JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AUTOMOBILE ENGINEERING

COURSE STRUCTURE AND SYLLABUS

For UG – R20

B. TECH - AUTOMOBILE ENGINEERING

(Applicable for batches admitted from 2020-2021)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
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COURSE STRUCTURE

I Year – I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	BSC-1	Mathematics - I	3	0	0	3
2	BSC-2	Engineering Chemistry	3	0	0	3
3	ESC-1	Engineering Mechanics	3	0	0	3
4	HSC-1	Communicative English	3	0	0	3
5	ESC-2	Programming for Problem Solving using C	2	0	2	3
6	BSC-L1	Engineering Chemistry Laboratory	0	0	3	1.5
7	ESC-L1	Programming for Problem Solving using C Laboratory	0	0	3	1.5
8	HSC-L1	English Communication Skills Laboratory	0	0	3	1.5
9	MC -1	Environmental Science	2	0	0	0
Total Credits			**17**	**0**	**11**	**19.5**

I Year – II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	BSC-3	Mathematics – II (Mathematical Methods)	3	0	0	3
2	BSC-4	Engineering Physics	3	0	0	3
3	ESC-3	Metallurgy & Materials Science	3	0	0	3
4	ESC-4	Basic Electrical and Electronics Engineering	3	0	0	3
5	ESC-5	Engineering Graphics	2	0	2	3
6	ESC-L2	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5
7	BSC-L2	Engineering Physics Laboratory	0	0	3	1.5
8	ESC-L3	Engineering Workshop & IT Workshop Laboratory	0	0	3	1.5
9	MC-2	Constitution of India	2	0	0	0
Total Credits			**17**	**0**	**9**	**19.5**

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II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	BSC-5	MATHEMATICS-III(Vector Calculus, Transforms and PDE)	3	0	0	3
2	PCC-1	Thermodynamics	3	0	0	3
3	PCC-2	Mechanics of Solids	3	0	0	3
4	PCC-3	Fluid Mechanics & Hydraulic Machines	3	0	0	3
5	PCC-4	Components of Automobile Chassis	3	0	0	3
6	PCC-L1	Mechanics of Solids & Metallurgy Lab	0	0	3	1.5
7	PCC-L2	Automobile Chassis lab	0	0	3	1.5
8	PCC-L3	Fluid Mechanics & Hydraulic Machines lab	0	0	3	1.5
9	SOC-1	Computer aided drafting and modelling lab	0	0	4	2
10	MC-3	Essence of Indian Traditional Knowledge	2	0	0	0
		Total Credits	**17**	**--**	**13**	**21.5**

II YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	ESC-6	Applied Thermodynamics	3	0	0	3
2	BSC-6	Complex Variables and Statistical Methods	3	0	0	3
3	PCC-5	Automobile Engines	3	0	0	3
4	PCC-6	Automobile Electrical and Electronics	3	0	0	3
5	HSC-2	Operations Research	3	0	0	3
6	ESC-L4	Automobile Assembly Drawing	0	0	3	1.5
7	PCC-L6	Automobile Engines & Fuels Lab	0	0	3	1.5
8	PCC-L7	Automobile Electrical & Electronics Lab	0	0	3	1.5
9	SOC-2	Machine Tools and Metrology Lab	1	0	2	2
		Total Credits	**16**	**--**	**11**	**21.5**
Honors/Minor Courses			**4**	0	**0**	**4**

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III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	PCC-7	Theory of Machines	3	0	0	3
2	PCC-8	Production Technology	3	0	0	3
3	PCC-9	Vehicle Dynamics	3	0	0	3
4	OE-1	**OPEN ELECTIVE**	3	0	0	3
5	PEC-1	1.Alternative Fuels for engines 2. Two and Three Wheelers 3. Microprocessor and Micro Controllers 4. Heat Transfer 5. Industrial Hydraulics and Pneumatics 6. MOOC's/NPTEL	3	0	0	3
6	PCC-L6	Production Technology Lab	0	0	3	1.5
7	PCC-L7	Theory of Machines Lab	0	0	3	1.5
8	SOC-3	Vehicle Design & Analysis Lab	0	0	4	2
9	MC-4	Professional Ethics And Human Values	2	0	0	0
10	Evaluation of Summer Internship, completed after II B. Tech II Semester					1.5
		Total Credits	**17**	--	**10**	**21.5**
Honors/Minor courses			**4**	0	**0**	**4**

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III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	PCC-10	Automobile Components and Chassis Design	3	0	0	3
2	PCC-11	Automobile Transmission systems	3	0	0	3
3	PCC-12	Vehicle Body Engineering	3	0	0	3
4	OE-2	**OPEN ELECTIVE**	3	0	0	3
5	PEC-2	1. CFD for Automobile Applications 2. Condition Monitoring 3. Noise Vibrations and Harshness 4. Mechatronics 5. Measurements and Control systems 6. MOOC's/NPTEL	3	0	0	3
6	PCC-L8	Auto Scanning & Vehicle Testing Lab	0	0	3	1.5
7	PCC-L9	Vehicle Maintenance Lab	0	0	3	1.5
8	PCC-L10	Vehicle Evaluation Lab	0	0	3	1.5
9	SOC-4	Soft Skills	0	0	4	2
10	MC-5	Research Methodologies & IPR	2	--		0
		Total Credits	**17**	--	**13**	**21.5**
Honors/Minor courses			**4**	**0**	**0**	**4**

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IV B.TECH I SEMESTER

S. No	Code	Course Title	L	T	P	Credits
1	PEC-3	1. Automobile Safety 2. Automobile HVAC 3. Special Purpose Vehicles 4. Engine Management Systems 5. Vehicle Infotronics 6. MOOC's/NPTEL	3	0	0	3
2	PEC-4	1. Automobile Certification and Homologation 2.Total Quality Management 3.Electric Vehicles and Hybrid Technology 4.Facilities Planning and Material Handling 5.Rapid Prototyping 6. MOOC's/NPTEL	3	0	0	3
3	PEC-5	1. Automobile Comfort Systems And Ergonomics 2.Lean Manufacturing 3.Vehicle Design Data Characteristics 4. Reliability Engineering 5.Smart, Autonomous and Connected Vehicles 6. MOOC's/NPTEL	3	0	0	3
4	OE-3	**OPEN ELECTIVE**	3	0	0	3
5	OE-4	**OPEN ELECTIVE**	3	0	0	3
6	HSC-3	Universal Human Values : Understanding Harmony	3	0	0	3
7	SOC-5	Artificial Intelligence and Machine Learning Lab	1	0	2	2
Evaluation of Summer Internship completed after III B.Tech II Semester						3
Total credits						**23**
Honors/Minor courses			**4**	**0**	**0**	**4**

IV B.TECH II SEMESTER

S. No.	Category	Code	Course Title	L	T	P	Credits
1	Major Project	PROJ	Project work*	0	4	16	12
Total credits							**12**

***Students can complete Project work @ Industries/ Higher Learning Institutions/ APSSDC.**

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OPEN ELECTIVES:

OPEN ELECTIVE-I:	1. Basic Automobile Engineering 2. Automobile Maintenance and Safety 3. Automobile Emissions and Effects
OPEN ELECTIVE-II:	1. Alternative Fuels for Automobiles 2. Vehicle Stability and Control 3. Electric Vehicles and Hybrid Technology
OPEN ELECTIVE-III:	1. Automobile Safety 2. Automobile Power train 3. IC Engines
OPEN ELECTIVE-IV:	1. Automobile Materials and Manufacturing Techniques 2. Engine Management Systems 3. Automobile Electrical and Electronics

MINOR in AUTOMOBILE ENGINEERING:

S. No	Subject	Prerequisites
1	Basic Automobile Engineering	NIL
2	IC Engines	NIL
3	Vehicle Body Engineering	Basic AE
4	Vehicle Dynamics	Basic AE, VBE
5	Automobile Electrical and Electronics	Basic AE
6	Electric Vehicles and Hybrid Technology	Basic AE ,AEE
7	Automobile Materials and Manufacturing	Basic AE
8	Automobile Pollution and its Effects	Basic AE, ICE

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PROPOSED SUBJECTS FOR B. Tech (HONORS) IN AUTOMOBILE ENGINEERING

HONORS IN AUTOMOBILE ENGINEERING		Pre-requisites
POOL – 1 (in II-II)		
1.	Engine Tribology	Automobile Engines
2.	Micro Electrical Mechanical Systems	Nil
3.	Standards And Test Procedures Of Fuel And Vehicle Emissions	Components of Automotive Chassis
4.	Engine Modeling	Automobile Engines
POOL-2 (in III-I)		
1.	Metal Forming Processes	Production Technology
2.	Statistical Design in Quality Control	Nil
3.	Design for Manufacturing & Assembly	Production Technology
4.	Robotics & Automation	Kinematics of Machinery
POOL-3 (in III-II)		
1.	Advanced Microcontroller for Automobile Systems	Basic Electrical & Electronics
2.	Automobile Sensors Actuators & Data Acquisition System	Automotive Electrical & Electronics
3.	Automobile Instrumentation And Embedded System	Automotive Electrical & Electronics
4.	Automobile Accident Investigation	Nil
POOL-4 (in IV-I)		
1.	Automobile Product Design And Development	Nil
2.	Analysis and Synthesis of Mechanisms	Kinematics of Machinery
3.	Gas Dynamics	Dynamics of Machinery
4.	Gear Engineering	Kinematics of Machinery

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I Year - I Semester		L	T	P	C
		3	0	0	3
MATHEMATICS-I					

Course Objectives:

- This course will illuminate the students in the concepts of calculus.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes:

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

- Utilize mean value theorems to real life problems (L3)
- Solve the differential equations related to various engineering fields (L3)
- Familiarize with functions of several variables which is useful in optimization (L3)
- Apply double integration techniques in evaluating areas bounded by region (L3)
- Students will also learn important tools of calculus in higher dimensions. Students willbecome familiar with 2- dimensional and 3-dimensional coordinate systems (L5)

UNIT I: Sequences, Series and Mean value theorems: (10 hrs)
Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series – Leibnitz's rule.
Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders.

UNIT II: Differential equations of first order and first degree: (10 hrs)
Linear differential equations – Bernoulli's equations – Exact equations and equations reducible toexact form.
Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonaltrajectories – Electrical circuits.

UNIT III: Linear differential equations of higher order: (10 hrs) Non-homogeneous equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, e^{ax} V(x) and $x^nV(x)$ – Method of Variation of parameters.
Applications: LCR circuit, Simple Harmonic motion.

UNIT IV: Partial differentiation: (10 hrs)
Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mc Laurent's series expansion of functions of two variables.
Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

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UNIT V: Multiple integrals: (8 hrs)
Double and Triple integrals – Change of order of integration – Change of variables.
Applications: Finding Areas and Volumes.

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2) B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2) Joel Hass, Christopher Heil and Maurice D. Weir, Thomas calculus, 14th Edition, Pearson.
3) Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 2013.
4) Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

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I Year - I Semester		L	T	P	C
		3	0	0	3
ENGINEERING CHEMISTRY					

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

COURSE OBJECTIVES

- ***Importance*** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- ***Outline*** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
- ***Express*** the increases in demand as wide variety of advanced materials are introduced; which have excellent engineering properties.
  Classify and discuss the materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries. Lubrication is also ***summarized***.
- ***Relate*** the need of fuels as a source of energy to any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence introduced.
- ***Explain*** the importance and usage of water as basic material in almost all the industries; ***interpret*** drawbacks of steam boilers and also how portable water is supplied for drinking purposes.

UNIT I: POLYMER TECHNOLOGY 8 hrs

Polymerisation:- Introduction, methods of polymerization (emulsion and suspension), mechanical properties.

Plastics: Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste (waste to wealth).

Elastomers:- Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).

Composite materials: Fiber reinforced plastics, conducting polymers, biodegradable polymers, biopolymers, biomedical polymers.

Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Analyze*** the different types of composite plastic materials and ***interpret*** the mechanism of conduction in conducting polymers.

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION 10 hrs

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery and zinc air cells), fuel cells (H_2-O_2, CH_3OH-O_2, phosphoric acid and molten carbonate).

Corrosion:-Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, factors influencing rate of corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electroless plating [nickel]), Paints (constituents, functions and special paints).

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Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Utilize*** the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and c***ategorize*** the reasons for corrosion and study methods to control corrosion.

UNIT III: CHEMISTRY OF MATERIALS 10 hrs

Part- A:

Nano materials:- Introduction, sol-gel method, characterization by (Brunauer Emmet Teller [BET]), (scanning electron microscopy [SEM]) and (transmission electron microscopy [TEM]) with example (TiO_2),applications of graphene and fullerenes, carbon nanotubes (types, preparation and applications) ***Thermal analysis techniques***: Instrumentation and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC).

Part-B:

Refractories: - Definition, classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

Lubricants: - Definition, mechanism of lubricants, properties (definition and importance).

Cement: - Constituents, manufacturing, parameters to characterize the clinker formation: lime saturation factor (LSF), silica ratio (SR) and alumina ratio (AR), chemistry of setting and hardening, deterioration of cement.

Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Synthesize*** nanomaterials for modern advances of engineering technology.
- ***Summarize*** the techniques that detect and measure changes of state of reaction.
- ***Illustrate*** the commonly used industrial materials.

UNIT IV: FUELS 10 hrs

Introduction, calorific value, higher calorific value, lower calorific values, problems using Dulong's formula, proximate and ultimate analysis of coal sample and their significance, numerical problems, petroleum (refining-cracking), synthetic petrol (Fischer Tropsch and Bergius), petrol knocking, diesel knocking, octane and cetane ratings, anti-knocking agents, Introduction to alternative fuels (Bio-diesel, ethanol, methanol, natural gas, liquefied petroleum gas, compressed natural gas), Flue gas analysis by Orsat apparatus, rocket fuels.

Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Differentiate*** petroleum, petrol, synthetic petrol and have knowledge how they are produced.
- ***Study*** alternate fuels and a***nalyse*** flue gases.

UNIT V: WATER TECHNOLOGY 8 hrs

Hardness of water, determination of hardness by complexometric method, boiler troubles (priming and foaming, scale formation, boiler corrosion, caustic embrittlement), internal treatments, softening of hard water (zeolite process and related sums, ion exchange process), treatment of industrial waste water, potable water and its specifications, steps involved in purification of water, chlorination, break point chlorination-desalination (reverse osmosis and electro dialysis).

Course Outcomes: ***At the end of this unit, the students will be able to***

- ***Analyze*** the suitable methods for purification and treatment of hard water and brackish water.

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Standard Books:

1. P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
4. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).

Reference:

1. K. Sesha Maheshwaramma and Mridula Chugh, "**Engineering Chemistry**", Pearson India Edn.
2. O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
3. CNR Rao and JM Honig (Eds) "**Preparation and characterization of materials**" Academic press,New York (latest edition)
4. B. S. Murthy, P. Shankar and others, "**Textbook of Nanoscience and Nanotechnology**", University press (latest edition)

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I Year - I Semester		L	T	P	C
		3	0	0	3
ENIGINEERING MECHANICS					

Objectives: The students completing this course are expected to understand the concepts of forces and its resolution in different planes, resultant of force system, Forces acting on a body, their free body diagrams using graphical methods. They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work - energy method.

UNIT – I
Objectives: The students are to be exposed to the concepts of force and friction, direction and its application.

Introduction to Engg. Mechanics – Basic Concepts.

Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.

Friction: Introduction**,** limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction

UNIT II
Objectives: The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.

Equilibrium of Systems of Forces: Free Body Diagrams, , Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

UNIT – III
Objectives: The students are to be exposed to concepts of centre of gravity. The students are to be exposed toconcepts of moment of inertia and polar moment of inertia including transfer methods and their applications.

Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity: Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies,Pappus theorems.

Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia:** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

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UNIT – IV
Objectives: The students are to be exposed to motion in straight line and in curvilinear paths, its velocity andacceleration computation and methods of representing plane motion.

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics- Work Energy method and applicationsto particle motion- Impulse momentum method.

UNIT – V
Objectives: The students are to be exposed to rigid motion kinematics and kinetics

Rigid body Motion: Kinematics and kinetics of translation, Rotation about fixed axis and plane motion, Work Energymethod and Impulse momentum method.

TEXT BOOK:
1. Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw Hill publications.

Course outcomes:
1. The student should be able to draw free body diagrams for FBDs for particles and rigid bodies in plane andspace and problems to solve the unknown forces, orientations and geometric parameters.
2. He should be able to determine centroid for lines, areas and center of gravity for volumes and their composites.
3. He should be able to determine area and mass movement of inertia for composite sections
4. He should be able to analyze motion of particles and rigid bodies and apply the principles of motion, workenergy and impulse – momentum.

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		L	T	P	C
I Year - I Semester		**3**	**0**	**0**	**3**
COMMUNICATIVE ENGLISH					

Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

Course Objectives

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Learning Outcomes

At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

Unit I:

Lesson-1: A Drawer full of happiness from "**Infotech English**", Maruthi Publications

Lesson-2: Deliverance by Premchand from "**The Individual Society",**Pearson Publications. (Non-detailed)

Listening: Listening to short audio texts and identifying the topic. Listening to prose, prose and Conversation.

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Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self introductions and introducing others.
Reading: Skimming text to get the main idea. Scanning to look for specific pieces of information.
Reading for Writing: Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.
Vocabulary: Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.
Grammar: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.
Pronunciation: Vowels, Consonants, Plural markers and their realizations

Unit II:
Lesson-1: Nehru's letter to his daughter Indira on her birthday from "**Infotech English**", Maruthi Publications
Lesson-2: Bosom Friend by Hira Bansode from "**The Individual Society",** Pearson Publications.(Non-detailed)
Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts, both in speaking and writing.
Speaking: Discussion in pairs/ small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings.**Reading**: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.
Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)

Grammar: Use of articles and zero article; prepositions.
Pronunciation: Past tense markers, word stress-di-syllabic words

Unit III:
Lesson-1: Stephen Hawking-Positivity 'Benchmark' from "**Infotech English**", Maruthi Publications
Lesson-2: Shakespeare's Sister by Virginia Woolf from "**The Individual Society",** Pearson Publications.(Non-detailed**)**
Listening: Listening for global comprehension and summarizing what is listened to, both in speaking and writing.
Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed.Functional English:Complaining and Apologizing.
Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension.Critical reading.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing.E-mail etiquette, Writing CV's.

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Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words

Grammar: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.
Pronunciation: word stress-poly-syllabic words.

Unit IV:
Lesson-1: Liking a Tree, Unbowed: Wangari Maathai-biography from "**Infotech English**", Maruthi Publications
Lesson-2: Telephone Conversation-Wole Soyinka from "**The Individual Society",** Pearson Publications**.**(Non-detailed)
Listening: Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.Functional English: Permissions, Requesting, Inviting.
Reading: Studying the use of graphic elements in texts to convey information, revealtrends/patterns/relationships, communicative process or display complicated data.
Reading for Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables.Writing SOP, writing for media.
Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.
Grammar: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms
Pronunciation: Contrastive Stress

Unit V:
Lesson-1: Stay Hungry-Stay foolish from "**Infotech English**", Maruthi Publications
Lesson-2: Still I Rise by Maya Angelou from "**The Individual Society",** Pearson Publications.(Non-detailed)
Listening: Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.
Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides.Functional English: Suggesting/Opinion giving.
Reading: Reading for comprehension. RAP StrategyIntensive reading and Extensive reading techniques.
Reading for Writing: Writing academic proposals- writing research articles: format and style.
Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.

Grammar: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)
Pronunciation: Stress in compound words

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Prescribed text books for theory for Semester-I:

1. "**Infotech English**", Maruthi Publications. (Detailed)
2. "**The Individual Society",** Pearson Publications.(Non-detailed)

Prescribed text book for Laboratory for Semesters-I & II:

1. "**Infotech English**", Maruthi Publications. (with Compact Disc)

Reference Books:

- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT;2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.

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I Year - I Semester		L	T	P	C
		2	0	2	3
PROGRAMMING FOR PROBLEM SOLVING USING C					

Course Objectives:

The objectives of Programming for Problem Solving Using C are

- To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
- To gain knowledge of the operators, selection, control statements and repetition in C
- To learn about the design concepts of arrays, strings, enumerated structure and union types. To learn about their usage.
- To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
- To assimilate about File I/O and significance of functions

Course Outcomes:

Upon the completion of the course the student will learn

- To write algorithms and to draw flowcharts for solving problems
- To convert flowcharts/algorithms to C Programs, compile and debug programs
- To use different operators, data types and write programs that use two-way/ multi-way selection
- To select the best loop construct for a given problem
- To design and implement programs to analyze the different pointer applications
- To decompose a problem into functions and to develop modular reusable code
- To apply File I/O operations

UNIT I

Introduction to Computers: Creating and running Programs, Computer Numbering System, Storing Integers, Storing Real Numbers

Introduction to the C Language: Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples, Scope, Storage Classes and Type Qualifiers.

Structure of a C Program: Expressions Precedence and Associativity, Side Effects, Evaluating Expressions, Type Conversion Statements, Simple Programs, Command Line Arguments.

UNIT II

Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators.

Selection & Making Decisions: Logical Data and Operators, Two Way Selection, Multiway Selection, More Standard Functions.

Repetition: Concept of Loop, Pretest and Post-test Loops, Initialization and Updating, Event and Counter Controlled Loops, Loops in C, Other Statements Related to Looping, Looping Applications, Programming Examples.

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UNIT III

Arrays: Concepts, Using Array in C, Array Application, Two Dimensional Arrays,Multidimensional Arrays, Programming Example – Calculate Averages
Strings: String Concepts, C String, String Input / Output Functions, Arrays of Strings, String Manipulation Functions String/ Data Conversion, A Programming Example – Morse Code
Enumerated, Structure, and Union: The Type Definition (Type def), Enumerated Types, Structure, Unions, and Programming Application.

UNIT IV

Pointers: Introduction, Pointers to pointers, Compatibility, L value and R value
Pointer Applications: Arrays, and Pointers, Pointer Arithmetic and Arrays, Memory Allocation Function, Array of Pointers, Programming Application.
Processor Commands: Processor Commands.

UNIT V

Functions: Designing, Structured Programs, Function in C, User Defined Functions, Inter-Function Communication, Standard Functions, Passing Array to Functions, Passing Pointers to Functions, Recursion
Text Input / Output: Files, Streams, Standard Library Input / Output Functions, Formatting Input / Output Functions, Character Input / Output Functions
Binary Input / Output: Text versus Binary Streams, Standard Library, Functions for Files, Converting File Type.

Text Books:

1) Programming for Problem Solving, Behrouz A. Forouzan, Richard F.Gilberg, CENGAGE.
2) The C Programming Language, Brian W.Kernighan, Dennis M. Ritchie, 2e, Pearson.

Reference Books:

1) Computer Fundamentals and Programming, Sumithabha Das, Mc Graw Hill.
2) Programming in C, Ashok N. Kamthane, Amit Kamthane, Pearson.
3) Computer Fundam

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I Year - I Semester		L	T	P	C
		0	0	3	1.5
ENGINEERING CHEMISTRY LABORATORY					

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na2CO3 solution.
2. Determination of alkalinity of a sample containing Na2CO3 and NaOH.
3. Determination of Mn^{+2} using standard oxalic acid solution.
4. Determination of ferrous iron using standard K2Cr2O7 solution.
5. Determination of Cu^{+2} using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Fe^{+3} by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of iso-electric point of amino acids using pH-metry method/conductometric method.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Determination of Mg^{+2} present in an antacid.
13. Determination of CaCO3 present in an egg shell.
14. Estimation of Vitamin C.
15. Determination of phosphoric content in soft drinks.
16. Adsorption of acetic acid by charcoal.
17. Preparation of nylon-6, 6 and Bakelite (demonstration only).

Of the above experiments at-least 10 assessment experiments should be completed in a semester.

Outcomes: The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

Reference Books

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.

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I Year - I Semester		L	T	P	C
		0	0	3	1.5
PROGRAMMING FOR PROBLEM SOLVING USING CLABORATORY					

Course Objectives:

- Apply the principles of C language in problem solving.
- To design flowcharts, algorithms and knowing how to debug programs.
- To design & develop of C programs using arrays, strings pointers & functions.
- To review the file operations, preprocessor commands.

Course Outcomes:

By the end of the Lab, the student

- Gains Knowledge on various concepts of a C language.
- Able to draw flowcharts and write algorithms.
- Able design and development of C problem solving skills.
- Able to design and develop modular programming skills.
- Able to trace and debug a program

Exercise 1:

1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five characters.
2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.
3. Write a C program to display multiple variables.

Exercise 2:

1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

Exercise 3:

1. Write a C program to convert a string to a long integer.
2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
3. Write a C program to calculate the factorial of a given number.

Exercise 4:

1. Write a program in C to display the n terms of even natural number and their sum.
2. Write a program in C to display the n terms of harmonic series and their sum.1 + 1/2 + 1/3 + 1/4 + 1/5 ... 1/n terms.
3. Write a C program to check whether a given number is an Armstrong number or not.

Exercise 5:

1. Write a program in C to print all unique elements in an array.
2. Write a program in C to separate odd and even integers in separate arrays.
3. Write a program in C to sort elements of array in ascending order.

Exercise 6:

1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix.

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Exercise 7:

1. Write a program in C to search an element in a row wise and column wise sorted matrix.
2. Write a program in C to print individual characters of string in reverse order.

Exercise 8:

1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

Exercise 9:

1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
2. Write a program in C to demonstrate how to handle the pointers in the program.

Exercise 10:

1. Write a program in C to demonstrate the use of & (address of) and *(value at address) operator.
2. Write a program in C to add two numbers using pointers.

Exercise 11:

1. Write a program in C to add numbers using call by reference.
2. Write a program in C to find the largest element using Dynamic Memory Allocation.

Exercise 12:

1. Write a program in C to swap elements using call by reference.
2. Write a program in C to count the number of vowels and consonants in a string using a pointer.

Exercise 13:

1. Write a program in C to show how a function returning pointer.
2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc( ) function.

Exercise 14:

1. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc( ) function. Understand the difference between the above two programs
2. Write a program in C to convert decimal number to binary number using the function.

Exercise 15:

1. Write a program in C to check whether a number is a prime number or not using the function.
2. Write a program in C to get the largest element of an array using the function.

Exercise 16:

1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to remove a file from the disk.

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I Year - I Semester		L	T	P	C
		0	0	3	1.5
ENGLISH COMMUNICATION SKILLS LABORATORY					

TOPICS

UNIT I:

Vowels, Consonants, Pronunciation, Phonetic Transcription, Common Errors in Pronunciation,

UNIT II:

Word stress-di-syllabic words, poly-syllabic words, weak and strong forms, contrastive stress (Homographs)

UNIT III:

Stress in compound words,rhythm, intonation,accent neutralisation.

UNIT IV:

Listening to short audio texts and identifying the context and specific pieces of information toanswer a series of questions in speaking.

UNIT V:

Newspapers reading;Understanding and identifying key terms and structures useful for writing reports.

Prescribed text book: "**Infotech English**", Maruthi Publications.

References:

4. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
5. English Pronunciation in use- Mark Hancock, Cambridge University Press.
6. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
7. English Pronunciation in use- Mark Hewings, Cambridge University Press.
8. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
9. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.

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I Year - I Semester		L	T	P	C
		2	0	0	0
ENVIRONMENTAL SCIENCE					

Course Objectives:

The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

UNIT I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information technology in environment and human health.

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT II

Natural Resources: Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT III

Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

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UNIT IV

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

UNIT V

Social Issues and the Environment: Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act - Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.

Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.

The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:

1) Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2) Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
3) Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

Reference Books:

1) Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2) A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3) Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4) Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age InternationalPublishers, 2014

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I Year - II Semester		L	T	P	C
		3	0	0	3
MATHEMATICS - II (MATHEMATICAL METHODS)					

Course Objectives:

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various realworld problems and their applications.

Course Outcomes:

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

- develop the use of matrix algebra techniques that is needed by engineers forpractical applications (L6)
- solve system of linear algebraic equations using Gauss elimination, Gauss Jordan,Gauss Seidel (L3)
- evaluate approximating the roots of polynomial and transcendental equations bydifferent algorithms (L5)
- apply Newton's forward & backward interpolation and Lagrange's formulae for equaland unequal intervals (L3)
- apply different algorithms for approximating the solutions of ordinary differentialequations to its analytical computations (L3)

UNIT I: Solving systems of linear equations, Eigen values and Eigen vectors: (10 hrs)
Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous equations linear equations – Gauss Elimination for solving system of equations – Eigen values and Eigen vectors and their properties.

UNIT-II: Cayley-Hamilton theorem and Quadratic forms: (10 hrs)
Cayley - Hamilton theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton theorem – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation. Singular values of a matrix, singular value decomposition (Ref. Book – 1).

UNIT III: Iterative methods: (8 hrs)
Introduction – Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method (One variable and simultaneous Equations) – Jacobi and Gauss-Seidel methods for solving system of equations.

UNIT IV: Interpolation: (10 hrs)
Introduction – Errors in polynomial interpolation – Finite differences – Forward differences – Backward differences – Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula – Newton's divide difference formula.

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UNIT V: Numerical integration and solution of ordinary differential equations: (10 hrs) Trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule – Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Runge-Kutta method (second and fourth order).

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, 43^{rd} Edition, Khanna Publishers.
2) B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc.Graw Hill Education.

Reference Books:

1) David Poole, Linear Algebra- A modern introduction, 4^{th} Edition, Cengage.
2) Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineeringand Science, Tata Mc. Graw Hill Education.
3) M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific andEngineering Computation, New Age International Publications.

Lawrence Turyn, Advanced Engineering

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DEPARTMENT OF AUTOMOBILE ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
ENGINEERING PHYSICS					

Unit-I: Wave Optics 12hrs

Interference: Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications -Colors in thin films- Newton's Rings- Determination of wavelength and refractive index.
Diffraction: Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits(Qualitative) – Grating - Dispersive power and resolving power of Grating(Qualitative).
Polarization: Introduction-Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

Unit Outcomes:
The students will be able to

- **Explain** the need of coherent sources and the conditions for sustained interference (L2)
- **Identify** engineering applications of interference (L3)
- **Analyze** the differences between interference and diffraction with applications (L4)
- **Illustrate** the concept of polarization of light and its applications (L2)
- **Classify** ordinary polarized light and extraordinary polarized light (L2)

Unit-II: Lasers and Fiber optics 10hrs

Lasers: Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein's coefficients – Population inversion –Lasing action- Pumping mechanisms – Ruby laser – He-Ne laser - Applications of lasers.

Fiber optics: Introduction –Principle of optical fiber- Acceptance Angle-Numerical Aperture- Classification of optical fibers based on refractive index profile and modes – Propagation of electromagnetic wave through optical fibers - Applications.

Unit Outcomes:
The students will be able to

- **Understand** the basic concepts of LASER light Sources (L2)
- **Apply** the concepts to learn the types of lasers (L3)
- **Identifies** the Engineering applications of lasers (L2)
- **Explain** the working principle of optical fibers (L2)
- **Classify** optical fibers based on refractive index profile and mode of propagation (L2)
- **Identify** the applications of optical fibers in various fields (L2)

UNIT III: Engineering Materials 8hrs

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius- Mossotti equation- Piezoelectricity.

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Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization- Magnetic susceptibility and permeability - Origin of permanent magnetic moment - Classification of
magnetic materials: Dia, para, Ferro, antiferro & Ferrimagnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials- Eddy currents- Engineering applications.

Unit Outcomes:

The students will be able to

- **Explain** the concept of dielectric constant and polarization in dielectric materials (L2)
- **Summarize** various types of polarization of dielectrics (L2)
- **Interpret** Lorentz field and Claussius- Mosotti relation in dielectrics(L2)
- **Classify** the magnetic materials based on susceptibility and their temperature dependence (L2)
- **Explain** the applications of dielectric and magnetic materials (L2)
- **Apply** the concept of magnetism to magnetic devices (L3)

Unit-IV: Acoustics and Ultrasonics **10hrs**

Acoustics: Introduction – requirements of acoustically good hall– Reverberation – Reverberation time– Sabine's formula (Derivation using growth and decay method) - Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedial measures.

Ultrasonics: Introduction - Properties - Production by magnetostriction and piezoelectric methods – Detection - Acoustic grating - Non Destructive Testing – pulse echo system through transmission and reflection modes - Applications.

Unit Outcomes:

The students will be able to

- **Explain** how sound is propagated in buildings (L2)
- **Analyze** acoustic properties of typically used materials in buildings (L4)
- **Recognize** sound level disruptors and their use in architectural acoustics (L2)
- **Identify** the use of ultrasonics in different fields (L3)

Unit-V: Crystallography and X-ray diffraction **8hrs**

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattice – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X- ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

Unit Outcomes:

The students will be able to

- **Classify** various crystal systems (L2)
- **Identify** different planes in the crystal structure (L3)
- **Analyze** the crystalline structure by Bragg's X-ray diffractometer (L4)
- **Apply** powder method to measure the crystallinity of a solid (L4)

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Text books:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company
2. Engineering physics – D.K. Battacharya and Poonam Tandon, Oxford University press.
3. Engineering Physics by P.K.Palanisamy SciTech publications.

Reference Books:

1. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons
2. Engineering Physics – M.R.Srinivasan, New Age Publications
3. Engineering Physics – D K Pandey, S. Chaturvedi, Cengage Learning
4. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press

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DEPARTMENT OF AUTOMOBILE ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
METALLURGY & MATERIALS SCIENCE					

Course Objective: To understand the basic fundamentals of Material science and Physical metallurgy. The basic concepts to be taught will help for the improvement, proper selection and effective utilization of materials which is essential to satisfy the ever increasing demands of the society.

UNIT – I

Structure of Metals and Constitution of alloys: Bonds in Solids, Metallic bond, crystallization of metals, Packing Factor - SC, BCC, FCC& HCP-line density, plane density. Grain and grain boundaries, effect of grain boundaries on the Properties of metal / alloys – determination of grain size. Imperfections – point, line, surface and volume- Slip and Twinning.
Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds

Equilibrium Diagrams : Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe3C.

UNIT –II

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.
Non-ferrous Metals and Alloys: Structure and properties of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

UNIT – III

Heat treatment of Alloys: Effect of alloying elements on Fe-Fe3C system, Annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

UNIT – IV

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization-Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Sintering Secondary operations-Sizing, coining, machining -Factors determining the use of powder metallurgy-Application of this process.

UNIT – V

Ceramic and composite materials: Crystalline ceramics, glasses, cermets, abrasive materials, Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and C - C composites. Nanomaterials – definition, properties and applications.

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TEXT BOOKS:

1. Introduction to Physical Metallurgy - Sidney H. Avener - McGrawHill
2. Essential of Materials science and engineering - Donald R.Askeland - Cengage.

REFERENCES:

1. Material Science and Metallurgy – Dr. V.D.kodgire- Everest Publishing House
2. Materials Science and engineering - Callister & Baalasubrahmanyam- Wiley Publications
3. Material Science for Engineering students – Fischer – Elsevier Publishers
4. Material science and Engineering - V. Rahghavan-PHI Publishers
5. Introduction to Material Science and Engineering – Yip-Wah Chung CRC Press
6. Material Science and Metallurgy – A V K Suryanarayana – B S Publications
7. Material Science and Metallurgy – U. C. Jindal – Pearson Publications

Course Outcomes:

CO1: Understand the crystalline structure of different metals and study the stability of phases in different alloy systems.

CO2: Study the behavior of ferrous and non ferrous metals and alloys and their application in different domains

CO3: Able to understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals.

CO4: Grasp the methods of making of metal powders and applications of powder metallurgy CO5: Comprehend the properties and applications of ceramic, composites andother advanced methods.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
BASIC ELECTRICAL AND ELECTRONICS ENGINEERING					

Preamble:

This course covers the topics related to analysis of various electrical circuits, operation of various electrical machines and electronic components to perform well in their respective fields.

Learning Objectives:

- To learn the basic principles of electrical circuital law's and analysis of networks.
- To understand principle of operation and construction details of DC machines.
- To understand principle of operation and construction details of transformers, alternator and 3-Phase induction motor.
- To study operation of PN junction diode, half wave, full wave rectifiers and OP-AMPs.
- To learn operation of PNP and NPN transistors and various amplifiers.

Unit - I
Electrical Circuits

Basic definitions – types of network elements – Ohm's Law – Kirchhoff's Laws – inductive networks – capacitive networks – series – parallel circuits – star-delta and delta-star transformations.- Numerical Problems.

Unit - II
DC Machines

Principle of operation of DC generator – EMF equation – types of DC machines – torque equation characteristics of DC motors – applications – three point starter – speed control methods of DC motor – Swinburne's Test-Brake test on DC shunt motor-Numerical problems.

Unit – III
AC Machines:
Transformers Principle of operation and construction of single phase transformers – EMF equation – Losses – OC & SC tests – efficiency and regulation-Numerical Problems.

AC Rotating Machines
Principle of operation and construction of alternators – types of alternators Regulation of alternator by synchronous impedance method – principle of operation of synchronous motor – principle of operation of 3- Phase induction motor – slip-torque characteristics – efficiency – applications- Numerical Problems.

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Unit IV
Rectifiers & Linear ICs

PN junction diodes – diode applications (half wave and bridge rectifiers). Characteristics of operationamplifiers (OP-AMP) – application of OP-AMPs (inverting, non-inverting, integrator and differentiator)- Numerical Problems.

Unit V

Transistos

PNP and NPN junction transistor, transistor as an amplifier– frequency response of CE amplifier – Basicconcepts of feedback amplifier-Numerical problems.

Learning Outcomes:

The student should be able to:

- Analyse various electrical networks.
- Understand operation of DC generators,3-point starter and DC machine testing by Swinburne's Test and Brake test.
- Analyse performance of single-phase transformer and acquire proper knowledge and working of 3-phase alternator and 3-phase induction motors.
- Analyse operation of half wave, full wave bridge rectifiers and OP-AMPs.
- Understanding operations of CE amplifier and basic concept of feedback amplifier.

Text Books:

1. Electrical Technology by Surinder Pal Bali, Pearson Publications.
2. Electronic Devices and Circuits by R.L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.

Reference Books:

1. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group
2. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
3. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications,2nd edition
4. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications,2nd edition
5. Industrial Electronics by G.K. Mittal, PHI

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DEPARTMENT OF AUTOMOBILE ENGINEERING

I Year - II Semester		L	T	P	C
		2	0	2	3
ENGINEERING GRAPHICS					

Course Objective: Engineering drawing being the principal method of communication for engineers, the objective is to introduce the students, the techniques of constructing the various types of polygons. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

Unit I
Objective: To introduce the students to use orthographic projections, projections of points & simple lines. To make the students draw the projections of the lines inclined to both the planes.
Introduction to Engineering graphics.
Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.
Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclinationand traces.

Unit II
Objective: The objective is to make the students draw the projections of the plane and solids inclined toboth the reference planes.
Projections of planes: Construction of polygons, regular planes perpendicular/parallel to one reference planeand inclined to the other reference plane, plane objects/ inclined to both the reference plane.
Projections of Solids – Prisms, Pyramids, Cones and Cylinders – simple positions.

Unit III
Objective:
The objective is to make the students draw the projections ands sections of the various types of solids indifferent positions inclined to both the planes.
Projections of Solids – Prisms, Pyramids, Cones and Cylinders – axis inclined to both the planes.
SECTIONS OF SOLIDS: Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views.

UNIT-IV
The knowledge of interpenetration of solids and development of surfaces is required in designing and manufacturing of the objects. Whenever two or more solids combine, a definite curve is seen at their intersection.
INTERPENETRATION OF RIGHT REGULAR SOLIDS: Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone, Prism Vs Cone.
DEVELOPMENT OF SURFACES: Development of Surfaces of Right Regular Solids – Prism, Cylinder,Pyramid, Cone and their parts.

Unit V
Objective: The objective is to represent the object in 3D view through isometric views. The student will beable to represent and convert the isometric view to orthographic view and vice versa.
Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

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TEXT BOOKS:

1. Engineering Drawing by N.D. Bhatt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

REFERENCE BOOKS:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

Course Outcomes:

CO1. To make the students to draw the attributes and its importance in the fields ofdesign and manufacturing

CO2. To make the student familiar with the techniques used for drawing various geometricelements used in engineering practice.

CO3. Making them to understand orthographic projections of points, lines, planes and solids in variouspositions with respect to different reference planes.

CO4. Ability to use the concepts of isometric projections to analyze 3D objects by viewing their2D projections and vice versa.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

I Year - II Semester		L	T	P	C
		0	0	3	1.5
BASIC ELECTRICAL & ELECTRONICS ENGINEERINGLABORATORY					

Learning Objectives:

- To predetermine the efficiency of dc shunt machine using Swinburne's test.
- To predetermine the efficiency and regulation of 1-phase transformer with O.C and S.C tests.
- To obtain performance characteristics of DC shunt motor &3-phase induction motor.
- To find out regulation of an alternator with synchronous impedance method.
- To control speed of dc shunt motor using Armature voltage and Field flux control methods.
- To find out the characteristics of PN junction diode & transistor
- To determine the ripple factor of half wave & full wave rectifiers.

Section A: Electrical Engineering:

The following experiments are required to be conducted as compulsory experiments:

1. Swinburne's test on D.C. Shunt machine (predetermination of efficiency of a given D.C. shunt machine working as motor and generator).
2. OC and SC tests on single phase transformer (predetermination of efficiency and regulation at given power factors).
3. Brake test on 3-phase Induction motor (determination of performance characteristics)
4. Regulation of alternator by Synchronous impedance method.
5. Speed control of D.C. Shunt motor by
   a) Armature Voltage control b) Field flux control method
6. Brake test on D.C. Shunt Motor.

Section B: Electronics Engineering:

The following experiments are required to be conducted as compulsory experiments:

1. PN junction diode characteristics a) Forward bias b) Reverse bias (Cut in voltageand resistance calculations)
2. Transistor CE characteristics (input and output)
3. Half wave rectifier with and without filters.
4. Full wave rectifier with and without filters.
5. CE amplifiers.
6. OP- amp applications (inverting, non inverting, integrator and differentiator)

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Learning Outcomes:

The student should be able to:

- Compute the efficiency of DC shunt machine without actual loading of the machine.
- Estimate the efficiency and regulation at different load conditions and power factors for single phase transformer with OC and SC tests.
- Analyse the performance characteristics and to determine efficiency of DC shunt motor &3-Phase induction motor.
- Pre-determine the regulation of an alternator by synchronous impedance method.
- Control the speed of dc shunt motor using Armature voltage and Field flux control methods.
- Draw the characteristics of PN junction diode & transistor
- Determine the ripple factor of half wave & full wave rectifiers.

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I Year - II Semester		L	T	P	C
		0	0	3	1.5
ENGINEERING PHYSICS LABORATORY					

(Any 10 of the following listed experiments)

List of Engineering Physics Experiments

1. Laser: Determination of wavelength using diffraction grating.
2. Young's modulus of given material by Strain gauge method.
3. Study of variation of magnetic field along the axis of a current carrying circularcoil by Stewart & Gee's method.
4. Determination of ultrasonic velocity in given liquid (Acoustic grating).
5. Determination of dielectric constant using charging and discharging method.
6. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
7. Estimation of Planck's constant using photoelectric effect.
8. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum).
9. Determination of numerical aperture and acceptance angle of an optical fiber.
10. Determination of thickness of thin object by wedge method.
11. Determination of radius of curvature of given plano convex lens by Newton's rings.
12. Determination of wavelengths of different spectral lines in mercury spectrumusing diffraction grating in normal incidence configuration.
13. Determination of dispersive power of the prism.
14. Sonometer: Verification of laws of string.
15. Measurement of magnetic susceptibility by Kundt's tube method.

References:

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.

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I Year - II Semester		L	T	P	C
		0	0	3	1.5
ENGINEERING WORKSHOP & IT WORKSHOP LABORATORY					

Course Objective:
To impart hands-on practice on basic engineering trades and skills.
Note: At least two exercises to be done from each trade.

ENGINEERING WORKSHOP:
Trade:

1. Carpentry
1. T-Lap Joint
2. Cross Lap Joint
3. Dovetail Joint
4. Mortise and Tenon Joint

2. Fitting
1. Vee Fit
2. Square Fit
3. Half Round Fit
4. Dovetail Fit

3. Black Smithy
1. Round rod to Square
2. S-Hook
3. Round Rod to Flat Ring
4. Round Rod to Square headed bolt

4. House Wiring
1. Parallel / Series Connection of three bulbs
2. Stair Case wiring
3. Florescent Lamp Fitting
4. Measurement of Earth Resistance

5. **Tin Smithy**
1. Taper Tray
2. Square Box without lid
3. Open Scoop
4. Funnel

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IT WORKSHOP:

1. **MATLAB**
2. **LATEX (Optional)**
3. **Sensors & Actuators (Any Two)**
   a. To study the temperature – resistance & Voltage characteristics of the thermistor.
   b. To study the characteristics of the pressure cell with respect to bridge voltage.
   c. To study the response of distance versus voltage & Resistance in Light Dependent Resistors (LDR).
   d. To study the response of distance versus voltage in photodiode & phototransistor.
   e. Speed control of DC motor, DC Servo motor & DC Stepper motor
   f. Circuit development using different relay
4. **Make use of "Assembly Level Coding" or " Embedded C Coding to execute the any TWOexperiments from the area of Microcontroller**
   a. Program for blinking LEDs (converge and diverge without overlapping) at any GPIO pins ofMicrocontroller
   b. Program for interfacing nxn LED matrix and displaying various patterns Microcontroller
   c. Program To Display Counter Of 0 To 9999 On Seven Segment Display
   d. Program for interfacing 16x2 LCD with Microcontroller
   e. Program To Control The Operation Of Relay And Buzzer
   f. Program of analog to digital converter for microcontroller
   g. Program of Real Time Control (RTC)
   h. Program To Control The Operation Of Stepper Motor
   i. Program To Control The Operation Of DC Motor
   j. Program To Control The Operation Of Servo Motor
   k. Program for displaying hello world message
5. **Make use of "Ladder Logic Programming" to execute the any TWO experiments from thearea of Programmable Logic Control (PLC)**
   a. Design a PLC ladder diagram to construct an alarm system which operates as follows

   If one input is on, nothing happens
   If any 2 inputs are on, red light turns on
   If any 3 inputs are on, an alarm sirens sound
   And if all the inputs are on then the fire department is to be notified.

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b. A conveyor is supposed to have exactly 45 parts on it. You have three indicating lights to indicate the conveyor count status: less than 45, yellow: exactly 45, green: and more than 45, red. The count of parts on the conveyor is set at 45 each morning by an actual count of parts. There are two sensors on the conveyor, one is actuated by parts entering the conveyor, and the other is actuated by parts leaving. Design a PLC program to carry out this process.

c. In certain process control application when the count reaches 25, a paint spray is to run for 40 seconds. Design, construct, and test PLC circuits for this process.

d. Design and implement ladder logic to interface analog sensor with PLC.

e. Design and Implement ladder logic algorithm for a Car Parking System usingSensors

Resources Required:

1. Sensors
   a) Temperature
   b) LDR
   c) Load Cell
   d) Piezoelectric
   e) Strain Gauge
   f) Pressure
   g) Proximity
2. Actuators
   a) DC Motor
   b) Servo Motor
   c) Stepper Motor
   d) Relays
3. Microcontroller development board with IDE
4. Any PLC programming software like Rexroth, Allen Bradly, Siemens, Omron etc.

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I Year - II Semester		L	T	P	C
		2	0	0	0
CONSTITUTION OF INDIA					

Course Objectives:

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high courtcontroller and auditor general of India and election commission of India.
- To understand the central and state relation financial and administrative.

UNIT-I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Learning outcomes:
After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History, features of Indian constitution
- Evaluate Preamble Fundamental Rights and Duties

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions;

Learning outcomes:-After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government
- Explain the role of President and Prime Minister
- Know the Structure of supreme court and High court

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

Learning outcomes:-After completion of this unit student will

- Understand the structure of state government
- Analyze the role Governor and Chief Minister
- Explain the role of state Secretariat
- Differentiate between structure and functions of state secretariat

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UNIT-IV

A. Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

Learning outcomes:-After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration role and importance
- Analyze the role of Myer and elected representatives of Municipalities
- Evaluate Zilla panchayat block level organisation

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women

Learning outcomes:-After completion of this unit student will

- Know the role of Election Commission apply knowledge
- Contrast and compare the role of Chief Election commissioner andCommissiononerate
- Analyze role of state election commission
- Evaluate various commissions of viz SC/ST/OBC and women

References:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government andPolitics Hans
7. J. Raj IndianGovernment and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hallof India Pvt. Ltd.. New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right),Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

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E-resources:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

Course Outcomes:

At the end of the semester/course, the student will be able to have a clear knowledge onthe following:

- Understand historical background of the constitution making and itsimportance for building ademocratic India.
- Understand the functioning of three wings of the government ie., executive,legislative and judiciary.
- Understand the value of the fundamental rights and duties for becoming goodcitizen of India.
- Analyze the decentralization of power between central, state and local self-government.
- Apply the knowledge in strengthening of the constitutional institutionslike CAG, ElectionCommission and UPSC for sustaining democracy.

1. Know the sources, features and principles of Indian Constitution.
2. Learn about Union Government, State government and its administration.
3. Get acquainted with Local administration and Pachayati Raj.
4. Be aware of basic concepts and developments of Human Rights.
5. Gain knowledge on roles and functioning of Election Commission.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
MATHEMATICS-III (VECTOR CALCULUS, TRANSFORMS AND PDE)					

Course Objectives:
- To familiarize the techniques in partial differential equations
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

Course Outcomes: At the end of the course, the student will be able to
- interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- estimate the work done against a field, circulation and flux using vector calculus (L5)
- apply the Laplace transform for solving differential equations (L3)
- find or compute the Fourier series of periodic signals (L3)
- know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)
- identify solution methods for partial differential equations that model physical processes (L3)

UNIT –I: Vector calculus: (10 hrs)
Vector Differentiation: Gradient– Directional derivative – Divergence– Curl– Scalar Potential.

Vector Integration: Line integral – Work done – Area– Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and problems on above theorems.

UNIT –II: Laplace Transforms: (10 hrs)
Laplace transforms – Definition and Laplace transforms of some certain functions– Shifting theorems – Transforms of derivatives and integrals – Unit step function –Dirac's delta functionPeriodic function – Inverse Laplace transforms– Convolution theorem (with out proof).
Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

UNIT –III: Fourier series and Fourier Transforms: (10 hrs)
Fourier Series: Introduction– Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions –Change of interval– Half-range sine and cosine series.

Fourier Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Sine and cosine transforms – Properties (article-22.5 in text book-1)– inverse transforms – Convolution theorem (without proof) – Finite Fourier transforms.

UNIT –IV: PDE of first order: **(8 hrs)**
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

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UNIT – V: Second order PDE and Applications: (10 hrs)

Second order PDE: Solutions of linear partial differential equations with constant coefficients –Non-homogeneous term of the type e^{ax+by} ,$\sin(ax+by), \cos(ax+by), x^m y^n$.

Applications of PDE: Method of separation of Variables– Solution of One dimensional Wave, Heat andtwo-dimensional Laplace equation.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **B. V. Ramana,**Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Dean. G. Duffy,** Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.
3. **Peter O' Neil,** Advanced Engineering Mathematics, Cengage.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
THERMODYNAMICS					

Course Objectives:
To impart the knowledge of the thermodynamic laws and principles so as to enable the student to prepare an energy audit of any mechanical system that exchange heat and work with the surroundings**.**

UNIT – I
Introduction: Basic Concepts : System, boundary, Surrounding, Universe, control volume, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process - Reversible, Quasi static & Irreversible Processes, cycle, Causes of Irreversibility. Energy in State and in Transition - Types, Work and Heat, Point and Pathfunction.
Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry –Reference Points – Const. Volume gas Thermometer – Scales of Temperature.

UNIT – II
Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system –Energy balance for closed systems-Specific heats- Internal energy, Enthalpy and Specific heats of Solids, liquids and Ideal gases, Some steady flow energy equation applied to Nozzle, Turbine, Compressor and heat exchanger devices,PMM-I.

UNIT - III
Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence, Corollaries, PMM of Second kind, Carnot cycle and its specialties, Carnot's theorem, Thermodynamic scale of Temperature.
Clausius Inequality, Entropy, Principle of Entropy Increase, Availability and Irreversibility (Basic definitions) – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT -IV
Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point and critical point, properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation, Property tables. Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

UNIT – V
Ideal Gas equation of state- Compressibility factor- Van der Waals equation of state- Beattie-Bridgeman equation of state- Benedict-Webb-Rubin equation of state- Viral equation of state-compressibility charts – variable specific heats .
Mixtures of perfect Gases – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes-Equivalent Gas constant and Molecular Internal Energy, Enthalpy, Specific Heat and Entropy of Mixture of Perfect Gases and Vapour.
Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, Saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier's Equation – Psychrometric chart.

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TEXT BOOKS:

1. Engineering Thermodynamics, PK Nag 6thEdn , McGrawHill.
2. Fundamentals of Thermodynamics – Sonntag, Borgnakke, Van Wylen, 6th Edn,Wiley

REFERENCES:

1. Thermodynamics by Prasanna Kumar, PearsonPublishers
2. Engineering Thermodynamics – Jones & DuganPHI
3. Thermodynamics, an Engineering Approach, Yunus A Cenegel, Michael A Boles, 8thEdn inSI Units, McGrawHill.
4. Thermodynamics – J.P.Holman ,McGrawHill
5. An Introduction to Thermodynamics - Y.V.C.Rao – Universitiespress.
6. Thermodynamics – W.Z.Black& J.G.Hartley, 3rd Edn Pearson Publ.
7. Engineering Thermodynamics – D.P.Misra, CengagePubl.
8. Engineering Thermodynamics – P.Chattopadhyay – Oxford Higher EdnPubl.

COURSE OUTCOMES:

After undergoing the course the student is expected to learn

CO1: Basic concepts of thermodynamics
CO2: Laws of thermodynamics
CO3: Concept of entropy
CO4: Property evaluation of vapors and their depiction in tables and charts
CO5: Evaluation of properties of perfect gas mixtures.

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II Year - I Semester		L	T	P	C
		3	0	0	3
MECHANICS OF SOLIDS					

Objective: The students completing this course are expected to understand the basic terms like stress, strain, poissons ratio…etc and different stresses and deflections induced in beams, thin cylinders, thick cylinders, and columns. Further, the student shall be able to understand the shear stresses due to torsion in circular shafts.

UNIT – I

SIMPLE STRESSES &STRAINS : Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses

- Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shockloadings.

UNIT – II

SHEAR FORCE AND BENDING MOMENT : Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads

– Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of abeam.

UNIT – III

FLEXURAL STRESSES : Theory of simple bending – Assumptions – Derivation of bending equation: M/ I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT – IV

DEFLECTION OF BEAMS : Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to pointloads,

- U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams, Statically indeterminate Beams and solutionmethods.

TORSION: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

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UNIT – V

THIN AND THICK CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures –compoundcylinders.

COLUMNS:

Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine'sFormula,

TEXT BOOK:

1. Strength of materials /GH Ryder/ Mc Millan publishers IndiaLtd.
2. Strength of materials by B.C. Punmia-lakshmi publications pvt.Ltd, New Delhi.

REFERENCES :

1. Mechanics of Materials by Gere &Timeshenko
2. Strength of Materials -By Jindal, UmeshPublications.
3. Strength of Materials by S.Timshenko- D. VAN NOSTRAND Company- PHIPublishers
4. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman-HarpercollinsCollege Division
5. Solid Mechanics, byPopov-
6. Mechanics of Materials/Gere and Timoshenko, CBS Publishers

COURSE OUTCOMES:

On the completion of the course the student will able to

CO1: Model & Analyze the behavior of basic structural members subjected to various loading and support conditions based on principles of equilibrium.

CO2: Understand the apply the concept of stress and strain to analyze and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment.

CO3: Students will learn all the methods to analyze beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components. Students are able to analyse beams and draw correct and complete shear and bending moment diagrams for beams.

CO4: Students attain a deeper understanding of the loads, stresses, and strains acting on a structure and their relations in the elastic behavior

CO5: Design and analysis of Industrial components like pressure vessels.

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II Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
FLUID MECHANICS AND HYDRAULIC MACHINES					

Course Objectives: The students completing this course are expected to understand the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Further, the student shall be able to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines**.**

UNIT I

Objective*:* After studying this unit student will know the concept of fluid and its properties,manometry, hydrostatic forces acting on different surfaces and also problem solvingtechniques.

Fluid statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws.

Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.

UNIT II

Objective: In this unit student will be exposed to the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.

Fluid kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortexflow.

Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend.

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

UNIT III

Objective: At the end of this unit student will be aware of the concepts related to boundary layer theory, flow separation, basic concepts of velocity profiles, dimensionless numbers and dimensional analysis.

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles.

Dimensional Analysis: Dimensions and Units, Dimensional Homogeneity, Non dimensionalization of equations, Method of repeating variables and Buckingham Pi Theorem.

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UNIT IV

Objective: In this unit student will know the hydrodynamic forces acting on vanes and performance evaluation of hydraulic turbines**.**

Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radialvanes.

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube- theory- functions andefficiency.

UNIT V

Objective: After studying this unit student will be in a position to understand the characteristic curves of hydraulic turbines and also evaluate the performance characteristics of hydraulic pumps**.**

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems- hydraulic ram, hydraulic lift, hydraulic coupling. Fluidics – amplifiers, sensors and oscillators. Advantages, limitations andapplications.

Centrifugalpumps: classification, working, work done – manometric head- losses and efficiencies- specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH. **Reciprocating pumps:** Working, Discharge, slip, indicatordiagrams.

TEXT BOOKS:

1. Fluid Mechanics- Fundementals and Applications by Y.A. Cengel, J.M.Cimbala, 6thEdn, McGrawHill
2. Fluid Mechanics - Dixon, 7thEdn,Elesvier

REFERENCE BOOKS:

1. Hydraulics, fluid mechanics and Hydraulic machinery- Modi andSeth
2. Fluid Mechanics and Hydraulic Machines - RK Bansal- Laxmi Publications (P)Ltd.
3. Fluid Mechanics and Hydraulic Machines -Rajput
4. Fluid Mechanics and Fluid Power Engineering - D.S. Kumar, Kotaria&Sons.
5. Fluid Mechanics and Machinery - D. Rama Durgaiah, New AgeInternational.

COURSE OUTCOMES:

From this course the student is expected to learn

CO1: The basic concepts of fluid properties.
CO2: The mechanics of fluids in static and dynamic conditions.
CO3: Boundary layer theory, flow separation and dimensional analysis.
CO4: Hydrodynamic forces of jet on vanes in different positions.
CO5: Working Principles and performance evaluation of hydraulic pump and turbines.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
COMPONENTS OF AUTOMOBILE CHASSIS					

COURSE OBJECTIVES:

i. To understand the basic knowledge about various vehicle frames, front axles, steering systemsand understand the conditions for true rolling motion of wheels duringsteering.
ii. To recognize the construction and working principle of drive line, final drive and differential systems
iii. To review the knowledge about the constructional feature of rear axle, wheels and tyres.
iv. To evaluatetheworkingprinciplesofbothconventionalandindependentsuspensionsystem.
iv. To demonstrate working principle of braking system used in automobile.

UNIT I

INTRODUCTION, FRAME, CLUTCHES & GEAR bOX

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames. Importance of Clutch, types and Applications. Requirement of Gear Box, Manual types of Gear Boxes including Synchromesh and its Applications

UNIT II

PROPELLER SHAFT AND FINAL DRIVE

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Final drive, different types, Double reduction and twin speed final drives, Multi–axled vehicles, Differential principle and types, Differential housings, limited speed differential, Differential locks.

UNIT III

AXLES AND TYRES

Construction and Design of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings and Types – Lift axle, Dead axle, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tyres and their constructional details.

UNIT IV

STEERING & SUSPENSION SYSTEM

Steering System: Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, EPAS.

Suspension System: Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi–Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Independent Suspension System, Shock Absorbers, Types and Constructional details.

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UNIT V

BRAKING SYSTEM

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Loading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Activators, Disc Brake Theory, Types and Construction, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Anti–Lock Braking System, Constructional Details.

TEXT BOOKS:

1. Kirpal Singh, Vol- I, Automobile Engineering, Standard Publisher, New Delhi ,2017
2. K.K.Ramalingam, "Automobile Engineering", scitech publication (India),2011.
3. R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited,2015

REFERENCES:

1. Heinz Hazler, Modern Vehicle Technology, Butterworth, London,2005.
2. HeldtP.M., Automotive Chassis, Chilton Co., New York,1990
3. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
4. N.K. Giri, Automotive Mechanics, Kanna Publishers,2007
5. William. H. Crows – Work shop Manuel –2005

COURSE OUTCOMES

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

i. Identify the different types of frame and chassis used inAutomotive.
ii. Relate different types of drive lines and drives used inAutomotive.
iii. Acquire knowledge about different types of front axle and rear axles used in motorvehicles.
iv. Examine the working principle of conventional and independent suspensionsystems.
v. Apply knowledge on working principles of brake and itssubsystems.

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II Year - I Semester		L	T	P	C
		0	0	3	1.5
MECHANICS OF SOLIDS AND METALLURGY LAB					

Course Objective: To impart practical exposure on the microstructures of various materials and their hardness evaluation. Also to impart practical knowledge on the evaluation of material properties through various destructive testing procedures.

NOTE: Any 6 experiments from each section A and B.

(A) MECHNICS OF SOLIDS LAB:

1. Direct tensiontest
2. Bending teston
   a) Simple supported
   b) Cantileverbeam
3. Torsiontest
4. Hardnesstest
   a) Brinells hardnesstest
   b) Rockwell hardnesstest
5. Test onsprings
6. Compression test oncube
7. Impacttest
8. Punch sheartest

(B) METALLURGYLAB:

1. Preparation and study of the Micro Structure of pure metals like Iron, Cu andAl.
2. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – Csteels.
3. Study of the Micro Structures of CastIrons.
4. Study of the Micro Structures of Non-Ferrousalloys.
5. Study of the Micro structures of Heat treatedsteels.
6. Hardeneability of steels by Jominy End QuenchTest.

To find out the hardness of various treated and untreatedsteels.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
AUTOMOBILE CHASSIS LAB					

COURSE OBJECTIVES:

i. To assemble and disassemble the parts of an ICengine.
ii. To identify the various component of an ICengine.
iii. To identify the various components in transmission systems of anautomobile.
iv. To assemble and disassemble the various components of transmissionsystem.
v. To study all the functions of automobilecomponents

LIST OF EXPERIMENTS

1. To study constructional and working principle ofclutch.
2. Assembly & Disassembly of GearBox.
5 Assembly & Disassembly of Transfer case.
6. Assembly & Disassembly of Differential & rearaxle.
7. Assembly & Disassembly of Stub AxleAssembly.
8. To assemble and disassemble Transfercase
9. To assemble and disassemble Differential, Rearaxle
10. To assemble and disassemble Frontaxle.
11. To Study different chassislayouts
12. To Study brakingsystem
13. To Study Steeringsystem
14. To Study Suspensionsystem

COURSE OUTCOMES:

i. Understand working of braking, steering, clutch, transmission, Suspensionsystems.
ii. Differentiate various subsystems of two, three & Four wheelervehicles
iii.Develop skills in Dismantling and assembling of chassiscomponents.

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II Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
FLUID MECHANICS & HYDRAULIC MACHINERY LAB					

Course Objective: To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

1. Impact of jets onVanes.
2. Performance Test on PeltonWheel.
3. Performance Test on FrancisTurbine.
4. Performance Test on KaplanTurbine.
5. Performance Test on Single Stage CentrifugalPump.
6. Performance Test on Multi Stage CentrifugalPump.
7. Performance Test on ReciprocatingPump.
8. Calibration ofVenturimeter.
9. Calibration of Orificemeter.
10. Determination of friction factor for a given pipeline.
11. Determination of loss of head due to sudden contraction in apipeline.
12. Turbine flowmeter.

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II Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
COMPUTER AIDED DRAFTING AND MODELLING LAB					

1. DRAFTING: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances, Study of DXE, IGES files.

2. SURFACE MODELING - Generation of various Surfaces using surface modeling.

A) **DRAFTING:** Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances, Study of DXE, IGES files.

B) **SURFACE MODELING** - Generation of various Surfaces using surface modeling.

C) The following contents to be done by any 3D software package:

(i) **PART MODELING:** Generation of various 3D models through Pad, revolve, shell, sweep, parent child relation, Boolean operations and various standard translators.

(ii) **Assembly drawings:** (Any four of the following using solid model software) Generation of various Parts/assemblies: like Screw Jack, Oldham's Coupling, Foot step bearing, Couplings, knuckle and cotter joints, Crankshaft, Connecting Rod, Piston and Cylinder.

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II Year - I Semester		**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE					

Course Objectives:

To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system

- The course aim of the importing basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledgesystem
- To understand the legal framework and traditional knowledge and biological diversity act 2002 and geographical indication act2003
- The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge andprotection
- To know the student traditional knowledge in differentsector

Course Outcomes:

After completion of the course, students will be able to:

- Understand the concept of Traditional knowledge and itsimportance
- Know the need and importance of protecting traditionalknowledge
- Know the various enactments related to the protection of traditionalknowledge
- Understand the concepts of Intellectual property to protect the traditionalknowledge

UNIT I

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

UNIT II

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT III

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.Geographical indications act 2003.

UNIT IV

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

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UNIT V

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

REFERENCE BOOKS:

1) Traditional Knowledge System in India, by Amit Jha,2009.
2) Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, PratibhaPrakashan2012.
3) Traditional Knowledge System in India by Amit Jha Atlantic publishers,2002
4) "Knowledge Traditions and Practices of India" Kapil Kapoor, MichelDanino

e-Resources:

1) https://www.youtube.com/watch?v=LZP1StpYEPM
2) http://nptel.ac.in/courses/121106003/

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II Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
APPLIED THERMODYNAMICS					

Course objectives:
This course is intended to study the thermodynamic analysis of major components of Rankine cycle, refrigeration cycles and compressible fluids and to analyze the energy transfers and transformations in these components including individual performance evaluation.

UNIT –I
VAPOUR POWER CYCLES: Carnot, Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating.

UNIT II
COMBUSTION: Fuels and combustion, concepts of heat of reaction, adiabatic flame temperature, Stoichiometry, flue gas analysis.
BOILERS : Classification – working principles of L.P & H.P boilers with sketches – mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – Draught: classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced andforced.

UNIT – III
STEAM NOZZLES: Function of a nozzle – applications - types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow - its effects, degree of super saturation and degree of under cooling, Wilsonline.
STEAM TURBINES: Classification – impulse turbine; mechanical details – velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-laval turbine - methods to reduce rotor speed-velocity compounding, pressure compounding and velocity & pressure compounding, velocity and pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency

UNIT - IV
REACTION TURBINE: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency – calculation of blade height.
STEAM CONDENSERS: Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump, cooling water requirement.

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UNIT – V

COMPRESSORS – Classification – fan, blower and compressor - positive displacement and non positive displacement type – reciprocating and rotory types.

Reciprocating: Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, saving of work, minimum work condition for two stage compression.

Rotary (Positive displacement type)Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiencyconsiderations.

Rotary (non positive displacement type)

Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

TEXT BOOKS:

1. Heat Engineering (MKS and SI units), VP Vasandani, DS Kumar, Metropolitanbooks
2. Basics & Applied Thermodynamics- P.K.Nag – 4th edition- McGrawHill

REFERENCES:

1. Thermal Engineering- Mahesh Rathore,TataMcGrawHill
2. Applied Thermodynamics by RYadhav
3. Applied Thermodynamics by Eastop&McConkey, 5thEdn,Pearson
5. Fluid Mechanics Fundementals and Applications by Y.A.Cengel,J.M.Cimbala, McGrawHill
6. Thermal Engineering-M.L.Marthur& Mehta/Jain bros.Publishers
7. Thermal Engineering / RK Rajput/ LakshmiPublications

Course outcomes:

CO1**:** Expected to learn the working of steam power cycles and also should be able to analyze and evaluate the performance of individual components

CO2: Student is able to learn the principles of combustion ,stochiometry and flue gas analysis

CO3: Students will be able to design the components and calculate the losses and efficiency of the boilers, nozzles, turbines and condensers**.**

CO4: Student is able to learn various types of compressors, principles of working and their performance evaluation.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
COMPLEX VARIABLES AND STATISTICAL METHODS					

Course Objectives:
- To familiarize the complex variables.
- To familiarize the students with the foundations of probability and statistical methods.
- To equip the students to solve application problems in their disciplines.

Course Outcomes: At the end of the course students will be able to
- apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
- find the differentiation and integration of complex functions used in engineering problems (L5)
- make use of the Cauchy residue theorem to evaluate certain integrals (L3)
- apply discrete and continuous probability distributions (L3)
- design the components of a classical hypothesis test (L6)
- infer the statistical inferential methods based on small and large sampling tests (L4)

UNIT – I: Functions of a complex variable and Complex integration: (10 hrs)
Introduction – Continuity – Differentiability – Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates –Harmonicand conjugate harmonic functions – Milne – Thompson method.
Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs) and problems on above theorems.

UNIT – II: Series expansions and Residue Theorem: (10 hrs)
Radius of convergence – Expansion in Taylor's series, Maclaurin's series andLaurent series.
Types of Singularities: Isolated – Essential –Pole of order m– Residues – Residue theorem (without proof) – Evaluation of real integral of the types $\int_{-\infty}^{\infty} f(x)dx$ and $\int_{c}^{c+2\pi} f(\cos\theta,\sin\theta)d\theta$.

UNIT – III: Probability and Distributions: (10 hrs)
Review of probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT – IV: Sampling Theory: (8 hrs)
Introduction – Population and Samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Representation of the normal theory distributions – Introduction to t, χ^2 and F-distributions – Point and Interval estimations – Maximum error of estimate.

UNIT – V: Tests of Hypothesis: (10 hrs)
Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **Miller and Freund's,** Probability and Statistics for Engineers,7/e, Pearson, 2008.

Reference Books:

1. **J. W. Brown and R. V. Churchill**, Complex Variables and Applications, 9th edition, Mc-Graw Hill, 2013.
2. **S.C. Gupta and V.K. Kapoor**, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
3. **Jay l. Devore,** Probability and Statistics for Engineering and the Sciences, 8thEdition,Cengage.
4. **ShronL.Myers, Keying Ye, Ronald E Walpole,** Probability and Statistics Engineers and the Scientists,8th Edition, Pearson 2007.
5. **Sheldon, M. Ross**, Introduction to probability and statistics Engineers and the Scientists, 4thEdition, Academic Foundation,2011

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE ENGINES					

UNIT-I:

Actual Cycles and Engine Construction: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines; Constructional Details of Four Stroke SI and CI Engines, Working Principle, Actual Indicator Diagram, Two Stroke Engine Construction and Operation, Comparison of Four Stroke and Two Stroke Engine Operation, Firing Order and Its Significance.

UNIT-II:

ENGINE TESTING & PERFORMANCE

Engine Performance Testing & Numerical- methods and Performance Characteristics; Testing and measurement equipment- dynamometers, Air & Fuel consumption, temperature, etc. Variables Affecting Engine Performance, Performance Maps. Lubrication and Cooling systems, Introduction to Supercharging and Turbocharging

UNIT-III:

SI ENGINE FUELING & COMBUSTION

Carburetor Working Principle, Requirements of an Automotive Carburetor, and types, Fuel Injection Systems; Pre-mixed charge combustion, SI Engine Combustion Conceptual models, Thermodynamic Analysis of Combustion, Cycle-to-Cycle Combustion variations and Knocking Combustion

UNIT-IV:

CI ENGINE FUELING & COMBUSTION

Fuel Injection and Spray Structure: Fuel Atomization and Droplet size distribution, Sauter Mean Diameter, Spray Penetration. Types of Combustion Chambers, CI Engine Combustion Conceptual Models: Conventional and Dec's Combustion Models. Diesel Combustion Process Characterization: Ignition Delay, Effect of Engine and Operational Parameters on Delay, Pre-mixed Combustion, Mixing Controlled Combustion. Thermodynamic Analysis. Multi Pulse Injections, Introduction to Low Temperature Combustion Like: Homogeneous Charge Compression Ignition(HCCI), Fuel Stratified Charge combustion/ Reactivity Controlled Compression Ignition (RCCI) Technologies, Pre-mixed Charge Compression (PCCI) and Dual fuel technologies

UNIT-V:

FORMATION OF ENGINE EMISSIONS & CONTROL TECHNOLOGIES (SI & CI)

Emission Effects on Health & Environment: Sources of Engine emissions: Formation of CO, NO, UBHC, Soot and Particulate Matter. Diesel NOx-Particulate Trade off: Effect of SI Design and operating variables: Effect of Diesel Engine Design and operating Variables. SI Engine Emission Control Technology: Add-on systems for treatment of Emissions with in Engine, Exhaust After treatment. CI Engine Emission Control Technology: Application of EGR, Exhaust after treatment and new engine technologies for emission control.

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Text Books:

1. IC Engines, M.L. Mathur & R.P. Sharma, DhanpathRai& Sons
2. Engine Emissions, Pollutant Formation and Advances in Control Technology, B.P. Pundir, Narosa Publishing House

Reference Books:

1. IC Engines Fundamentals, John B. Heywood, Mc Graw Hill Publications
2. Engineering Fundamentals of I C Engines, WiliardW.Pulkrabek, Prentice Hall Publications
3. Mixture Formation in Internal Combustion Engines, CarstenBaumgaten, Springer Pub
4. Thermal Engineering, PL Ballaney, Khanna Publishers, 25th Edition.

Web Links:

1. http://nptel.ac.in/courses/112105123/
2. http://nptel.ac.in/courses/112108148/
3. http://nptel.ac.in/courses/112104113/
4. http://nptel.ac.in/courses/112104033/

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
AUTOMOBILE ELECTRICAL AND ELECTRONICS					

UNIT-I

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. Lighting System: Insulated and Earth Return System, Details of Head Light and Side Light, LED Lighting System, Head Light Dazzling and Preventive Methods – Horn, Wiper System andTrafficator.

UNIT-II

Starting System

Condition at Starting, Behavior 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.

UNIT-III

Charging System

Generation of Direct Current, Shunt Generator Characteristics, Armature Reaction, Third Brush Regulation, Cutout. Voltage and Current Regulators, Compensated Voltage Regulator, Alternators Principle and Constructional Aspects and Bridge Rectifiers, New Developments.

UNIT-IV

Fundamentals of Automotive Electronics

Current Trends in Automotive Electronic Engine Management System, Electro Magnetic Interference Suppression, Electromagnetic Compatibility, Electronic Dashboard Instruments, Onboard Diagnostic System, Security and Warning System.

UNIT-V

Sensors & Actuators:

Types of Sensors: Sensor for Speed, Throttle Position, Exhaust Oxygen Level, knock, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Impact sensor, Air Mass Flow for Engine Application. Solenoids, Stepper Motors, Relay.

Text Books

1. Young A.P. & Griffiths. L. “Automotive Electrical Equipment”, ELBS & NewPress-1999.
2. William B.Riddens “Understanding Automotive Electronics”, 5th edition - Butter worth Heinemann Woburn,1998.

References

1. Bechhold “Understanding Automotive Electronics”, SAE,1998.
2. Crouse, W.H “Automobile Electrical Equipment”, McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
3. Judge A.W “Modern Electrical Equipment of Automobiles”, Chapman & Hall, London,1992.
4. Kholi.P.L “Automotive Electrical Equipment”, Tata McGraw-Hill Co., Ltd., New Delhi,1975.
5. Robert Bosch “Automotive Hand Book”, SAE (5th Edition),2000.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
OPERATIONS RESEARCH					

Course Objectives:
The objective of the course is to understand the availability of resources and constraints in an industry and optimize them through the applications of appropriate resource management tools.

UNIT – I
Development – definition– characteristics and phases – operation research models – applications.
LINEAR PROGRAMMING: problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – dualityprinciple.

UNIT – II
TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – degeneracy, assignment problem – formulation – optimal solution - variants of assignment problem- traveling salesman problem.
SEQUENCING – Introduction – flow –shop sequencing – *n* jobs through two machines – *n* jobs through three machines – job shop sequencing – two jobs through 'm' machines.

UNIT –III
REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

UNIT –IV
THEORY OF GAMES: Introduction to decision theory – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.
WAITING LINES: Introduction to Kendallis notation–classification of queuing models, single channel – with infinite population and finite population models– multichannel – with infinite population.

UNIT – V
Network Analysis: Project planning, scheduling and controlling – tools for project management – critical path method – programme evaluation and review technique (PERT) – cost analysis and crashing – resource leveling – updating.

TEXT BOOKS:
1. Operations Research-An Introduction/Hamdy A Taha/Pearsonpublishers
2. Operations Research –Theory & publications / S.D.Sharma-Kedarnath/McMillan publishers India Ltd

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REFERENCES:

1. Introduction to O.R/Hiller &Libermann/TMH
2. Operations Research /A.M.Natarajan,P.Balasubramani,A. Tamilarasi/PearsonEducation.
3. Operations Research: Methods & Problems / Maurice Saseini, ArhurYaspan& Lawrence Friedman/Wiley
4. Operations Research / R.Pannerselvam/ PHI Publications.
5. Operations Research / Wagner/ PHIPublications.
6. Operation Research /J.K.Sharma/MacMilanPubl.
7. Operations Research/ Pai/ OxfordPublications
8. Operations Research/S Kalavathy / VikasPublishers
9. Operations Research / DS Cheema/University Science Press
10. Operations Research / Ravindran, Philips, Solberg / Wileypublishers

Course Outcomes:

After studying the course, the students are able to

1. Formulate the resource management problems and identify appropriate methods to solvethem
2. Apply LPP, transportation and assignment models to optimize the industrialresources
3. Solve decision theory problems through the application of gametheory
4. Apply the replacement and queuing models to increase the efficiency of thesystem
5. Model the project management problems through CPM andPERT

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
AUTOMOBILE ASSEMBLY DRAWING					

Course Objective: The student will acquire a knowledge of fastening arrangements such as welding, riveting the different styles of attachment for shaft. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components.
(Production Drawing to be included)

Machine Drawing Conventions:

Need for drawing conventions – introduction to ISconventions

a) Conventional representation ofmaterials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs,ribs.
b) Types of sections – selection of section planes and drawing of sections andauxiliary sectional views. Parts not usuallysectioned.
c) Methodsofdimensioning,generalrulesforsizesandplacementofdimensionsforholes, centers, curved and taperedfeatures.
d) Title boxes, their size, location and details - common abbreviations & their liberalusage
e) Types of Drawings – working drawings for machineparts.

I. Drawing of Machine Elements and simpleparts

Objective: To provide basic understanding and drawing practice of various joint, simple mechanical parts Selection of Views, additional views for the following machine elements and parts with every drawing proportions.

a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, setscrews.
b) Keys, cottered joints and knucklejoint.
c) Rivetted joints forplates
d) Shaft coupling, spigot and socket pipejoint.
e) Journal, pivot and collar and foot step bearings, Cam profiles andMechanisms.

II. AssemblyDrawings:

Objective: The student will be able to draw the assembly from the individual part drawing.
Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

a) Engine parts –Gear pump, Fuel pump Petrol Engine connecting rod, pistonassembly.
b) Other machine parts – stub axial assembly, steering gear box assembly, differentialassembly and clutchassembly.
c) Valves : spring loaded safety valve, feed check valve and air cock, Controlvalves

NOTE: First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

TEXT BOOKS:

1. Machine Drawing – N.Siddeswar, K.Kannaiah&V.V.S.Sastry -TMH
2. Machine Drawing –K.L.Narayana, P.Kannaiah&K. Venkata Reddy / New Age/Publishers

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REFERENCES:

1. Machine Drawing –P.S.Gill,
2. Machine Drawing –Luzzader
3. Machine Drawing –Rajput
4. Machine Drawing – N.D. Junnarkar,Pearson
5. Machine Drawing – Ajeeth Singh, McGrawHill
6. Machine Drawing – KC John,PHI
7. Machine Drawing – B Battacharya,Oxford
8. Machine Drawing – Gowtham and Gowtham,Pearson

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
AUTOMOBILE ENGINES AND FUELS LAB					

Course Objectives: To study the characteristics of the fuels and lubricants used in automobile and get practical knowledge in assembly & dismantling of engine components.

ENGINES LAB

LIST OF EXPERIMENTS

1. Draw the Valve and Port Timing Diagrams for 4S and 2S engines and compare with ideal cycle
2. Evaluate the Performance and Emissions from 4S Petrol Engine
3. Evaluate the Performance and Emissions from 4S Diesel Engine
4. Evalaution of Frictional Power from the Mores Test on a 4-Stroke Multi Cylinder Engine
5. Determination of Frictional Power by the retardation and Motoring Test on IC Engine
6. Draw the Heat Balance Sheet for a 4-Stroke Petrol or Diesel Engine
7. Analysis of Combustion Characteristics like ; P-θ, Differential Heat Release Rate, Integral Heat Release Rate and Ignition Delay of diesel engine
8. Calculation of Stiochiometric Air- Fuel mixtures of Conventional fuels through oxidation Equation and compare with Spectrometric analysis
9. Calculate the Volumetric Efficiency of a conventional fuel and compare with Gas based Dual Fuel Operation, when secondary fuel is inducted through inlet manifold
10. Dismantle and Assemble of Agriculture single Cylinder and Multi- Cylinder Automotive Engines

FUELS LAB

LIST OF EXPERIMENTS

1. ASTM distillation test of liquidfuels.
2. Gas Chromatograph with Mass Spectrometry
3. FTIR analysis
4. NMR Analysis C13/H1
5. HPLC Analysis
6. Calorific value of liquid and gaseousfuel.
7. Flash and Fire points of petrol and diesel. (closed and opentype)
8. Temperature dependence of viscosity of lubricants & Fuels by RedwoodViscometer.
9. Viscosity index of lubricants & Fuels by SayboltViscometer.
10. Ash content and Carbon ResidueTest.
11. Drop point of grease and mechanical penetration ingrease.
12. Cloud and Pour pointTest.

Course outcomes:

Attending the laboratory the students shall be able to :

1. The student after undergoing this course is expected to know the principles in assembly & dismantling of enginecomponents
2. At the end of the lab learn characteristics of the fuels and lubricants used inautomobile

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
AUTOMOBILE ELECTRICAL AND ELECTRONICS LAB					

Note :Any 5 Experiments from each stream and rest can be considered as extra experiments
Automotive Electrical

1. Experiment on testing and study of different types of Batteries andconstructions.
2. Testing, dismantling and assembling of starter motor used inautomobile.
3. Testing, dismantling and assembling of alternator used inautomobile.
4. Study of different colour code system used in automotive wiringsystem.
5. Demonstration and study of Battery Ignition System and their parts used in AutomobileVehicles.
6. Study of different Electrical Equipment's &Accessories(Speedometer,Warninglights,Electric Horn, Wind shield wiperssystem).
7. Study of different sensor used in modern automotivesystem.
8. Study of various electronics system(Electronicfuelinjectionsystem, Electronicignitionsystem,Air bag, ABS, Electronic fuel injectorcleaner).
9. Demonstration and experiment on lighting system of two wheeler and FourWheeler.
10. Demonstration, experiment and diagnosis on ignitionsystem.

Automotive Electronics:

1. Verification of truth table of LogicGates.
2. Verification of truth table of Adder, Subtractor &Flip-Flops.
3. Characteristics of rectifiers – Half wave & Fullwave.
4. Timer –555
5. Characteristics ofSCR.
6. D/A and A/Dconverters.
7. Interfacing stepper motor control and CRTterminal
8. Assembly language programmingexercise.
9. Interfacing A/D converter and simple dataacquisition
10. Microcontroller Programming andInterfacing
11. EPROM Interfacing

Text Books:

1. Allan Bonnick, *"Automotive Computer Controlled Systems"*, 2011.
2. Tom Weather Jr and ClandC.Hunter, *"Automotive Computers and ControlSystem"*, Prentice Hall Inc., New Jersey.
3. Young A. P & Griffiths L, *"Automobile Electrical and Electronic Equipments"*, English Languages Book Society & New Press, 1990

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Reference Books:

1. Santini Al, *"Automotive Electricity and Electronics"*, Cengage Learning, 2012.
2. Tom Denton, *"Automotive Electrical and Electronic System"*, SAE International, 2004.
3. William B. Ribbens, *"Understanding Automotive Electronics"*, 6th Edition, Newnes, 2003.BOSCH, *"Automotive Handbook"*, 8th Edition, BENTLEY ROBERT Incorporated, 2011.
4. Norm Chapman, *"Principles of Electricity and electronics for the Automotive Technician"*,Delmar Cengage Learning, 2008.
5. Judge A.W, *"Modern Electrical Equipment of Automobiles"*, Chapman & Hall, London, 1992.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year - II Semester		L	T	P	C
		1	0	2	2
MACHINE TOOLS AND METROLOGY LAB					

Note: minimum of 6 experiments from each section

Course Objective: This practical course covers the topics related to precession measuring instrumentsand the working and operations of various machinetools.

Section-I
METROLO
GY LAB

1. Measurement of lengths, heights, diameters by vernier calipers, micrometersetc.
2. Measurement of bores by internal micrometers and dial boreindicators.
3. Use of gear tooth vernier calipers and checking the chordal thickness of spurgear.
4. Machine tool alignment test on thelathe.
5. Machine tool alignment test on millingmachine.
6. Angle and taper measurements by bevel protractor, Sine bars,etc.
7. Use of spirit level in finding the straightness of a bed and flatness of asurface.
8. Thread measurement by two wire/ three wire method & tool makers microscope.
9. Surface roughness measurement byTalysurf.

Section-II
MACHINE TOOLS LAB

1. Introduction of general purpose machines -lathe, drilling machine, milling machine, shaper,planing machine, slotting machine, cylindrical grinder, surface grinder and tool and cuttergrinder.
2. Step turning and taper turning on lathemachine
3. Thread cutting and knurling on -lathemachine.
4. Drilling andtapping
5. Shaping andplanning
6. Slotting
7. Milling
8. Cylindrical surfacegrinding
9. Grinding of toolangles.

Course Outcome: After completing the course the student will be able to operate various precessionmeasuring instruments and working and operations of various machines tools.

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III Year-I Semester		L	T	P	C
		3	0	0	3
THEORY OF MACHINES					

Course Objectives:

- To study about the kinematic links, different types of pairs, mechanisms and principles involved in assessing the displacement, velocity and acceleration at any point in a link of a mechanism
- To understand the kinematic aspects of friction involved in machineries such as belts, clutches and brakes
- To understand the basic concepts of toothed gearing and kinematics of gear trains
- To understand the motion resulting from a specified set of linkages and cam mechanisms for specified output motions
- To understand the undesirable effects of unbalancing resulting from prescribed motions in mechanism
- To study about the fundamentals of vibration and dynamics of mechanisms

UNIT-I MECHANISMS: Machine Structure – Kinematic link, pair and chain – Grublers criteria – Constrained motion – Degrees of freedom – Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

UNIT-II FRICTION: Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT-III GEARS: Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains – Determination of speed and torque

UNIT-IV CAMS: Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions
BALANCING: Static and dynamic balancing – Single and several masses in different planes – Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi-cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method.

UNIT-V VIBRATION: Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi-rotor systems – Geared shafts – Critical speed of shaft.

TEXT BOOKS:

1. Rattan.S.S, “Theory of Machines”, Tata McGraw–Hill Publishing Co., New Delhi, 2004.
2. Ballaney.P.L, “Theory of Machines”, Khanna Publishers, New Delhi, 2002.

REFERENCES:

1. Rao,J.S and Dukkipati, R.V, “Mechanism and Machine Theory”, Second Edition, Wiley Eastern Ltd., 1992.
2. Malhotra, D.R and Gupta, H.C., “The Theory of Machines”, Satya Prakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., “Theory of Machines and Mechanisms”, Affiliated East West Press, 1989.
4. Shigley, J.E. and Uicker, J.J., “Theory of Machines and Mechanisms”, McGraw-Hill, 1980.

5. Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall, 1979.

Course Outcomes: On completion of the course the students should be able to

- Demonstrate the fundamentals of mechanisms and their applications and able to analyse the kinematic properties of mechanism such as displacement, velocity and acceleration
- Analyze the effect of friction in machines such as belt drives, clutches and brakes
- Understand the basic nomenclature of gears and analyze gear kinematics.
- Perform the kinematic analysis of cam and demonstrate the balancing of any kinematic system
- Analyze different types of Vibrations

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III Year-I Semester		L	T	P	C
		3	0	0	3
PRODUCTION TECHNOLOGY					

Course Objective:
To impart basic knowledge and understanding about the primary manufacturing processes such as casting, joining, bulk forming, and sheet metal forming and their relevance in current manufacturing industry.

UNIT – I
CASTING: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Moulding – moulding methods - ingredients of moulding sand –. Moulding materials, Properties of moulding sand, testing of moulding sand. Types of moulding – Hand moulding – Machine moulding. Core – different types of cores – materials – properties of core sand – core manufacturing.

UNIT – II
Principles of Gating: Gating ratio and design of gating systems. Risers – Types, function and design, casting design considerations. Methods of melting and types of furnaces - cupola, electric arc, resistance and induction furnace. Solidification of castings-Solidification of pure metals and alloys-Short & long freezing range alloys. Fettling. Casting defects. Basic principles and applications of special casting processes - Centrifugal casting – True, semi and centrifuging, die casting, Investment casting and shell moulding.

UNIT – III
Welding : Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, submerged arc welding, TIG & MIG welding. Electro – slag welding.
Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering & Brazing.
Heat affected zones in welding; pre & post heating, weldability of metals, welding defects – causes and remedies – destructive and non-destructive testing of welds.

UNIT – IV
Plastic deformation in metals and alloys: Recovery, recrystallization and grain growth. Hot working and Cold working-Strain hardening and Annealing. Bulk forming processes: Forging - Types of Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

UNIT – V
Sheet metal forming: Blanking and piercing, Forces and power requirement in these operations, Deep drawing, Stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools.
High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.

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TEXT BOOKS:

1. Manufacturing Processes for Engineering Materials – Kalpakjian S and Steven R Schmid- Pearson Pub, 5th Ed.
2. Manufacturing Technology -Vol I- P.N. Rao- TMH

REFERENCES:

1. Manufacturing Science – A.Ghosh & A.K.Malik – East West Press Pvt. Ltd
2. Process and materials of manufacture- Lindberg- PHI
3. Production Technology- R.K. Jain- Khanna
4. Production Technology-P C Sharma-S. Chand
5. Manufacturing Processes- H.S. Shaun- Pearson
6. Manufacturing Processes- J.P. Kaushish- PHI
7. Workshop Technology -WAJ Chapman/CBS Publishers & Distributors Pvt.Ltd.
8. Production Technology-HMT- Tata McGraw-Hill

Course Outcomes:

- Able to design the patterns and core boxes for metal casting processes
- Able to design the gating system for different metallic components
- Know the different types of welding processes
- Learn about plastic deformation processes

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-I Semester		L	T	P	C
		3	0	0	3
VEHICLE DYNAMICS					

Course Objective:
To impart basic knowledge and understanding underlying the development and design of road vehicles under the influence of dynamic loads and to model, simulate and analyze the conventional road vehicles for better ride comfort.

UNIT I
Introduction: Hypothetical vehicle control loop, Fundamental Approach, Vehicle coordinates, motion variables. Forces – Dynamic axle loads, Static loads on level ground, aerodynamic forces on body, hitch forces – Numericals.

UNIT-II
Acceleration & Braking Performance – Power limited acceleration, Fundamental Expressions, Constant retardation, Wind Resistance, Power, Braking forces, Brakes: disc and drum, front, rear and four wheel braking, Road friction rolling resistance, Numericals.

UNIT-III
Road Loads: Aerodynamic, Mechanics of pressure distribution – Aerodynamic forces: lift & drag, Spoilers, Lift force, side force and roll, pitch and yaw moments, Crosswind sensitivity. Rolling Resistance, Factors affecting pressure, velocity, slip, temperature– Total road loads – Fuel Economy Effects.

UNIT-IV
Ride Excitation sources – road roughness, wheel assembly, driveline excitation, engine transmission. **Vehicle response properties**: Suspension isolation, suspension stiffness & damping Wheel Hop Resonance. Road-tyre friction – dynamic response of tires – Rigid body bounce, pitch motion. Perception of ride and other vibration forms, Numericals.

UNIT-V
Steady – State Cornering: Introduction, Low and high speed turning –Tire cornering forces, governing expressions, understeer gradient, over steer and neutral conditions. Characteristic speed, critical speed, yaw velocity gain, sideslip angle, static margin. Suspension effects on cornering: roll moment distribution – effect of tractive forces on cornering – Numericals.

TEXT BOOKS:
1. Thomas Gillespie, “Fundamentals of Vehicle dynamics.” Society of Automotive engineers Inc, 2014
2. Wong H, Theory of Ground Vehicles, McGraw Hill, Second edition, 2006.

REFERENCES:
1. Hans B Pacejka, Tire and Vehicle Dynamics, 3rd Edition, Elsevier Ltd., 2012.
2. Amitosh D, Vehicle Dynamics, Galgotia Book Ltd., 2010.
3. Rao V Dukkipati, Road Vehicle Dynamics,Springer 2008
4. Werner and Karl, Ground Vehicle Dynamics,Springer Berlin Heidelberg, 2008.

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COURSE OUTCOMES:

- Understand the principles underlying the development and design of road vehicles under the influence of dynamic loads.
- Analyze the performance and establish the design specifications for the acceleration and braking conditions.
- Model, simulate and analyze the conventional road vehicles for better ride comfort.
- Analyze the cornering forces and effects of tractive forces on cornering

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III Year-I Semester		L	T	P	C
		3	0	0	3
ALTERNATIVE FUELS FOR ENGINES (PROGRAM ELECTIVE-I)					

Course Objectives: To impart the necessity of finding alternative energy sources for automobiles and to understand merits and demerits, performance characteristics of various sources of fuels and their comparison.

UNIT I
CONVENTIONAL FUELS FOR I.C. ENGINES

Petroleum based conventional fuels for SI and CI engine, Demand and Availability of crude oil – vehicle population increase – national and international standards for conventional and alternative fuels.
Desirable characteristics of SI Engine fuels – Petrol – Properties, Specification, chemical structure, Volatility characteristics, knock rating and additives. Desirable characteristics of CI Engine fuels – Diesel – Properties, Specification, chemical structure, Ignition quality, Cetane rating and additives.

UNIT II
ALCOHOLS AS FUELS

Availability of different alternative fuels for engines. Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission characteristics in engines. Advantages and disadvantages of alcohol fuels

UNIT III
VEGETABLE OILS AND BIODIESEL AS FUELS

Properties of Vegetable oils and biodiesel- Methods of using vegetable oils – Blending, preheating, and emulsification – Preparation of biodiesel from non-edible, edible oil and Algae - Performance, combustion and emission Characteristics in diesel engines. Advantages and disadvantages of Vegetable oils and biodiesel

UNIT IV
HYDROGEN AS FUEL

Hydrogen – Properties, Production methods, storage and safety aspects. Issues & limitation in Hydrogen. Methods of using hydrogen in engines. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Hydrogen fuel.

UNIT V
BIOGAS, CNG AND LPG AS FUELS

Biogas, Compressed Natural gas (CNG) and LPG – Properties and production methods. CO_2 and H_2S scrubbing in Biogas, Modifications required for use in Engines- Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Gaseous fuels. Working of LPG and CNG kits used in automotive engines.

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REFERENCES

1. Arumugam S. Ramadhas, "Alternative Fuels for Transportation" CRC Press, 2011.
2. Ayhan Demirbas and M. Fatih Demirbas, "Algae Energy-Algae as a New Source of Biodiesel", Springer-Verlag London Limited 2010.
3. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008
4. David M. Mousdale, "Introduction to Biofuels", CRC Press, 2015.
5. Ganesan.V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
6. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
7. M. K. Gajendra Babu and K. A. Subramanian, "Alternative Transportation Fuels-Utilisation in Combustion Engines", CRC Press, 2013.
8. M.L. Mathur, R.P.Sharma "A course in internal combustion engines", Dhanpatrai publication, 2003.
9. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.

Course Outcomes:

By the end of this course, students will be able to

- Possess a comprehensive understanding of available alternative fuels for IC engines. They will possess complete knowledge on producing different biofuels, modifying them and using them in IC engines
- Acquire the skills in developing new technologies for alternative fuels efficiently in IC engines.
- Demonstrate the importance of using alternative fuels for sustainable energy supply and for emission control in IC engines.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-I Semester		L	T	P	C
		3	0	0	3
TWO AND THREE WHEELERS (PROGRAM ELECTIVE-I)					

Course Objectives:
The objective of this course is to make the students know and understand the constructional details, operating characteristics and design aspects of Two and Three wheelers.

UNIT I INTRODUCTION
Classifications- design considerations –weight and dimension limitations – requirements, stability problems, gyroscopic effect- pendulum effect of two and three wheelers.

UNIT II POWER UNITS, IGNITION SYSTEMS ELECTRICAL &BRAKING SYSTEMS
2 stoke and 4 stoke engines. Design criteria for engines – design of cylinders, cylinder head, cooling fins, crank case, connecting rod and crank shaft. Carburetor types. Wiring layout for two wheelers. Braking system in two wheelers, Fundamentals of EFI.

UNIT III CLUTCHES AND TRANSMISSION
Types of clutches. Design of clutch system. Gears for two and three wheelers. Design of gear box and gear change mechanism. Belt, chain and shaft drive. Freewheeling devices, starting systems.

UNIT IV FRAMES, SUSPENSION, WHEELS AND TYRES
Types of frames. Wheel frames- construction design of frames for fatigue strength, torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details of wheel and tyres.

UNIT V THREE WHEELERS
Auto rickshaws - Pick-Ups and delivery type vehicle, frames and transmission, wheel types, wheel mountings attachment, tyre types. Brake systems.

REFERENCES

1. 'Cycle Motor Manual', Templeton Press Ltd., London, 1992.
2. Irving P.E., "Motor Cycle Engineering", Temple Press Book, London, 1964
3. Johns.B.A., 'Motorcycles', Good Heart will, 1984.
4. M.M.Griffin., 'Motor cycles from inside and outside', Prentice Hall Inc, New Jersey, 1978.
5. Marshal Cavandedish, 'Encyclopedia of Motor cycling', New York, 1989
6. Servicing Manuals- various motor cycles, Scooters, Mopeds and three wheelers.
7. Srinivasan.S., 'Motor cycle, Scooter, Mopeds', New century book house, 1988

Course Outcomes:

At the end of the course the students will have through knowledge over different frames, suspension system and transmission unit used in various two and three wheeler vehicles.

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III Year-I Semester		L	T	P	C
		3	0	0	3
MICRO PROCESSORS AND MICRO CONTROLLERS (PROGRAM ELECTIVE-I)					

Course Objectives: The student will

- Learn concepts of microprocessor, different addressing modes and programming of 8086.
- Understand interfacing of 8086, with memory and other peripherals.
- Learn concept of DMA, USART RS-232 and PIC controller.
- Study the features of 8051 Microcontroller.
- Study the features of advanced processors.

UNIT-I: 8086/8088 MICROPROCESSORS
Register organization of 8086, Architecture, signal description of 8086, physical memory organization, general bus operation, I/O addressing capability, special purpose activities, Minimum mode, maximum mode of 8086 system and timings, the processor 8088, machine language instruction formats, addressing mode of 8086, instruction set off 8086,assembler directives and operators.

UNIT-II: 8086 MICROPROCESSOR PROGRAMMING
Machine level programs, programming with an assembler, Assembly language programs, introduction to stack, stack structure of 8086/8088, interrupts and interrupt service routines, interrupt cycle of 8086, non-mask able interrupt and mask able interrupts, interrupt programming.

UNIT-III: PROGRAMMABLE PERIPHERALS AND INTERFACING
Semiconductor memory interfacing, dynamic RAM interfacing, interfacing i/o ports, PIO 8255 modes of operation of 8255,interfacing to D/A and A/D converters, stepper motor interfacing, control of high power devices using 8255.Programmable interrupt controller 8259A, the keyboard /display controller8279, programmable communication interface 8251 USART, DMA Controller 8257.

UNIT-IV: 8051 MICROCONTROLLER
Introduction to microcontrollers, 8051Microcontrollers, 8051pin description, connections, I/O ports and memory organization, MCS51addressing modes and instructions, assembly language programming tools.

UNIT-V: PIC MICROCONTROLLERS AND ARM 32-BIT MICROCONTROLLER
Overview and features, PIC16Cx/7X instructions, interrupts in PIC 16C61/71, PIC 16F8XX Flash controllers, I/O ports and timers. Introduction to 16/32 Bit processors, ARM architecture and organization, ARM / Thumb programming model, ARM / Thumb instruction set.

TEXT BOOKS:

1. A.K.Ray, K.M.Bhurchandi, "Advanced Microprocessors and Peripherals", Tata McGraw Hill Publications,2000.
2. N.Sentil Kumar, M.Saravanan, S.Jeevananthan, "Microprocessors and Microcontrollers", Oxford University Press, 2010.
3. Ramesh S. Goankar, "Microprocessor Architecture, Programming and Applications with 8085", 5th Edition, Prentice Hall

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REFERENCES:

1. Ajay V Deshmukh, "Microcontrollers", TATA McGraw Hill publications, 2012.
2. Krishna Kant, "Microprocessors and Microcontrollers", PHI Publications, 2010.

Course Outcomes:

After going through this course the student will be able to

- develop programs for different addressing modes.
- perform 8086 interfacing with different peripherals and implement programs
- describe the key features of serial and parallel communication and able to
- design a microcontroller for simple applications.

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III Year-I Semester		L	T	P	C
		3	0	0	3
HEAT TRANSFER (PROGRAM ELECTIVE-I) **(Heat transfer data book allowed)**					

Course Objective: To understand different modes of heat transfer and apply these basics in the design of thermal systems

UNIT – I:
Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.
Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions
One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

UNIT – II:
One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature
One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.

UNIT – III:
Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation– Buckingham Π Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations.
Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.
Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

UNIT – IV:
Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.
Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT V:
Heat Transfer with Phase Change:
Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling
Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.
Radiation Heat Transfer : Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

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TEXT BOOKS:

1. Heat Transfer by HOLMAN, Tata McGraw-Hill
2. Heat Transfer by P.K.Nag, TMH

REFERENCE BOOKS:

1. Fundamentals of Heat Transfer by Incropera & Dewitt, John wiley
2. Fundamentals of Engineering, Heat& Mass Transfer by R.C.Sachdeva, NewAge.
3. Heat& Mass Transfer by Amit Pal – Pearson Publishers
4. Heat Transfer by Ghoshdastidar, Oxford University press.
5. Heat Transfer byA Practical Approach, YunusCengel, Boles, TMH
6. Engineering Heat and Mass Transfer by Sarit K. Das, DhanpatRai Pub

Note: Heat and Mass transfer Data Book by C P Kothandaraman and Subrahmanyan is used to design and analyze various thermal processes and thermal equipment.

Course Outcomes: At the end of the course, the student should be able to

- Represent the physical problems of heat transfer in terms of governing equations or mathematical models
- Differentiate between different boundary conditions and apply the same for solving heat transfer problems
- Design thermal systems applying the concepts of heat transfer under steady state and well as unsteady state conditions
- Design, select and analyze the heat exchangers
- Apply the radiation concepts to the engineering devices.

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III Year-I Semester		L	T	P	C
		3	0	0	3
INDUSTRIAL HYDRAULICS AND PNEUMATICS (PROGRAM ELECTIVE-I)					

Course Objectives:
The students will acquire the knowledge:

1. To learn basic concepts of fluid power
2. To learn the functions and working of basic elements of Hydraulic and Pneumatic systems
3. To learn the basic components and their functions of Hydraulic and Pneumatic circuits
4. To learn the operating principles and working of hydraulic and pneumatic devices
5. To learn the procedures of installation, Maintenance and Trouble shooting of Hydraulic and pneumatic systems

Unit – I:
Fluid Power: Power transmission modes, hydraulic systems, pneumatic systems, laws governing fluid flow: Pascal's law, continuity equation, Bernoulli's theorem, Boyle's, Charles', Gay-lussec' laws, flow through pipes - types, pressure drop in pipes, Working fluids used in hydraulic and pneumatic systems- types, ISO/BIS standards and designations, properties.

Unit– II:
Hydraulic and Pneumatic Elements:
Hydraulic pipes-Types, standards, designation methods and specifications, pressure ratings, applications and selection criteria, pumping theory, Hydraulic Pumps - types, construction, working principle, applications, selection criteria and comparison, hydraulic Actuators, Control valves, Accessories - their types, construction and working, pneumatic Pipes - materials, designations, standards, properties and piping layout, air compressors, Air receivers, air dryers, Air Filters, Regulators, Lubricators (FRL unit): their types, construction, working, specifications and selection criteria of following air preparation and conditioning elements, pneumatic Actuators and Control valves - types, construction, working, materials and specifications

Unit– III:
Hydraulic and Pneumatic Circuits:
ISO symbols used in hydraulic and pneumatic circuit, basic Hydraulic Circuits – types (such as intensifier, regenerative, synchronizing, sequencing, speed control, safety), circuit diagram, components, working and applications, basic Pneumatic Circuits – types (such as speed control, two step feed control, automatic cylinder reciprocation, time delay, quick exhaust), circuit diagram, components, working and applications, pneumatic Logic circuit design - classic method, cascade method, step counter method, karnaughveitch maps and combinational circuit design.

Unit-IV
Hydraulic and Pneumatic Devices:
Hydraulic and Pneumatic devices – Concept and applications, construction, working principle, major elements, performance variables of: Automotive hydraulic brake, Industrial Fork lift, Hydraulic jack, Hydraulic press, automotive power steering, automotive pneumatic brake, automotive air suspension, Pneumatic drill, Pneumatic gun.

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Unit-V

Installation, Maintenance and Trouble-Shooting:

Installation of hydraulic and pneumatic system causes and remedies for common troubles arising in hydraulic elements, maintenance of hydraulic systems, causes and remedies for troubles arising in pneumatic elements, maintenance of pneumatic systems.

Textbooks:

1. Majumdar, S.R. Oil Hydraulic Systems Tata McGraw-Hill Publication, New Delhi,3/e, 2013
2. Majumdar, S.R. Pneumatic Systems Tata McGraw-Hill Publication, New Delhi,3/e, 2013

References:

1. Srinivasan, R. Hydraulic and Pneumatic Controls Vijay Nicole Imprints Private, New Delhi, Limited, 2/e, 2008
2. Jagadeesha, T. Fluid Power Generation, Transmission and Control Universities Press (India) Private Limited, New Delhi,1/e, 2014
3. Jagadeesha, T. Pneumatics Concepts, Design and Applications Universities Press (India) Private Limited, New Delhi,1/e, 2014
4. Parr, Andrew Hydraulic and Pneumatics a Technician's and Engineer's Guide Jaico Publishing House, New Delhi,2/e, 2013
5. Shanmuga Sundaram, K. Hydraulic and Pneumatics Controls - Understanding Made Easy S. Chand Company Ltd., New Delhi, 1/e, 2006

Course outcomes:

Upon successful completion of this course the student should be able to:

- Illustrate the basic concepts of fluid power
- Understand the functions of elements of Hydraulic and Pneumatic systems
- Analyze the functions of hydraulic and Pneumatic circuits
- Illustrate the working of various hydraulic and pneumatic devices.
- Interpret the procedure of installation, maintenance and trouble shooting of hydraulic and Pneumatic systems

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
PRODUCTION TECHNOLOGY LAB					

Course Objective: To impart practical exposure on manufacturing processes and equipment.

1. Design and making of pattern
    i. Single piece pattern
    ii. Split pattern
2. Sand properties testing
    i. Sieve analysis (dry sand)
    ii. Clay content test
    iii. Moisture content test
    iv. Strength test (Compression test & Shear test)
    v. Permeability test
3. Mould preparation
    i. Straight pipe
    ii. Bent pipe
    iii. Dumble
    iv. Gear blank
4. Gas cutting and welding
5. Manual metal arc welding
    i. Lap joint
    ii. Butt joint
6. Injection moulding
7. Blow moulding
8. Simple models using sheet metal operations
9. Study of deep drawing and extrusion operations
10. Study of Basic powder compaction and sintering
11. Study of TIG/MIG Welding
12. Study of Resistance Spot Welding
13. Study of Brazing and soldering
14. Study of Plastic Moulding Process.

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

- Design and manufacture simple patterns
- Control sand properties in foundry
- Operate arc welding, gas welding and resistance welding equipment
- Use blow moulding and injection moulding equipment

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III Year-I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
THEORY OF MACHINES LAB					

Course Objectives:

- To evaluate performance of a Hartnel governor
- To determine the frequencies of vibration in case of free and forced vibrations of a spring- mass system and whirling speed of a shaft
- To determine motion characteristics of a slider crank mechanism and cam-follower mechanism
- To demonstrate various mechanical power transmission devices / components like screw jack and gears.

1. To determine whirling speed of shaft theoretically and experimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyse the motion of a motorized gyroscope when the couple is applied along its spin axis
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of a flywheel
8. To plot follower displacement vs cam rotation for various Cam Follower systems.
9. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism
10. To find coefficient of friction between belt and pulley.
11. To study simple and compound screw jack and determine the mechanical advantage , velocity ratio and efficiency
12. To study various types of gears- Spur, Helical, Worm and Bevel Gears

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

- Evaluate performance of a Hartnel governor
- Determine the frequencies of vibration in case of free and forced vibrations of a spring- mass system and whirling speed of a shaft
- Determine motion characteristics of a slider crank mechanism and cam-follower mechanism
- Demonstrate various mechanical power transmission devices / components like screw jack and gears.

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III Year-I Semester		L	T	P	C
		0	0	4	2
VEHICLE DESIGN AND ANALYSIS LAB					

Course Objectives:

1. To familiarize the students to use modelling software for modelling engine components.
2. To design chassis components with dimensions and strength requirements.
3. To learn the use of standard practices in modelling of components.
4. The use of modelling software to control the quality of the final engineered product.
5. To visualize the complete assembly of the various system.

PART-A - CHASSIS DESIGN EXPERIMENTS (At least 6 experiments)

1. Design and Analysis of frame.
2. Design and Analysis of clutch assembly
3. Design and Analysis of constant mesh gearbox.
4. Design and Analysis of Propeller shaft with universal joint.
5. Design and Analysis of rear axle.
6. Design and Analysis of steering system.
7. Design and Analysis of suspension system.
8. Design and simulation of Differential.
9. Design and simulation of Epicyclic (Gear box).

PART-B – COMPUTATIONAL EXPERIMENTS

Simulation of fluid flow with specific application to

(i) Manifolds,

(ii) After treatment devices and

(iii) Vehicle Aerodynamics

Course Outcomes:

Students will be able to visualize the automotive components with the help of modelling software.

i. Make the modifications instantly if required at the initial stage itself.
ii. Demonstrate the knowledge on designing components to withstand the loads and deformations.
iii. Synthesize, analyze and document the design of the various components.
iv. Demonstrate the ability to use engineering techniques for developing vehicle components with industry standards.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE COMPONENTS AND CHASSIS DESIGN					

Course Objectives:

- To make students familiar with the constructional details of chassis and components
- To understand about various steering systems, steering linkages and steering gear boxes
- To understand the principle of suspension system
- To learn the gear box design
- To learn the principles of CVT

UNIT I
Chassis and Vehicle Overall
Center of Gravity and handling properties –Body weight & Body center gravity – Mass Moment of Inertia. Vehicle Frame: Study of Loads –Moments and Stresses on Frame Members. Design of Frames for Passenger and Commercial Vehicle.

UNIT II
Steering Design:
Rack & Pinion: Advantages & Disadvantages, Configurations, Steering gear, manual with side tie rod take-off, Steering gear, manual with centre tie rod take-off Recirculating Ball type: Advantages & Disadvantages, Steering Gear, Power Steering Systems: Hydraulic, Electro-Hydraulic and Electrical systems and Steering Kinematics: Maximum displacement of Rack, Calculation of inner and outer wheel angles, Length of Tie rod.

UNIT III
Suspension System:
Wheel travel requirement, Sprung & un-sprung mass distribution, Calculation of Tyre rolling radius, checking of camber change & Toe Change, front view swing arm length, side view swing arm length, Calculation of Jacking force & its effects on suspension, Camber change rate, Wheel base and wheel track change, Anti Dive and Anti- squat considerations

UNIT IV
Gear Box Design:
In-line shaft arrangement, Internal gear arrangement, Face-dog selectors, Bearing arrangement, Crown wheel and pinion layout, Differential location and type, Transverse-shaft arrangement, Selector system, Selector interlock system, Lubrication method and Gearbox casing.

UNIT V
Continuous Variable Transmission (CVT):
Tuning of CVT: Speed & Power- Shift speed, engagement speed, power curves; Drive ratio & efficiency; Driven (secondary) clutch; Driving (primary) clutch; Pressure Spring; Fly weight System, Belt, and Gearing.

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TEXT BOOKS:

1. Automotive Chassis by Jonsen Reimpell, Butterworth Heinemann Pub, 2001
2. Clutch Tuning Hand Book by Olav Aaeen, for serious racers and one who wants more performance from their variable ratio belt transmission.

REFERENCES:

1. Automotive Chassis Volume 1 by Giancarlo Genta & Lorenzo Morello, Springer, 2009
2. Manual Gear Box Design by Alec Stokes, SAE International, Butterworth Heinemann Pub, 1992.

Course Outcomes: After the completion of the course, students should be able to

- Design the frames for the passenger and Commercial vehicles
- Understand the different steering systems design
- Summarize the need for suspension systems and its types

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE TRANSMISSION SYSTEMS					

OBJECTIVES:

- To know about the various components in transmission system and drive line units of automobiles.
- To learn the working principle of transmission system and hydrodynamic transmission.
- The students able to know about the various automatic transmission systems in a vehicle.
- The students able to know the applications of automatic transmission in a vehicle.
- To know about the hydrostatic drive principle and working of electric drive in a vehicle.

UNIT- I HYDRODYNAMIC TRANSMISSION

Fluid coupling-working principle and Constructional details, Torque capacity and Performance characteristics. Reduction of drag torque in fluid coupling. Torque converter-working principle and constructional details, performance characteristics.

UNIT-II EPICYCLIC GEARBOXES

Requirements of Epicycle gear system, Epicycle gearbox working and operation and Constructional details. Principle of Planetary gear trains - Wilson Gear box, Hydraulic Control system for Automatic Transmission.

UNIT-III AUTOMATIC TRANSMISSIONS APPLICATION

Need for automatic transmission, “Turbo glide” Transmission, Continuously Variable Transmission (CVT) – Types and of a typical CVT and applications, Automatic Transmissions.

UNIT-IV HYDROSTATIC TRANSMISSION

Hydrostatic drive- various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive.

UNIT V ELECTRIC DRIVE

Electric drive, layout of electric drive, types- Principle of early and modified Ward Leonard Control system-Advantages & limitations. Comparison of early and modified ward Leonard control system. Maintenance of transmission system

TEXT BOOKS:

- Heldt, P.M., "Torque converters", Chilton Book Co., 1962.
- Newton and Steeds, "Motor vehicles", Illiffe Publishers, 1985.
- Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.
- A Text book of Auto Transmission and Electrical systems by K.S Raghu Ram.
- Automotive Transmissions Fundamentals, Selection, Design and Application 2011. Naunheimer, H., Bertsche, B., Ryborz, J., Novak, W.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

REFERENCES:

- SAE Transactions 900550 & 930910.
- Hydrostatic transmissions for vehicle applications, I Mech E Conference, 1981
- Crouse, W.H., Anglin, D.L.," Automotive Transmission and Power Trains construction", McGraw-Hill, 1976.
- Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2002

Course Outcomes:

- Understand the concept of hydrodynamic transmissions.
- Know about the automatic and hydrostatic transmissions and their performance.
- Learn about the epi-cyclic gear boxes and electric drives

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		3	0	0	3
VEHICLE BODY ENGINEERING					

Course Objectives:

- To make students familiar with car body details and vehicle aero dynamics
- To understand the bus body details, commercial vehicle details, body materials, trim and mechanisms

UNIT-I: Car Body Details

Types: Saloon, Convertibles, Limousine, Estate Car, Racing and Sports Car. Visibility: Regulations, Driver's Visibility, Tests for Visibility, Methods of Improving Visibility and Space in Cars. Safety: Safety Design, Safety Equipments for Cars. Car Body Construction; Design Criteria, Prototype Making, Initial Tests, Crash Tests on Full Scale Model, Dummies and Instrumentation

UNIT-II: Vehicle Aerodynamics

Objectives. Vehicle Drag and Types; Various Types of Forces and Moments, Effects of Forces and Moments, Side Wind Effects on Forces and Moments, Various Body Optimization Techniques for Minimum Drag, Wind Tunnel Testing: Flow Visualization Techniques, Scale Model Testing, Component Balance to Measure Forces and Moments.

UNIT-III: Bus Body Details

Types: Mini Bus, Single Decker, Double-Decker, Two Level and Articulated Bus. Bus Body Layout; Floor Height, Engine Location, Entrance and Exit Location, Seating Dimensions. Constructional Details: Frame Construction, Double Skin Construction, Types of Metal Sections used, Regulations, Conventional and Integral Type Construction.

UNIT-IV: Commercial Vehicle Details

Types of Body; Flat Platform, Drop Side, Fixed Side, Tipper Body, Tanker Body, Light Commercial Vehicle Body Types. Dimensions of Driver's Seat Relation to Controls. Drivers Cab Design.

UNIT-V: Body Materials, Trim and Mechanisms

Steel Sheet, Timber, Plastic, GRP, Properties of Materials; Corrosion, Anticorrosion Methods. Selection of Paint and Painting Process. Body Trim Items. Body Mechanisms

Text Books

1. James E Duffy, "Modern Automotive Technology", Goodheart-Wilcox; Seventh Edition, 2011
2. Jack Erjavec, "Automotive Technology – A systems approach", Cengage Learning, 2009,

Reference Books:

1. Geoff Davies, Materials for Automotive Bodies, Elsevier, Butterworth Heinemann, ISBN 0 7506 5692 1, 2003
2. Body Engineering , S. F. Page
3. Automotive Chassis – P.M. Heldt, Chilton & Co. 1952

Course Outcomes: After the completion of the course, the students should be able to

- Understand car body details and vehicle aero dynamics
- Learn the bus body details, commercial vehicle details, body materials, trim and mechanisms

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		3	0	0	3
CFD FOR AUTOMOBILE APPLICATIONS (PROGRAM ELECTIVE-II)					

Course Objectives:

- To get conversant with the governing equations in CFD and its application areas
- To understand Elliptic, Parabolic and Hyperbolic partial differential equations and solve the linear equations.
- To analyze the CFD problem by Finite difference and Finite volume methods and apply different computational Techniques.

UNIT-I

Introduction: Philosophy of Computational Fluid Dynamics (CFD), Impact of CFD and its use as research and design tool. Application areas: Automobile & Engine, Civil engineering, Environmental, Naval Architecture.

Governing Equations of fluid dynamics: Derivation, discussion of their physical meaning, models of the flow, substantial derivative, Divergence of a velocity, Navier-Stokes Equation, Physical boundary conditions, Forms of governing equation suited to CFD

UNIT-II

Mathematical behavior of Partial Differential Equations: Classification of Quasi-Linear PDE, The Eigenvalue Method, Hyperbolic, parabolic & Elliptic equations.

Solution of System of Linear Equations: Algorithms for the solution of linear problems; awareness of typical applications for such software and practical issues associated with implementation. Efficient direct and iterative solution algorithms for large, sparse, linear equation systems.

UNIT-III

Finite difference discretization: Basic aspects of discretization, finite difference method, difference equations, Polynomial Approach; Explicit and Implicit schemes, stability analysis; Grid transformations, transformation of equations

Basic Computational Techniques: Lax-Wendroff Technique, Mac Cormack's Technique, Space Marching, Relaxation Technique, Alternating direction implicit method.

UNIT-IV

Basics of Finite Volume Methods: Finite volume discretization, Approximation of Surface Integrals, Approximation of Volume Integrals, Interpolation schemes, Upwind Interpolation, Linear Interpolation, Quadratic Upwind Interpolation, and Higher-Order Schemes.

Applications of Finite Volume Methods: One-dimensional steady state diffusion, Steady one-dimensional convection and diffusion, Assessment of the central differencing scheme for convection-diffusion problemsand TDMA algorithm.

UNIT-V

Introduction to finite element method: Basics of finite element method, stiffness matrix, Iso-parametric elements, Formulation of finite elements for one dimensional flow and heat transfer problems.

CFD applied to Automobiles: Introduction of automobile parts and its aerodynamics design analysis. Advantages of the CFD used in automobile. Case studies.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

Text Books:

1. Computational Fluid Dynamics the Basics with Applications, John D Anderson, Jr., McGraw Hill Book Company.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H K Versteeg, W Malalasekera, Pearson Education Ltd

References:

1. Numerical Heat Transfer and Fluid Flow, Suhas V Patankar, Hemisphere Publishing Co.
2. Fundamentals of Computational Fluid Dynamics, Tapan K. Sengupta, Universities Press.
3. Computational Method for Fluid Dynamics, Joel H. Ferziger and Milovan Peric, 3rd Edition, Springer, 2002.
4. Computational Fluid Mechanics and Heat Transfer, Dale A. Anderson, John C. Tannehill and Richard H. Pletcher,2nd Edition, Taylor and Francis, 1984.

Course Outcomes: After the completion of the course, the student will be able to

- Familiarize with the governing equations in CFD and its application areas
- Understand Elliptic, Parabolic and Hyperbolic partial differential equations and solve the linear equations.
- Analyse the CFD problem by Finite difference method and apply different computational Techniques.
- Analyse the CFD problem by Finite volume method and understand different applications
- Familiarize with finite element method and applications of CFD in the design of automobiles.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		3	0	0	3
CONDITION MONITORING (PROGRAM ELECTIVE-II)					

Course Objectives:

- To understand the types of maintenance used and its significance, role of condition based maintenance in industries, familiarize with different condition monitoring techniques and its advantages in industries.
- To implement the basic signal processing techniques.
- To understand the role of vibration monitoring, its methodology and its use in condition monitoring of rotating and reciprocating machines.
- To understand the significance of mechanical fault diagnosis and non-destructive testing techniques in monitoring and maintenance.
- To study condition monitoring of rolling element bearing, gears and tool condition monitoring techniques in machining.

UNIT – I

Introduction to maintenance and condition based maintenance, Definition, system approach, objectives, responsibilities of maintenance department, maintenance strategies, principles of maintenance, concepts of maintainability, availability and reliability, implementation of CBM, comparison of CBM with other maintenance techniques and case studies (overview). Introduction to condition monitoring, basic concept, techniques - visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring.

UNIT – II

Basic signal processing techniques Probability distribution and density, Fourier analysis, Hilbert Transform, Cepstrum analysis, Digital filtering, Deterministic / random signal separation, Time-frequency analysis. Wavelet Transform Introduction to Wavelets, Continuous Wavelet Transform (CWT), Discrete Wavelet Transform (DWT), Wavelet Packet Transform (WPT),types of wavelets –Haar wavelets, Shannon wavelets, Meyer wavelets, Daubechies wavelets, Coifmann wavelets and applications of wavelets.

UNIT - III

Vibration Monitoring, Introduction, vibration data collection, techniques, instruments, transducers, selection, measurement location, time domain analysis, frequency domain analysis, time-frequency domain analysis and commonly witnessed machinery faults diagnosed by vibration analysis.
Rotating and reciprocating machines, Vibration signals from rotating and reciprocating machines – signal classification, signals, generated by rotating machines, signals generated by reciprocating machines.

UNIT – IV

Mechanical fault diagnosis, Wear monitoring and lubricant analysis - sources of contamination, techniques, Spectrometric, Oil Analysis Procedure (SOAP) and ferrography. Non-destructive testing techniques, Measurement of surface and subsurface flaws – liquid penetrant inspection, eddy current inspection, radiographic inspection, ultrasonic inspection.

UNIT – V

Condition monitoring of rolling element bearings and gear, Introduction, construction, types of faults, rolling element bearing diagnostics and gear diagnostics. Tool wear monitoring, Introduction, techniques and case studies.

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TEXT BOOKS:

1. Robert Bond Randall – Vibration-Based Condition Monitoring – Industrial, Aerospace and Automotive applications, John Wiley & Sons Ltd., 2011
2. R.A.Collacot – Mechanical Fault Diagnosis – Chapman and Hall Ltd., 1977.
3. ISTE Course material on Condition Monitoring.
4. R.C.Mishra, K.Pathak – Maintenance Engineering and Management, Prentice Hall of India Pvt. Ltd., 2002.
5. K. P. Soman, K. I. Ramachandran, N. G. Resmi – Insight into wavelet from theory to practice, Third Edition, Prentice Hall of India,

REFERENCES BOOKS:

1. John S. Mitchell, Introduction to Machinery Analysis and Monitoring, Penn Well Books, 1993.
2. Elsevier-“Hand book of Condition Monitoring” ELSEVIER SCIENCE
3. R.A. Collacott, “Vibration monitoring and diagnosis”, Wiley, 1979.
4. Rao J.S. “Vibratory Condition Monitoring of Machines”, CRC Press, 2000.
5. “Condition Monitoring manual”, National Productivity Council, New Delhi.

Course Outcomes: At the end of this course the student shall be able to:

- Understand the types of maintenance used and its significance, role of condition based maintenance in industries, familiarize with different condition monitoring techniques and its advantages in industries.
- Implement the basic signal processing techniques.
- Understand the role of vibration monitoring, its methodology and its use in condition monitoring of rotating and reciprocating machines.
- Understand the significance of mechanical fault diagnosis and non-destructive testing techniques in monitoring and maintenance.
- Study condition monitoring of rolling element bearing, gears and tool condition monitoring techniques in machining.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		3	0	0	3
NOISE, VIBRATIONS AND HARSHNESS (PROGRAM ELECTIVE-II)					

Course Objectives:

- To acquire the knowledge in basic of vibration and noise
- To understand the effect of noise an human comfort and environment
- To know the methods of vibration and noise measurement.

UNIT I
FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION
Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping

UNIT II
EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK
General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.

UNIT III
VEHICLE NOISE AND VIBRATION—SOURCES, PREDICTION, AND CONTROL
Introduction to Vehicle Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire/Road Noise—Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

UNIT IV
VEHICLE INTERIOR NOISE AND VIBRATION SOURCES - PREDICTION AND CONTROL
Introduction to Vehicle Interior Noise and Vibration Sources, Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors-Prediction and Control,

UNIT V
NOISE AND VIBRATION TRANSDUCERS, SIGNAL PROCESSING, AND MEASURING TECHNIQUES
Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, System for Data Acquisition, Noise and Vibration Measurements, Noise and Vibration Data Analysis, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Traceability of Vibration and Shock Measurements.

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TEXT BOOKS:

1. Clarence W. de Silva , "Vibration Monitoring, Testing, and Instrumentation ",CRC Press, 2007
2. David A.Bies and Colin H.Hansen "Engineering Noise Control: Theory and Practice "Spon Press, London, 2009

REFERENCES:

1. Allan G. Piersol ,Thomas L. Paez "Harris' Shock and Vibration Handbook", McGraw-Hill , New Delhi, 2010
2. Colin H Hansen "Understanding Active Noise Cancellation" , Spon Press , London 2003
3. Matthew Harrison "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles ", Elsevier Butterworth-Heinemann, Burlington, 2004

Course Outcome:

At the end of the course, the student will understand the sources, effects, prediction, control techniques, measurement techniques of noise, vibration pertaining to an automobile.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		3	0	0	3
MECHATRONICS (PROGRAM ELECTIVE-II)					

Course Objective
The main objective of this course is

1. To introduce the integrative nature of Mechatronics.
2. To describe the different components and devices of mechatronics systems.

UNIT-I
Mechatronics systems – elements & levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT-II
Hydraulic and pneumatic actuating systems - Fluid systems, Hydraulic systems, and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems. Mechanical actuating systems and electrical actuating systems – basic principles and elements.

UNIT-III
Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT-IV
System and interfacing and data acquisition – Data Acquisition Systems, Analog to Digital and Digital to Analog conversions; Digital Signal Processing – data flow in DSPs, block diagrams, typical layouts, interfacing motor drives.

UNIT-V
Dynamic models and analogies, System response. Process Controllers – Digital Controllers, Programmable Logic Controllers, Design of mechatronics systems & future trends.

TEXT BOOKS:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran, GK Vijaya Raghavan & MS Balasundaram/WILEY India Edition

REFERENCES:

1. Mechatronics /Smaili A, Mrad F/ Oxford Higher Education, Oxford University Press
2. Mechatronics Source Book / Newton C Braga/Thomson Publications,Chennai.
3. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
4. Mechatronics System Design / Devdas Shetty/Richard/Thomson.
5. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
6. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition / W.Bolton/ Pearson, 2012
7. Mechatronics – Principles and Application / Godfrey C. Onwubolu/Elsevier, Indian print

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COURSE OUTCOMES:

After completion of this course, the student shall be able to use the various mechatronics systems devices and components in the design of electro mechanical systems.

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III Year-II Semester		L	T	P	C
		3	0	0	3
MEASUREMENTS AND CONTROL SYSTEMS (PROGRAM ELECTIVE-II)					

Course Objectives:

- To impart knowledge of architecture of the measurement system
- To deliver the different working principles of mechanical measurement system.
- To study concept of mathematical modelling of the control system.
- To acquaint with control system under different time domain.

UNIT-I

Introduction: Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs.
Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range.
Errors in measurement: Types of errors, Effect of component errors, Probable errors.
Displacement Measurement: Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Nozzle Flapper Transducer

UNIT-II

Strain Measurement: Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors.
Measurement of Angular Velocity: Tachometers, Tacho generators, Digital tachometers and Stroboscopic Methods.
Acceleration Measurement: theory of accelerometer and vibrometers, practical accelerometers, strain gauge based and piezoelectric accelerometers

UNIT-III

Pressure Measurement: Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, High Pressure Measurements, Bridge man gauge.
Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges.
Flow Measurement: Bernoulli flowmeters, Ultrasonic Flowmeter, Magnetic flow meter, Rota meter.
Temperature Measurement: Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples, Pyrometers.

UNIT-IV

Sensitivity analysis of sensor-influence of component variation, Signal conditioning: Amplifier, Conversion, Filtering, Impedance Buffering, Modulation / Demodulation, Linearization, Grounding and Isolation Introduction to control systems, Classification of control system. Open loop and closed loop systems. Mathematical modelling of control systems, concept of transfer function, Block diagram algebra.

UNIT-V

Transient and steady state analysis of first and second order system: Time Domain specifications. Step response of second order system. Steady-state error, error coefficients, steady state analysis of different type of systems using step, ramp and parabolic inputs.
Stability analysis: Introduction to concepts of stability, The Routh criteria for stability, Experimental determination of frequency response, Stability analysis using Root locus, Bode plot and Nyquist Plots, State space modeling, Process control systems, ON-OFF control. P-I-D Control.

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Text Books:

1. Measurement Systems: Applications and Design, by EO Doebelin,5 th Edition, McGraw Hill
2. Mechanical Engineering Measurements, A K Sawhney, Dhanpat Rai& Sons, New Delhi
3. Instrumentation & Mechanical Measurements, A K Thayal
4. Control System Engineering by Nagrath IJ and Gopal M, Wiley Eastern Ltd.
5. Modem Control engineering: by K Ogata, Prentice Hall

References:

1. Control systems by Dhanesh Manik, Cengage Learning.
2. Engineering Metrology and Measurements by N V Raghavendra and L Krishnamurthy, Oxford University Press.
3. Instrumentation and Control System, W. Bolton, Elsevier.
4. Experimental Methods for Engineers by J P Holman, McGraw Hills Int. Edition.
5. Engineering Experimentation by EO Doebelin, McGraw Hills Int. Edition.
6. Mechanical Measurements by S P Venkateshan, Ane books, India

Course Outcomes: After the completion of the course, the students should be able to

- Classify various types of static characteristics and types of errors occurring in the system.
- Select proper measuring instrument for linear and angular displacement.
- Learn about pressure and temperature measurement.
- Analyze error and differentiate various types of control systems and time domain specifications.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
AUTO SCANNING & VEHICLE TESTING LAB					

Course Objective: To impart to the learner the skills to analyze engine and to study its performance, wheel balancing and alignment machines.

1. Computerized engine analyzer study and practice.
2. Computerized wheel balancing machine study and practice.
3. Two wheeler chassis dynamometer study and practice
4. Study of wind tunnel -determining of coefficient of drag for a given automobile model.
5. Road worthiness test a) Acceleration b) Gradeability c) Maximum speed d) Constant speed fuel consumption (High way drive) e) city drive fuel consumption tests.
6. Head light focusing test.
7. Visibility test.
8. Braking distance test.
9. Drawings of automobile bodies -light and heavy vehicles for different seating capacities.
10. Dimensional drawings of bus depots and service station workshop layouts.

Course outcomes: The students completing the course will be able to understand automotive scan tools and diagnostic equipment for fault diagnosis and troubleshooting.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		0	0	3	1.5
VEHICLE MAINTENANCE LABORATORY					

COURSE OBJECTIVES:

- To impart the fundamental knowledge in evaluation and maintenance.
- To know about the various methods of maintaining vehicles and their subsystems.

STUDY EXPERIMENTS:

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

LIST OF PRACTICAL EXPERIMENTS

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

Course Outcomes: At the completion of the course, the student should be able to

- Acquire the fundamental knowledge in evaluation and maintenance.
- Understand the various methods of maintaining vehicles and their subsystems.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		0	0	3	1.5
VEHICLE EVALUATION LAB					

Course objectives: To make the learner understand the various standards used for testing of vehicles

(Note: Minimum 6 Experiments)
(Demonstration of these standards for the identified tests also permitted)

1. Brake Performance Evaluation for 4 -Wheelers (as per IS 11852-2001, Part 1 to 8, and IS 11852-2003, Part 9) Brake Performance
2. Gradeability Test for all Vehicles (as per AIS 003:1999 & IS 13988-2002)
3. Coast Down Test for all Vehicles (as per IS 14785-2000)
4. Pass-by Noise Level Measurement Test for all vehicles (as per IS 3028-1998)
5. Interior Noise Level Measurement Test for N2 / N3 and M2 / M3 category of vehicles (as per AIS 020)
6. Constant Speed Fuel Consumption
   As per IS 10881-1994 for 2-Wheelers
   As per AIS 054 for 3-Wheelers
   As per IS 11921-1993 for Other than 2-Wheelers
7. Speedometer Calibration (as per IS 11827-2008 for all Vehicles)
8. Turning Circle Diameter Check for all vehicles other than 2- Wheelers (as per IS 12222-2011)
9. Steering Effort Measurement for all vehicles other than 2- Wheelers (as per IS 11948-1998)
10. Hood Latch Test (for all four wheelers fitted with a front bonnet) (as per IS 14226-1995)
11. Odometer Calibration (as per IS 11850:1986) for all vehicles
12 Stationary Noise Level Measurement (as per ISO 5130:1982(E), IS 10399:1998 for all vehicles
13. Tell Tale Symbols Checks (as per AIS: 071-2009)
14. Cooling Performance Trials (as per IS 14557-1998) for all vehicles fitted with water cooled engines other than 2 and three wheelers
15. Range Test for LPG / CNG fuelled vehicles (as per AIS 055) Physical Verification Tests for All type of vehicles (as per CMVR)
16. Vehicle Weighment for all vehicles (as per IS 11825-1986) Wheel Guard Measurement for Passenger Cars (as per IS 13943-1994)
17. Safety Checks for CNG / LPG fuelled vehicles (as per AIS 026, AIS 027 and AIS 028)
18. Requirement of Temporary Cabin for Drive Away Chassis (as per AIS 070)
19. Electro-Magnetic Radiation from Automotive Vehicles (as per AIS 004)
20. Acceleration performance of 2 wheeler (as per IS 10407: 1998)
21. Acceleration performance of automotive vehicles other than 2 & 3 wheelers (as per IS 11851:1986)
22. Fuel efficiency test Highway fuel consumption City fuel consumption
23. Manoeuvrability on Serpentine Course
24. Spark arrester devices as per petroleum rule 2002 chapter 10 ESC evaluation
25. Bus body code as per AIS:052
26. Truck code as per AIS:093
27. Ambulance code as per AIS:125
28. School Bus as per AIS:063
29. Sleeper Coach as per AIS:119
30. Double Decker Buses as per AIS:139

Course outcomes: Students at the end of the course will be able to gain knowledge on various standards used for testing of vehicles.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE SAFETY (PROGRAM ELECTIVE-III)					

Course objective: To impart the knowledge of the safety concepts, comfort and convenience system, driver assistance system and other requirements of automotive safety**.**

UNIT-I
INTRODUTION
Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction. Safety standards.

UNIT-II
SAFETY AND FATIGUE ASPECTS
Design of body, forces in roll over, head on impact, plastics collapse and analysis, fatigue and vibration, test on box sections, structural vibration.

UNIT-III
SAFETY CONCEPT
Active safety: driving safety, conditional safety, perceptibility safety, operating safety- crash safety
Passive safety: exterior safety, interior, safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.
Safety equipment: Seat belt, regulations, automatic seat belt tightened system, Anti-locking braking system(ABS), Speed limiting device(SLD)
Automatic traction control, automatic vehicle stability control, Collapsible steering system, tilt able steering system, air bags system, bumpers design for safety.

UNIT-IV
COLLISION WARNING AND AVOIDANCE
Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection, braking system interactions.

UNIT-V
COMFORT AND CONVENIENCE SYSTEM
Steering and mirror adjustment system, central locking system, tyre pressure monitoring and control system, rain sensor system, automatic climate control systems, environment information system.

TEXT BOOKS:

1. Bosch /Automotive Handbook/5th edition /SAE publication
2. Junsz Pawlowski/Vehicle Body Engineering/Business book limited, 1989.
3. Ronald K Jurgen/Navigation and Intelligent Transportation Systems-Progress in Technology/ Automotive Electronics Series, SAE. USA,1998.

Course Outcomes: After the completion of the course, the student will be able to
- Understand the design of the automobile body for safety and different safety standards
- Design the automobile body with respect to safety and fatigue aspects
- Understand active and passive safety systems
- Familiarize with different comfort and convenience systems

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE HVAC (PROGRAM ELECTIVE-III)					

Course objective: To impart the knowledge of the refrigeration, Psychrometry, Air Conditioning Systems, Air-distribution systems and air-conditioning service and control required for automobiles.

UNIT I
Refrigeration
Introduction - Methods of refrigeration, Vapour compression refrigeration system - Vapour absorption refrigeration system, commonly used refrigerants, Refrigerants used in automobile air conditioning

UNIT II
Psychrometry
Psychrometric properties, tables, charts - Psychrometric processes - Comfort charts – Factors affecting comfort - Effective temperature - Ventilation requirements

UNIT III
Air Conditioning Systems
Classification and layouts - Central / unitary air conditioning systems - Components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems.
Load Analysis: Outside & inside design consideration - Factors affecting load on refrigeration & air conditioning systems - Cooling & heating load calculations - Load calculations for automobiles - Effect of air conditioning load on engine performance.

UNIT IV
Air Distribution Systems
Distribution duct system, sizing, supply / return ducts - Types of grills, diffusers, ventilation, air noise level - Layout of duct systems for automobiles and their impact on load calculations.
Air Routine & Temperature Control: Objectives - evaporator air flow - Through the ASHRAE-circulating unit - Automatic temperature control - Controlling flow - Control of air handling systems.

UNIT V
Air Conditioning Service and Control
Air conditioner maintenance & service - servicing heater system - Removing & replacing components.
Air Conditioning Control: Common control such as thermostats- Humidity status – Control dampers - Pressure cut-outs and relays

Text Books

1. Mark Schnubel, "Automotive heating and Air conditioning", Today's Technician, 5th edn,2013
2. C. P. Arora, Refrigeration & Air Conditioning
3. William. H. Cruise – Automotive Air-Conditioning. Mc-Graw Hill

References

1. Steven Daly, "Automotive Air Conditioning and Climate Control Systems", Butterworth - Heinemann; 1 edition (2006)
2. Norman C. Harris, "Modern Air-Conditioning Practice", McGraw-Hill Education 1984
3. R.J. Dossat, "Principles of Refrigeration", Prentice Hall, 5th ed, 2001.

4. Paul Lung, "Automotive Air Conditioning", C.B.S. Publisher & Distributor, (Delhi. 1991)

Course Outcomes: After the completion of the course, students will be able to

- Understand the basic of refrigeration and vapour compression refrigeration system.
- Familiarize with the concepts of Psychrometry, Air Conditioning and Air Distribution systems
- Understand the various aspects of Air conditioning Maintenance, Service and Control.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
SPECIAL PURPOSE VEHICLES (PROGRAM ELECTIVE-III)					

Course Objectives:

- To enhance the knowledge of the students about the various equipments used in earth moving, applications.
- To understand the construction and working of the vehicle for constructional application
- To describe the working nature of farm equipment's based on their application.
- To discriminate the various industrial vehicles based on the purpose.
- To acquire the knowledge on the functioning of military vehicle.

UNIT I
EARTH MOVING EQUIPMENTS
Construction layout, capacity and applications of dumpers, articulated haulers, front-end loaders, backhoe loaders, bulldozers, scrappers, motor graders, skid steer loaders, excavator, hydraulic shovels, bucket conveyors , surface miners – high wall Miners. Selection criteria of prime mover for dumpers.

UNIT II
CONSTRUCTIONAL EQUIPMENTS
Construction layout, capacity and applications of cranes – types , Articulated Trucks ,concrete ready mixer, trenchers, Asphalt Pavers , road recliners, Compactors – types , draglines, drillers, borewell machine .

UNIT III
FARM EQUIPMENTS
Classification of tractors – Main components of tractor. Working attachment of tractors – Auxiliary equipment –- Top lifting harvesters. General description, working, specification and functions paddy harvesting machines, Sugarcane harvesting, feller bunchers, forest machines.

UNIT IV
INDUSTRIAL VEHICLES
Constructional features, capacity and working of fork lifts, Utility vehicles, towing vehicles, man-lift chassis, scissor lift trucks, material handlers, recliners, Street sweepers.

UNIT V
MILITARY AND COMBAT VEHICLES
Special features and constructional details of Main Battle tank, gun carriers, transport vehicles, Armoured vehicle-launched bridge, amphibious bridging vehicle, communication vehicles.

TEXT BOOKS:

1. Abrosimov. K. Bran berg.A. andKatayer.K."Road making Machinery ", MIR Publishers, Moscow, 1971.
2. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers, 1987.
3. Wong.J.T., "Theory of Ground vehicles ", John Wiley & Sons, New York, 1987.

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REFERENCES:

1. B. Geleman and M. Moskovin, Farm tractors, MIR publishers, Moscow.
2. Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co ltd., London.
3. Kolchin, A., and V.Demidov, Design of Automotive Engines for Tractor, MIR Publishers, 1972.
4. Peurifoy R.L "Construction Planning, Equipment and Methods", Tata McGraw-Hill, New Delhi, 2002.
5. Wong J "Terramechanics and Off-Road Vehicle Engineering", Butterworth-Heinemann, 2009

Course Outcomes: After the completion of the course, the student will be able to

- Acquire the knowledge about the various equipments used in earth moving, applications.
- Understand the construction and working of the vehicle for constructional application
- Describe the working nature of farm equipment's based on their application.
- Discriminate the various industrial vehicles based on the purpose.
- Acquire the knowledge on the functioning of military vehicle.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
ENGINE MANAGEMENT SYSTEMS (PROGRAM ELECTIVE-III)					

Course objective: To impart the knowledge of the Spark Ignition and compression ignition engine management systems, engine diagnostics procedure, Computerised electronic fuel injection systems and air flow fuel management strategies.

UNIT-I

Computerized Electronic Fuel Injection: Engine Input Sensors Coolant & Intake Temperature, Crankshaft Position, Camshaft Position, Manifold Absolute Pressure, Throttle Position, Oxygen, Air/Fuel Ratio, Knock Speed& Distance, Battery & Switches Output Devices -Relays, Injector Sequencing & Management, Ignition Operation, Idle Air Control, EGR, EVAP, Waste gate Solenoids, Torque Converter & Speed Control, Malfunction Indicator Light

UNIT -II

Speed Density/Mass Air Flow Fuel Management Strategies: Key ON Mode, Crank Mode, Open & Closed Loop, Wide-Open Throttle, Adaptive Memory Cells, Cruise &Deceleration, Wide-Open Throttle, Key OFF Mode Fuel Injection Systems -Electronic Fuel Systems, Computer Self-Diagnostic Circuits, Electronic Throttle Actuator Control Systems, Fuel Control, Fuel Supply System Control, Injection System Inspection and Maintenance.

UNIT -III

Engine Diagnostic Procedures: Fuel System testing, On Board Diagnostics, Monitored &Non Monitored Circuits, Diagnostic Trouble Codes, Digital Engine Control System: Open loop and close loop control system, engine cooling and warm up control, idle speed control, acceleration and full load enrichment, deceleration fuel cut-off. Fuel control maps, open loop control of fuel injection and closed loop lambda control exhaust emission control, on-board diagnostics, diagnostics, future automotive electronic systems, Electronic dash board instruments – Onboard diagnosis system.

UNIT -IV

SI Engine Management: Feedback carburettor system, throttle body injection, multi-point fuel injection and direct injection systems, Layout and working of SI engine management systems like Bosch Mono-jetronic, L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contactless electronic ignition system, Electronic spark timing control. Three-way catalytic converter, conversion efficiency versus lambda.

UNIT - V

CI Engine Management: Fuel injection system, parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced, post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve control in electronically controlled systems.

TEXT BOOKS:

1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
2. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004

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REFERENCES:

1. Halderman, J. & Linder, J. (2012). Automotive Fuel and Emissions Control Systems (3rd Edition) Upper Saddle River, NJ: Pearson Education.
2. Halderman, J. D. (2011). Diagnosis &Troubleshooting of Automotive Electrical, Electronic, &Computer Systems (6th Edition) Upper Saddle River, NJ: Pearson Education.
3. Understanding Automotive Electronics – Bechfold SAE 1998
4. Automobile Electronics by Eric Chowanietz SAE
5. Fundamentals of Automotive Electronics - V.A.W.Hilliers - Hatchin, London
6. Automobile Electrical & Electronic Equipment (2000) Young, Griffitns - Butterworths, London.
7. Understanding Automotive Electronics, William B. Ribbens, 5th Edition, Newnes, Butterworth–Heinemann, 2001.
8. Automotive Computers & Digital Instrumentation – Robert N. Brandy, Prentice Hall, 2004
9. The Fundamentals of Electrical Systems - John Hartly - Longman Scientific & Technical, 2002.

Course Outcomes: After the completion of the course, the student will be able to

- Acquire the knowledge about Computerized Electronic Fuel Injection, Battery & Switches Output Devices
- Understand the Air Flow Fuel Management Strategies and Electronic fuel systems.
- Describe the Engine Diagnostic Procedures Fuel System testing.
- Analyze the spark ignition and compression ignition management systems.

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IV Year-I Semester		L	T	P	C
		3	0	0	3
VEHICLE INFOTRONICS (PROGRAM ELECTIVE-III)					

Course objective: To impart the knowledge of Smart Control of Vehicle dynamics, Global Positioning systems, Driver assistance systems, Intelligent Vehicle and Adaptive control systems and other systems pertaining to Vehicle Infotronics.

UNIT-I: Overview of Infotronics
Concept of Infotronics, Web-enabled Vs Web Based systems, Applications of Infotronics, Vehicle buses and protocols – LIN, CAN, MOST & Flexray.

UNIT-II: Systems in vehicle
Smart control of Vehicle[ESP] dynamics, drive Electronic Throttle control by wire, active suspensions/mounting system, Automated Guided Vehicles(AGV), Multi-disciplinary optimization in Vehicles (MDO) and advanced propulsion systems(APS), Radio Communication Technologies For Vehicle Information Systems, IEEE 802.11 and DSRC.

UNIT-III: Telematics
Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition, driver assistance systems.

UNIT-IV: Intelligent vehicle Control
Active and Semi active suspensions/Mounts for NVH, Optimization and stability of Hydraulic Engine mounts and Bushing in Vehicle, Rollover control and Active stability control, combined control of ride comfort in passenger cars, Active Roll over control in hydraulically actuated articulated vehicles, intelligent drive by wire vehicles, Design and realization of seer and brake by wire.

UNIT-V: Adaptive Control System
Conventional control schemes, system model for adaptive control, Design of self-tuning controllers, ACC overview, system based on ACC, Stop and Go, Anti- collision system, Impact of ACC on traffic and drivers, Adaptive noise control, automatic and adaptive control of highway traffic and moving vehicles. Power steering and power window: Requirements, Introduction, characteristics.

TEXT BOOKS:
1. Intelligent Vehicle Technology by L VlACIC, M PARENT, F HARA, Butterworth-Heinemann publication.
2. Navigation and Intelligent transportation systems By Ronald K. Jurgen, SAE.

REFERENCE BOOKS:
1. Robert Bosch, Automotive Hand Book by SAE
2. Understanding Automotive Electronics by Willam B. Ribbens, SAE
3. Understanding Automotive Electronics by Bechhold, SAE.

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Course Outcomes: After the completion of the course, the student will be able to

- Acquire the knowledge about Infotronics and its applications
- Understand the Smart control of Vehicle dynamics and Radio Communication Technologies for Vehicle Information Systems.
- Describe the global positioning systems and driver assistance systems.
- Understand the Intelligent Vehicle and Adaptive control systems.

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IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE CERTIFICATION AND HOMOLOGATION (PROGRAM ELECTIVE-IV)					

Course objective: To understand the classifications of vehicles, different Vehicle Performance and Road and Track Testing procedures and analyse the procedures for Active and Passive Safety testing and components testing.

UNIT I
Introduction
Specification & Classification of Vehicles, Regulations overview(ECE, FMVSS, AIS, CMVR, ADR), Type approval and Conformity of Production, Engine and Vehicle specifications, Two Wheeler certification.

UNIT II
Vehicle Performance Testing
Methods for evaluating vehicle performance- energy consumption (well to wheel) in conventional automobiles, performance, emission and fuel economy, Operation at full load and part load conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, Gradeability test, Turning circle diameter test, Steering Impact test, Steering effort test.

UNIT III
Road and Track Testing:
Initial inspection, PDI, engine running in and durability, intensive driving, maximum speed and acceleration, brake testing on the road, hill climbing, handling and ride characteristics, safety, mechanism of corrosion, three chamber corrosion testing, wind tunnel testing, road testing, test tracks, coast down test, Portable exhaust measurement system.

UNIT IV
Active and Passive Safety Testing:
Wheel rim testing for cornering and radial fatigue, Fire resistance test, bumper test, crash test, side impact test, rollover test, safety belt test, Airbag test, Safety belt anchorages, Seat anchorages & head restraints, Occupant protection Impact test, Side door intrusion test.

UNIT V
Components Testing:
Size and Ply rating of tyres, Safety Glasses, Wind screen wiping system, Hydraulic brake hose, Hydraulic brake fluid, Rear view mirror specification (Exterior), Rear view mirror specification (Interior), Wheel rims, Wheel nut, Wheel discs & hub caps, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints, door locks & door retention.
Overview and study of testing standards like; AIS testing standards, Euro Standards, SAE standards. ISO26262 standards for functional safety of electrical and/or electronic systems in automobiles.

TEXT BOOKS
1. Raymond M. Brach and R. Matthew Brach, "Vehicle Accident Analysis and Reconstruction Methods", SAE International, 2011
2. Automotive Industry Standards, AIS

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REFERENCES

1. Ulrich Seiffert and Lothar Wech, "Automotive Safety Handbook", SAE International, 2007
2. ISO Standards, ICS: 43.020, 43.040, 43.100

Course Outcomes: After the completion of the course, the student will be able to

- Understand the specifications and classification of the vehicles
- Understand the methods for evaluating vehicle performance
- Describe the different road and track testing.
- Understand the active and passive safety testing and components testing.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
TOTAL QUALITY MANAGEMENT (PROGRAM ELECTIVE-IV)					

Course Objectives:

- To understand the concepts of TQM, quality and business performance
- To understand importance of customer satisfaction and loyalty
- To analyze organizing for quality implementation
- To learn the concept of cost of quality
- To understand ISO 9000 universal standards of quality

UNIT – I

INTRODUCTION: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT – II

CUSTOMER FOCUS AND SATISFACTION: The importance of customer satisfaction and loyalty-Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

UNIT – III

ORGANIZING FOR TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

UNIT – IV

THE COST OF QUALITY: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

UNIT – V

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system

TEXT BOOKS:

1. Total Quality Management / Joel E.Ross/Taylor and Francis Limited
2. Total Quality Management/P.N.Mukherjee/PHI

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REFERENCES:

1. Beyond TQM / Robert L.Flood
2. Statistical Quality Control / E.L. Grant / McGraw Hill.
3. Total Quality Management- A Practical Approach/H. Lal
4. Quality Management/KanishkaBedi/Oxford University Press/2011
5. Total Engineering Quality Management/Sunil Sharma/Macmillan

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

- Understand the concepts of TQM, Quality and Business performance
- Understand importance of customer satisfaction and loyalty
- Summarize the concept of cost of quality
- Understand ISO 9000 universal standards of quality

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
ELECTRICAL VEHICLES AND HYBRID TECHNOLOGY (PROGRAM ELECTIVE-IV)					

Course Objectives: The course should enable the students to:

- General aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control.

UNIT I
INTRODUCTION
Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II
DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES
Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.

UNIT III
ENERGY SOURCES
Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery charging- Quick Charging devices. Battery Management System.
Polymer Exchange Membrane Fuel Cell- Characteristics- Half reactions of fuel cell. Cells in series and parallel- water management - Thermal Management.

UNIT IV
MOTORS
Characteristics of DC motors (Brush and Brushless), AC single phase and 3-phase motor, PM motors, Switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/AC converters.

UNIT V
SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES
Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles. Choice of Tires.

TEXT BOOKS:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press, 2003
2. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2005.

REFERENCES:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “John Wiley & Sons, 2003
2. Lino Guzzella, “Vehicle Propulsion System” Springer Publications, 2005
3. Ron Hokinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication, 2005

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Course Outcomes: The students will be able to understand

- Electric and hybrid vehicle operation and architectures
- Design of hybrid and electric vehicles.
- Energy requirement for vehicles.
- Vehicle characteristics, operating modes, and performance parameters of the vehicle
- Different subsystems of hybrid and electric vehicles

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IV Year-I Semester		L	T	P	C
		3	0	0	3
FACILITIES PLANNING AND MATERIAL HANDLING (PROGRAM ELECTIVE-IV)					

Course Objectives:

- To understand the overall facilities planning process
- To educate product, process and schedule design and their effects on the facility layout
- To introduce concepts of material handling and safety in industries.

UNIT-I Design of layout of factories, Office, Storage area, Consideration of facilities for working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout –Systematic layout planning, Design of Assembly lines, Line balancing methods.

UNIT II
Computer applications in layout designs, Environmental aspects like lighting, Ventilation, dust control, humidity. Different type of Plant services like steam compressed air.

UNIT III
Plant safety, Elements off Industrial safety- Causes and prevention of accidents – Pollution and environmental consideration.

UNIT IV
Introduction, Material Handling Process, Material Handling principles, Classification of Material Handling Equipment, Relationship of material handling to plant layout.

UNIT V
Basic Material Handling systems: Selection, Material Handling method- path, Equipment, function oriented systems.
Methods to minimize cost of material handling- Maintenance of Material Handling Equipments, Safety in handling, Ergonomics of Material Handling equipment. Design, Miscellaneous equipment

Text books:

1. A W Peymberton, Plant layout and Material Handling, John Wiley
2. James A Apple, Plant layout and Material Handlin, Krieger Pub Co,1998
3. John A Sehbin, Plant layout and Material Handling-
4. K C Arora & Shinde, Aspects of Material handling, Lakshmi Publications.
5. P B Mahapatra, Operations Management, PHI, 2010

Course Outcomes: The students will be able to

- Assess the value of facility planning on the strategy of a firm
- Develop a systematic plant layout
- Know the environmental and economic aspects in facilities planning
- Understand various material handling systems

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IV Year-I Semester		L	T	P	C
		3	0	0	3
RAPID PROTOTYPING (PROGRAM ELECTIVE-IV)					

Course Objectives: The course should enable the students to understand and use techniques for processing of CAD models for rapid prototyping and apply fundamentals of rapid prototyping techniques.

UNIT I
Introduction: Introduction to Prototyping, Traditional Prototyping vs Rapid Prototyping (RP), Classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process.

UNIT II
CAD Modelling and Data Processing for RP: CAD model preparation, Data interfacing: formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures; Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing, Tool path generation.

UNIT III
RP Processes-1: Process Physics, Tooling, Process Analysis, Material and technological aspects, Applications, limitations and comparison of various rapid manufacturing processes. Photo polymerization (Stereo-lithography (SL), Micro-stereo lithography), Powder Bed Fusion (Selective laser Sintering (SLS),

UNIT IV
RP Processes-2: Electron Beam melting (EBM), Extrusion-Based RP Systems (Fused Deposition Modelling (FDM), 3D Printing, Sheet Lamination (Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Beam Deposition (Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD).

UNIT V
Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS.

Reference Books:

1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
2. Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.
3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4. Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
5. Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer,

Course Outcomes:
On completion of this course students will be able to:
1. Understand and use techniques for processing of CAD models for rapid prototyping.
2. Understand and apply fundamentals of rapid prototyping techniques.
3. Use appropriate tooling for rapid prototyping process.
4. Utilize rapid prototyping techniques.

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IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE COMFORT SYSTEMS AND ERGONOMICS (PROGRAM ELECTIVE-V)					

Course Objectives:

- To understand the engineering principles that underpins the design of an automotive vehicle for the comfort of the occupants and other road users.
- To recognize the future direction of the design of comfort systems within the automotive engineering sector.
- To appreciate the role and use of comfort systems in automobile engineering.
- To know about the safety systems in a vehicle and deformation behaviour of a vehicle.

UNIT- I

INTRODUCTION TO COMFORT SYSTEMS: Vehicle occupants and other road users. Driver assistance systems-Traffic jam assist, Road sign assistant, Intelligent headlight control, Remote park assist, Side view assist, Interior comfort systems-Seat and comfort actuation, Window lift and sunroof drives.

UNIT- II

DESIGN AND OPERATION OF COMFORT SYSTEMS: Introduction to systems such as: NVH (noise, vibration and harshness) of chassis, engines and power train, ride quality and sound quality; heating, ventilation and air conditioning systems.

UNIT- III

DRIVER COMFORT: Passenger car and commercial vehicle – driving, seating, visibility, man-machine system, Psychological factors – stress and attention of a driver.

UNIT- IV

PASSENGER COMFORT: Ingress and egress, spaciousness, ventilation, temperature control, dust and fume prevention and vibration.

UNIT- V

OTHER SYSTEMS: Steering and mirror adjustment, Central locking system- Garage door opening system, Tyre pressure control system, Rain sensor system, Environment information system.

VEHICLE ERGNOMICS: Introduction to human body, Anthropometrics and its application to vehicle ergonomics and cabin design. Ergonomic research methods / ergonomic audit.Case studies on integrating design and ergonomics.

Text Books:

1. Ergonomics in Automotive Design, Prof. S. Karmakar, IITG.
2. Julian Happian-Smith, “An introduction to modern vehicle design”, Butterworth Heinmenn, 2001

References:

1. Tony Lewin, “How to Draw Cars like a Pro”, Motor books International, 2003
2. Thom Taylor, Lisa Hallett, “How to Draw Cars like a Pro”, Motor books International; 2Rev Ed edition, 2006
3. J. Brian Peacock, Waldemar Karwowski, “Automotive ergonomics”, Taylor & Francis ltd, 1993

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DEPARTMENT OF AUTOMOBILE ENGINEERING

Course Outcomes: After the completion of the course, the student will be able to

- Understand the engineering principle that underpins the design of an automotive vehicle for the comfort of the occupants and other road users.
- Recognize the future direction of the design of comfort systems within the automotive engineering sector.
- Appreciate the role and use of comfort systems in automobile engineering.
- Know about the safety systems in a vehicle and deformation behaviour of a vehicle.

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IV Year-I Semester		L	T	P	C
		3	0	0	3
LEAN MANUFACTURING (PROGRAM ELECTIVE-V)					

Course Objectives: To understand the Lean and factory simulation, and comparison of Lean manufacturing with other methods and also the tools of Lean manufacturing, Value Stream mapping and best practices in Lean manufacturing.

Unit I
Introduction to Lean and Factory Simulation: History of Lean and comparison to other methods – The 7 Wastes, their causes and the effects – An overview of Lean Principles / concepts / tools – Stockless Production.

UNIT-II The Tools of Lean Manufacturing: Continuous Flow – Continuous Flow Manufacturing and Standard Work Flow – 5S and Pull Systems (Kanban and ConWIP systems) – Error Proofing and Set-up Reduction – Total Productive Maintenance (TPM) – Kaizen Event examples. Toyota production systems, Ford production systems

Unit- III
Value Stream Mapping – Current state: Preparation for building a Current State Value Stream Map – Building a Current State Map (principles, concepts, loops, and methodology) – Application to the factory Simulation scenario.

Unit - IV
Value Stream Mapping – Future State: Key issues in building the Future State Map – Process tips in building the map and analysis of the customer loop, supplier loop, manufacturing loop and information loop – Example of completed Future State Maps – Application to factory simulation – Implementation of lean practices – Best Practices in Lean Manufacturing.

UNIT-V
TQM Tools and Techniques: The seven traditional tools of quality, new management tools, and six sigma: Concepts, methodology, applications to manufacturing, service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA, Stages, and Types. Quality circles, Quality Function Deployment (QFD), Taguchi quality loss function, TPM, Concepts, improvement needs, Cost of Quality, Performance measures

Text Books:

1. Womack J. P., Jones D.T. and Roos D. – 'The Machine that Changed the World: the Story of Lean Production' – Simon & Schuster, New York – 1996
2. Liker J. K. – 'Becoming Lean' – Industrial Engineering and Management Press – 1998
3. Womack J. P. and Jones D. T. – 'Lean Thinking' – Simon & Schuster, USA – 1996
4. Rother M. and Shook J. – 'Learning to See' – The Lean Enterprise Institute, Brookline, USA – 2003

Course Outcomes: After the completion of the course, the student will be able to
- Understand the basics of Lean manufacturing and comparison with other methods of manufacturing
- Learn the tools used in Lean Manufacturing and total predictive maintenance
- Appreciate the value stream mapping and Application to the factory Simulation scenario.

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IV Year-I Semester		L	T	P	C
		3	0	0	3
VEHICLE DESIGN DATA CHARACTERISTICS (PROGRAM ELECTIVE-V)					

Course Objectives: To understand the fundamentals of vehicle design, power estimation and performance. To determine the gear ratios and determine the characteristics of different vehicle sub systems.

UNIT-I
INTRODUCTION: Fundamentals of vehicle design, laden and un-laden weights, Front and rear axle weights, Frontal Area, maximum speed, maximum acceleration, gradeability in different gears, vehicle center of gravity

UNIT-II
POWER ESTIMATION: Analysis of air and rolling resistances at various vehicle speeds - Calculation, Estimation of Driving force, determination of power requirement at different loads and speeds, Maximum Power calculation, numericals.

UNIT-III
PERFORMANCE: Torque and Mechanical Efficiency at different vehicle speeds, Pressure – Volume diagram, Calculation of Mean Effective Pressure and Engine Cubic Capacity, numericals.

UNIT-IV
VELOCITY, ACCELERATION AND TURNING MOMENT: Connecting rod length to Crank Radius Ratio, Piston Velocity and Acceleration against Crank Angle plot, Gas force, inertia force and Resultant force against Crank Angle plot, Turning Moment and Side Thrust against Crank Angle plot.

UNIT-V
POWER TRAIN: Determination of Gear Ratios, Acceleration and Gradeability, Numericals on Vehicle performance.
OVERALL VEHICLE PERFORMANCE: Characteristics of different vehicle sub systems.

TEXT BOOKS:
1. Heinz Heisler Advanced Vehicle Technology, 2nd edition, Publisher Elsevier -2002.
2. Hilliers Fundamentals of Motor Vehicle Technology 6th Edition, Publisher Oxford - 2014

REFERENCES:
1. N. K. Giri, Automotive Mechanics, Khanna Publishers, New Delhi, 2005.
2. Heldt, P.M., High Speed Combustion Engines, Oxford and I.B.H. Publishing Co. Kolkata, 2002.

Course Outcomes: After the completion of the course, the student will be able to
- Understand the fundamentals of vehicle design, power estimation and performance.
- Learn the velocity, acceleration and turning moment and analyse corresponding plots
- Appreciate the overall performance and determination of gear ratios.

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IV Year-I Semester		L	T	P	C
		3	0	0	3
RELIABILITY ENGINEERING (PROGRAM ELECTIVE-V)					

Course Objectives:

- To comprehend the concept of Reliability
- Derive the expressions for probability of failure, Expected value and standard deviation of Binominal distribution, Poisson distribution, normal distribution and Weibull distributions.
- Formulating expressions for Reliability analysis of series-parallel and Non-series parallel systems
- Deriving expressions for Time dependent and Limiting State Probabilities using Markov models.

UNIT –I

Rules for combining probabilities of events, Definition of Reliability. Significance of the terms appearing in the definition. Probability distributions: Random variables, probability density and distribution functions. Mathematical expectation, Binominal distribution, Poisson distribution, normal distribution, Weibull distribution.

UNIT – II

Hazard rate, derivation of the reliability function in terms of the hazard rate. Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failures). Bath tub curve. Preventive and corrective maintenance. Modes of failure. Measures of reliability: mean time to failure and mean time between failures.

UNIT – III

Classification of engineering systems: series, parallel and series-parallel systems- Expressions for the reliability of the basic configurations. Reliability evaluation of Non-series-parallel configurations: Decomposition, Path based and cutest based methods, Deduction of the Paths and cutsets from Event tree.

UNIT – IV

Discrete Markov Chains: General modeling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation of one component repairable model. Absorbing states. Continuous Markov Processes: Modeling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating time dependent and limiting state Probabilities of one component repairable model. Evaluation of limiting state probabilities of two component repairable model.

UNIT – V

Approximate system Reliability analysis of Series systems, parallel systems with two and more than two components, Network reduction techniques. Minimal cutest/failure mode approach.

TEXT BOOKS:

1. “Reliability evaluation of Engineering systems”, Roy Billinton and Ronald N Allan, BS Publications.
2. “Reliability Engineering”, Elsayed A. Elsayed, Prentice Hall Publications.

REFERENCES:

1. “Reliability Engineering: Theory and Practice”, By Alessandro Birolini, Springer Publications.
2. “An Introduction to Reliability and Maintainability Engineering”, Charles Ebeling, TMH Publications.
3. “Reliability Engineering”, E. Balaguruswamy, TMH Publications.

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

- Apply fundamental knowledge of Reliability to modeling and analysis of series parallel and Non-series parallel systems.
- Understand Discrete Markov Chains and Continuous Markov Processes
- Analyze the Reliability analysis of Series systems, parallel systems and Network reduction techniques

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
SMART, AUTONOMOUS AND CONNECTED VEHICLES (PROGRAM ELECTIVE-V)					

Course Objectives: To understand the concept of automobile electronics, Connected and Autonomous Vehicle Technology, Sensor Technology, Advanced Driver Assistance system, Troubleshooting and Maintenance of Advanced Driver Assistance Systems and Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation.

UNIT-I
Introduction – Concept of Automobile Electronics - History and Evaluation - Infotainment, Body, Chassis, and Powertrain Electronics - Advanced Driver Assistance Electronic Systems.
Connected and Autonomous Vehicle Technology: Basic Control System Theory applied to Automobiles-Overview of the Operation of ECUs-Basic Cyber-Physical System Theory and Autonomous Vehicles-Role of Surroundings Sensing Systems and Autonomy- Role of Wireless Data Networks and Autonomy

UNIT-II
Sensor Technology for Advanced Driver Assistance Systems: Basics of Radar Technology and Systems - Ultrasonic Sonar Systems - Lidar Sensor Technology and Systems - Camera Technology - Night Vision Technology - Other Sensors - Use of Sensor Data Fusion - Integration of Sensor Data to On-Board Control Systems, overview on wireless Technology.

UNIT-III: Wireless Networking and Applications to Vehicle Autonomy: Basics of Computer Networking – the Internet of vehicles- Wireless Networking Fundamentals - Integration of Wireless Networking and On-Board Vehicle Networks - Review of On-Board Networks – Use & Function

Advanced Driver Assistance System Technology: Basics of Theory of Operation – Applications: Legacy, New and Future - Integration of ADAS Technology into Vehicle Electronics - System Examples - Role of Sensor Data Fusion

UNIT-IV: Connected Car Display Technology: Center Console Technology - Gauge Cluster Technology - Heads-Up Display Technology - Warning Technology – Driver Notification
Impaired Driver Technology: Driver Impairment Sensor Technology - Sensor Technology for Driver Impairment Detection -Transfer of Control Technology
Vehicle Prognostics Technology: Monitoring of Vehicle Components - Basic Maintenance - End-of-Life Predictions - Advanced Driver Assistance System Sensor Alignment and Calibration.

UNIT-V: Autonomous Vehicles: Driverless Car Technology - Moral, Legal, Roadblock Issues - Technical Issues - Security Issues
Troubleshooting and Maintenance of Advanced Driver Assistance Systems: Failure Modes – Self Calibration - Sensor Testing and Calibration - Redundant Systems - Standard Manufacturing Principles.
Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation: Uber/Lyft – Disruptive Technology –Trucking – Farming – Mining - Shipping & Rail – Military

Text books:

1. G. Mullett, *Wireless Telecommunications Systems and Networks*, Thomson – Delmar Learning, ISNB#1-4018-8659-0,2006
2. G. Mullett, *Basic Telecommunications: The Physical Layer*, Thomson – Delmar Learning, ISBN#1-4018-4339-5, 2003

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

- Understand the concept of Automobile Electronics and Connected and Autonomous Vehicle Technology
- Learn Sensor Technology for Advanced Driver Assistance Systems, Troubleshooting and Maintenance of Advanced Driver Assistance Systems and Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation

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IV Year-I Semester		**L**	**T**	**P**	**C**
		1	**0**	**2**	**2**
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB					

Course Objectives: To acquire the knowledge on Artificial Intelligence and Machine Learning

1. Data Preprocessing with Weka or Python
2. Building Decision Trees for Soybean classification model using Weka or Python
3. Generating association rules on Weather data using Weka or Python
4. Exploring machine learning models including classification and clustering using scikit-learn or Weka or Python
5. Build Neural Network Classifier using Weka or Python
6. Supervisely - Perform Data Labelling for various images using object recognition
7. Image Classifier using Tensor Flow or OpenCV
8. Automatic Facial recognition using Microsoft Azure or OpenCV

References:

1. Weka Documentation, https://www.cs.waikato.ac.nz/ml/weka/documentation.html
2. Weka Knowledge Flow, https://www.cs.waikato.ac.nz/~eibe/WEKA_Ecosystem.pdf

Course outcomes: The student will be able to apply the techniques learnt to real-life problems.

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III Year-I Semester		L	T	P	C
		3	0	0	3
BASIC AUTOMOBILE ENGINEERING (OPEN ELECTIVE-I)					

Course Objectives:
The course imparts the principles of automobile systems and provides the salient features of safety, emission and service of automobiles.

UNIT – I
Engines – Classification
INTRODUCTION: Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation

UNIT – II
TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotchkiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

UNIT – III
STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toe-in, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT – IV
SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.
BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, and wheel cylinder tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes.
ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, Bendix drive mechanism solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator.

UNIT – V
ENGINE SPECIFICATIONS AND SAFETY SYSTEMS: Introduction- engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling.
Safety: Introduction, safety systems - seat belt, air bags, bumper, anti-lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.

TEXT BOOKS:
1. Automotive Mechanics – Vol. 1 & Vol. 2 / Kirpal Singh/standard publishers
2. Automobile Engineering / William Crouse/TMH Distributors
3. Automobile Engineering/P.S Gill/S.K. Kataria & Sons/New Delhi.

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REFERENCES:

1. Automotive Engines Theory and Servicing/James D. Halderman and Chase D. Mitchell Jr., / Pearson education Inc.
2. Automotive Engineering / K Newton, W.Steeds & TK Garrett/SAE
3. Automotive Mechanics : Principles and Practices/ Joseph Heitner/Van Nostrand Reinhold
4. Automobile Engineering / C Srinivasan/McGraw-Hill.

Course Outcomes:

The student after undergoing the course, shall learn about transmission, steering, suspension, braking and safety and should know the vehicle troubleshooting.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE MAINTENANCE AND SAFETY (OPEN ELECTIVE-I)					

Course objective: To impart the knowledge of the safety concepts, and electrical and chassis maintenance. To learn about different comfort and safety systems used in automobiles.

UNIT I
INSPECTION SCHEDULE AND MAINTENANCE OF RECORDS
Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: general safety, tool safety.

UNIT II
ENGINE MAINTENANCE
Tools used for engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components, servicing and maintenance of fuel system, engine tune-up, cooling system: water pump, radiator, thermostat. Lubrication system maintenance, anticorrosion and anti-freeze additives

UNIT III
CHASSIS MAINTENANCE
Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system. Service and maintenance of brake – disc and drum brakes, steering wheel and suspension systems, wheel alignment, and vehicle body maintenance

UNIT IV
ELECTRICAL SYSTEM MAINTENANCE
Servicing and maintenance of battery, starter motor, alternator and generator, ignition system lighting system, electric horn, and wiper motor.

UNIT-V
COMFORT AND SAFETY SYSTEMS
Steering and mirror adjustment system, central locking system, tyre pressure monitoring and control system, rain sensor system, automatic climate control systems, environment information system, air bag system, collapsible steering column, anti-lock braking system, electronic brake force distribution.

Text Books:

1. Knott and Phil Knott, “An Introductory Guide to Motor Vehicle Maintenance: Light
2. Vehicles”, EMS publishing, 2010
3. Vehicle Maintenance and Garage Practice by Jigar A Doshi, PHI Pub, 2014.
4. Prasad, Priya and Belwafa Jamel, "Vehicles Crashworthiness and Occupant Protection”, American Iron and Steel Institute, USA
5. JullianHappian-Smith “An Introduction to Modern Vehicle Design” SAE, 2002

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Reference Books:

1. William H. Crouse and Donald L. Anglin, "Automotive Mechanics", 10th edition, 2007
2. Tim Giles, "Automotive service: Inspection, maintenance and repair", 3rd edition, 2007
3. Jack Erjavec, "Automotive technology: A systems approach", 5th edition, 2009
4. Recent development in Automotive Safety Technology", SAE International Publication. Editor: Daniel J Helt,2013

Course outcomes: After the completion of the course, the student should be able to acquire knowledge of the safety concepts, understand engine maintenance and electrical and chassis maintenance.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE EMISSIONS AND ITS EFFECTS (OPEN ELECTIVE-I)					

Course objective: To impart the knowledge of different regulatory test procedures, pollutants and particulates.
To acquire understanding about SI engine and CI engine emissions and different emission control techniques.

UNIT I
Laws and Regulation: Historical background, regulatory test procedures (European cycles). European statutory limits, Pollutants: Carbon and Nitrogen compounds-(CO.CO_2 NOx), Hydrocarbons. Volatile compounds, evaporative emissions, particulates.

UNIT-II
SI engine emissions: Mechanism & formation of HC, CO and NOx in SI engines. Engine operating variables affecting pollutants.
CI engine emissions: Mechanism & formation of HC, CO and NOx, and Soot in CI engines. Factors affecting emission formation.

UNIT-III
Emission Control Techniques in SI Engines:
Lean burn & stratified charge engines. Multipoint fuel injection and gasoline direct injection systems, exhaust gas composition, catalytic convertors, positive crank case ventilation and evaporative emission control.

UNIT-IV
Emission Control Techniques in CI Engines:
Common rail fuel injection in diesel engines. Post combustion treatments: exhaust gas recirculation, particulate traps, particulates trap regeneration, installation of catalysts in exhaust lines treatment, diesel oxidation converter.

UNIT-V
Health and environmental effects: Effects of HC, CO, NOx, SOx, CO_2 and PM emissions from SI and CI engine on living beings. Effect on environment, Acid rain formation, climate change.

TEXT BOOKS:

1. Internal Combustion Engine Fundamentals/Heywood/Mc Graw Hill
2. Internal combustion engines and air pollution/ Edward Frederic Obert/ Intext Educ. Pub
3. Bosch – Gasoline fuel injection /Bosch Publications
4. Bosch – Diesel fuel injection /Bosch Publications
5. Engine emissions – B. P. Pundir, Narosa Publishers

REFERENCE BOOKS:

1. Automobiles and Pollution /Paul Degobert/ OPHRYS
2. SAE Surface Vehicle Emissions Standards Manual/ Society of Automotive Engineers
3. Automobile Pollution, Concerns, Priorities, and Challenges/ Shyam Kishor Agarwal/ APH Publishing
4. Diesel engine operation manual /V.L. Maleev/CBS Pub

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5. Engine emission /Springer and Patterson/Plenum Press
6. Internal Combustion Engines /Heins Aeisth /SAE Publications.

Course outcome: The students completing this course will be in a position to derive various measures to be taken to reduce the exhaust gas pollutants coming out of automobiles to meet the laws and regulations in practice.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		3	0	0	3
ALTERNATIVE FUELS FOR AUTOMOBILES (OPEN ELECTIVE-II)					

Course Objectives: To impart the necessity of finding alternative energy sources for automobiles. To understand merits and demerits, performance characteristics of various sources of fuels and their comparison.

UNIT I
CONVENTIONAL FUELS FOR I.C. ENGINES
Petroleum based conventional fuels for SI and CI engine, Demand and Availability of crude oil – vehicle population increase – national and international standards for conventional and alternative fuels.
Desirable characteristics of SI Engine fuels – Petrol – Properties, Specification, chemical structure, Volatility characteristics, knock rating and additives. Desirable characteristics of CI Engine fuels – Diesel – Properties, Specification, chemical structure, Ignition quality, Cetane rating and additives.

UNIT II
ALCOHOLS AS FUELS
Availability of different alternative fuels for engines. Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of alcohol fuels

UNIT III
VEGETABLE OILS AND BIODIESEL AS FUELS
Properties of Vegetable oils and biodiesel- Methods of using vegetable oils – Blending, preheating, and emulsification – Preparation of biodiesel from non-edible, edible oil and Algae - Performance, combustion and emission Characteristics in diesel engines. Advantages and disadvantages of Vegetable oils and biodiesel

UNIT IV
HYDROGEN AS FUEL
Hydrogen – Properties, Production methods, storage and safety aspects. Issues & limitation in Hydrogen. Methods of using hydrogen in engines. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Hydrogen fuel.

UNIT V
BIOGAS, CNG AND LPG AS FUELS
Biogas, Compressed Natural gas (CNG) and LPG – Properties and production methods. CO2 and H2S scrubbing in Biogas, Modifications required for use in Engines- Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Gaseous fuels. Working of LPG and CNG kits used in automotive engines.

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REFERENCES

1. Arumugam S. Ramadhas, "Alternative Fuels for Transportation" CRC Press, 2011.
2. Ayhan Demirbas and M. Fatih Demirbas, "Algae Energy-Algae as a New Source of Biodiesel", Springer-Verlag London Limited 2010.
3. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008
4. David M. Mousdale, "Introduction to Biofuels", CRC Press, 2015.
5. Ganesan.V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
6. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
7. M. K. Gajendra Babu and K. A. Subramanian, "Alternative Transportation Fuels-Utilisation in Combustion Engines", CRC Press, 2013.
8. M.L. Mathur, R.P.Sharma "Internal combustion engines", Dhanpatrai publication, 2003.
9. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.

Course Outcomes:

By the end of this course, students will be able to

- Possess a comprehensive understanding of available alternative fuels for IC engines. They will possess complete knowledge on producing different biofuels, modifying them and using them in IC engines
- Acquire the skills in developing new technologies for alternative fuels efficiently in IC engines.
- Demonstrate the importance of using alternative fuels for sustainable energy supply and for emission control in IC engines.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		3	0	0	3
VEHICLE STABILITY AND CONTROL (OPEN ELECTIVE-II)					

Course Objectives: To impart the knowledge of vehicle dynamics and tires.

- To analyse longitudinal, lateral and vertical dynamics.
- To perform the mathematical modelling of vehicle.

Unit I: Introduction to vehicle dynamics - Dynamics of the motor vehicle, Vehicle fixed coordinates system, Earth fixed coordinates system, Details of vehicle systems, wheel angles and typical data of vehicles.
Tires - Types, axis system, mechanics of pneumatic tires-tire forces Tire forces and moments, Tire structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire. Ride property of tires. Conicity and Ply Steer, Tire models, Estimation of tire road friction.

Unit II: Longitudinal dynamics - Forces and moments on vehicle, Equation of motion, Tire forces, rolling resistance, weight distribution, Tractive effort and Power available from the engine, Calculation of Maximum acceleration Braking torque, Braking Force, Brake Proportioning, Braking Efficiency, Stopping Distance, Prediction of Vehicle performance. ABS, stability control, Traction control.

Unit III: Lateral Dynamics - Steering geometry, Types of steering systems, Fundamental condition for true Rolling, Development of lateral forces. Steady state handling characteristics. Yaw velocity, Lateral Acceleration, Curvature response & directional stability.

Unit IV: Vertical Dynamics - Human response to vibrations, Sources of Vibration, Suspension systems, Functions of suspension system. Body vibrations: Bouncing and pitching. Doubly conjugate points. Body rolling. Roll centre and roll axis, Stability against body rolling.

Unit V: Mathematical Modelling of Vehicle - Quarter car suspension model; Half car suspension model; Full car suspension model for ride and road holding performance considering two degree freedom model for sprung & un-sprung mass, two degree freedom model for pitch & bounce and motion of vehicle on undulating road.

Text Books:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", 2013, Society of Automobile Engineers Inc., ISBN: 978-1560911999
2. J. Y. Woung, "Theory of Ground Vehicles", John Willey & Sons, NY.
3. Rajesh Rajamani, "Vehicle dynamics and control", Springer publication.

References:

1. J. G. Giles, "Steering, Suspension & Tyres", Ilete Books Ltd., London.
2. W. Steed, "Mechanics of Road Vehicles", Ilete Books Ltd. London.
3. P. M. Heldt , "Automotive Chassis", Chilton Co. NK.
4. Reza N Jazar , "Vehicle Dynamics : Theory and Application", Springer publication

Course Outcomes: After the completion of the course, the student should be able to acquire the knowledge of vehicle dynamics. The student should be able to analyse longitudinal, lateral and vertical dynamics and perform the mathematical modelling of vehicle.

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III Year-II Semester		L	T	P	C
		3	0	0	3
ELECTRICAL VEHICLES AND HYBRID TECHNOLOGY (OPEN ELECTIVE-II)					

Course Objectives: The course should enable the students to:

- Study Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control.
- Understand about vehicle dynamics,
- Design the required energy storage devices,
- Understand the hybrid electric vehicles.

UNIT I
INTRODUCTION
Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II
DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES
Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.

UNIT III
ENERGY SOURCES
Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery charging- Quick Charging devices. Battery Management System.
Polymer Exchange Membrane Fuel Cell- Characteristics- Half reactions of fuel cell. Cells in series and parallel- water management - Thermal Management.

UNIT IV
MOTORS
Characteristics of DC motors (Brush and Brushless), AC single phase and 3-phase motor, PM motors, Switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/AC converters.

UNIT V
SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES
Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles. Choice of Tires.

TEXT BOOKS:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press, 2003
2. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2005.

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KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF AUTOMOBILE ENGINEERING

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained "John Wiley & Sons, 2003
2. Lino Guzzella, "Vehicle Propulsion System" Springer Publications, 2005
3. Ron Hokinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication, 2005

Course Outcomes: The students able to understand

- Electric and hybrid vehicle operation and architectures
- Design of hybrid and electric vehicles.
- Energy requirement for vehicles.
- Vehicle characteristics, operating modes, and performance parameters of the vehicle
- Different subsystems of hybrid and electric vehicles

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE SAFETY (OPEN ELECTIVE-III)					

Course objective: To impart the knowledge of the safety concepts, comfort and convenience system, driver assistance system and other requirements of automotive safety**.**

UNIT-I
INTRODUTION
Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction. Safety standards.

UNIT-II
SAFETY AND FATIGUE ASPECTS
Design of body, forces in roll over, head on impact, plastics collapse and analysis, fatigue and vibration, test on box sections, structural vibration.

UNIT-III
SAFETY CONCEPT
Active safety: driving safety, conditional safety, perceptibility safety, operating safety- crash safety
Passive safety: exterior safety, interior, safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.
Safety equipment: Seat belt, regulations, automatic seat belt tightened system, Anti-locking braking system (ABS), Speed limiting device(SLD)
Automatic traction control, automatic vehicle stability control, Collapsible steering system, tilt able steering system, air bags system, bumpers design for safety.

UNIT-IV
COLLISION WARNING AND AVOIDANCE
Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection, braking system interactions.

UNIT-V
COMFORT AND CONVENIENCE SYSTEM
Steering and mirror adjustment system, central locking system, tyre pressure monitoring and control system, rain sensor system, automatic climate control systems, environment information system.

TEXT BOOKS:

1. Bosch /Automotive Handbook/5th edition /SAE publication
2. Junsz Pawlowski/Vehicle Body Engineering/Business book limited, 1989.
3. Ronald K Jurgen/Navigation and Intelligent Transportation Systems-Progress in Technology/ Automotive Electronics Series, SAE. USA,1998.

Course Outcomes: After the completion of the course, the student will be able to
- Understand the design of the automobile body for safety and different safety standards
- Design the automobile body with respect to safety and fatigue aspects
- Understand active and passive safety systems
- Familiarize with different comfort and convenience systems

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE POWER TRAIN (OPEN ELECTIVE-III)					

Course objective: To impart the knowledge of the combustion in spark ignition and compression ignition engines.
To acquire knowledge on gear trains, propeller shaft, front and rear axles.

Unit I:
Combustion in I.C Engines – Stages of Combustion in S.I Engines – Phenomenon of Detonation and Pre Ignition – Stages of Combustion in C.I Engines – Diesel Knock – Factors influencing abnormal combustion in S.I Engines – Factors influencing abnormal combustion in C.I Engines – Requirements of S.I. and C.I. Engine combustion chambers – Types of S.I and C.I. engine combustion chambers – S.I. Engine Combustion chambers – Ricardo turbulent, Bath tub, Wedge head, Spheroidal and Hemispherical. C.I Engine Combustion chambers – Direct injection type, pre-combustion chambers and Turbulence chambers and types – Air cell combustion chamber – Relative advantage s and disadvantages.

Unit II:
Dynamics of moving vehicles-Types of resistances encountered by a vehicle-Road resistance, Gradient resistance, Air resistance-Traction-Tractive effort-Simple related problems. Need of a gear box in the transmission system- Types of gear boxes- Principles and operation of sliding mesh-constant mesh-synchromesh gearbox- Types of gear shifting mechanism- Floor shifting mechanism -Column shifting mechanism-working principle of simple epi-cyclic gear train- Principle and working of freewheel unit.

Unit-III:
Overdrive mechanism- Transfer case – Fluid coupling – Construction and working -Advantages and disadvantages -percentage slip in fluid coupling -Torque converter its principle and working – Principle of automatic transmission system and advantages-CVT-Principle of operation in two wheeler-advantages and disadvantages. Working principle of AMT (Automated Manual Transmission) with block diagram.

Unit IV:
Propeller shaft – Function of propeller shaft – slip joint or sliding joint – universal joint -. Types of universal joints- cross type or spider and two yoke type-ball and trunnion type- constant velocity type-Different types of Constant velocity joints. Differential gear-Final drive-purpose of final drive, types of final drive- Bevel, worm and worm wheel, Hypoid gear and Palloid gear-single and double reduction final drives – Four wheel drive – differential gear – differential lock – self-locking differential – Transaxle.
Unit V: Front axle and rear axle: Live and dead axles – Components of Front axle -stub axle-types of stub axles-Elliot-Reversed Elliot-Lamoine-Reversed Lamoine. Loads on the rear axle-Types of rear axles-semi floating-Three quarter floating-fully floating axles-Axle Housings and types-Split, Banjo and Salisbury types-Types of drives-Hotchkiss drive, Torque tube drive.
Wheels and tyres: Wheel quality, assembly, types of wheels, wheel rims. Construction of tyres and tyre specifications.

Text Books:
1. Automobile Engineering Vol. I & II by Dr. Kirpal Singh
2. Automotive Mechanics by Heitner
3. Automobile Engineering by G.B.S. Narang
4. Automobile Engineering by R.B.Gupta
5. Automobile Engineering by Banga and Nathun Singh

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Course objective: After the completion of the course, the student should be able to understand the combustion in spark ignition and compression ignition engines. The student should be able to analyse gear trains, propeller shaft, and front and rear axles.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
IC ENGINES (OPEN ELECTIVE-III)					

Course Objectives:

- To impart the knowledge and providing holistic view on IC Engines and its developments
- To enable the students to calculate the performance and testing of IC engines
- To learn SI & CI fuelling system and combustion behaviour and its advancements to meet the stringent emission norms
- Understanding the formation and control strategies of SI and CI Engine emissions

UNIT-I:

Engine Principles: Introduction, Comparison of Air Standard and Actual Cycles, Constructional Details of Four Stroke SI and CI Engines, Working Principle, Actual Indicator Diagram, Two Stroke Engine Construction and Operation, Comparison of Four Stroke and Two Stroke Engine Operation, Firing Order and Its Significance.

UNIT-II:

ENGINE TESTING & PERFORMANCE

Engine Performance Testing & Numerical- methods and Performance Characteristics; Performance Maps. Lubrication and Cooling systems, Introduction to Supercharging and Turbocharging; Introduction to Engine Cooling and Lubrication

UNIT-III:

SI ENGINE COMBUSTION

Carburettor Working Principle, Requirements of an Automotive Carburettor, and types, Fuel Injection Systems; Pre-mixed charge combustion, SI Engine Combustion Conceptual models, Knocking Combustion

UNIT-IV:

CI ENGINE COMBUSTION

Fuel Injection and Spray Structure: Fuel Atomization. Diesel Combustion Process Characterization: Ignition Delay, Effect of Engine and Operational Parameters on Delay, Pre-mixed Combustion and Mixing Controlled Combustion.

UNIT-V:

ADVANCED COMBUSTION MODES

GDI, Flexi Fuel, CAI, Introduction to Low Temperature Combustion Like: Homogeneous Charge Compression Ignition(HCCI), Fuel Stratified Charge combustion/ Reactivity Controlled Compression Ignition (RCCI) and Pre-mixed Charge Compression (PCCI) technologies.

Text Books:

1. IC Engines, M.L. Mathur & R.P. Sharma, Dhanpath Rai & Sons
2. Engine Emissions, Pollutant Formation and Advances in Control Technology, B.P. Pundir, Narosa Publishing House

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Reference Books:

1. IC Engines Fundamentals, John B. Heywood, Mc Graw Hill Publications
2. Engineering Fundamentals of I C Engines, Wiliard W.Pulkrabek, Prentice Hall Publications

Course Outcomes: At the end of the course, the students should be able to

- Differentiate the ideal, air standard cycles and actual thermodynamic cycles.
- Evaluate the Engine performance based on the experimental data
- Analyse the fuelling system and combustion behaviour of SI engine
- Analyse the fuelling system and combustion behaviour of CI engine
- Explain the formation of emissions and its control strategies of bot SI & CI Engines.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE MATERIALS AND MANUFACTURING TECHNIQUES (OPEN ELECTIVE-IV)					

Course objective: To impart the knowledge of common engineering materials and processes with relevance to automotive applications. The student shall learn about battery materials and technology, primary and secondary processes for automotive applications and futuristic technology and material for automotive applications.

UNIT-I
Introduction to common engineering materials; metallic and non-metallic automotive materials. Materials and processes with relevance to automotive applications. Advanced materials, light weight material, nano material and synthesis and in-situ materials for automotive applications, corrosion, Standards for automotive materials.

UNIT-II
High strength low alloy steels (HSLA), Advanced high strength steels, dual phase steels, martensitic steels, Advanced plastics and composites, Novel material for automotive applications, ultra-light weight material, Graphene - Case studies.

UNIT-III
Battery materials and technology, case studies related to automotive applications. Case studies on crank shaft, connecting rod, piston, gear and gear box, propeller shaft.

UNIT-IV
Primary and secondary processes for automotive applications – casting, forging, heavy and sheet forming, hard and soft machining, moulding, surface modification processes and Heat Treatment, Joining methods for automotive applications .Case studies on Vehicle body materials- G.I and Interstitial Free Steel processes, Power train components -Tailor Welded Blank.

UNIT-V
Futuristic technology and material for automotive applications, Designing hybrid materials- material for auto piloting, manufacturing considerations for various lightweight automotive structures , 3D printing-materials, processes and applications. Case studies on Li-ion battery, polymer composites and sensor materials.

Text Books:

1. Michel F Ashby, “Material Selection in Mechanical Design”, Butterworth Heinemann, 2007.
2. Michel F Ashby, “Material and Design: The Art and Science of Material Selection in Product Design”, Butterworth Heinemann, 2008.
3. John Mortimer, “Advanced Manufacturing in the Automotive Industry” Springer, 1997.
4. Harry Peck, “Design for Manufacturing”, Pitman Publications, 1983.
5. Cantor B, Johnston, Colin Grant and Patrick, “Automotive Engineering: Lightweight, Functional and Novel Materials”, Taylor & Francis Ltd, 2008.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

Course Outcomes: After the completion of the course, the student shall acquire the knowledge of engineering materials and processes with relevance to automotive applications. The student should be able to learn about battery materials and technology, primary and secondary processes for automotive applications and futuristic technology and material for automotive applications.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
ENGINE MANAGEMENT SYSTEMS (OPEN ELECTIVE-IV)					

Course objective: To impart the knowledge of the Spark Ignition and compression ignition engine management systems, engine diagnostics procedure, computerised electronic fuel injection systems and air flow fuel management strategies.

Unit-I

Computerized Electronic Fuel Injection: Engine Input Sensors Coolant & Intake Temperature, Crankshaft Position, Camshaft Position, Manifold Absolute Pressure, Throttle Position, Oxygen, Air/Fuel Ratio, Knock Speed& Distance, Battery & Switches Output Devices -Relays, Injector Sequencing & Management, Ignition Operation, Idle Air Control, EGR, EVAP, Waste gate Solenoids, Torque Converter & Speed Control, Malfunction Indicator Light

Unit-II

Speed Density/Mass Air Flow Fuel Management Strategies: Key ON Mode, Crank Mode, Open & Closed Loop, Wide-Open Throttle, Adaptive Memory Cells, Cruise &Deceleration, Wide-Open Throttle, Key OFF Mode Fuel Injection Systems -Electronic Fuel Systems, Computer Self-Diagnostic Circuits, Electronic Throttle Actuator Control Systems, Fuel Control, Fuel Supply System Control, Injection System Inspection and Maintenance.

Unit-III

Engine Diagnostic Procedures Fuel System testing: On Board Diagnostics, Monitored & Non Monitored Circuits, Diagnostic Trouble Codes, Digital Engine Control System: Open loop and close loop control system, engine cooling and warm up control, idle speed control, acceleration and full load enrichment, deceleration fuel cut off. Fuel control maps, open loop control of fuel injection and closed loop lambda control exhaust emission control, on-board diagnostics, diagnostics, future automotive electronic systems, Electronic dash board instruments – Onboard diagnosis system.

Unit-IV

SI Engine Management: Feedback carburettor system, throttle body injection, multi-point fuel injection and direct injection systems, Layout and working of SI engine management systems like Bosch Mono-jetronic, L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contactless electronic ignition system, Electronic spark timing control. Three-way catalytic converter, conversion efficiency versus lambda.

Unit-V

CI Engine Management: Fuel injection system, parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced, post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve control in electronically controlled systems.

Text Books:

1. Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
2. Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition, 2004

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DEPARTMENT OF AUTOMOBILE ENGINEERING

References:

1. Halderman, J. & Linder, J. (2012). Automotive Fuel and Emissions Control Systems (3rd Edition)Upper Saddle River, NJ: Pearson Education.
2. Halderman, J. D. (2011). Diagnosis & Troubleshooting of Automotive Electrical, Electronic, &Computer Systems (6th Edition) Upper Saddle River, NJ: Pearson Education.
3. Understanding Automotive Electronics – Bechfold SAE 1998
4. Automobile Electronics by Eric Chowanietz SAE
5. Fundamentals of Automotive Electronics - V.A.W.Hilliers - Hatchin, London
6. Automobile Electrical & Electronic Equipments (2000) Young, Griffitns - Butterworths, London.
7. Understanding Automotive Electronics, William B. Ribbens, 5th Edition, Newnes, Butterworth–Heinemann, 2001.
8. Automotive Computers & Digital Instrumentation – Robert N. Brandy, Prentice Hall, 2004
9. The Fundamentals of Electrical Systems - John Hartly - Longman Scientific & Technical, 2002.

Course Outcomes:

After the completion of the course, the student will be able to

- Acquire the knowledge about Computerized Electronic Fuel Injection, Battery & Switches Output Devices
- Understand the Air Flow Fuel Management Strategies and electronic fuel systems.
- Describe the Engine Diagnostic Procedures Fuel System testing.
  Analyze the spark ignition and compression ignition management systems.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		3	0	0	3
AUTOMOBILE ELCTRICAL & ELECTRONICS (OPEN ELECTIVE-IV)					

Course objective: To acquire the knowledge of Batteries and Accessories, Starting system, Charging system, Automotive Electronics, Sensors and Actuators.

UNIT-I
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. Lighting System: Insulated and Earth Return System, Details of Head Light and Side Light, LED Lighting System, Head Light Dazzling and Preventive Methods – Horn, Wiper System and Trafficator.

UNIT-II
Starting System
Condition at Starting, Behavior 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.

UNIT-III
Charging System
Generation of Direct Current, Shunt Generator Characteristics, Armature Reaction, Third Brush Regulation, Cutout. Voltage and Current Regulators, Compensated Voltage Regulator, Alternators Principle and Constructional Aspects and Bridge Rectifiers, New Developments.

UNIT-IV
Fundamentals of Automotive Electronics
Current Trends in Automotive Electronic Engine Management System, Electro Magnetic Interference Suppression, Electromagnetic Compatibility, Electronic Dashboard Instruments, Onboard Diagnostic System, Security and Warning System.

UNIT-V
Sensors & Actuators
Types of Sensors: Sensor for Speed, Throttle Position, Exhaust Oxygen Level, knock, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Impact sensor, Air Mass Flow for Engine Application. Solenoids, Stepper Motors, Relay.

Text Books:

1. Young A.P. & Griffiths. L. “Automotive Electrical Equipment”, ELBS & NewPress-1999.
2. William B.Riddens “Understanding Automotive Electronics”, 5th edition -Butter worth Heinemann Woburn, 1998.

References:

1. Bechhold “Understanding Automotive Electronics”, SAE,1998.
2. Crouse, W.H “Automobile Electrical Equipment”, McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
3. Judge A.W “Modern Electrical Equipment of Automobiles”, Chapman & Hall, London, 1992.
4. Kholi.P.L “Automotive Electrical Equipment”, Tata McGraw-Hill Co., Ltd., New Delhi, 1975.
5. Robert Bosch “Automotive Hand Book”, SAE (5th Edition), 2000.

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Course Outcomes: After the completion of the course, the student should be able to acquire the knowledge of Batteries and Accessories, Starting system, Charging system, Automotive Electronics, Sensors and Actuators.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

MINOR		L	T	P	C
		4	0	0	4
BASIC AUTOMOBILE ENGINEERING					

Course Objectives:
The course imparts the principles of automobile systems and provides the salient features of safety, and service of automobiles.

UNIT – I
Engines – Classification
INTRODUCTION: Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation

UNIT – II
TRANSMISSION SYSTEM: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotchkiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

UNIT – III
STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT – IV
SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.
BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, and wheel cylinder tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes.
ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator.

UNIT – V
ENGINE SPECIFICATIONS AND SAFETY SYSTEMS: Introduction- engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling.
Safety: Introduction, safety systems - seat belt, air bags, bumper, anti-lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.

TEXT BOOKS:
1. Automotive Mechanics – Vol. 1 & Vol. 2 / Kirpal Singh/standard publishers
2. Automobile Engineering / William Crouse/TMH Distributors
3. Automobile Engineering/P.S Gill/S.K. Kataria & Sons/New Delhi.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

REFERENCES:

1. Automotive Engines Theory and Servicing/James D. Halderman and Chase D. Mitchell Jr., / Pearson education Inc.
2. Automotive Engineering / K Newton, W.Steeds & TK Garrett/SAE
3. Automotive Mechanics : Principles and Practices/ Joseph Heitner/Van Nostrand Reinhold
4. Automobile Engineering / C Srinivasan/McGraw-Hill.

Course Outcomes:

The student after undergoing the course, shall learn about transmission, steering, suspension, braking and safety and vehicle troubleshooting.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

MINOR		L	T	P	C
		4	0	0	4
IC ENGINES					

Course Objectives:

- To impart the knowledge and providing holistic view on IC Engines and its developments
- To enable the students to calculate the performance and testing of IC engines
- To learn about SI & CI fuelling system and combustion behaviour and its advancements to meet the stringent emission norms
- Understanding the formation and control strategies of SI and CI Engine emissions

UNIT-I:

Engine Principles: Introduction, Comparison of Air Standard and Actual Cycles, Constructional Details of Four Stroke SI and CI Engines, Working Principle, Actual Indicator Diagram, Two Stroke Engine Construction and Operation, Comparison of Four Stroke and Two Stroke Engine Operation, Firing Order and Its Significance.

UNIT-II:

ENGINE TESTING & PERFORMANCE

Engine Performance Testing & Numerical- methods and Performance Characteristics; Performance Maps. Lubrication and Cooling systems, Introduction to Supercharging and Turbocharging; Introduction to Engine Cooling and Lubrication

UNIT-III:

SI ENGINE COMBUSTION

Carburettor Working Principle, Requirements of an Automotive Carburettor, and types, Fuel Injection Systems; Pre-mixed charge combustion, SI Engine Combustion Conceptual models, Knocking Combustion

CI ENGINE COMBUSTION

Fuel Injection and Spray Structure: Fuel Atomization. Diesel Combustion Process Characterization: Ignition Delay, Effect of Engine and Operational Parameters on Delay, Pre-mixed Combustion and Mixing Controlled Combustion.

UNIT-V:

ADVANCED COMBUSTION MODES

GDI, Flexi Fuel, CAI, Introduction to Low Temperature Combustion Like: Homogeneous Charge Compression Ignition(HCCI), Fuel Stratified Charge combustion/ Reactivity Controlled Compression Ignition (RCCI) and Pre-mixed Charge Compression (PCCI) technologies.

Text Books:

1. IC Engines, M.L. Mathur & R.P. Sharma, Dhanpath Rai & Sons
2. Engine Emissions, Pollutant Formation and Advances in Control Technology, B.P. Pundir, Narosa Publishing House

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Reference Books:

1. IC Engines Fundamentals, John B. Heywood, Mc Graw Hill Publications
2. Engineering Fundamentals of I C Engines, Wiliard W.Pulkrabek, Prentice Hall Publications

Course Outcomes: At the end of the course, the students should be able to

- Evaluate the Engine performance based on the experimental data
- Analyse the fuelling system and combustion behaviour of SI engine
- Analyse the fuelling system and combustion behaviour of CI engine
- Explain the formation of emissions and its control strategies of bot SI & CI Engines.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

MINOR		L	T	P	C
		4	0	0	4
VEHICLE BODY ENGINEERING					

Course Objectives:

- To make students familiar with car body details and vehicle aero dynamics
- To understand the bus body details, commercial vehicle details, body materials, trim and mechanisms

UNIT-I: Car Body Details

Types: Saloon, Convertibles, Limousine, Estate Car, Racing and Sports Car. Visibility: Regulations, Driver's Visibility, Tests for Visibility, Methods of Improving Visibility and Space in Cars. Safety: Safety Design, Safety Equipment's for Cars. Car Body Construction; Design Criteria, Prototype Making, Initial Tests, Crash Tests on Full Scale Model, Dummies and Instrumentation

UNIT-II: Vehicle Aerodynamics

Objectives: Vehicle Drag and Types; Various Types of Forces and Moments, Effects of Forces and Moments, Side Wind Effects on Forces and Moments, Various Body Optimization Techniques for Minimum Drag, Wind Tunnel Testing: Flow Visualization Techniques, Scale Model Testing, Component Balance to Measure Forces and Moments.

UNIT-III: Bus Body Details

Types: Mini Bus, Single Decker, Double-Decker, Two Level and Articulated Bus. Bus Body Layout; Floor Height, Engine Location, Entrance and Exit Location, Seating Dimensions. Constructional Details: Frame Construction, Double Skin Construction, Types of Metal Sections used, Regulations, Conventional and Integral Type Construction.

UNIT-IV: Commercial Vehicle Details

Types of Body; Flat Platform, Drop Side, Fixed Side, Tipper Body, Tanker Body, Light Commercial Vehicle Body Types. Dimensions of Driver's Seat Relation to Controls. Drivers Cab Design.

UNIT-V: Body Materials, Trim and Mechanisms

Steel Sheet, Timber, Plastic, GRP, Properties of Materials; Corrosion, Anticorrosion Methods. Selection of Paint and Painting Process. Body Trim Items. Body Mechanisms

Text Books

1. James E Duffy, "Modern Automotive Technology", Goodheart-Wilcox; Seventh Edition, 2011
2. Jack Erjavec, "Automotive Technology – A systems approach", Cengage Learning, 2009,

Reference Books:

1. Geoff Davies, Materials for Automotive Bodies, Elsevier, Butterworth Heinemann, ISBN 07506 5692 1, 2003
2. Body Engineering , S. F. Page
3. Automotive Chassis – P.M. Heldt, Chilton & Co. 1952

Course Outcomes: After the completion of the course, the students should be able to

- Understand car body details and vehicle aero dynamics
- Understand the bus body details, commercial vehicle details, body materials, trim and mechanisms

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DEPARTMENT OF AUTOMOBILE ENGINEERING

MINOR		L	T	P	C
		4	0	0	4
VEHICLE DYNAMICS					

Course Objective:
To impart basic knowledge and understanding underlying the development and design of road vehicles under the influence of dynamic loads.

UNIT I
Introduction: Hypothetical vehicle control loop, Fundamental Approach, Vehicle coordinates, motion variables. Forces – Dynamic axle loads, Static loads on level ground, aerodynamic forces on body, hitch forces – Numericals.

UNIT-II
Acceleration & Braking Performance – Power limited acceleration, Fundamental Expressions, Constant retardation, Wind Resistance, Power, Braking forces, Brakes: disc and drum, front, rear and four wheel braking,
Road friction rolling resistance, Numericals.

UNIT-III
Road Loads: Aerodynamic, Mechanics of pressure distribution – Aerodynamic forces: lift & drag, Spoilers, Lift force, side force and roll, pitch and yaw moments, Crosswind sensitivity. Rolling Resistance, Factors affecting pressure, velocity, slip, temperature– Total road loads – Fuel Economy Effects.

UNIT-IV
Ride Excitation sources – road roughness, wheel assembly, driveline excitation, engine transmission. Vehicle response properties: Suspension isolation, suspension stiffness & damping Wheel Hop Resonance. Road-tyre friction – dynamic response of tires – Rigid body
bounce, pitch motion.Perception of ride and other vibration forms, Numericals.

UNIT-V
Steady – State Cornering: Introduction, Low and high speed turning –Tire cornering forces,
governing expressions, understeer gradient, over steer and neutral conditions. Characteristic speed, critical speed, yaw velocity gain, sideslip angle, static margin. Suspension effects on cornering: roll moment distribution – effect of tractive forces on cornering – Numericals.

TEXT BOOKS:
1. Thomas Gillespie, “Fundamentals of Vehicle dynamics.” Society of Automotive engineers Inc, 2014
2. Wong H, Theory of Ground Vehicles, McGraw Hill, Second edition, 2006.

REFERENCES:
1. Hans B Pacejka, Tire and Vehicle Dynamics, 3rd Edition, Elsevier Ltd., 2012.
2. Amitosh D, Vehicle Dynamics, Galgotia Book Ltd., 2010.
3. Rao V Dukkipati, Road Vehicle Dynamics,Springer 2008
4. Werner and Karl, Ground Vehicle Dynamics,Springer Berlin Heidelberg, 2008.

Course Outcomes: After the completion of the course, the student will be able to have knowledge and understanding underlying the development and design of road vehicles under the influence of dynamic loads.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

MINOR		L	T	P	C
		4	0	0	4
AUTOMOBILE ELCTRICAL AND ELECTRONICS					

Course objective: To acquire the knowledge of Batteries and Accessories, Starting system, Charging system, Automotive Electronics, Sensors and Actuators.

UNIT-I
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. Lighting System: Insulated and Earth Return System, Details of Head Light and Side Light, LED Lighting System, Head Light Dazzling and Preventive Methods – Horn, Wiper System and Trafficator.

UNIT-II
Starting System
Condition at Starting, Behavior 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.

UNIT-III
Charging System
Generation of Direct Current, Shunt Generator Characteristics, Armature Reaction, Third Brush Regulation, Cutout. Voltage and Current Regulators, Compensated Voltage Regulator, Alternators Principle and Constructional Aspects and Bridge Rectifiers, New Developments.

UNIT-IV
Fundamentals of Automotive Electronics
Current Trends in Automotive Electronic Engine Management System, Electro Magnetic Interference Suppression, Electromagnetic Compatibility, Electronic Dashboard Instruments, Onboard Diagnostic System, Security and Warning System.

UNIT-V
Sensors & Actuators
Types of Sensors: Sensor for Speed, Throttle Position, Exhaust Oxygen Level, knock, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Impact sensor, Air Mass Flow for Engine Application. Solenoids, Stepper Motors, Relay.

Text Books

1. Young A.P. & Griffiths. L. “Automotive Electrical Equipment”, ELBS & NewPress-1999.
2. William B.Riddens “Understanding Automotive Electronics”, 5th edition -Butter worth Heinemann Woburn, 1998.

References

1. Bechhold “Understanding Automotive Electronics”, SAE,1998.
2. Crouse, W.H “Automobile Electrical Equipment”, McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
3. Judge A.W “Modern Electrical Equipment of Automobiles”, Chapman & Hall, London,1992.
4. Kholi.P.L “Automotive Electrical Equipment”, Tata McGraw-Hill Co., Ltd., New Delhi,1975.
5. Robert Bosch “Automotive Hand Book”, SAE (5th Edition),2000.

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Course Outcomes: After the completion of the course, the student should be able to acquire the knowledge of Batteries and Accessories, Starting system, Charging system, Automotive electronics, Sensors and Actuators.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

MINOR		L	T	P	C
		4	0	0	4
ELECTRICAL VEHICLES AND HYBRID TECHNOLOGY					

Course Objectives: To

- Understand the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control.

UNIT I
INTRODUCTION
Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II
DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES
Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems.

UNIT III
ENERGY SOURCES
Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery charging- Quick Charging devices. Battery Management System.
Polymer Exchange Membrane Fuel Cell- Characteristics- Half reactions of fuel cell. Cells in series and parallel- water management - Thermal Management.

UNIT IV
MOTORS
Characteristics of DC motors (Brush and Brushless), AC single phase and 3-phase motor, PM motors, Switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/AC converters.

UNIT V
SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES
Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles. Choice of Tires.

TEXT BOOKS:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press, 2003
2. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2005.

REFERENCES:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “John Wiley & Sons, 2003
2. Lino Guzzella, “Vehicle Propulsion System” Springer Publications, 2005
3. Ron Hokinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication, 2005

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DEPARTMENT OF AUTOMOBILE ENGINEERING

Course Outcomes: The students able to understand

- Electric and hybrid vehicle operation and architectures
- Design of hybrid and electric vehicles.
- Energy requirement for vehicles.
- Vehicle characteristics, operating modes, and performance parameters of the vehicle
- Different subsystems of hybrid and electric vehicles

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DEPARTMENT OF AUTOMOBILE ENGINEERING

MINOR		L	T	P	C
		4	0	0	4
AUTOMOBILE MATERIALS AND MANUFACTURING TECHNIQUES					

Course objective: To impart the knowledge of common engineering materials and processes with relevance to automotive applications. The student shall learn about battery materials and technology, primary and secondary processes for automotive applications and futuristic technology and material for automotive applications.

UNIT-I
Introduction to common engineering materials; metallic and non-metallic automotive materials. Materials and processes with relevance to automotive applications. Advanced materials, light weight material, nano material and synthesis and in-situ materials for automotive applications, corrosion, Standards for automotive materials.

UNIT-II
High strength low alloy steels (HSLA), Advanced high strength steels, dual phase steels, martensitic steels, Advanced plastics and composites, Novel material for automotive applications, ultra-light weight material, Graphene - Case studies.

UNIT-III
Battery materials and technology, case studies related to automotive applications. Case studies on crank shaft, connecting rod, piston, gear and gear box, propeller shaft.

UNIT-IV
Primary and secondary processes for automotive applications – casting, forging, heavy and sheet forming, hard and soft machining, moulding, surface modification processes and Heat Treatment, Joining methods for automotive applications .Case studies on Vehicle body materials- G.I and Interstitial Free Steel processes, Power train components -Tailor Welded Blank.

UNIT-V
Futuristic technology and material for automotive applications, Designing hybrid materials- material for auto piloting, manufacturing considerations for various lightweight automotive structures , 3D printing-materials, processes and applications. Case studies on Li-ion battery, polymer composites and sensor materials.

Text Books:

1. Michel F Ashby, “Material Selection in Mechanical Design”, Butterworth Heinemann, 2007.
2. Michel F Ashby, “Material and Design: The Art and Science of Material Selection in Product Design”, Butterworth Heinemann, 2008.
3. John Mortimer, “Advanced Manufacturing in the Automotive Industry” Springer, 1997.
4. Harry Peck, “Design for Manufacturing”, Pitman Publications, 1983.
5. Cantor B, Johnston, Colin Grant and Patrick, “Automotive Engineering: Lightweight, Functional and Novel Materials”, Taylor & Francis Ltd, 2008.

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Course Outcomes: After the completion of the course, the student shall acquire the knowledge of common engineering materials and processes with relevance to automotive applications. The student should be able to learn about battery materials and technology, primary and secondary processes for automotive applications and futuristic technology and material for automotive applications.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

MINOR		L	T	P	C
		4	0	0	4
AUTOMOBILE POLLUTION AND ITS EFFECTS					

Course objective: To impart the knowledge of different regulatory test procedures, pollutants and particulates.
To acquire understanding about SI engine and CI engine emissions and different emission control techniques.

UNIT I
Laws and Regulation: Historical background, regulatory test procedures (European cycles). European statutory limits, Pollutants: Carbon and Nitrogen compounds-(CO.CO_2 NOx), Hydrocarbons. Volatile compounds, evaporative emissions, particulates.

UNIT-II
SI engine emissions: Mechanism & formation of HC, CO and NOx in SI engines. Engine operating variables affecting pollutants.
CI engine emissions: Mechanism & formation of HC, CO and NOx, and Soot in CI engines. Factor affecting emission formation.

UNIT-III
Emission Control Techniques in SI Engines:
Lean burn & stratified charge engines. Multipoint fuel injection and gasoline direct injection systems, exhaust gas composition, catalytic convertors, positive crank case ventilation and evaporative emission control.

UNIT-IV
Emission Control Techniques in CI Engines:
Common rail fuel injection in diesel engines. Post combustion treatments:exhaust gas recirculation, particulate traps, particulates trap regeneration,installation of catalysts in exhaust lines treatment, diesel oxidation converter.

UNIT-V
Health and environmental effects: Effects of HC, CO, NOx, SOx, CO_2 and PM emissions from SI and CI engine on living beings. Effect on environment, Acid rain formation, climate change.

TEXT BOOKS:

1. Internal Combustion Engine Fundamentals/Heywood/Mc Graw Hill
2. Internal combustion engines and air pollution/ Edward Frederic Obert/ Intext Educ. Pub
3. Bosch – Gasoline fuel injection /Bosch Publications
4. Bosch – Diesel fuel injection /Bosch Publications
5. Engine emissions – B. P. Pundir, Narosa Publishers

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REFERENCE BOOKS:

1. Automobiles and Pollution /PaulDegobert/ OPHRYS
2. SAE Surface Vehicle Emissions Standards Manual/ Society of Automotive Engineers
3. Automobile Pollution, Concerns, Priorities, and Challenges/ Shyam Kishor Agarwal/ APH Publishing
4. Diesel engine operation manual /V.L. Maleev/CBS Pub
5. Engine emission /Springer and Patterson/Plenum Press
6. Internal Combustion Engines /Heins Aeisth /SAE Publications.

Course outcome: The students completing this course will be in a position to derive various measures to be taken to reduce the exhaust gas pollutants coming out of automobiles to meet the laws and regulations in practice.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year-II Semester	Honors	L	T	P	C
		4	0	0	4
ENGINE TRIBOLOGY					

Course Objectives:
The course imparts the basic principles of automobile tribology and assessment of surface texture measurement. The students shall learn about lubrication, its classification and rheodynamics lubrication.

UNIT I
Introduction:
General tribological considerations in the design of bearings, gears, cams, reciprocating components

UNIT II
Engine Tribology Basics: Tribological aspects of engine components such as bearings, piston assembly, valve train and drive train components. Surface properties of metals, composites, Surface texture measurement and assessment, statistical methods of surface texture assessment

UNIT III
Friction: Theories of friction, Sliding friction – Rolling friction characteristics of common metals and non-metals – friction under different environments. Engine friction – Losses and engine design parameters.
Wear: Wear theories, types of wear and their mechanism, factors affecting wear, selection of materials for different wear situations, measurement of wear, tribometers and tribometry. Engine wear mechanisms, wear resistant materials and coatings and failure mode analysis

UNITIV
Lubrication: Hydrodynamics, basic concepts, generalized Reynolds equation, slider bearings, fixed & pivoted shoe bearings, hydrodynamic journals bearings, short and finite bearings, thrust bearings, sintered bearing, non-circular bearings and multi side surface bearings. Hydrostatic bearing -basic concepts, bearing pads, flat, conical and spherical pad thrust bearing, multi-recess journal and thrust bearings, air and gas lubricated bearings.

UNIT V
Lubricants: Type of lubricants, properties and testing, service, lubrication of tribological components, lubrication system, lubricant monitoring, ferrography and other rapid testing methods for lubricants contamination.
Rheodynamics (Static) Lubrication: Non-Newtonian fluids, characteristics, general recommendations of lubricants, SAE & other cloud numbers, thixotropic materials and Bingham solids, grease lubrication, tribology of components in extreme environments like vacuum, pressure, temperature

Text Books
1. Friction and Lubrication, Bowden F.P. & Tabor D., Heinemann Edu. Books Ltd. 1974
2. A. Cameron, “Basic Lubrication Theory”, Ellis Harwood Ltd, 1981.

Reference Books:
1. A. Cameron, “The principles of lubrication”, Longmans Green & Co. Ltd, 1966.
2. D.D. Fuller, “Theory and Practice of Lubrication for Engineers”, John Wiley and Sons, 1984.

Course Outcomes: After the completion of the course, the student will be able to understand the basic principles of automobile tribology and assessment of surface texture measurement. The students shall learn about lubrication, its classification and rheodynamics lubrication.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year-II Semester		**L**	**T**	**P**	**C**
		4	**0**	**0**	**4**
MICRO ELECTRO MECHANICAL SYSTEMS					

Course Objectives:

- To understand basics of Micro Electro Mechanical Systems (MEMS), mechanical sensors and actuators
- To illustrate thermal sensors and actuators used in MEMS.
- To apply the principle and various devices of Micro-Opto-Electro Mechanical Systems (MOEMS), magnetic sensors and actuators.
- To analyze applications and considerations on micro fluidic systems.
- To illustrate the principles of chemical and bio medical micro systems.

UNIT-I

INTRODUCTION: Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.

MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo-electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT-II

THERMAL SENSORS AND ACTUATORS: Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, Peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

UNIT-III

MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

UNIT-IV

MICRO FLUIDIC SYSTEMS: Applications, considerations on micro scale fluid, fluid actuation methods, dielectro-phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, micro fluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS: RF – based communication systems, RF MEMS, MEMS inductors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter

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DEPARTMENT OF AUTOMOBILE ENGINEERING

UNIT-V

CHEMICAL AND BIO MEDICAL MICRO SYSTEMS: Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo-resistors, chemo-capacitors, chemo-transistors, electronic nose (E-nose), mass sensitive chemo-sensors, fluorescence detection, calorimetric spectroscopy.

TEXT BOOK:

1. MEMS, Nitaigour Premchand Mahalik, TMH

REFERENCE BOOKS:

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edward Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

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

- To understand basics of Micro Electro Mechanical Systems (MEMS), mechanical sensors and actuators
- Illustrate thermal sensors and actuators used in MEMS.
- To apply the principle and various devices of Micro-Opto-Electro Mechanical Systems (MOEMS), magnetic sensors and actuators.
- Analyze applications and considerations on micro fluidic systems.
- Illustrate the principles of chemical and bio medical micro systems.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year-II Semester		L	T	P	C
		4	0	0	4
STANDARDS AND TEST PROCEDURES OF FUEL AND VEHICLE EMISSIONS					

Course Objectives:
The course imparts the understanding of emission standards followed all over the world. The student shall learn the mass emissions, fuel standards and evaporative emissions test procedures. The students shall learn about engine and chassis dynamometers.

UNIT I
Test/Driving Cycles - Emission standards
Test Cycles for Light, Medium and Heavy Duty Vehicles: US Environmental Protection Agency (US EPA), European, Japanese, Indian Driving Cycles, Types of Emission tests, Indian, US, TREM, Evaporative and European Emission standards

UNIT II
Mass Emissions Testing Procedure
Sampling Procedure, chassis dynamo meter, CVS bags, dilution, CFV, Cyclonic separators, PEMS

UNIT III
Fuel Standards and Evaporative Emissions Testing Procedure
Fuel standards, Fuel Requirements, Effect of temperature on fuel, SHED methods, USEPA Evaporative test procedure

Unit IV
Emission Measurements systems
NDIR Analyser, Flame Ionization Detector, Chemiluminescene Analyser, Para magnetic Oxygen Analyser, Smoke meters, Aldehyde measurement, FTIR Analyser, Particulate mass (Dilution-Tunnel technique) and Particle number measurement.

Unit V
Engine and Chassis Dynamometers
Construction and working principles of Inertia, Water- Brake/Hydraulic and Electric Dynamometer. Diagnostics of engine emissions with Engine Dynamo, Transient Engine Dynamo and Chassis Dynamo and its comparison. Factors affecting the accuracy of the Dynamometer.

Text Books:
1. Evangelos G. Giakoumis, Driving and Engine Cycles, Springer, ISBN: 978-3-319-49034-2

References
1. T J Barlow, S Latham et al., A Reference Book of Driving Cycles for use in the Measurement of Road Vehicle Emissions., TRL Limited, ISSN: 0968-4093
2. Engine Emissions, B P Pundir, Narosa Publications

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Course Outcomes: After the completion of the course, the student will be able to

2. Understand the emission standards followed all over the world.
3. Learn the mass emissions, fuel standards and evaporative emissions test procedures.
4. Learn about engine and chassis dynamometers.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

II Year-II Semester		L	T	P	C
		4	0	0	4
ENGINE MODELLING					

Course Objectives:
The course imparts the understanding of the fundamental governing equations and other basic concepts of engine modelling. The student shall learn the thermodynamic combustion models of engines, modelling of charging system and mathematical modelling of spark ignition engines.

UNIT I
Fundamentals: Governing equations, Equilibrium charts of combustion chemistry, Chemical reaction rates, Approaches of modeling, Model building and integration methods. Gas exchange through valves, engine and porting geometry, exhaust gas recirculation, valve lift.

UNIT II
Thermodynamic Combustion Models of Engines: Single zone models, premixed and diffusive combustion models, combustion heat release using Wiebe function, wall heat transfer correlations, ignition delay, internal energy estimation, two-zone model, heat release analysis.

UNIT III
Modelling of Charging System: Constant-pressure and pulse turbo-charging, compressor and turbine maps, charge air cooler.

UNIT IV
Fuel Spray Characteristics: Fuel injection, overall spray structure, fuel atomization, spray penetration, droplet size distribution, spray evaporation models, thick spray models, droplet turbulence-interactions, droplet impingement on walls.

UNIT V
Mathematical Models of SI Engines: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions, progressive combustion, Auto-ignition Modeling, single zone models, multi-zone models and mass burning rate estimation, SI engine with stratified charge. Friction in pumping, in piston assembly, bearings and valve train. Friction estimation.

Text Books

1. Internal Combustion Engine Fundamentals, John B Heywood, McGraw-Hill, 1988.
2. Internal Combustion Engine Modeling, J.I. Ramos, Hemisphere Publishing Corporation, 1989.
3. Modeling Engine Spray and Combustion Processes, G. Stiesch, Springer Verlag, 2003.

References:

1. Simulating Combustion: Simulation of combustion and pollutant formation for engine, Günter P. Merker, Christian Schwarz, Gunnar Stiesch, Frank Otto, Springer, 2008.
2. Introduction to Modeling and Control of IC Engine Systems, Guzzella Lino, Springer Verlag, 2004.
3. Thermodynamic analysis of combustion engines, Ashley, S, Campbell, John Wiley and Sons, 1980.
4. Combustion Modeling in Reciprocating Engines, J. N. Mattavi and C. A. Amann, Plenum press 1980.

5. Design and Simulation of Four-Stroke Engines, G. P. Blair, SAE, 1999.
6. Modelling Diesel Combustion, Lakshminarayanan, P. A., Aghav, Yoghesh V., Mechanical Engineering Series, Springer, 2010.
7. Computer Simulation of SI Engine Processes – V. Ganesan
8. Computer Simulation of CI Engine Processes – V. Ganesan

Course Outcomes: After the completion of the course, the student will be able to

- Understand the fundamental governing equations and other basic concepts of engine modelling.
- Learn the thermodynamic combustion models of engines, modelling of charging system and mathematical modelling of spark ignition engines.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-I Semester		L	T	P	C
		4	0	0	4
METAL FORMING PROCESSES					

Course Objectives:
The course gives the understanding of the classification of the forming processes, and basic concepts of yield criteria. The student shall learn the understanding of forging, rolling mills, explosive forming, water hammer forming and electro hydraulic forming.

Unit – I
Classification of forming processes – flow curves and their significance in forming – Effect of temperature, speed and metallurgical structure on forming processes – Effect of friction on forming processes. Basic concepts of yield criteria – types.

Unit – II
Classifications of forging processes - Forging equipment – forging die design procedure for simple products – forging defects – determination of forging load – concept of P/M forging – Applications.

Unit – III
Rolling mills – Estimation of rolling load and power – rolling defects – Applications.
Direct extrusion equipment - hydrostatic extrusion - extrusion of tubes – determination of extrusion stress - extrusion defects – Applications.

Unit – IV
Drawing of rods, wires and tubes-Determination of drawing loads through conical dies, sheet metal forming: Shearing, blanking, bending, punching, piercing, stretch forming, deep drawing, rubber pad forming – Applications.

Unit – V
High rate energy forming processes: Introduction - Effect on mechanical properties and microstructures – Explosive forming, Electro hydraulic forming – Electromagnetic forming, Water hammer forming.

Text Books:

1. Dieter, Mechanical Metallurgy, McGraw-Publishing Co., New York, 1998.
2. P.C.Sharma, Production Engineering, S.Chand& Co., New Delhi, 1995.

Text / Reference Books:

1. G.W.Rowe, An Introduction to the Principles of Metal Working", Edward, Arnold Publications, 1973.
2. Gyril Donaldson, Tool Design, Tata McGraw Hill Publishing Co. Ltd., 1989.
3. ASTME, Hand Book – Fundamental of Tool Design, Prentice Hall of India, Pvt. Ltd., New Delhi, 1976

Course Outcomes: After the completion of the course, the students will be able to

- Understand the classification of the forming processes and basic concepts of yield criteria. T
- Learn the understanding of forging, rolling mills, explosive forming, water hammer forming and electro hydraulic forming.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-I Semester		L	T	P	C
		4	0	0	4
STATISTICAL DESIGN IN QUALITY CONTROL					

Course Objectives:

- To Interpret quality engineering in production design, Loss Function and Quality Level in production process
- To explain tolerance design for N-type. L-type and S-type characteristics and tolerance allocation
- To interpret ANOVA techniques and need for ANOVA with multiple level factors.
- To make use of orthogonal arrays for typical test strategies and interpolate experimental results
- To explain six sigma DMAIC methodology and tools for process improvement in services and small organizations

UNIT-I

QUALITY VALUE AND ENGINEERING: An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances.(N-type, S-type and L-type)

UNIT-II

TOLERANCE DESIGN AND TOLERANCING: Functional limits, tolerance design for N-type. L-type and S-type characteristics, tolerance allocation for multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

UNIT-III

ANALYSIS OF VARIANCE (ANOVA): Introduction to ANOVA, Need for ANOVA, NO way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT-IV

ORTHOGONAL ARRAYS: Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

UNIT-V

SIX SIGMA AND THE TECHNICAL SYSTEM: Six sigma DMAIC methodology, tools for process improvement, six sigma in services and small organizations, statistical foundations, statistical methodology.

TEXT BOOK:

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill/ Intl. II Edition, 1995.

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REFERENCES:

1. Quality Engineering in Production systems by G. Taguchi, A. Elsayed et al, McGraw Hill Intl.Pub 1989.
2. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi*I* Prentice Hall Pvt.Ltd. New Delhi

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

- Interpret quality engineering in production design, Loss Function and Quality Level in production process
- Illustrate tolerance design for N-type. L-type and S-type characteristics and tolerance allocation
- Interpret ANOVA techniques and need for ANOVA with multiple level factors.
- Make use of orthogonal arrays for typical test strategies and interpolate experimental results
- Understand six sigma DMAIC methodology and tools for process improvement in services and small organizations

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-I Semester		L	T	P	C
		4	0	0	4
DESIGN FOR MANUFACTURING & ASSEMBLY					

Course Objectives:

- To understand the basic concepts of design for manual assembly
- To interpret basic design procedure of machining processes
- To understand design considerations metal casting, extrusion and sheet metal work
- To interpret the design considerations of various metal joining process.
- To interpret the basic design concepts involved in the assembly automation

UNIT – I

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design? Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, weight on Handling Time, Effects of Combinations of Factors and application of the DFA Methodology.

UNIT – II

Machining processes: Overview of various machining processes-general design rules for machining dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT – III

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, and deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT – IV

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design ofbrazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies –drop forging die design – general design recommendations.

UNIT – V

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, and single station assembly lines.

Design for Additive Manufacturing: Design considerations, allowances

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TEXT BOOKS:

1. Design for manufacture, John Cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla

REFERENCE:

- ASM Hand book Vol.20

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

- Understand the basic concepts of design for manual assembly
- Identify basic design procedure of various machining processes.
- Illustrate the design considerations metal casting, extrusion and sheet metal work
- Interpret the design considerations of various metal joining process.
- Understand the basic design concepts involved in the assembly automation and additive manufacturing.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-I Semester		L	T	P	C
		4	0	0	4
ROBOTICS & AUTOMATION					

Course Objective:
The objective of this course is to impart basic knowledge related to industrial robots for their control, design and application in robotics & automation Industries.

UNIT-I
Introduction to Robotics:
Types and components of a robot, Classification of robots, Kinematics systems; Definition of mechanisms and manipulators, Degrees of Freedom

UNIT-II
Robot Kinematics and Dynamics
Kinematic Modelling: Translation and Rotation, Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity, and Statics
Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler Lagrange formulation, Newton Euler formulation

UNIT-III
Robot Sensors & Actuators
Sensors: Contact and Proximity, Position, Velocity, Force, Tactile, Introduction to Cameras, Camera calibration, Geometry of Image formation Euclidean/Similarity/Affine/Projective transformations, Vision applications in robotics.
Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators

UNIT-IV
Control Hardware and Interfacing
Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID, Linear and Non-linear controls.
Embedded systems: Microcontroller Architecture and integration with sensors, actuators, components, Programming Applications for Industrial robot - programming in – VAL II

UNIT-V
AI in Robotics:
Applications in unmanned systems, defence, medical, industries, Robotics and Automation for Industry 4.0, Robot safety and social robotics.

Text Books:
- Introduction to Robotics: J. Craig , Pearson
- Robot Dynamics and Control, Spong& Vidyasagar, Mc Graw Hill

References:
- Robotics Engineering: R. Klafter, PHI
- Robotics : Subir K Saha , Mc GrawHill
- Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill

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Course Outcomes:
After the completion of this course, the students will be able to:

- Perform kinematic and dynamic analyses with simulation.
- Design control laws for a simple robot.
- Integrate mechanical and electrical hardware for a real prototype of robotic device.
- Select a robotic system for given industrial application.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		4	0	0	4
ADVANCED MICROCONTROLLER FOR AUTOMOBILE SYSTEMS					

Course Objectives: The student will

- Learn concepts of microprocessors and micro controllers, micro controller peripheral configurations.
- Understand different micro controllers assembly language and programming for multi-tasking.
- Learn concepts of micro controller architecture and architectural inheritance.
- Study the features of sub systems and peripherals.

UNIT-I
Micro-processors and Micro-controllers:
Salient differences and salient features between micro-controllers and micro-processors; requirements of micro-controllers for Real Time applications; Integrated Development Environment – Editor –Machine Code; Compiler – Cross compiler - Debugger –Emulator – Simulator. C and C++ compliers and de-buggers. Micro-controller peripheral configurations;

UNIT-II
Programming: 8, 16 and 32 bit Microcontrollers using assembly language and embedded C, Programming for multi-tasking; process scheduling; prioritization of tasks; AVR microcontroller

UNIT-III
Architecture: AVR microcontroller, ATMEGA 8, 16, memory organization, addressing modes, instruction set, programming techniques, Assembly language & C programming- Development, Tools, Cross Compilers, Hardware Design Issues. ARM Microcontroller: Arcon RISC Machine, Architectural Inheritance, Core & Architectures -Registers, ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families.

UNIT-IV
Designing of Sub-systems and Peripherals:
Designing of (i) Timers, (ii) Data acquisition interfaces; and (iii) drivers; Programming of Timers – Control and status registers – Capture and compare mode – PWM - Watchdog Timers
Analog Interfacing: - ADC – DAC-Data acquisition system design, Memory Interfacing: General memory bus timing, external bus timing, memory interface examples, configuration of interrupts.

UNIT-V
Communication interface
Synchronous Serial Interface SPI - description – Design issues of Serial Communication Interface (SCI) - Expansion of I / O space -I2C Bus - Principle - Data Transfer on the I2C Bus - Software Implementation – Design of RS232 – Ethernet – Parallel port – USB; Design of parallel port interface- LED, LCD, Keypad-Relays-Solenoids-DC motor- Stepper motor-Case Study- Microcontroller based PID controllers; Communication between Multiple Processors.

Text Books:
1. ARM Systems Developer's Guides- Designing & Optimizing System Software – Andrew N. Sloss, Dominic Symes, Chris Wright, 2008, Elsevier.
2. Dananjay V. Gadre 'Programming and Customizing the AVR microcontroller', McGraw Hill 2001
3. Ramesh S. Goankar, "Microprocessor Architecture, Programming and Applications with 8085", 5th Edition, Prentice Hall

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Reference Book:

1 Embedded Systems: Introduction to Arm(r) Cortex -M Microcontrollers by Jonathan W Valvano.
2. Make: AVR Programming by Elliot Williams.
3. Automotive Microcontrollers, volume 2 by Ronald K Jurgen (SAE Publication).
4. Designing Embedded Hardware Second Edition by John Catsoulis (Publisher: O'Reilly Media).

Course Outcomes: After the completion of the course, the student will be able to

- Understand the concepts of microprocessors and micro controllers, micro controller peripheral configurations.
- Understand different micro controllers assembly language and programming for multi-tasking.
- Acquire knowledge about the concepts of micro controller architecture and architectural inheritance.
- Understand the features of sub systems and peripherals.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		4	0	0	4
AUTOMOBILE SENSORS ACTUATORS & DATA ACQUISITION SYSTEM					

Course Objectives: The student will

- Learn the fundamental principles of transducers, classification and understand the different characteristics of the transducers.
- Understand different vehicle body sensors and their working.
- Learn concepts of different automotive vehicle convenience and security systems.
- Study the different Automotive Actuator Technologies– features, operation and application.

UNIT-I
Fundamental Principles of Transducer:
Transducers classification and basic principles, General Input-output configuration, static characteristics and dynamic characteristics of instruments, Variable resistance transducers, Metal and semiconductor strain gages and their signal conditioning ,Inductive transducers, Electromagnetic sensors, Hall effect sensors, Capacitive transducers, Piezoelectric transducers and their signal conditioning, Ultrasonic sensors

UNIT-II
Vehicle Sensors:
Vehicle Body:- Torque sensors/ Force sensors, Sensors Flap air flow sensors, Temperature sensor, Ultrasonic sensors, Ranging radar (ACC) Power Train:- Fuel level sensors, Speed and RPM sensors, Lambda Oxygen sensor, Hotwire air mass meter, NOX sensors Chassis:- Steering wheel angle sensor, Vibration and acceleration sensors, Pressure sensors, Speed and RPM sensors, torque sensors, roll and yaw sensors

UNIT-III
Automotive Vehicle Convenience and Security Systems:
Tyre pressure monitoring systems, two wheeler and four wheeler security systems, parking guide systems, anti-lock braking system, future safety technologies. Vehicle diagnostics and health monitoring, Safety and Reliability, Traction Control, Vehicle Dynamics Control, accelerators and tilt sensors for sensing skidding and anti-collision - anti-collision techniques using ultrasonic Doppler sensors.

UNIT-IV
Actuators:
Automotive Actuator Technologies-Operation and application of Brushed DC and Brushless DC Motor, Magneto-rheological Actuators-Suspension semi active actuators, Magneto - strictive anti vibration actuators, Solenoids and actuators, Piezoelectric Actuators, Micro positioning, Motion controller-Servo and stepper motors, Smart micro actuators, different types of relays, Switched reluctance motor.

UNIT-V
Data acquisition and processing:
Single channel DAS, Multi-channel DAS, Components used in DAS– Converter Characteristics-Resolution-Non-linearity, settling time, Monotonicity DAS Hardware, DAS Software. Data logger – DIGITAL TO ANALOG CONVERTERS (DACS): Principles and design of – Parallel R– 2R, Weighted resistor, inverted ladder ANALOG TO DIGITAL CONVERTERS (ADCS): Classification of A/D converters. Parallel feedback – Successive approximation – Ramp comparison – Dual slope integration

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Text Books:

1. D. Patranabis, "Sensors and Transducers", PHI Learning Private Limited.
2. W. Bolton, "Mechatronics", Pearson Education Limited

References:

- William B. Ribbens, Understanding Automotive Electronics, 5th edition, Newnes, 2016

Course Outcomes: After the completion of the course, the student will be able to

- Learn the fundamental principles of transducers, classification and understand the different characteristics of the transducers.
- Understand different vehicle body sensors and their working.
- Understand the concepts of different automotive vehicle convenience and security systems.
- Analyse different Automotive Actuator Technologies– features, operation and application.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		4	0	0	4
AUTOMOBILE INSTRUMENTATION AND EMBEDDED SYSTEM					

Course Objectives:

- To acquire the knowledge on working of automotive instruments
- To gain knowledge on measurement analysis
- To develop the knowledge on embedded systems
- To attain the knowledge on real time operating system(RTOS)

UNIT-I
Measurement Characteristics:
Instrument Classification, Characteristics of Instruments - Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments

UNIT-II
Automotive Instrumentation:
Modern automotive instrumentation - computerized instrumentation system, multiplexing, sampling and advantages - Measurements - fuel quality, coolant temperature, oil pressure vehicle speed, Display devices - LED, LCD, VFD, CRT and types, CAN Bus and wind shield information system.
On board diagnostics - fault code displays. Off board diagnostics - engine data display, expert system occupant protection system - Airbag deployment system security and warning systems.

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

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

UNIT-V
Real Time Operating Systems (RTOS):
Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems, RTOS – Interrupt handling, task scheduling; embedded system design issues in system development process – Action plan, use of target system, emulator, use of software tools

Text Books

1. William B. Ribbens - Understanding Automotive Electronics, 5th edition- Butter worth Heinemann, Woburn- 2015
2. Rajkamal, 'Embedded System - Architecture, Programming, Design', Tata McGraw Hill, 2013

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References

1. Daniel W. Lewis 'Fundamentals of Embedded Software', Prentice Hall of India, 2014.
2. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 2013
3. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw Hill

Course Outcomes: After the completion of the course, the student should be able to

- Familiarize on measurement characteristics
- Acquire the knowledge on working of automotive instruments
- Gain knowledge on measurement analysis
- Develop the knowledge on embedded systems
- Attain the knowledge on real time operating system(RTOS)

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DEPARTMENT OF AUTOMOBILE ENGINEERING

III Year-II Semester		L	T	P	C
		4	0	0	4
AUTOMOBILE ACCIDENT INVESTIGATION					

Course Objectives:

- To familiarize on the effect of the forces acting on a vehicle in motion and during a collision
- To acquire the knowledge on brake and tyre characteristics and their Influence on a vehicle
- To develop knowledge on the Accident reconstruction techniques
- To gain knowledge on damage assessment and cost estimation

UNIT-I

Forces, Effect of Friction and Collision:

Forces during collision- Newton‘s Laws of motion on a moving vehicle; determination of tractive effort and tractive resistance. Effect of friction on stopping distances, cornering speeds and rolling
Deceleration and braking theory; brake efficiency; Vehicle collision: Collision with moving and stationary bodies; conservation of momentum and energy; calculation of impact speeds; Effect of vehicle Projections on impact and load transfer.

UNIT-II

Brakes and its Behaviour:

Influence of vehicle brake characteristics on vehicle. Types of brake circuits: single line braking circuit; front and rear split circuit; diagonally split circuit; H-split; L-split; full dual circuit; air/hydraulic circuits; air brake circuits; Types of pressure valves: pressure limiting valves; load sensing valve; inertia sensing valve. Characteristics of brake fluid: types of fluid; constituents; contamination boiling point; vapor lock point Brake defects: braking faults like effect of air in brake fluid, temporary loss of breaking, air contamination, heat soak, uneven braking, brake fade, drum expansion.

UNIT-III

Tyre Behaviour and Characteristics:

Influence of vehicle tyre characteristics on vehicle, Tyre Specifications, Vehicle handling and tyre behavior: slip angle; self-aligning torque; cornering force; centrifugal force; cornering power; instantaneous center. neutral steer; under steer; over steer; effects of fault suspension dampers on vehicle handling Factors affecting adhesion, effects of impact or concussion damage.

UNIT-IV

Accident Reconstruction Techniques:

Tyre marks and vehicle damage: skid marks; scuff marks; deceleration scuff and Tyre prints; debris; secondary impact; vehicle position before and after impact. Accident scene construction plans: immediate scene, intermediate scene, extended scene; sketch plans and scale plans using CAD; triangulation, base line and offsets.

UNIT-V

Damage Assessment and Cost Evaluation:

Damage assessment: vehicle details; vehicle condition; body repair; mechanical components; geometry; production of damage assessment report; post-repair inspection. Manufacturer’s down times, computer estimation of paint and materials; cash in lieu of repairs Repair methods and materials: suitability of repair methods; vehicle construction; materials used in vehicle construction; method and types of joining; plastic repairs.

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Text Books:

1. Vehicular Accident Investigation and Reconstruction, Donald J Van Kirk CRC Press, 01-Jan-2012 – Law
2. Accident investigation in the private sector - Volume One, Two and Three by Jack Murray, M.B.A., C.L.I., C.F.E.

References:

1. Road Vehicle Dynamics, Rao S, Dukkipatti
2. Vehicle Accident Analysis and Reconstruction Methods, Second Edition, Raymond Brach, Matthew Brach - Published by SAE International with a Product Code of R-397

Course Outcomes: After the completion of the course, the students should be able to

- Familiarize on the effect of the forces acting on a vehicle in motion and during a collision
- Acquire the knowledge on brake and tyre characteristics and their Influence on a vehicle
- Develop knowledge on the accident reconstruction techniques
- Gain knowledge on damage assessment and cost estimation

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		4	0	0	4
AUTOMOBILE PRODUCT DESIGN AND DEVELOPMENT					

Course Objectives:

- To familiarize on the basics of engineering design process
- To acquire the concepts of benchmarking for quality improvement
- To gain knowledge on the systematic methods of creative designing
- To get Expertise in the various steps involved in automotive product design
- To get Expertise in the various processes involved in automotive product development

UNIT-I
Engineering Design Process
Need for developing products – importance of engineering design – types of design – design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process –various phases of product development-planning for products –establishing markets- market segments- relevance of market research. Introduction to Automotive design, History of Automotive design, Car design brands & brand values and Brand history and Styling DNA and Case studies.

UNIT-II
Bench Marking:
Identifying customer needs –voice of customer –customer populations- hierarchy of human needs, data collection methods – affinity diagrams –establishing engineering characteristics-competitive benchmarking-quality function deployment- house of quality- product design specification-case studies.

UNIT-III
Creative Design:
Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition –functional representation –morphological methods

UNIT-IV
Product Design:
Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method- weighted decision matrix –analytic hierarchy process –introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture

UNIT-V
Product Development:
Industrial design –Advance product Quality plan(APQP)- human factors design –user friendly design– design for serviceability – design for environment – prototyping and testing – Production part approval process(PPAP) –Feedback assessment and Corrective action- cost evaluation.

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Text Books:

1. George E.Dieter, Linda Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009,
2. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 4th Edition, 2009, Tata McGraw-Hill Education

References:

1. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education
2. YousefHaik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, CengageLearning, 2010,
3. Clive L.Dym, Patrick little, "Engineering Design: A Project-based Introduction", 3rd Edition,John Wiley & Sons, 2009.

Course Outcomes: After the completion of the course, the student should be able to

- Familiarize on the basics of engineering design process
- Acquire the concepts of benchmarking for quality improvement
- Gain knowledge on the systematic methods of creative designing
- Expertise in the various steps involved in automotive product design
- Expertise in the various processes involved in automotive product development

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		4	0	0	4
ANALYSIS AND SYNTHESIS OF MECHANISMS					

Course Objectives:

- To understand the general concepts of kinematics of plane motion.
- To learn the concepts of advanced kinematics of plane motion.
- To understand graphical methods for synthesis with function and path generation.
- To analyze the graphical methods for synthesis with velocity
- To illustrate the synthesis of four-bar mechanisms for prescribed extreme values of the angular velocity of driven link.

UNIT – I
ADVANCED KINEMATICS OF PLANE MOTION- I: Introduction to plane motion. The Inflection circle, Euler – Savary Equation, Bobillier's Construction , Collinear axis , Hartmann's Construction ,Inflection circle for the relative motion of two moving planes, Application of the Inflection circle to kinematic analysis.

UNIT – II
ADVANCED KINEMATICS OF PLANE MOTION – II: Polode curvature, Hall's Equation, Polode curvature in the four bar mechanism, coupler motion, relative motion of the output and input links, Determination of the output angular acceleration and its Rate of change, Freudenstein's collineation –axis theorem, Carter –Hall circle, The circling – point curve for the Coupler of a four bar mechanism.

UNIT – III
INTRODUCTION TO SYNTHESIS-GRAPHICAL METHODS – I: The Four bar linkage ,Guiding a body through Two distinct positions, Guiding a body through Three distinct positions, The Roto center triangle , Guiding a body through Four distinct positions, Burmester's curve.

UNIT – IV
INTRODUCTION TO SYNTHESIS-GRAPHICAL METHODS – II: Function generation- General discussion, Function generation: Relative – Roto center method, Overlay's method, Function generation-Velocity – pole method, Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

UNIT – V
INTRODUCTION TO SYNTHESIS – ANALYTICAL METHODS: Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation, Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition, Method of components, Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link, Method of components.

TEXT BOOKS:
1. Kinematics and Dynamics of plane mechanisms/ Jeremy Hirsch horn/McGraw-Hill.
2. Theory of Machines and Mechanisms/ J. E Shigley and J.J. Uicker Jr. / McGraw-Hill.

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REFERENCES:

1. Design of machinery / Robert L Norton third edition/ McGraw-Hill 2004
2. Theory of Mechanisms and Machines/ Amitabh Ghosh and Ashok Kumar Mallik/ E. W. P. Publishers.
3. Kinematic Linkage Design/ Allen S.Hall Jr. / PHI.
4. Kinematics and Dynamics of Machinery/Charles E Wilson/Pearson/3rd Edition

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

- To understand the general concepts of kinematics of plane motion.
- To learn the concepts of advanced kinematics of plane motion.
- To understand graphical methods for synthesis with function and path generation.
- To analyze the graphical methods for synthesis with velocity
- To illustrate the synthesis of four-bar mechanisms for prescribed extreme values of the angular velocity of driven link.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		4	0	0	4
GAS DYNAMICS					

Course Objectives: The student will acquire the knowledge

- To learn basic concepts of compressible fluid flow
- To learn the isentropic flow of an ideal gas and effects of back pressure on nozzles
- To learn the simple frictional flow in constant area duct of adiabatic and isothermal Flows
- To learn the conditions to form the shock waves due to the effect of heat transfer in convergent-divergent nozzle
- To understand the difference between finite difference, volume and element method.

UNIT-I

INTRODUCTION TO GAS DYNAMICS: control volume and system approaches acoustic waves and sonic velocity -Mach number - classification of fluid flow based on Mach number - Mach cone-compressibility factor - general features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

UNIT-II

ISENTROPIC FLOW OF AN IDEAL GAS: basic equation - stagnation enthalpy, temperature, pressure and density stagnation, acoustic speed - critical speed of sound- dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function.
Steady one dimensional isentropic flow with area change-effect of area change on flow parameters chocking- convergent nozzle - performance of a nozzle under decreasing back pressure -De Lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.

UNIT-III

SIMPLE FRICTIONAL FLOW: adiabatic flow with friction in a constant area duct-governing equations – Fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct-governing equations - limiting conditions.
Steady one dimensional flow with heat transfer in constant area ducts- governing equations – Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy.

UNIT-IV

EFFECT OF HEAT TRANSFER ON FLOW PARAMETERS: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations – Rankine - Hugoniat equations - Prandtl velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.

UNIT-V

Computational Fluid Dynamics: Conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations (Derivation), conservation of energy principle, and special forms of the Navier-stokes equations. Difference between Finite Difference, Volume and Element Methods

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Text Books:

1. Compressible fluid flow /A. H. Shapiro / Ronald Press Co., 1953
2. Fundamentals of compressible flow with aircraft and rocket propulsion/S. M. Yahya/New Age international Publishers
3. Fundamental of Gas dynamics-2nd edition/ M J Zucker/ Wiley publishers
4. Computationalfluiddynamics-Basics with applications/John.D.Anderson/McGraw-Hill

References:

1. Elements of gas dynamics / HW Liepman&A Roshko/Wiley
2. Aircraft & Missile propulsion /MJ Zucrow/Wiley
3. Gas dynamics / M.J. Zucrow& Joe D.Holfman / Krieger Publishers

Course Outcomes: The student at the end of the course will be able

- To learn basic concepts of compressible fluid flow
- To learn the isentropic flow of an ideal gas and effects of back pressure on nozzles
- To learn the simple frictional flow in constant area duct of adiabatic and isothermal Flows
- To learn the conditions to form the shock waves due to the effect of heat transfer in convergent-divergent nozzle
- To understand the difference between finite difference, volume and element method.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

IV Year-I Semester		L	T	P	C
		4	0	0	4
GEAR ENGINEERING					

Course Objectives:

- To understand the principles of gear tooth action and spur gears.
- To illustrate the concepts of helical and bevel gears.
- To interpret the design considerations and methodology of worm gear teeth and gear failures.
- To analyze design of gear trains for various applications.
- To understand the optimization of gear design parameters

UNIT-I

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing processes and inspection, gear tooth failure modes, stresses, selection of right kind of gears.
Spur Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings, AGMA standards.

UNIT-II

Helical Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of helical gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings, AGMA standards.
Bevel Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

UNIT-III

Worm Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, complete design of worm gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Heat dissipation considerations. Design of gear shaft and bearings.
Gear failures: Analysis of gear tooth failures, Nomenclature of gear tooth wear and failure, tooth breakage, pitting, scoring, wear, overloading, gear-casing problems, lubrication failures

UNIT-IV

Gear trains: Simple, compound and epicycle gear trains, Ray diagrams, Design of a gear box of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.

UNIT-V

Optimal Gear design: Optimization of gear design parameters, Weight minimization, Constraints in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques

TEXT BOOKS:

1. Maleev and Hartman, Machine Design, C.B.S. Publishers, India.
2. Henry E.Merrit,Gear engineering, Wheeler publishing, Allahabad, 1992.

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REFERENCES:

1. Practical Gear design by Darle W. Dudley, McGraw-Hill
2. Earle Buckingham, Analytical mechanics of gears, Dover publications, New York, 1949.
3. G.M.Maitha, Hand book of gear design, Tata McGraw Hill publishing company Ltd., New Delhi,1994.

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

- Understand the principles of gear tooth action and spur gears.
- Illustrate the concepts of helical and bevel gears.
- Interpret the design considerations and methodology of worm gear teeth and gear failures.
- Analyze design of gear trains for various applications.
- Understand the optimization of gear design parameters.