control System, Schaum's series. 2001.	
Online Resources: NA	

PROGRAM ELECTIVE-6

COURSE NAME: RAPID PROTOTYPING					
Course Code : AU832E1					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This course provides the fundamental knowledge to Rapid Prototyping and Automated fabrication, including the generation of suitable CAD models, current Rapid Prototyping fabrication technologies, their underlying material science, the use of secondary processing, and the impact of these technologies on society. The rapid prototyping process will be illustrated by the actual design and fabrication of a part.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems. **Stereo Lithography Systems:** Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.	10 Hrs
Unit-2	
Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Application, Fusion Deposition ModellingPrinciple, Process parameter, Path generation, Applications. **Solid Ground Curing:** Principle of operation, Machine details, Applications.Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.	10 Hrs
Unit-3	
Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer. GenisysXs printer HP system 5, object Quadra systems. **Rapid Tooling:** Indirect Rapid tooling, Silicon rubber tooling, Aluminium filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, etc. Direct Rapid Tooling Direct. AIM.	10 Hrs
Unit-4	

Rapid Tooling: Indirect Rapid tooling, Silicon rubber tooling, Aluminium filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, etc, .Direct Rapid Tooling Direct. AIM. **Rapid Tooling:** Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling.	10 Hrs
Unit-5	
Software for RP: STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools. **Rapid Manufacturing Process Optimization:** Factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation.	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Analyze the history of 3D printing. CO2 Differentiate the types of Rapid Prototyping techniques. CO3 Explain the state of rapid tooling. CO4 Relate the different software's used in rapid prototyping CO5 Classify different manufacturing process involved in rapid prototyping CO6 Compare the applications of Rapid Prototyping technologies	
Text Books: 1.Stereo Lithography and other RP & M Technologies, Paul F.Jacob s: SME, NY 1996. 2. Rapid Manufacturing, Flham D.T&Dinjoy S.S Verlog London 2001.	
Reference Books: 1. Rapid Prototyping, Terry Wohler's Report 2000" Wohler's Association 2000. 2. Rapid Prototyping Materials, Gurumurthi, IIScBangalore. 3. Rapid Automated, Lament wood. Indus press New York	
Online Resources: NA	

COURSE NAME: TRIBOLOGY					
Course Code : AU832E2					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This paper deals with the study of basics of tribology such a pressure developed in an oil film and about various types of lubrication and the various types of bearings and its design

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
Introduction to Tribology: Properties of oils and equation of flow: Viscosity, Newton's Law of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, classification of lubricants. **Hydrodynamic Lubrication:** Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, idealized full journal bearings.	10 Hrs
Unit-2	
Mechanism of pressure development in an oil film: Reynold's investigations, Reynold's equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems.	10 Hrs
Unit-3	
Slider / Pad bearing with a fixed and pivoted shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, influence of end leakage, numerical examples.	10 Hrs
Unit-4	
Oil flow and thermal equilibrium of journal bearing: Oil flow through bearings, self-contained journal bearings, bearings lubricated under pressure, thermal equilibrium of journal bearings. **Hydrostatic Lubrication:** Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.	10 Hrs
Unit-5	

Bearing Materials: Commonly used bearings materials, properties of typical bearing materials. **Wear:** Classification of wear, wear of polymers, wear of ceramic materials, wear measurements, effect of speed, temperature and pressure. **Behavior of tribological components:** Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. Tribological measures, Material selection, improved design, surface engineering.	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 To understand the mechanics of fluid in tribology. CO2 To understand the mechanism of pressure development in oil film. CO3 To design various types of bearings.	
Text Books: 1. Fundamentals of Tribology , Basu S K., Sengupta A N., Ahuja B. B., , PHI 2006 2. Introduction to Tribiology Bearings, Mujumdar B. C., S. Chand company pvt. Ltd 2008.	
Reference Books: 1. Theory and Practice of Lubrication for Engineers, Fuller, D., New York company 1998 2. Principles and Applications of Tribiology, Moore, Pergamaon press 1998 3. Tribology in Industries, Srivastava S., S Chand and Company limited, Delhi 2002 4. Lubrication of bearings – Theoretical Principles and Design, Redzimovskay E I., Oxford press company 2000	
Online Resources: NA	

COURSE NAME: FRACTURE MECHANICS					
Course Code : AU832E3					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This course provides the basic knowledge about Fracture Mechanics and their use in modern machine design. A thorough discussion on Failure of material due to crack and various types of cracks are discussed.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
Fracture Mechanics Principles: Introduction, Mechanisms of Fracture, and a crack in structure, the Griffith's criterion, modern design – strengths, stiffness and toughness. Stress intensity approach **Stress Analysis for members with Cracks:** Linear elastic fracture mechanics, Crack tip stress and deformations, Relation between stress intensity factor and fracture toughness, Stress intensity based solutions. Crack tip plastic zone estimation, Plane stress and plane strain concepts. The Dugdale approach, the thickness effect.	09 Hrs
Unit-2	
Elastic – Plastic Fracture Mechanics: Introduction, Elasto–plastic factor criteria, crack resistance curve, J-integral, Crack opening displacement, crack tip opening displacement. Importance of R-curve in fracture mechanics, experimental determination of J-integral, COD and CTOD.	10 Hrs
Unit-3	
Dynamic and Crack Arrest: Introduction, the dynamic stress intensity and elastic energy release rate, crack branching, the principles of crack arrest, the dynamic fracture toughness. **Fatigue and fatigue crack growth rate:** Fatigue loading, various stages of crack propagation, the load spectrum, approximation of the stress spectrum, the crack growth integration, fatigue crack growth laws.	10 Hrs
Unit-4	
Fracture Resistance of Materials: Fracture criteria, fatigue cracking criteria, effect of alloying and second phase particles, effect of processing and anisotropy, effect of temperature, closure.	10 Hrs
Unit-5	

Computational Fracture Mechanics: Overview of numerical methods, traditional methods in computational fracture mechanics – stress and displacement marching, elemental crack advance, virtual crack extension, the energy domain integral, finite element implementation. Limitations of numerical fracture analysis. **Fracture toughness testing of metals:** Specimen size requirements, various test procedures, effects of temperature, loading rate and plate thickness on fracture toughness. Fracture testing in shear modes, fatigue testing, and NDT methods.	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Predict material failure for any combination of applied stresses. CO2 Estimate failure conditions of a structure. CO3 Determine the stress intensity factor for simple components of simple geometry. CO4 Predict the likelihood of failure of a structure containing a defect.	
Text Books: 1.Introduction to Fracture Mechanics, Karen Hellan McGraw Hill Pub.2000 2.Fracture of Engineering Brittle Materials, Jayatilake, Applied Science, London. 2001.	
Reference Books: 1.Fracture Mechanics – Fundamentals and Application, T.L. Anderson, CRC press 1998 2.Elementary Engineering Fracture Mechanics, David Broek, Artinus Nijhoff, London 1999. 3.Fracture and Fatigue Control in Structures, Rolfe and Barsom, Printice Hall 2000. 4.Fundamentals of Fracture Mechanics, Knott, Bureworth 2000.	
Online Resources: NA	

COURSE NAME: NON-DESTRUCTIVE TESTING					
Course Code : AU832E4					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3**

Course objectives: This course provides the fundamental knowledge various methods of non-destructive testing.

Prerequisites: NIL

Units	**Teaching Hours**
Unit-1	
Selection of ND methods, visual inspection, leaks testing, liquid penetration inspection, its advantages and limitations. **Magnetic particle inspection:** Methods of generating magnetic field, types of magnetic particles and suspension liquids – steps in inspection – application and limitation. **(**	10 Hrs
Unit-2	
Eddy current inspection: Principles, operation variables, procedure, inspection coils, and detectable discounts by the method. **Microwave inspection:** Microwave holography, applications and limitations.	10 Hrs
Unit-3	
Ultrasonic inspection: Basic equipment characteristics of ultrasonic waves, variables inspection. inspection methods pulse echo A, B, C scans transmission, resonance techniques transducer elements, couplets, search units, contact types and immersion types inspection standard-standard reference blocks, inspection of products like casting, extrusions, rolled product, weld set.	10 Hrs
Unit-4	
Radiography inspection: Principles, radiation source-Rays and gamma rays-rays tubes, radio graphic films, scenes and filters, image intensifiers, techniques charts, industrial radiography, image quality, radiography sensitivity, Peneramotors, electron, neural radiology, application of ICT. Thermal inspection principles, equipment inspection methods applications.	10 Hrs
Unit-5	

Optical Holography: Basics of Holography, recording and reconstruction-info metric techniques of inspection, procedures of inspection, typical applications. Acoustical Holography: systems and techniques applications. Indian Standard for NDT.	10 Hrs
List of Experiments (If any): NA	**Practical Hours**
Self-study : NIL	
Site/Industrial Visits : NA	
Course outcomes: : CO1 Differentiate the types non-destructive testing techniques. CO2 Classify different non-destructive testing process involved CO3 Compare the applications of non-destructive testinG	
Text Books:	
Reference Books: 1. McGonnagle JJ "Non Destructive testing" – Garden and reach New York 2. Non-destructive Evolution and quality control" volume 17 of metals hand book 9 edition Asia internal 1989 3. Davis H.E Troxel G.E Wiskovil C.T the Testing instruction of engineering materials Mc graw hill.	
Online Resources: NA	

Course Name: RESEARCH METHODOLOGY					
Course Code : AU832E5					
	L	**T**	**P**	Category	**PEC**
Contact Hrs./Week	**02**	**0**	**02**	CIA Marks	**50**
Contact Hrs./Sem.	**30**	**0**	**15**	ESE Marks	**50**
Credits.	**02**	**0**	**01**	Exam Hours	**3 hrs**

Course objectives:

- To understand some basic concepts of research and its methodologies
- To identify appropriate research topics
- To select and define appropriate research problem and parameters
- To organize and conduct research/project in a more appropriate manner
- To write a research report and thesis

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	
Research methodology – definition and significance, Types of research – exploratory research, conclusive research, modelling research, algorithmic research, casual research, theoretical and empirical research, cross-sectional and time series research. Research process- steps, research problems, objectives, characteristics, hypothesis and research in an evolutionary perspective	**9**
Unit-2	
Research design- definition, types –descriptive and experimental, validity and reliability of instrument, Validity of findings- internal and external validity, Variables in Research, types of data – primary and secondary data, methods of a data collection for scientific and business research, experiments, construction and validation of questionnaire, measurement and scaling. Types of scale – Thurstone's Case V scale model, Osgood's Semantic Differential scale, Likert scale, Q-sort scale.	**9**
Unit-3	
Sampling methods – Probability sampling methods – simple random sampling with replacement and without replacement, stratified sampling, cluster sampling. Non-probability sampling method – convenience sampling, judgment sampling, quota sampling. Nonparametric tests- One sample tests – one sample sign test, Kolmogorov-Smirnov test, run test for randomness, two sample tests – two sample sign test, Mann-Whitney U test, K-sample test – Kruskal Wallis test (H-test)	**9**
Unit-4	

Hypothesis testing – Testing of hypotheses concerning means (one mean and difference between two means – one tailed and two tailed tests), concerning variance _ one tailed Chi-square test. Introduction to Discriminant, Factor analysis, cluster analysis, multi-dimensional scaling, conjoint analysis, multiple egression and correlation, application of statistical software for data analysis.	**9**
Unit-5	
Report writing – types of report, guidelines to write report, typing instruction, need of summary, importance of language in the preparation of research report, oral presentation. Recording the findings of research – publication- contents to meet the journals standard – impact factor – citation and citation index, policy on academic honesty and integrity – academics cheating and plagiarism. Opportunities to carry out research projects with funding/assistance from various Government agencies.	**9**
Self-study :	
Site/Industrial Visits :	
Course outcomes: CO1: To develop understanding of the basic framework of research process. {L1, L2} {PO1, PO2} CO2: To develop an understanding of various research designs and techniques. {L1, L2} {PO1, PO4} CO3: To identify various sources of information for literature review and data collection. {L1, L2, L4} {PO1, PO2, PO3, PO4} CO4: CO4: To develop an understanding of hypothesis testing and analysis. { L-1, L-2, L-4, L-5} {PO1, PO3, PO4} CO5: Appreciate the components of scholarly writing and evaluate its quality {L1, L2, L6} {PO8, PO10}	
Text Books: T1. Garg, B.L, Karadia R, Agarwal F, and Agarwal, "An introduction to Research Methodology", RBSA Publishers, 2002. T2. Kothari C.R, "Research Methodology: Methods and Techniques", New Age International, 1990.	
Reference Books: R1. Sinha, S.C and Dhiman A.K, "Research Methodology", 2nd volume, Ess Publications, 2002. R2. Trochim W.M.K, "Research Methods: the concise knowledge base", Atomic Dog Publishing, 2005. R3. Donald R. Cooper and Pamela S. Schindler, business Research Methods, 9th edition, Tata Mcgraw Hill, 2006. R4. Y. P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004Gall, "Metals Hand Book", American Society for Metals, 1988.	

Online Resources:
W1. https://www.coursera.org/learn/research-methods
W2. https://nptel.ac.in/downloads/121106007/