KUMARAGURU COLLEGE OF TECHNOLOGY
(An autonomous Institution affiliated to Anna University, Chennai)
COIMBATORE – 641 049

B.E., AUTOMOBILE ENGINEERING
REGULATION 2017

CURRICULUM AND SYLLABUS
III to VIII Semesters

DEPARTMENT OF AUTOMOBILE ENGINEERING
# DEPARTMENT OF AUTOMOBILE ENGINEERING

**B.E., AUTOMOBILE ENGINEERING**

**CURRICULUM- REGULATION- 2017**

## SEMESTER 3

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**Total Credits** 23

**Total Contact Hours/week** 29
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**Total Credits**: 22

**Total Contact Hours/week**: 28

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**Total Credits**: 22

**Total Contact Hours/week**: 27

Signature of BOS chairman, Auto
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Total Credits 23

Total Contact Hours/week 29

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Total Credits 18

Total Contact Hours/week 23
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## PROFESSIONAL ELECTIVES

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# Automotive Technology and Management

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## ONE CREDIT COURSES

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SEMESTER 3
Course Outcomes (COs):

After successful completion of this course, the students should be able to:

**CO1:** Form partial differential equations and solve certain types of partial differential equations.

**CO2:** Know how to find the Fourier Series and half range Fourier Series of a function.

**CO3:** To know how to solve one dimensional wave equation, one dimensional heat equation in steady state using Fourier series.

**CO4:** Apply Fourier series to solve the steady state equation of two dimensional heat equation in Cartesian coordinates.

**CO5:** Apply the Fourier transform, Fourier sine and cosine transform to certain functions and use Parseval’s identity to evaluate integrals.

**CO6:** Evaluate $Z$-transform for certain functions. Estimate Inverse $Z$-transform of certain functions and to solve difference equations using them.

Pre-requisite: NIL

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CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Course Assessment methods:

**Direct**

1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

**Indirect**

1. Course-end survey
PARTIAL DIFFERENTIAL EQUATIONS 9+3 Hours
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange’s linear equation – Linear Homogeneous partial differential equations of second and higher order with constant coefficients.

FOURIER SERIES 9+3 Hours
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval’s identity – Harmonic Analysis.

BOUNDARY VALUE PROBLEMS – ONE DIMENSIONAL EQUATIONS 5+2 Hours
Classification of second order quasi linear partial differential equations – Formulation of wave and heat equations using physical laws - Solutions of one dimensional wave equation – One dimensional heat equation (excluding insulated ends)

BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQUATIONS 4+1 Hours
Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

FOURIER TRANSFORM 9+3 Hours

Z–TRANSFORM 9+3 Hours

Theory : 45 Hours  Tutorial: 15 Hours  Total:60 Hours

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

CO1: Understand the construction details of various types of automotive Frames and basic chassis layouts. [K2]

CO2: Understand the basic function steering system and steering components [K2]

CO3: Select the appropriate transmission system for various automobiles [K3]

CO4: Infer the final drive system of a vehicle [K2]

CO5: Apply the knowledge for selection of suitable axles, wheels and tyres for a vehicle. [K3]

CO6: Distinguish various types of suspension system, brake system. [K2]

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation)       S-Strong, M-Medium, W-Weak

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Course Assessment methods:

Direct
1. Assignments/Mini Projects
2. Internal Test
3. End semester Examination

Indirect
1. Course Exit Survey

Frames and Steering System


Transmission and Drive Line

Requirement of transmission system, Different types of gearboxes - Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox. Automatic transmission - Types and Operations. Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube

**Axles, Wheels and Tyres**


**Suspension System**


**Braking System**


**List of Experiments**

1. Measurement of the automotive frames
2. Measurement of steering angle
3. Assessment of Automotive chassis
4. Performance test on suspension test Rig
5. Assessment of wheels and tyres
6. Study of final drive assembly
7. Study of different gearboxes
8. Study of different types of brake systems

**Theory :45 Hrs** **Tutorial: --- Hrs** **Practical : 30 Hrs** **Total Hours: 75**

**References:**

Course Outcomes
After successful completion of this course, the students should be able to:
CO1: Understand the basic concepts of stress and strain [K₂]
CO2: Compare the beams of different cross sections for shear force, bending moment & bending stress [K₄]
CO3: Understand and apply the different approaches for calculating slope and deflection for various types of beams [K₃]
CO4: Analyze the shafts and columns with different edge conditions by using different theories [K₄]
CO5: Understand the concepts and theories necessary to design the structural elements and pressure vessels [K₂]
CO6: Apply concepts of strength of materials to obtain solutions to real time Engineering problems [K₆]

Pre-requisite:
Engineering Mechanics

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Course Assessment methods:
Direct
1. Assignments/Mini Projects
2. Internal Test
3. End semester Examination
Indirect
1. Course Exit Survey

CONCEPT OF STRESSES AND STRAINS

ANALYSIS OF BEAMS
Types of beams and loads – shear force and bending moment diagrams for cantilevers, simply supported and over hanging beams. Theory of pure bending – Bending stresses in simple and composite beams. Shear stress distribution in beams of different sections.
DEFLECTION OF BEAMS
Slope and deflection of cantilever, simply supported beam by double integration method – Macaulay’s method – Moment area method – Castigliano’s theorem.

TORSION OF SHAFTS
Theory of pure torsion, derivation of shear stress produced in terms of torque in a circular shaft. Strength, stiffness of shaft and Torsional rigidity & power transmitted – Expression for torque in terms of polar moment of inertia in a circular shaft subjected to torsion – Circular shafts in series and parallel – Circular shaft subjected to combined bending and torsion – Circular shaft subjected to combined bending and torsion – Composite Shaft.

COLUMNS AND CYLINDERS
Columns and struts: Member subjected to combined bending and axial loads, Euler’s theory, Crippling load, Rankine’s theory.
Cylinders And Shells: Thin cylinder, thin spherical shells under internal pressure – Thick cylinders – Lame’s equation – Shrink fit and compound cylinders.

List of Experiments

1. Tension & Shear Test on Mild Steel Rod
2. a) Torsion Test on Mild Steel Rod
   b) Compression Test on Concrete Cube.
3. Hardness Test- Brinell, Vickers and Rockwell Hardness tests
4. Impact Test- Izod, Charpy Impact Tests
5. Test on Helical Springs- Compression and Tension Springs
6. Deflection Test on Beams

Theory: 45 Hrs    Tutorial: 0 Hrs    Practical: 30 Hrs    Total Hours: 75

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

CO1: Understand the Casting processes used for components manufacturing
CO2: Understand the Forming and Powder metallurgy processes used for manufacturing bulk and Sheet metal components
CO3: Understand the principles of Welding Processes used in manufacturing practices
CO4: Understand the Conventional Machining and Machine tools used for components manufacturing
CO5: Understand the Principles behind the Unconventional machining processes used for components manufacturing
CO6: Understand the Principles behind Forming of Plastics

Pre-requisite:
1. Nil

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CO/PO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

Course Assessment methods:
Direct
1. Continuous Assessment Test
2. Assignments
3. End Semester Examination

Indirect
1. Course Exit Survey

CASTING 9 Hours
Casting types, procedure to make sand mould, types of core, moulding tools, machines used for moulding, special moulding processes – CO₂ moulding, Shell moulding, Investment moulding, Permanent mould casting, Pressure die casting, Centrifugal casting, Continuous casting, Casting defects, Application of Castings in Automobile.

FORMING PROCESSES AND POWDER METALLURGY 9 Hours
Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning - Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy - Forming and Shaping of Plastics –Types of plastics and Molding Types - Principles of Hydro forming process, its advantages and limitations.

WELDING 9 Hours
welding, Plasma arc welding, Thermit welding, Electron beam welding, Laser beam welding - defects in welding - Soldering and brazing- Application of Welding in Automobile.

**MACHINE TOOLS FOR MACHINING**

**9 Hours**

Introduction to the Lathe, Shaper, Planer, Milling machines, Drilling machines, Cylindrical grinding machine, Capstan and Turret lathe - CNC machines.

**UNCONVENTIONAL MACHINING PROCESSES**

**9 Hours**

Principles and applications of the Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, and Electron beam machining and Laser beam machining.

**List of Exercises: Machining exercises using Machine Tools**

1. **LATHE**
   1.1. Facing, plain turning and step turning
   1.2. Taper turning using compound rest.
   1.3. Taper turning using taper turning attachment
   1.4. Single start V thread, cutting and knurling

2. **SHAPER AND SLOTTER**
   2.1. Machining a V-block (in a Shaper)
   2.2. Machining internal key-way (in a Slotter)

3. **DRILLING**
   3.1. Drilling 4 or 6 holes at a given pitch circle on a plate
   3.2. Drilling, reaming and tapping

4. **MILLING**
   4.1. Plain Milling Exercise
   4.2. Gear Milling Exercise

5. **GRINDING**
   5.1. Cylindrical Grinding Exercise

6. **FOUNDRY**
   6.1 Moulding using single and Split Pattern

7. **SMITHY (Hand Forging exercises)**
   7.1 Making of a Square rod from a round rod
   7.2 Making of a Square and Hexagonal head in a round rod

**Theory :45 Hrs  Practical : 15 Hrs  Total Hours: 60**

**References:**

(Use of standard Steam tables with moliier chart, HMT Data book and Refrigerant tables are permitted)

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

CO1: Understand Thermodynamic laws and their applications. 

CO2: Apply energy balance to systems and control volumes, in situations involving heat and work interactions.

CO3: Differentiate between high grade and low grade energies.

CO4: Understand Properties of steam.

CO5: Integrate the basic concepts into various thermal applications like air compressor, refrigeration and air conditioning.

CO6: Enlighten the various mode of heat transfer and their engineering application.

**Pre-requisite:** Nil

**CO/PO Mapping**

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**Course Assessment methods:**

**Direct**

1. Assignments
2. Internal Test
3. Group Presentation
4. End semester Examination

**Indirect**

1. Course Exit Survey

**FIRST LAW OF THERMODYNAMICS**

System, thermodynamic equilibrium, state, property, process, cycle, energy, work, heat, first law of thermodynamics, PMM I, ideal gases, steady flow energy equation and application of first law of thermodynamics to closed and open systems. Simple Problems.
SECOND LAW OF THERMODYNAMICS

Statements of second law of thermodynamics, heat engine, heat pump, refrigerator, carnot cycle, carnot theorem, entropy and entropy changes for a closed system.

AIR STANDARD CYCLE AND COMPRESSOR


PROPERTIES OF STEAM AND VAPOUR POWER CYCLE

Steam formation, properties of steam. Use of steam tables and Mollier chart, Ideal Rankine cycle, Reheat and regenerative cycle Rankine cycle. Simple problems.

PSYCHROMETRY, REFRIGERATION AND AIR CONDITIONING

Properties of atmospheric air, Psychrometric relations, Psychrometric Processes and chart. Principles of refrigeration, Types - Vapour compression and Vapour absorption types – Coefficient of performance (COP), Properties of refrigerants – Basic Principle, Summer, winter and Year round Air conditioning. Introduction to Automotive air conditioning systems. Simple Problems.

HEAT TRANSFER


Theory : 45 Hrs
Tutorial: 15 Hrs
Total Hours: 60

References:
Course objectives

• To help the students look into the functioning of simple to complex devices and systems
• To enable the students to design and build simple systems on their own
• To help experiment with innovative ideas in design and team work
• To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

1. Nil

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CO/PO Mapping

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Programme Outcomes (POs)

Course Assessment methods:

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Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the third semester, students will focus primarily on IOT with C programming using Audino.
GUIDELINES:
1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90
Course Outcomes

After successful completion of this course, the students should be able to

**CO 1:** Develop skills in maintaining the harmony in the family.
**CO 2:** Create impulsive activities for healthy family
**CO 3:** Be receptive to troubled individuals
**CO 4:** Gain healthy life by practicing Kundalini Yoga & Kayakalpa
**CO 5:** Possess Empathy among family members.
**CO 6:** Reason the life and its significance

Pre-requisites:
1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES

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Course Assessment methods

**Direct**
1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test

**Indirect**
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. **Family system:** Introduction to Family Values – elements of family values - Adjustment, Tolerance, Sacrifice - Family structure in different society – work life balance.
2. **Peace in Family:** Family members and their responsibility - Roles of parents, children, grant parents - Respectable women hood
3. **Core value:** **Empathy:** Unconditional love - Respect - Compassion - sacrifice - Care &share - helping – emotional support - hospitality – cleanliness
4. **Blessing:** Blessing - methods - Vibration effect - Benefits - Reason for misunderstanding in the Family and resolution through blessings.
5. **Healthy Family**: Good relationship with neighbors - Counseling - Simplified Kundalini Yoga - Kaya Kalpa Yoga

**Workshop mode**

**REFERENCES**

1. FAMILY - www.download.nos.org/331courseE/L-13%20FAMILY.pdf


4. FAMILY VALUES IN A HISTORICAL PERSPECTIVE - The Tanner Lectures on www.tannerlectures.utah.edu/_documents/a-to-z/s/Stone95.pdf

Course Outcomes
After successful completion of this course, the students would be able to
CO 1: Analyze the impact of engineering solutions in a global and societal context.
CO 2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems.
CO 3: Highlight the importance of ecosystem and biodiversity.
CO 4: Consider issues of environment and sustainable development in his/her personal and professional undertakings.
CO 5: Paraphrase the importance of conservation of resources.
CO 6: Play an important role in transferring a healthy environment for future generations.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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Course Assessment methods

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INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies – Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams – benefits and problems – Water conservation, rain water harvesting, watershed management.

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

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies.
Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

**ECOSYSTEMS AND BIODIVERSITY** 9 Hours

**ECOSYSTEM:** Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).


**ENVIRONMENTAL POLLUTION** 8 Hours

Definition – Causes, effects and control measures of: (a) Air pollution – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

**SOCIAL ISSUES AND THE ENVIRONMENT** 7 Hours


**HUMAN POPULATION AND THE ENVIRONMENT** 7 Hours


Theory: 45 Hours

**REFERENCES**

SEMESTER 4

Signature of BOS chairman, Auto
NUMERICAL METHODS AND PROBABILITY

(Common to AE/AUE/CE/ME/MCE/EEE)

COURSE OUTCOMES
After successful completion of this course, the students will be able to

CO1: Apply various numerical techniques for solving non-linear equations and systems of linear equations.
CO2: Analyze and apply the knowledge of interpolation and determine the integration and differentiation of the functions by using the numerical data.
CO3: Predict the dynamic behaviour of the system through solution of ordinary differential equations by using numerical methods.
CO4: Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.
CO5: Apply the concepts of probability to random variables.
CO6: Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

Pre-requisite: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect
1. Course-end survey
SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9+3 Hours


INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3 Hours

Lagrange’s and Newton’s divided difference interpolation – Newton’s forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson’s rules.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3 Hours


BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS 9+3 Hours

Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain – Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes – Solution of one dimensional wave equation by explicit scheme.

PROBABILITY AND RANDOM VARIABLES 9+3 Hours


Theory: 45 Hours Tutorials: 15 Hours Total: 60 Hours

REFERENCES

Course Objective:
Impart knowledge on IC engines and its subsystems for understanding their role in automobiles.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the various components of the engine and its functions.
CO2: Examine the combustion process in SI and CI Engine for understanding the performance and emission characteristics.
CO3: Summarize various fuel supply and injection system used in IC engines.
CO4: Identify the suitable lubrication and cooling system to be used in IC Engines.
CO5: Explain the concepts of Supercharging and Turbocharging.
CO6: Analyze the various properties of fuels used in IC engines.

Pre-requisite:
1 U17AUT3104 - Thermodynamics and Thermal Engineering

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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ENGINE CONSTRUCTION AND ITS COMPONENT  L:  9 Hrs
Four stroke SI and CI engines – Working principle- Constructional details of engine components, function, materials, Intake system components - Discharge coefficient, Pressure drop Air filter, intake manifold, Connecting Pipe, Exhaust system components – Exhaust manifold and exhaust pipe, Spark arresters - Exhaust mufflers, Types, operation.

COMBUSTION IN SI ENGINES  L:  12 Hrs
Combustion process in IC engines, Stages of combustion, Flame propagation Flame velocity and area of flame front - Rate of pressure rise - Cycle to cycle variation, Abnormal combustion - Theories of detonation -Effect of engine operating and design variables on combustion, Combustion chambers – types, factors controlling combustion chamber design. Gasoline injection Systems
COMBUSTION IN CI ENGINES  
L:  12 Hrs

LUBRICATION AND COOLING SYSTEM  
L:  3 Hrs
Need for cooling system – Types of cooling system – Liquid cooled system: Thermosyphon system, Forced circulation system, pressure cooling system – properties of coolant, additives for coolants Need for lubrication system – Mist lubrication system, wet sump any dry sump lubrication – Properties of lubricants, consumption of oil.

SUPERCHARGING AND TURBOCHARGING  
L:  9 Hrs

List of Exercises :
P:  30 Hrs
1 Dismantling and Assembly of Engine components.
2 Experimental investigation on performance and emission characteristics of Twin cylinder C.I engines
3 Experimental Investigation on Performance, combustion and emission characteristics of Single cylinder D.I Diesel engines
4 Heat Balance Test on Automotive Engine
5 Experimental investigation on performance and emission characteristics of Multi cylinder S.I engines
6 Study on CRDI and MPFI fuel injection system.
7 Flash and fire point of fuels
8 Cloud and pour point test
9 Calorific value of liquid and gaseous fuel
10 Viscosity of fuels, Lubricants
11 Drop point of grease and mechanical penetration in grease.

Theory : 45 Hrs  
Practical: 30 Hrs  
Total Hours: 75

References:
2 IC Engines Combustion and Emissions, B.P.Pundir, Narosa Publishers, 2010
Course Objective:
To understand the fundamental concepts of fluid flow and its application in flow measurement devices, pipes and hydraulic machines.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Understand the properties of the fluid, flow concepts and measuring devices
CO2: Apply the fluid flow concepts and solve the problems
CO3: Analyse the practical flow problems using mathematical techniques
CO4: Apply the laws of conservation in flow through pipes
CO5: Illustrate the working principles of hydraulic machines
CO6: Correlate the Fluid Mechanics principles by performing laboratory experiments.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
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PROPERTIES OF FLUIDS AND FLUID STATICS
L: 9 Hrs
Fluid properties: Mass density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, compressibility, surface tension and capillarity. Fluid statics: fluid pressure at a point, variation of pressure within a static fluid, hydrostatic law – Pressure head, Pascal’s law. Measurement of pressure – Piezometric tube, manometry.

FLUID KINEMATICS AND FLUID DYNAMICS
L: 12 Hrs
Fluid dynamics: Euler’s equation of motion along a streamline – Bernoulli’s equation. Practical applications of Bernoulli’s equation in flow measurement devices like venturimeter, orificemeter and pitot tube. Concept of impulse momentum equation & angular momentum principle with applications.

**DIMENSIONAL AND MODEL ANALYSIS**
L: 9 Hrs
Dimensional analysis: dimensions, dimensional homogeneity, methods of dimensional analysis- Buckingham π theorem. Model analysis – Advantages and applications of model testing. Similitude, derivations of important dimensionless numbers, model laws.

**FLOW THROUGH PIPES**
L: 9 Hrs
Laminar and turbulent flow characteristics, laminar flow through circular pipes – Hagen Poiseuille law, Turbulent flow – development of Darcy – Weisbach equation, major and minor losses in pipes, Flow through pipes in series and parallel.

**HYDRAULIC MACHINES**
L: 6 Hrs

**Practical**

**List of Exercises:**

1. Verification of Bernoulli’s theorem
2. Determination of Darcy's friction factor
3. Determination of coefficient of discharge of Venturimeter
4. Determination of coefficient of discharge of Orificemeter
5. Determination of coefficient of discharge of notches
6. Determination of coefficient of discharge of mouthpiece/Orifice
7. Performance study on centrifugal pump
8. Performance study on gear oil pump/Reciprocating Pump
9. Load test on Pelton wheel turbine
10. Load test on Francis turbine
11. Load test on Kaplan turbine

| Theory: 45 Hrs | Practical: 30 Hrs | Total Hours: 75 |

**References:**

Course Objective:
To make the students to understand the concepts of I.S. conventions, methods of dimensioning and sectioning, to draw part and assembly drawings using drawing instruments and software tools.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Interpret the conventional representation of components
CO2: Construct part drawings with required views and dimensions
CO3: Apply the knowledge of Limits, Fits and Tolerances in the drawings.
CO4: Build part and assembly drawings according to BIS with Bill of Materials
CO5: Identify and draw the different types of Screwed Fastenings.
CO6: Make use of CAD software to model and draft components and assemblies.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping

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Introduction

L: 3 Hrs

Need of Graphical Language, Importance Machine Drawing
Classification of Machine Drawings:
Part Drawing and Assembly Drawing

Sectioning

L: 3 Hrs

Conventional Representations

L: 7 Hrs

Standard parts and Screwed Fastenings.

Limits, Fits, Dimensional and Form Tolerances

L: 9 Hrs

Definitions, Classifications of Fits, System of Fits, Selection of Fits, Method of Indicating Fits on Drawings, Tolerance Grade, Positions of Tolerance, Form Tolerance, Fundamental of Deviations, Shaft and Hole Basis systems, Method of Placing Limit Dimensions

Part and Assembly Drawings

L: 8 Hrs

Introduction, BOM and its Importance, Assembly procedures
Practical

List of Exercises: (Any Five to be practiced)  P: 30 Hrs

1. Part and Assembly Drawing of Screw Jack
2. Part and Assembly Drawing of Knuckle Joints
3. Part and Assembly Drawing of Universal coupling
4. Part and Assembly Drawing of Lathe Tail Stock
5. Part and Assembly Drawing of Gear Pump
6. Part and Assembly Drawing of Crankshaft with connecting rod and piston
7. Part and Assembly Drawing of Single Plate Clutch

| Theory: 30 Hrs | Practical: 30 Hrs | Total Hours: 60 |

References:

Course Objective:
Impart knowledge for the construction of vehicle with light weight, improved aerodynamics and body trims in accordance with safety regulations.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Classify the vehicles and define basic terminologies.
CO2: Select appropriate body material for automobiles.
CO3: Calculate various aerodynamic forces and moments acting on vehicle.
CO4: Examine the various loads distribution in vehicle frames.
CO5: Familiarize the ergonomics concepts related to the vehicles.
CO6: Apply various safety aspects as per the norms.

Pre-requisite:
1 U17AUI3201 - Automotive Chassis and Transmission

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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VEHICLE BODY DETAILS  L: 7 Hrs
Body Terminologies, Vehicle body construction techniques, BIW, Regulations, Drivers visibility - Methods for improving visibility and space in cars, Seat – dimensions & parameters, Types of loads, Frame design and bending - Idealized structure, surface, crash worthiness, vehicle safety - Crash and Roll Test.

VEHICLE AERODYNAMICS  L: 8 Hrs
Aerodynamics – concept, objectives, Forces and Moments – types and effects on vehicle body, Body optimization techniques for minimum drag and lift. Wind tunnel testing – concept – types - test setup - testing process - Flow visualization techniques - Scale model testing - Component balance to measure aerodynamic forces
CAR BODY DETAILS  
L: 8 Hrs

BUS BODY DETAILS  
L: 8 Hrs

COMMERCIAL BODY DETAILS  
L: 7 Hrs
Types of body, flat platform, drop side, fixed side, tanker body, tipper body - designs, volume/weight considerations, pay load and related regulations, light commercial vehicle body types. Dimensions of driver’s seat in relation to controls, drivers cab design.

BODY MATERIALS AND MECHANISMS  
L: 7 Hrs

| Theory : 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
5  The Passenger Car Body - Dieler Anselm., SAE International and Vogel Verlag, 2000
6  Materials for Automobile Bodies - Geoff Davies., Butterworth-Heinemann, 2012
7  The Repair of Vehicle Bodies - A. Robinson, W. A. Livesey., Butterworth-Heinemann Ltd, 2018
8  Aerodynamics of Road Vehicles - Wolf-Heinrich Hucho., Published by SAE International, USA, 1998
9  Vehicle Aerodynamics - Dr. V. Sumantran and Dr. Gino Sovram., SAE International, USA, 1994
Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:
1. U17INI3600 - Engineering Clinic - I

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Content:
The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fourth semester, students will focus primarily on solid modelling and Python programming.
GUIDELINES:
1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90
Course Outcomes

After successful completion of this course, the students should be able to

- **CO 1**: Develop the ethical values in both professional and personal life
- **CO 2**: Develop ability to take decision to reinforce professional life
- **CO 3**: Rational in professional skills required for diverse society
- **CO 4**: Excel in ingenious attitude to congregate professional life
- **CO 5**: Research into the professional stand
- **CO 6**: Spruce an Individual with decorum to achieve professional life

**Pre-requisites**:
1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES

**CO/PO Mapping**

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**Course Assessment methods**

**Direct**
1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test

**Indirect**
1. Mini project on values / Goodwill Recognition

**Values through Practical activities:**

1. **Professional skills With Values**: Positive Attitude, Adaptability, Responsibility, Honesty and Integrity, Self Esteem, & Self Confidence
2. **Building Innovative work cultures**: Creative thinking, Critical thinking, Conflict Resolution, Problem Solving, & Decision making
3. **Professional Work Ethics**: Types of Ethics, Etiquette, personality Grooming, Emotional quotient, Human Dignity, Safety & Role of Professional in Social Responsibility

5. **Case studies in engineering ethics**: Discussion of case studies relating to Public safety, health, welfare, Quality of product, Improper conduct by management, Product responsibility, Intellectual property

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**Workshop mode**

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**REFERENCES**

1. LEARNING TO DO SOURCEBOOK 3 - UNESCO-UNEVOC -PDF
   [www.unevoc.unesco.org/fileadmin/user_upload/pubs/LearningToDo.pdf](http://www.unevoc.unesco.org/fileadmin/user_upload/pubs/LearningToDo.pdf)

2. DECLARATION OF PROFESSIONAL VALUES AND ETHICAL STANDARDS

3. KARMA YOGA - SWAMI VIVEKANANDA
   [www.vivekananda.net/PDFBooks/KarmaYoga.pdf](http://www.vivekananda.net/PDFBooks/KarmaYoga.pdf)

4. PROFESSIONAL ETHICS IN ENGINEERING - Sasurie College of Engineering

5. ENGINEERING ETHICS CASE STUDY; Challenger
Course Outcomes:
After successful completion of this course, the students will be able to:

CO 1: Gain Knowledge about the Constitutional Law of India
CO 2: Understand the Fundamental Rights and Duties of a citizen
CO 3: Apply the concept of Federal structure of Indian Government
CO 4: Analyze the Amendments and Emergency provisions in the Constitution
CO 5: Develop a holistic approach in their life as a Citizen of India

Pre-requisites : NIL

CO/PO Mapping
(S/M/W indicates strength of correlation)   S-Strong, M-Medium, W-Weak

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Course Assessment methods

Direct
1. Group Activity / Quiz/ Debate / Case studies
2. Class test / Assignment

Indirect
Surveys

THEORY COMPONENT:

Module.1: Introduction to Indian Constitution  4 hours
Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India

Module.2: Fundamental Rights  8 hours
Module.3: Federal Structure 8 hours
Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

Module.4: Amendment to Constitution 6 hours
Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India

Module.5: Emergency Provisions 4 hours
National Emergency, President Rule, Financial Emergency Local Self Government – Constitutional Scheme in India

Total 30 hours

| Theory: 30 | Tutorial: 0 | Practical: 0 | Project: 0 | Total: 30 hours |

REFERENCES

   awmin.nic.in/coi/coiason29july08.pdf

2. Introduction to the Constitution of India by Durgadas Basu

3. The Constitution of India – Google free material -
   www.constitution.org/cons/india/const.html

4. Parliament of India – PDF format
   download.nos.org/srsec317newE/317EL11.pdf

5. The Role of the President of India – By Prof.Balkrishna

6. Local Government in India – E Book - Pradeep Sachdeva
   https://books.google.com/books/.../Local_Government_in_India..
SEMESTER 5
Course Objective:
To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Distinguish the various basic electrical and electronics systems of an automobile.
CO2: Select a battery, starter motor, lamps etc for a suitable application
CO3: Recognize and understand the different wiring diagrams used in automobile manuals.
CO4: Build a simple automobile electrical systems.
CO5: Perform simple programs with the 8085 microprocessor.
CO6: Apply the fundamental concepts of electronics for designing a 9/12V power supply.

Pre-requisite:
1 Nil

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)       S-Strong, M-Medium, W-Weak

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TYPES OF BATTERIES
Batteries – types, construction and working principle of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal Hydride Battery, Sodium Sulphur Battery and Aluminum air Battery, lithium ion batteries, Characteristics of batteries, battery rating, capacity and efficiency, Various Tests on battery, battery – charging techniques, maintenance of batteries.

STARTING AND CHARGING SYSTEM
Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators- construction and Characteristics, Voltage and Current Regulation, Cut –out relays and regulators, charging circuits
IGNITION SYSTEM L: 9 Hrs

FUEL INJECTION SYSTEM L: 9 Hrs
Introduction, electronic fuel carburetion, fuel injection- types and system overview, components of fuel injection system, diesel fuel injection – introduction of diesel fuel injection, diesel exhaust emissions, electronic control of diesel injection

WIRING, LIGHTING AND OTHER INSTRUMENTS L: 9 Hrs
Automotive electrical wiring, terminals and switching, multiplexed wiring system, electromagnetic compatibility(EMC), Lighting system – basic lighting system, Head Lamp and Indicator Lamps, Anti–Dazzling and Dipper system

Practical

List of Exercises : P: 30 Hrs
Automotive Electrical Laboratory
   1 Testing of Batteries and Battery maintenance
   2 Load Test on Starter motors and Alternators
   3 Diagnosis of Ignition system
   4 Study of Automotive Electrical Wiring
   5 Study of Power Window
Automotive Electronics Laboratory
   6 Study of rectifiers
   7 Study of 555 timer
   8 Study of Logic gates
   9 Micro Processor programming and interfacing
  10 Design of power supply

| Theory :45 Hrs | Tutorial: 30 Hrs | Total Hours: 75 |

References:
1 Tom Denton, Automotive Electrical and Electronic Systems, Burlington, MA 01803, Elsevier Butterworth-Heinemann,2004
2 Young, A.P. and Griffith, S.L., Automobile Electrical Equipments, ELBS and New Press,1999
Course Objective:
This course focuses on the fundamentals concepts and formulation of the finite element method for solving engineering problems arising in structural mechanics & heat transfer.

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

CO1: Recognize the concepts of finite element method.
CO2: Formulate finite element techniques for design problems
CO3: Devise equations in finite element analysis for 1D, 2D and 3D problems.
CO4: Analyze and solve problems in heat transfer and structural mechanics
CO5: Familiarize a CAE software, to simulate engineering problems in heat transfer and structural mechanics
CO6: Apply finite element techniques for Non Linear Analysis.

Pre-requisite:
1 U17MAT4101- Numerical Methods and Probability

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FINITE ELEMENT METHODS  L: 9 Hrs

ONE DIMENSIONAL PROBLEMS  L: 9 Hrs
TWO DIMENSIONAL PROBLEMS

HEAT TRANSFER ANALYSIS
Basic differential equations of heat transfer, one dimensional and two dimensional finite element formulation using variational method, one dimensional steady state heat transfer problems involving conduction and convection. Analysis of tapered fin, Formulation of thermal stress problems and examples

ISOPARAMETRIC FORMULATION

NON LINEAR ANALYSIS

List of Exercises:
1. Structural analysis of frames using Truss Elements
2. Static Structural Analysis using 2D Elements
3. Heat Transfer Analysis using 1D Elements
4. Heat Transfer Analysis using 2D Elements
5. Buckling Analysis of Connecting rod
6. Torsional Analysis of bar using 3D Analysis
7. Dynamic Analysis of Leaf and Coil springs
8. Material Non linearity of Axially loaded bars

Theory: 45 Hrs | Practical: 30 Hrs | Total Hours: 75

References:
4. JN Reddy
Course Objective:
To impart knowledge on theory and design of machine elements and train them in solving design problems involving common machine elements.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Familiarize and apply the design morphology in designing various machine elements
CO2: Selecting suitable material for the machine elements
CO3: Calculate and analyze the forces acting on the Machine element
CO4: Choosing the appropriate machine element for the required function
CO5: Designing a machine element from the given data
CO6: Justify the design and present it in an effective manner

Pre-requisite:
1  U17AU13202- Strength of Materials

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)   S-Strong, M-Medium, W-Weak

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L: 9 Hrs  T: 3 Hrs

INTRODUCTION
Introduction to design and machine elements and, Classification of design – Selection of materials – Factors of safety in design – Endurance limit of materials – Determination of endurance limit for ductile materials.

DESIGN OF SHAFTS AND SPRINGS
L: 9 Hrs  T: 3 Hrs
GEAR DESIGN

L: 9 Hrs  T: 3 Hrs

DESIGN OF BEARINGS

L: 9 Hrs  T: 3 Hrs

FLYWHEELS

L: 9 Hrs  T: 3 Hrs
Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. Engine flywheels stresses of rim of flywheels. Design of hubs and arms of flywheel – Turning moment diagram.

| Theory : 45 Hrs | Tutorial: 15 Hrs | Total Hours: 60 |

References:

3 “Material selection in mechanical design” Michael F ashby, Butterworth-Heinemann,2001
Course Objective:
Understand the mechanisms of mechanical systems and analyze the forces and motions.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Calculate the velocity and acceleration of simple mechanisms.
CO2: Create the cam profile for different follower motions.
CO3: Identify the different gear trains and calculate the gear ratio.
CO4: Solve and draw the plots for the static and dynamic balancing of various mechanical systems.
CO5: Evaluate the free and forced vibrations for different applications.
CO6: Summarise the kinematic aspect of the mechanisms in automotive applications

Pre-requisite:
1  NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)   S-Strong, M-Medium, W-Weak

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BASICS OF MECHANISMS  
T: 9 Hrs   T: 3 Hrs

DESIGN OF CAM PROFILE  
T: 9 Hrs   T: 3 Hrs
Types of cams, Types of followers, Radial cam, Terminology of radial cam, Types of follower motions: uniform motion, simple harmonic motion, constant acceleration/deceleration motion, cycloidal motion, Cam profile for knife edge, Roller and flat faced follower – Graphical method (Mushroom)

KINEMATICS OF GEAR TRAINS  
T: 9 Hrs   T: 3 Hrs
Gear profile and geometry – Nomenclature of spur and helical gears, Classification of gear trains, Calculation of Gear ratio, Number of teeth for the gears in the gear trains, Velocities of the gears in gear
trains such as Simple, Compound, Reverted and Epicyclic (using tabulation method) gear trains, Differential gear train.

**BALANCING**

| Theory: 45 Hrs | Tutorial: 15 Hrs | Total Hours: 60 |

Static and dynamic balancing – Single and several masses in different planes – Whirling of shafts – Critical speed of shafts – 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

**VIBRATIONS**


References:

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

1. U17INI4600 - Engineering Clinic - II

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Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fifth semester, students will focus primarily on Design project combining concepts learnt in Engineering clinics I and II.
GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90
Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Understand the transformation from self to society
CO 2: Acquire knowledge about disparity among Human Beings
CO 3: Realize the new ethics in creating a more sustainable Society
CO 4: Develop skills to manage challenges in social issues
CO 5: Acquire the skills for Management of Social work & Holistic Society
CO 6: Validate the social liabilities at dissimilar situations

Pre-requisites :
1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES

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CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Course Assessment methods

Direct
1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test

Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

4. **Emerging Ethics for Sustainable Society:** Unison of Men in Society - Positive Social Ethics - Cause and Effect - Ensuring an Equitable Society - Effect of Social Media in society - development of Education and Science in the Society

5. **Social Welfare:** Social welfare Organization - Programme by Government and NGO's - Benefits of Social Service - Balancing the Family and Social Life – Development of Holistic Society

**Workshop mode**

**REFERENCES**

1. SOCIAL PROBLEMS IN INDIA - ForumIAS.com – PDF
discuss.forumias.com/uploads/File
upload/…/711b18f321d406be9c79980b179932.pdf...

2. INVESTING IN CULTURAL DIVERSITY AND INTERCULTURAL DIALOGUE: UNESCO ...

3. INDIAN SOCIETY AND SOCIAL CHANGE - University of Calicut
www.universityofcalicut.info/SDE/BA_sociology_indian_society.pdf

4. CULTURE, SOCIETY AND THE MEDIA - E-class
www.eclass.uoa.gr/…/MEDIA164/…/%5BTony_Bennett,_James_Curran,_Michael_G

5. SOCIAL WELFARE ADMINISTRATION - IGNOU
www.ignou.ac.in/upload/Bswe-003%20Block-2-UNIT-6-small%20size.pdf
SEMESTER 6
Course Objective:
To give insight on the concepts of automotive embedded systems and to impart skills in developing models.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Select suitable sensors for measuring parameters in automotive systems
CO2: Choose the appropriate actuator and driver for automotive applications
CO3: Outline the concepts of embedded systems
CO4: Design of hardware model for automotive system using microcontroller
CO5: Build codes for automotive embedded applications
CO6: Compare the wired and wireless communication protocols

Pre-requisite:
1 U17AUT5201 - Automotive Electrical and Electronics Engineering

CO-PO/PSO Mapping
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SENSORS
Introduction to automotive sensors, Proximity sensors - inductive, capacitive, magnetic, Photoelectric, Ultrasonic sensors, Thermistor, Thermocouple, Hall effect sensor, Load cell, Optical rain sensor, Liquid level sensor, Lambda sensor, NOX sensor, MAP and MAF, Knock sensor, Angle sensor, Vibration sensor, Acceleration sensor, Pressure sensor, RPM sensor, Torque sensors, Position sensor.

ACTUATORS
Solenoid – Types, Solenoid Switching, Relays and Optoisolators – Electromechanical relay, driving a relay, solid-state relay, Reed switch, Optoisolator, Operation and application of BLDC motors, Servo and stepper motors, Piezoelectric Actuators, Actuator Driver - H Bridge driver, Door actuator driver, Stepper motor driver, Transistor driver, Signal conditioner - Amplifier, Filter, Data Acquisition.
EMBEDDED SYSTEM

L: 9 Hrs

INTERFACING WITH MICROCONTROLLER

L: 9 Hrs
Sensor Interfacing: Analog and digital sensor, keyboard interface with 8/32 bit controller.
Actuator Interfacing: Motor control applications - Pulse width modulation (PWM), LCD display, relay and solenoid Interfacing with 8/32 bit controller. Serial communication interfacing.

COMMUNICATION PROTOCOLS

L: 9 Hrs
Introduction to Communication protocol in embedded systems, Wired communication protocols – SPI, I2C and USB, CAN. Wireless communication protocols - Bluetooth HC05, Wi-Fi, RF transmitter and receiver, Internet of Things (IoT).

List of Exercises:

P: 30 Hrs
1. Study of 8/32 Bit Microcontroller Architecture
2. LED Blinking using PWM
3. Interfacing Analog sensor
4. Interfacing Digital sensors
5. Interfacing DC Motor speed control with PWM
6. Interfacing Relay and solenoid Control application
7. Interfacing LCD
8. Implementing the Communication protocols – wireless and wired protocols
9. Interface EEPROM for writing and reading the ECU diagnostic code
10. Interrupts and Timers
11. Design and Build CAN communication Network
12. Interfacing Serial communication

Theory : 45 Hrs
Practical: 30 Hrs
Total Hours: 75

References:
3. Automotive Sensors, BOSCH. 2002
Course Objective:
To make the students familiarize over the forces and moments that generated in a vehicle and its influence over performance in acceleration and braking, handling qualities and ride qualities.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Identify the forces acting on vehicle for the given conditions and draw free body diagram
CO2: Infer and explain the phenomena of the forces that acts on the vehicle
CO3: Determine the reaction forces induced in the vehicle
CO4: Develop mathematical model of the vehicle system and elements
CO5: Provide solution by developing model and solving it
CO6: Justify the vehicle response for the forces and moments that acts on the vehicle

Pre-requisite:
1 U17AUT5104- Mechanics of Machines

CO-PO/PSO Mapping
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LONGITUDINAL DYNAMICS  
L: 9 Hrs

TIRE MECHANICS  
L: 9 Hrs
RIDE DYNAMICS
L: 9 Hrs
Vibration – introduction, types, terminologies, source of vibration, human response, Degrees of freedom-single, two and multi degrees of freedom system, free, forced and damped vibration, magnification factor, transmissibility, vibration absorbers, pitch and bounce motion, oscillation centers, Suspension- types, active and semi active suspension, sprung mass and un-sprung mass, calculation of effective spring rate.

LATERAL DYNAMICS
L: 9 Hrs
Vehicle control-low speed cornering and static steering – Ackerman steering geometry, steady-state cornering- steering factors, vehicle control parameters ( understeer, neutral steer and over steer) steady state handling – lateral acceleration gain , characteristic speed, yaw velocity gain and critical speed-effect of braking on vehicle handling and constant radius testing and fish hook measurement testing.

VEHICLE STABILITY AND NOISE
L: 9 Hrs
Stability of a vehicle – on slope, on curve and banked road
Noise- Introduction, properties of sound, sound level designation and measurement techniques- sound isolation and absorption- silencer and mufflers.

Practical

List of Exercises :
P: 30 Hrs
1 Simulation of a telescopic suspension system
2 Simulation of a Rack and Pinion Steering system
3 Simulation of Mc Phearson strut suspension system
4 Simulation of braking characteristics of a four wheeler passenger car
5 Simulation of Cornering characteristics of a four wheeler passenger car.
6 Simulation test for roll stability of a four wheeler passenger car.
7 Driving Simulation of a passenger car in ISO Lane change and 3D road

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References:
1 Fundamentals of vehicle dynamics, Gillespie T D , SAE USA ,1992
2 Automotive Mechanics, Giri N K, Khanna Publisher, 2007
4 Road Vehicle dynamics – Theory and Application ,Masato Abe, Elsevier ,2009
7 Elementary Vehicle Dynamics, Cole D E , Ann Arbor, Michigan, USA,1972.
10 Dr.R Krishnakumar,Vehicle Dynamics, NPTEL course https://nptel.ac.in/courses/107106080/

Signature of BOS chairman, Auto
Course Objective:
This course will introduce general aspects of Hybrid and Electric Vehicle (HEV) technologies, including architectures, modeling, sizing, sub-system design and vehicle control. It will cover energy storage sources, electric propulsion systems, power electronics design, and HEV control.

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

CO1: Describe the configuration of hybrid and electric vehicles.
CO2: Identify the basic components of hybrid and elective vehicles.
CO3: Assess the characteristics and performance of the electric vehicle
CO4: Select suitable electric propulsion and control systems for HEV.
CO5: Choose proper energy storage systems for vehicle applications
CO6: Describe the operation of fuel cell and solar cell vehicles.

Pre-requisite:
U17AUT5201 - Automotive Electrical and Electronics Engineering

ELECTRIC PROPULSION SYSTEMS
L: 8 Hrs

ENERGY STORAGE SYSTEMS
L: 8 Hrs
Requirements in Hybrid and Electric Vehicles, Types of batteries – lead acid batteries, nickel based batteries, and lithium based batteries - Battery Charging, Battery Characterization - capacity, discharge rate, state of charge, state of discharge, depth of Discharge, Technical characteristics, battery pack design, battery management system, Ultra capacitors.
ELECTRIC VEHICLES  L:  7 Hrs
History of electric vehicles, social importance of electric mobility, performance of e-vehicles -tractive effort and transmission requirements, vehicle performance, energy consumption, Specifications - System Components, Electric drive-trains topologies, power flow control in electric drive-train, fuel efficiency analysis.

HYBRID VEHICLES  L:  7 Hrs
History of hybrid vehicles, social and environmental importance of hybrid vehicles, impact of modern drive-train on energy supplies. Hybrid Electric Drive-train configurations - basic concept of hybrid traction, architecture - merits and challenges, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

HEV PERFORMANCE  L:  8 Hrs

FUEL CELL AND SOLAR VEHICLES  L:  7 Hrs

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References:
TOTAL QUALITY MANAGEMENT AND PROJECT MANAGEMENT

Course Objective:
Expose the students to learn how to apply the Total Quality Management Techniques for an industry in turn for the product & To develop their ability in planning and execution of a project effectively.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Relate quality concepts and philosophies of TQM
CO2: Apply TQM tools as a means to improve quality
CO3: Select the lean six sigma tools for improving the productivity
CO4: Categorize the structure of the organization
CO5: Identify competency in project planning, scheduling and related activities
CO6: Develop network models and analyze the cost accounting

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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Course Assessment methods:

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<td>2 Continuous Assessment Tests</td>
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<td>3 End-Semester Examination</td>
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TQM PRINCIPLES

TQM TOOLS & STATISTICAL TOOLS
QUALITY SYSTEMS

PROJECT ORGANIZATION AND MANAGEMENT
Introduction, project characteristics, taxonomy of projects, project identification and formulation. Organizing human resources, organizing systems & procedures for implementation. Project direction, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

PLANNING ,SCHEDULING , NETWORK MODELS, PROJECT APPRAISAL
PERT & CPM Cost accounting systems, lowest Cost schedule, crashing of networks, linear programming formulation of event oriented networks, updating of networks, LOB technique. computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections. Cost analysis of the project, components of capital Cost of a project, modern approach to project performance analysis.

Theory : 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45

References:

Signature of BOS chairman, Auto
Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

**CO1:** Identify a practical problems and find a solution

**CO2:** Understand the project management techniques

**CO3:** Demonstrate their technical report writing and presentation skills

Pre-requisite:

1. U17INI5600 - Engineering Clinic - III

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Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fourth semester, students will focus primarily on Reverse engineering project to improve performance of a product.
GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90
Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Acquire knowledge on the Essence of Indian Knowledge Tradition
CO 2: Know the great Indian personalities and follow their trail
CO 3: Understand the specialty of democracy
CO 4: Disseminate our Nation and its values to propagate peace
CO 5: Contribute with their energy and effort for a prosperous India
CO 6: Propagate the youth and the contribution for development of our Nation

Pre-requisites:
1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES
5. U17VEP5505 / SOCIAL VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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Course Assessment methods

Direct
1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test

Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. Essence of Indian Knowledge Tradition:
Basic structure of Indian Knowledge System - Modern Science and Indian Knowledge System - Yoga and Holistic Health care - Case studies - Philosophical Tradition - Indian Linguistic Tradition - Indian Artistic Tradition.


4. **India’s Contribution to World peace**: Nonaligned Nation – Principle of Pancha Sheela – Mutual respect, non-aggression, non-interference, Equality and cooperation – Role of India in UNO - Yoga India’s gift to the world.


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**REFERENCES**

1. KNOWLEDGE TRADITIONS AND PRACTICES OF INDIA, CBSE Publication
   ___cbeacademic.nic.in/web_material/Circulars/2012/68_KTP1/Module_6_2.pdf

2. CULTURAL HERITAGE OF INDIA - SCERT Kerala

3. LEARNING TO DO: VALUES FOR LEARNING AND WORKING TOGETHER - UNESCO
   www.unesdoc.unesco.org/images/0014/001480/148021e.pdf

4. INDIA AFTER GANDHI.pdf - Ramachandra Guha - University of Warwick
   www2.warwick.ac.uk/fac/arts/history/students/modules/hi297/.../week1.pdf

5. INDIA’S CONTRIBUTION TO THE REST OF THE WORLD - YouSigma
   www.yousigma.com/interesting facts/indiasgifttotheworld.pdf

6. INDIA AS AN EMERGING POWER - International Studies Association
   web.isanet.org/Web/Conferences/.../11353cac-9e9b-434f-a25b-a2b51dc4af78.pdf
SEMESTER 7
VEHICLE MAINTENANCE AND RECONDITIONING  
L  T  P  J  C
2  0  2  0  3

**Course Objective:**
Impart knowledge and skill on Vehicle Maintenance and Troubleshooting of automotive systems.

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

- CO1: Familiarise the need and procedures of service records used for vehicle maintenance
- CO2: Examine and troubleshoot engine malfunctions
- CO3: Identify the conditions of battery and auxiliary electrical systems.
- CO4: Describe the repair procedure for vehicle chassis and body components
- CO5: Assess and rectify the wheel and tire parameters
- CO6: Inspect and troubleshoot the HVAC system

**Pre-requisite:**
1. U17AUI3201 - Automotive Chassis and Transmission

**CO-PO/PSO Mapping**
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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**LAYOUT OF AUTOMOTIVE SERVICE STATION - RECORDS AND PROCEDURES**
L: 8 Hrs

Introduction to vehicle maintenance, Importance and need for maintenance, preventive and breakdown maintenance. Tools and Instruments used in Maintenance shop, Layout of Automotive Repair, Service & Maintenance Shop.

Preparation of check lists, safety. Inspection schedule, maintenance of records, log sheets Trip sheet and Road test report. Service schedule and service history maintenance, Workshop Management, spare parts warranty.

**REPAIR AND MAINTENANCE OF ENGINE AND CHASSIS SYSTEM**
L: 8 Hrs

Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up.- Need for overhauling- Preparation of Cost sheets ( estimation )- Engine performance analysis-Troubleshoot and Remedies Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft

**MAINTENANCE OF ELECTRICAL SYSTEM**  
L: 6 Hrs  
Testing methods for checking electrical components, checking- battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of electronic systems, checking and servicing of instrument cluster.

**REPAIR AND MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VEHICLE BODY**  
L: 8 Hrs  
Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance. Manufacture recommended fluids- Kaizen method on schedule services, how to increase productivity and efficiency- Case studies. Field surveys. - Latest technologies in servicing

### Practical

**List of Exercises :**

1. Lighting System Trouble shooting & Servicing.  
2. Fault diagnosis of Air-Conditioning system.  
3. Tire maintenance and wheel balancing.  
4. Measurement of camber, caster, kingpin inclination and alignment of toe-in and toe-out  
5. Braking System Troubleshooting & Servicing  
6. Diagnosis of Engine ECU  
8. Experimental Study about Gearbox, Steering, Suspension system Maintenance  
9. On-road Braking, Acceleration and Fuel economy test

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<th>Theory: 30 Hrs</th>
<th>Practical: 30 Hrs</th>
<th>Total Hours: 60</th>
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**References:**

4. Automotive Trouble shooting and Maintenance by Anderson Ashburn  
6. Service Manuals from Different Vehicle Manufacturers  
Course Objective:
Impart knowledge on the wastes produced from automobiles and the emission formation mechanisms.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the impact of pollutants on global environment and its climatic change
CO2: Examine the emission formation mechanisms and techniques to minimize emissions formation in I.C. engines.
CO3: Describe automotive emission control technologies.
CO4: Familiarise about emission standard, measurement, test procedure and regulations
CO5: Identify the wastes produced from automobiles.
CO6: Explain the available disposal methods of waste.

Pre-requisite:
1  U17AUI4201- Automotive Engines and Systems

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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POLLUTANT FORMATION EFFECT ON ENVIRONMENT    L:  7 Hrs

EMISSION FORMATION IN S.I ENGINES    L:  7 Hrs
Pollution formation in SI Engines – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating and design variables on emission formation.

EMISSION FORMATION IN C.I ENGINES    L:  7 Hrs
Pollutant Formation In CI Engines – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines— Particulate emission in diesel engines- Effect of operating and design variables on emission formation.

Signature of BOS chairman, Auto
EMISSION CONTROL AND MEASUREMENT TECHNIQUES  L:  12 Hrs

AUTOMOTIVE WASTES  L:  6 Hrs
Introduction-Types of Automobile waste-Electrical waste, Battery waste, Copper elements-Electronic circuit wastes-Tyre wastes-Mechanical wastes, Body panel, Chassis components.

WASTE DISPOSAL AND MANAGEMENT TECHNIQUES  L:  6 Hrs
Battery disposal procedure, management of battery waste, Steps involved in recycling batteries, Hydrometallurgical process, Hydrometallurgical process, Mercury distillation-Tyre disposal techniques.

| Theory: 30 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
1 IC Engines Combustion and Emissions, B.P.Pundir, Narosa Publishers, 2010
2 Internal Combustion Engines,Ganesan, V- Tata McGraw-Hill Co.- 2017
Course Outcomes
After successful completion of this course, the students should be able to:
CO1: Identify practical problems and find a solution related to automotive and relative domains
CO2: Understand the project management practices
CO3: Demonstrate their report writing and presentation skills

Pre-requisite:
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CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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GUIDELINES:
1. The Project work in Phase-I and II may contain a theoretical study and analysis, experimental analysis, design, modeling & simulation, fabrication of a model or a prototype or a combination of the above related to automotive area and allied areas.
2. The project work include literature review, modeling, analysis, simulation, fabrication, testing and analysis & correlation of test data etc.
3. Can be individual or a group project, with maximum of 4 students per group.
4. The progress of the project is evaluated based on a minimum of three reviews and end semester review.
5. In Phase-I of the project, literature survey, projects task plan and design phases should have been completed
6. A project report is required to be submitted at the end of the semester in the required format.
7. The review presentations and project report should contain the individual work allocation & contribution, estimated & actual time schedule with charts (PERT/GANTT), literature survey, drawings in addition to the details of project work carried out.

Total Hours 90
Course Outcomes

After successful completion of this course, the students should be able to:

- **CO 1**: Aware of the concept of Universal Brotherhood and support the organizations which are working for it.
- **CO 2**: Follow the path of Ahimsa in every aspect of their life.
- **CO 3**: Uphold the Universal declaration of Human Rights.
- **CO 4**: Understand the unequal distribution of wealth in the World and bestow their effort towards inclusive growth.
- **CO 5**: Sensitize the environmental degradation and work for the sustainable development.
- **CO 6**: Amalgamate harmony through Non-violence and edify the nation headed for upholding development.

Pre-requisites:
1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES
5. U17VEP5505 / SOCIAL VALUES
6. U17VEP6506 / NATIONAL VALUES

**CO/PO Mapping**

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**Course Assessment methods**

**Direct**
1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test

**Indirect**
1. Mini project on values / Goodwill Recognition

**Values through Practical activities:**

1. **Universal Brotherhood**: Meaning of Universal Brotherhood- Functioning of Various organization for Universal human beings - Red Cross, UN Office for Humanitarian Affairs
2. Global Peace, Harmony and Unity: Functions of UNO - Principal Organizations - Special organization – Case study relating to disturbance of world peace and role of UNO – Participatory role of Students/Individual in attaining the Global peace and Unity.


5. Inclusive growth and sustainable development: Goals to transform our World: No Poverty - Good Health - Education – Equality - Economic Growth - Reduced Inequality – Protection of environment – Case study on inequality and environmental degradation and remedial measures.

Workshop mode

REFERENCES


2. THREE-DIMENSIONAL ACTION FOR WORLD PROSPERITY AND PEACE- IIM Indore - www.iimind.ac.in/.../Three-Dimensional-Action-for-World-Prosperity-and-Peace-Glo...


5. THE ETHICS OF SUSTAINABILITY – Research Gate www.researchgate.net/file.PostFileLoader.html?id...assetKey..

**************************
SEMESTER 8
Course Outcomes
After successful completion of this course, the students should be able to:

CO1: Identify and solve practical problems and find a solution related to automotive and relative domains
CO2: Understand the project management techniques
CO3: Demonstrate their report writing and presentation skills

Pre-requisite:

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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GUIDELINES:

1. To continue the Phase- I project and executing the same in consultation with the project coordinator and project guide
2. A Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment is a must to complete and an effort leading to paper publication or patenting is desired.
3. A working model or prototype is to be submitted for end semester evaluation for the most appropriate problems.
4. A project report is required to be submitted at the end of the semester in the required format.
5. The review presentations and project report should contain the individual work execution & contribution, actual time schedule with charts (PERT/GANTT), literature survey, drawings, analysis report, DFMEA/FMEA charts in addition to the details of project work carried out.
6. Project work done at Industry should be duly supported by certificate from the Industry.
7. The progress of the project is evaluated based on a minimum of three reviews and end semester viva-voce examination.

Total Hours 360
PROFESSIONAL ELECTIVE
AUTOMOTIVE DESIGN
Course Objective:
The course provides basic knowledge on designing of IC engine components.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Understand the design procedure for piston and cylinder
CO2: Apply the design assumption in validating the types of connecting rod used in IC engines.
CO3: Calculate the parameters required for designing the crankshaft
CO4: Understand the steps involved in designing of different types of automotive clutch
CO5: Apply the assumption and design valves and valve train
CO6: Explain design methods for engine components

Pre-requisite:
1. U17AUI3202 - Strength of Materials
2. U17AUI4201 - Automotive Engines and Systems

**CO-PO/PSO Mapping**
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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**DESIGN OF CYLINDER AND PISTON**  L: 9 Hrs
Choice of material for cylinder and piston, design assumptions and procedure for cylinder and piston. Design of cylinder, piston, piston pin, piston rings.

**DESIGN OF CONNECTING ROD**  L: 9 Hrs
Design of Connecting Rod-determining minimum length of connecting rod, small end design, Big end design, shank design, design of cap bolts.

**DESIGN OF CRANKSHAFT**  L: 9 Hrs
Balancing of I.C. engines, significance of firing order. Material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations, development of short and long crank arms. Front and rear-end details.
DESIGN OF CLUTCH  
L: 9 Hrs
Design of single plate clutch, multiplate clutch, design of centrifugal clutch, and cone clutch, energy dissipated, torque capacity of clutch, design of Clutch Components.

DESIGN OF VALVES AND VALVE TRAIN  
L: 9 Hrs

| Theory: 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
1 Engine Design – Giles J. G., Lliffe Book Ltd.1968
2 Engine Design – Crouse, Tata McGraw Publication, Delhi
4 Vehicular Engine Design – Hoag, Kevin, Springer
5 Internal Combustion Engine Design – John Manning, Ricardo UK Ltd
Course Objective:
Build knowledge on design of Automotive Chassis components.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Calculate loads, moments and stresses on frame members and suspensions.
CO2: Design front axle and examine the steering components
CO3: Explain the design concepts of final drive and rear axle
CO4: Determine parameters involved in gear box design.
CO5: Solve problems related to Automotive braking System
CO6: Improve the overall design of chassis.

Pre-requisite:
1. U17AUI3201 - Automotive Chassis and Transmission
2. U17AUI3202 - Strength of Materials

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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VEHICLE FRAME AND SUSPENSION  
L: 9 Hrs
Design of Leaf Springs-Coil Springs and Torsion Bar Springs.

FRONT AXLE AND STEERING SYSTEMS  
L: 9 Hrs

DRIVE LINE AND REAR AXLE  
L: 9 Hrs
Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings and design aspects of final drive.
GEAR BOX
Gear train calculations, layout of gearboxes. Design of gearboxes.

BRAKING SYSTEM
Function, stopping time and distance, weight transfer during braking, brake actuating mechanisms – mechanical, hydraulic and pneumatic, disc and drum brakes - design of brake shoes and friction pads.

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References:
Course Objective:
Impart knowledge on various CFD Techniques to solve simple fluid flow and heat transfer problems.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Introduce Governing Equations of viscous fluid flows
CO2: Discretize the governing equations by Finite Difference Method and Finite volume Method.
CO3: Solve basic convection and diffusion equations and understand its role in fluid flow and heat transfer problems..
CO4: Apply the solution algorithms to determine the flow field variables.
CO5: Understand turbulence equations in mathematical form and various types of grids used to solve the flow problem.
CO6: Create confidence to solve flow and heat transfer problems by using commercial software packages.

Pre-requisite:
1 U17AU14202- Fluid Mechanics and Machinery

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GOVERNING EQUATIONS AND BOUNDARY CONDITIONS  L:  8 Hrs

FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION  L:  9 Hrs
Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three –dimensional diffusion

**FINITE VOLUME METHOD FOR CONVECTION DIFFUSION**  
L: 10 Hrs  
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

**FLOW FIELD ANALYSIS**  
L: 9 Hrs  

**TURBULENCE MODELS AND MESH GENERATION**  
L: 6 Hrs  
Turbulence models, mixing length model, Two equation (k-ε) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh.

**PRACTICAL ASPECT OF CFD**  
L: 3 Hrs  
Grid generation – Structured and unstructured mesh, Case study using commercial CFD software

| Theory : 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
7. https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules
Course Objective:
To Impart Knowledge In Simulating IC Engine Processes.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Understand the significance of various processes in I.C Engines.
CO2: Learn the simulation of engine combustion based on first and second law of thermodynamics.
CO3: Calculate minimum air required for combustion of I.C Engines.
CO4: Write combustion equation for hydrocarbon fuels.
CO5: Apply the simulation techniques for modification of combustion chamber
CO6: Apply the simulation techniques to develop new engine concept

Pre-requisite:
1 U17AUI4201 - Automotive Engines and Systems

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INTRODUCTION

COMBUSTION AND STOICHIOMETERY
Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air required for combustion, excess air supplied and stoichiometric air required for complete combustion. Conversion of volumetric analysis to mass analysis.

ADIABATIC FLAME TEMPERATURE
Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state. SI Engine simulation with air as working medium, deviation between actual and ideal cycle.
SIMULATION OF IC ENGINES L: 9 Hrs
SI and CI engine simulation – Air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – Part throttle, full throttle and supercharged conditions

SIMULATION OF NEW ENGINE CONCEPT L: 9 Hrs
Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine and controlled auto ignition engine.

| Theory: 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
AUTOMOTIVE MANUFACTURING
Course Objective:
Impart knowledge on various processes involved in the manufacturing of automotive components.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Distinguish the various Manufacturing Processes employed in manufacturing Engine components
CO2: Choose the right Manufacturing Process for manufacturing Transmission system components
CO3: Select the relevant Heat and surface treatment methods for Engine and Transmission Components
CO4: Outline the Automotive Body Components Manufacturing methods
CO5: Identify the surface Coating Processes used in Automotive Industry
CO6: Suggest the suitable machining process for Automotive components manufacturing

Pre requisite:
1 U17AUI3203-Manufacturing Technology

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**ENGINE COMPONENTS**
L: 10 Hrs
Casting of Engine block - conventional and expendable pattern, Casting of cylinder heads, Cylinder liners, Crankshaft, Connecting rod and Gudgeon pins forging and casting, machining and heat treatment.
Casting of Piston - gravity casting, squeeze casting, machining and finishing and piston ring manufacturing.
Upset forging of valves - heat treatment and surface improvement.
Engine bearing manufacturing.

**TRANSMISSION COMPONENTS - I**
L: 10 Hrs
Manufacturing of friction plates using conventional blanking and fine blanking. Manufacture of composite friction lining, composite moulding of phenol formaldehyde lining.
Casting of gear box casing,
Precision forging of gears, gear hobbing, shaping, powder metallurgy, orbital forming of spur, helical, and bevel gears, hypoid gears, heat treatment and finishing.

**TRANSMISSION COMPONENTS-II**

L: 10 Hrs

Propeller shaft – Continuous Casting, extrusion, heat treatment and surface hardening, Composite propeller shaft manufacturing.
Forging of rear axles, casting of rear axle casing.
Manufacturing of wheels and brake drums.

**BODY COMPONENTS**

L: 10 Hrs

Injection moulding – Introduction, instrument panel, bumpers, Reinforced Reaction injection moulding.
Manufacture of metal and polymer panels.
Adhesives and sealants
Manufacturing of Springs , Wrap forming of coil springs, leaf springs, Composite leaf springs

**SURFACE COATINGS**

L: 5 Hrs

Chemical Vapour deposition, Physical Vapour deposition, sol-gel processing
Spraying, Plating, Painting in paint booth.

| Theory: 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

**References:**

Course Objective:
To learn the design process /aspects and its effect on different manufacturing processes and to acquire knowledge for providing tolerance specification and representation used in assembly.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the design aspects for selection of Materials, Manufacturing processes for economical production.
CO2: Identification of design processes for various machining and metal joining processes.
CO3: Apply a systematic understanding of design knowledge in the areas of metal casting and forging.
CO4: Familiarise the knowledge of Geometric Dimensioning and Tolerances.
CO5: Identify the details required for mechanical documentation.
CO6: Integrate the knowledge of compliance analysis and interference analysis for assembly.

Pre-requisite:
1 U17AUI3203 - Manufacturing Technology

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DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY
L: 9 Hrs
DFM approach, DFM guidelines, standardization, group technology, value engineering, comparison of materials on Cost basis.

GEOMETRIC DIMENSIONING & TOLERANCE INTRODUCTION
L: 9 Hrs
Process capability, process capability metrics, Cp, Cpk, Cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law, 6σ concept.

Signature of BOS chairman, Auto
TOLERANCE CHARTING TECHNIQUE
L: 9 Hrs
Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

DESIGN FOR MANUFACTURE
L: 9 Hrs
Design features to facilitate machining, datum features - Functional and manufacturing, component design-machining considerations, redesign for manufacture, examples Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols – Case studies.

SELECTIVE ASSEMBLY
L: 9 Hrs
Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples

| Theory : 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
Course Objective:
Provide knowledge on properties, micromechanics, macro mechanics and also the manufacturing of Composite materials.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the types, advantages and properties of Composite Materials
CO2: Apply the knowledge of micro mechanics to calculate the properties of a Lamina
CO3: Calculate the properties of a Laminate
CO4: Analyze the material properties and failure criteria of Composites
CO5: Explain the basic design concepts and materials used for sandwich construction
CO6: Summarize the methods used for fabrication of fiber

Pre-requisite:
1 Nil

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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STRESS STRAIN RELATION

METHODS OF ANALYSIS

LAMINATED PLATES
Governing differential equation for a general laminate, angle ply and cross ply laminates. Failure criteria for composites.
SANDWICH CONSTRUCTIONS  L:  8 Hrs
Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels.

FABRICATION PROCESS  L:  7 Hrs

| Theory: 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
5 https://nptel.ac.in/courses/101104010/
Course Objective:
Expose the students with fundamental and advanced knowledge in the field of Additive manufacturing technology and its industrial applications.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Classify the concepts and terminologies of additive manufacturing
CO2: Apply the reverse engineering concepts for design development
CO3: Identify the variety of additive manufacturing techniques based on end product applications
CO4: Design and develop newer tooling models
CO5: Familiarise with cutting edge technologies in rapid tooling and manufacturing
CO6: Analyse the cases relevant to Additive manufacturing

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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INTRODUCTION
L: 9 Hrs

REVERSE ENGINEERING & CAD MODELING
L: 9 Hrs
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping; CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.
ADDITIVE MANUFACTURING SYSTEMS 
L:  9 Hrs

SINTERING BASED ADDITIVE MANUFACTURING SYSTEMS 
L:  9 Hrs

TOOLING 
L:  9 Hrs
Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications Case studies automotive, aerospace and electronics industries

| Theory : 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
AUTOMOTIVE ELECTRICAL AND ELECTRONICS
U17AUE0009 AUTOMOTIVE CONTROL SYSTEM

Course Objective:
To impart knowledge in the Model based system design. By the end of the course, it should enable the student
- To obtain the mathematical model of any system/sub system of a vehicle.
- To model and simulate automotive systems with the help of modern simulation tools
To design a suitable controller for any given application.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Identify the level of the system that is more suitable for model based system design
CO2: Select appropriate modelling technique according to the available inputs for automobiles.
CO3: Understand and apply the fundamental laws of physics and mathematics to obtain the mathematical model of any system / sub system of a vehicle.
CO4: Create a simulation model of a simple automotive system
CO5: Implement a suitable controller applicable for any automotive system.
CO6: Analyse the performance of the sub-system / system using software tools based on the test inputs given to the system.

Pre-requisite:
1 U17AUI6201- Automotive Embedded Systems

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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MODEL BASED SYSTEM DESIGN  L:  6 Hrs
Introduction to model based design, Model based system design in Functional level, Architectural level, Implementation level, limitations on model based design, Process Design- requirements, mathematical modeling, validation and verification, In-loop testing - SIL, HIL

MODELING TECHNIQUES  L:  6 Hrs
Introduction to Modeling - Graphical modeling, Signal flow modeling, State machines modeling, Transfer function modeling, State space modeling, Event based modeling, Statistical modeling for system identification
MATHEMATICAL MODELING OF ELEMENTARY SYSTEMS  
System, Control system, Modeling – Lumped system dynamic behavior represented by ordinary differential equations – Modeling Translational and rotational mechanical Systems, Electrical systems, Electrical Analogous for Mechanical Systems, hydraulic systems and thermal systems

INTRODUCTION TO TIME AND FREQUENCY RESPONSE ANALYSIS  
Time response, test signals, obtaining dynamic response of first order and second order linear systems for different inputs through simulation – Transient response specifications – Delay time, rise time, peak overshoot, undamped natural frequency, damping factor, settling time 
Introduction to Frequency response, frequency domain specifications, Excitation and response signals of systems

REALTIME SIMULATION OF AUTOMOTIVE SYSTEMS  
Introduction to controllers, different types of controllers, tuning of PID controller, Plant and Controller stand alone simulation, Plant and controller implementation on single target, RT simulation by Separating the plant from the controller, Controller and plant on real time target

Practical  
P: 30 Hrs

List of Exercises:  
(Note: The Simulation tutorial given in the syllabus is not for the End semester Exam)  
1 Mathematical modelling of elementary systems using simulink  
2 Modelling of suspension system using simulink and simscape  
3 Determination of time response parameters for an automotive system using simulink.  
4 Multibody dynamic simulation of a simple system using Matlab  
5 Implementation of controller to a simple automotive system  
6 Tuning of PID controller  
7 Simulation of a cruise control system using dSPACE

Theory : 30 Hrs  
Tutorial: 30 Hrs  
Total Hours: 60

References:  
1 Peter Wilson and H.AlanMantooth “Model based Engineering for complex Electronics system” 2013,Newness  
2 AgamKumarTyagi “Matlab and simulink for Engineers” Oxford Higher education,2012  
5 Web course by Zachariah chambers and Marc Herniter –Rose Hulman institute of technology on “Introduction to model based design and Advanced model based design.”  

Signature of BOS chairman, Auto
Course Objective:
To familiarize the students with the fundamentals of modern auxiliary vehicle systems which includes the construction and operational details of ECUs, engine auxiliaries, safety, security, comfort and driver assistance systems.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Apply the concept of embedded systems for automotive applications.
CO2: Outline the importance of stability and safety systems in automobiles.
CO3: Interface automotive sensors and actuators with microcontrollers.
CO4: Obtain an overview of vehicle comfort systems.
CO5: Review the telematics systems in modern vehicles.
CO6: Recognize the various automotive security systems.

Pre-requisite:
1 NIL

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**DIGITAL VEHICLE CONTROL SYSTEMS**
L: 9 Hrs
Modern Automotive Systems, need for electronics in automobiles, applications, Microcontroller and Microprocessors in automobiles, Input devices – oxygen sensors, fuel metering, vehicle speed sensors, detonation sensor, flow sensor, throttle position sensors, Output devices – displays, solenoids, stepper motors, and relays, Engine Control Unit.

**ENGINE SYSTEMS**
L: 9 Hrs
Gasoline injection systems - throttle body injection, advanced GDI and multi point fuel injection system, Electronic ignition systems – distributor less ignition system, solid-state ignition system, electronic spark timing control, Open loop and Close loop control system, engine cooling and warm up control, detonation and idle speed control, exhaust emission control, on-board diagnostics.
SAFETY SYSTEMS  
L: 9 Hrs
Active Safety - vehicle motion control, collision avoidance control, vehicle stabilization system, antilock-braking system, traction control system, anti-slip regulation, electronic stability program, dual circuit brakes, safety glass, bad weather equipment – wiper-washer systems.
Passive Safety - air bags, seat belt pretensioner systems, occupant and passenger safety, driver monitoring systems, pedestrian protection, collapsible steering, rollover bars, head restraints, anti-burst door locks.

COMFORT SYSTEMS  
L: 9 Hrs
Power Steering, ePAS, Cruise control, Adaptive cruise control, Transmission - fundamentals, control, types MT, AT, CVT and DCT, hill assist, HVAC – Climate Control, Tyre pressure monitoring systems, Seats, Mirrors, Sun-Roofs, Park assist, Infotainment – Car Stereo and Radio.

DRIVER ASSISTANCE SYSTEMS  
L: 9 Hrs
Telematics, global positioning systems, geographical information systems, navigation systems, voice command systems, automotive vision system, lane departure warning system, Security Systems – central lock, vehicle immobilizers, keyless entry, anti-theft technology, smart card system, number plate coding.

| Theory | 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
Course Objective:
- To create an awareness on the recent developments in Fuel cell technology
- Develop a single cell of PEM fuel cell / Microbial fuel cell

Course Outcomes:
After successful completion of this course, the students should be able to:
- CO1: Identify the different components and materials used in a fuel cell
- CO2: Familiarize with the safety aspects and the recent advancements in field of fuel cells
- CO3: Apply the knowledge of thermodynamics and material science to understand the thermodynamic equations and electrochemical kinetics of the fuel cell
- CO4: Compare the different types of fuel cells and choose an appropriate fuel cell suitable for specific application
- CO5: Develop a single cell of PEM fuel cell / Microbial fuel cell on their own
- CO6: Estimate the performance of the fuel cell

Pre-requisite:
- NIL

CO-PO/PSO Mapping
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INTRODUCTION TO FUEL CELLS  
L: 9 Hrs
Introduction – working and types of fuel cell – low, medium and high temperature fuel cells - Proton Exchange Membrane fuel cell, Solid Oxide fuel cell, Alkaline fuel cells, Molten carbonate fuel cell, Phosphoric acid fuel cell, liquid and methanol type fuel cells, Microbial fuel cell

FUEL CELLS COMPONENTS FOR AUTOMOTIVE APPLICATIONS  
L: 9 Hrs
Fuel cells for automotive applications, components of fuel cell - Membrane Electrode Assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates, materials for fuel cell- carbon fibre, Fuel cell based vehicle, technological advancements in fuel cell vehicle systems
FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE  L:  9 Hrs
Thermodynamics and electrochemical kinetics of fuel cells, Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, ohmic resistance, kinetic performance, mass transfer effects on membrane electrode assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates

FUELING - PRODUCTION AND STORAGE OF HYDROGEN  L:  9 Hrs

FUEL CYCLE ANALYSIS  L:  9 Hrs
Introduction to fuel cycle analysis – application to fuel cell and other competing technologies like battery powered vehicles, SI engine fuelled by natural gas and hydrogen and hybrid electric vehicle, road map of fuel cells to market- concern and challenges

List of Exercises : Assignment (Project)
Build a Proton Exchange Membrane fuel cell
Performance Analysis of a single cell using manual fuel cell test station

| Theory : 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
Course Objective:
Provide knowledge in concepts of acquiring ECU data, storage and exchange of data for ECU Communication in vehicle network systems.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the concepts of Communication Protocols
CO2: Compare the different communication protocols
CO3: Select suitable communication protocols for Automotive Application
CO4: Develop and understand Embedded C code for CAN Protocol
CO5: Understand the in-vehicle networking protocols in automobile
CO6: Apply the knowledge to In vehicle network diagnostics

Pre-requisite:
1 NIL

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EMBEDDED NETWORKING
L: 9 Hrs

CONTROLLER AREA NETWORK (CAN) PROTOCOL
L: 9 Hrs
History and foundation of CAN, CAN Applications, Main characteristics of CAN, CAN in OSI Reference Model, CAN Data Link Layer, Principles of data exchange in CAN, Arbitration, Data Frame, Remote Frame, Error detection and management in CAN, CAN physical Layer, Bit encoding, Bit timing and synchronization, Relationship between data rate and bus length, Single wire and twin wire media.
CAN repeaters, Medium-to-medium gateway, Protocol handlers, Micro-controllers and line drivers, Time-Triggered CAN (TTCAN), CANoe based applications development.

**LOCAL INTERCONNECT NETWORK (LIN) PROTOCOL**

**L:** 9 Hrs
Introduction to LIN, LIN consortium, LIN specification, LIN features, Technical overview, Work flow concept, LIN operation, LIN frame format, Scheduling table, Network management of LIN cluster, LIN Transport Layer, LIN node configuration and identification, LIN diagnostics, LIN physical layer.

**FLEXRAY PROTOCOL**

**L:** 9 Hrs
Future on board systems, Need for FlexRay, Origin of FlexRay, FlexRay consortium, FlexRay Objectives, FlexRay Features, Application requirements, Working of FlexRay, Network topologies, ECU architecture, Segment Configuration, Communication Cycles, FlexRay frame format, Timing of configuration protocol, Error control, and FlexRay core mechanisms, Coding and Decoding, Medium Access Control, Frame and Symbol Processing, Clock Synchronization, FlexRay Components.

**IN VEHICLE NETWORK DIAGNOSTICS**

**L:** 9 Hrs

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**References:**

1. Multiplexed Networks for Embedded Systems - by Dominique Paret
   Publisher: John Wiley & Sons
   Release Date: July 2007.
3. Embedded Networking with CAN and CANopen Paperback – June 28, 2016 by Olaf Pfeiffer (Author), Andrew Ayre (Author), Christian Keydel (Author) - Embedded Systems Academy Inc.; 1 edition (June 28, 2016)
Course Objective:
This course is to impart knowledge on autonomous vehicle and driver assistant systems and also the architectural overview of IoT

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Gain knowledge on different driver assistant system of autonomous vehicle and their applications
CO2: Understand the Radio communication technologies for Intelligent Vehicle
CO3: Identify different control techniques
CO4: Select the appropriate architectures for motion autonomy
CO5: Understand the model of autonomous vehicles needed in road applications
CO6: Apply IoT configurations for Intelligent Vehicle

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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AN INTRODUCTION TO AUTONOMOUS DRIVING TECHNOLOGIES
L: 9 Hrs

RADIO COMMUNICATION AND INTELLIGENT-TRANSPORTATION-SYSTEMS
L: 9 Hrs
Introduction – ITS communication systems, Multimedia communication in a car, Current ITS communication systems and services - Inter-vehicle communication system - Road-vehicle communication system - Device technologies.
INTELLIGENT VEHICLE DECISION AND CONTROL TECHNOLOGIES

DECISIONAL ARCHITECTURES FOR MOTION AUTONOMY
Introduction - Robot control architectures and motion autonomy - Sharp control and decisional architecture for autonomous vehicles - Motion planning for vehicles - Trajectory planning and state time space - Nonholonomic path planning.

IOT – INTERNENT OF THINGS
Introduction of IoT - IoT – architecture, Basic Components ,Network Protocol Stack - M2M and IoT Technology Fundamentals - Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management - Applications of IoT.

Theory : 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45

References:
AUTOMOTIVE TECHNOLOGY & MANAGEMENT
U17AUE0014 OFF ROAD VEHICLES

Course Objective:
Impart knowledge on different types of special purpose vehicles and their systems.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Categorise vehicles based on their specification.
CO2: Infer the different types of subsystem and its functioning used in the construction of special purpose vehicle
CO3: Classify and observe the application of special purpose vehicles in construction activities.
CO4: Explain various safety systems used in Utility and military vehicles.
CO5: Interpret kinematics used in the off-road vehicles to understand its operational stability.
CO6: Identify the design requirements of tracked vehicles.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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LAYOUT AND REQUIREMENTS
L:  9 Hrs
Requirements of Off Road vehicles- Classification of Off Road vehicles-Construction layout, drive, capacity based on ARAI, Frame, Engine Location, type of wheel, Transmission, Multi-axle vehicles and applications.

TRACTORS
L:  9 Hrs
Classification of tractors-lay out of wheeled tractor- power transmission system- steering system-accessories of wheeled tractors- hydraulic control system- power take off unit and special implements

EARTH MOVING MACHINES
L:  9 Hrs

Signature of BOS chairman, Auto
MILITARY AND SPECIAL UTILITY VEHICLES

L: 9 Hrs
Special features and constructional details of tankers, gun carriers and transport vehicles. Oil tankers-
Articulated vehicles, working -features of Ambulance, fire extinguishing vehicle. Mobile Cranes: Basic
characteristics of truck cranes, stability & design features, control systems & safety devices

VEHICLE SYSTEMS

L: 9 Hrs
Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational
hydraulics. Hydro-pneumatic suspension cylinders. Power steering system.
Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for
Dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler.

| Theory: 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
1 “Construction, planning, equipment and methods “, Robert L Peurifoy, Tata McGraw Hill
Publishing company Ltd.
2 “Farm machines and equipments”, Nakra C.P., Dhanparai Publishing company Pvt. Ltd
3 “Road making machinery”, Abrosimov.K. Bran berg.A and Katayer.K., MIR
Publishers, Moscow, 1971
4 “Construction planning and equipment”, Satyanarayana. B., standard publishers and
distributors, New Delhi.
Course Objective:
Provide the fundamental knowledge about the construction, performance and dynamic behaviour of automotive tyres.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the various methods of tyre manufacturing.
CO2: Identify the forces and moments acting on tyres.
CO3: Explain wear possibilities, their causes and measurements
CO4: Estimate the safety of tyres and its failure analysis
CO5: List the types of tyre testing methods
CO6: Summarize Tyre retreading and recycling.

Pre-requisite:
1  NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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INTRODUCTION TO BASICS OF TYRES
L: 10 Hrs

TYRE FORCES AND MOMENTS
L: 8 Hrs
RUBBER ABRASION AND TYRE WEAR  
L: 8 Hrs

TYRE RETREADING, TYRE DURABILITY AND FAILURE  
L: 10 Hrs
ANALYSIS
Defects of tyres – Tyre classification for defects – causes and discussions - Examination of: (i) Returned tyres (ii) Tyres for retreading - Norm of tyre adjustments for fast wear, poor retreading Bead/casing failures. Hot and cold process.

NON-DESTRUCTIVE TESTS AND INSPECTIONS,  
L: 9 Hrs
RECOVERY AND RE-USE

| Theory : 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
3  Bireswar Banerjee, “Tyre Retreading” Smithers Information Ltd., 2015
5  Tom French, Tyre technology, The University of Michigan, 1989.
Course Objective:
Familiarize the tests to be performed on the vehicle and its subsystems.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the basic measurement systems.
CO2: Examine the vehicle body strength using crash tests.
CO3: Explain the various engine performance testing methods.
CO4: Estimate the different vehicle test parameters and its influence on fuel economy.
CO5: Summarize the tests performed on steering, suspension and its impact on driving stability.
CO6: List the tests conducted to analyse the transmission, brakes and wheel performance.

Pre-requisite:
1  NIL

**CO-PO/PSO Mapping**
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INTRODUCTION TO MEASUREMENT SYSTEMS  L:  3 Hrs
Introduction - static and dynamic measurement - closed and open loop system - Requirements and characteristics

VIBRATION MEASUREMENT AND VEHICLE BODY STRENGTH ANALYSIS  L:  9 Hrs
Instrument – Accelerometer and signal conditioning, Graphical presentation. Dynamic simulation sled testing, methodology, Vehicle acceleration measurement and Documentation.
Dolly roll over test, dolly role over fixture, photographic / video coverage, instrumentation. Vehicle roof strength test – test procedure and test measurements. Door system crush test - procedure and measurements.
ENGINE TESTING & FUEL ECONOMY  
L:  8 Hrs
I.S Code for Engine testing – Laboratory testing: Basic engine parameters, Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers.
Field Testing: Type I & II, test route selection, vehicle test speeds, cargo weights, driver selection, test data form, calculations. Test on rough terrain, pot holes with laden and unladen conditions.

VEHICLE STEERING, SUSPENSION AND STABILITY TEST  
L:  14 Hrs
Analysis of constant radius test, constant steer angle test, constant speed variable radius test, constant speed variable steer angle test, response gain test.
Measurement of dimensional and geometric characteristics, measurement of centre of gravity position, measurement of moments and products of inertia, measurement of suspension kinematic characteristics, measurement of suspension elastic and coulomb friction characteristics, measurement of shock absorber characteristics.

WHEELS AND TRANSMISSION AND BRAKE PERFORMANCE TEST  
L:  11 Hrs
Friction Clutches - Diagnosing of Slippage, Drag, Binding and Vibration - Performance of Automatic Transmission Systems

| Theory : 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
10  Giles J. G, “Vehicle Operation & Performance”.
Course Objective:
Provide knowledge on Entrepreneurship to be become responsible Entrepreneurs.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: List the merits and demerits of entrepreneurial culture
CO2: Develop the entrepreneurial characteristics to understand strength and weakness
CO3: Utilize the opportunity
CO4: Formulate a business plan to solve problems
CO5: Choose the processes involved in setting up a business
CO6: Compare the role of government and banks in promoting entrepreneurship.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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ENTREPRENEURSHIP
Entrepreneur - Types of Entrepreneurs, Intrapreneur, Multiprener, Entrepreneurship in Economic Growth of a country, Factors Affecting Entrepreneurial Growth

ACHIEVEMENT MOTIVATION TRAINING
Factors influencing a person to become on his own. Need to achieve. Training through Activities. Goal setting. Role Play. Awareness programs.

MARKET RESEARCH & MARKETING
BUSINESS PLAN

SUPPORT TO ENTREPRENEURS

Theory : 45 Hrs          Tutorial: 0 Hrs          Total Hours: 45

References:
Course Objective:
Provides knowledge on fleet management methods and Motor vehicle act.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Collect concept of personal Management objectives and functions.
CO2: Explain the Passenger transport operation.
CO3: Explain the Good Transport management Systems.
CO4: Describe the Motor Vehicle Act.
CO5: Outline the process of traffic engineering and its management.
CO6: Extend knowledge of fleet management.

Pre-requisite:
NIL

CO-PO/PSO Mapping
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INTRODUCTION
L: 9 Hrs
Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

PASSENGER TRANSPORT OPERATION
L: 9 Hrs
Structure of passenger transport organizations- Typical depot layouts- Requirements and Problems on fleet management- Fleet maintenance- Planning -Scheduling operation & control- Personal & training-training for drivers & conductors- Public relations, Propaganda, publicity and passenger amenities- Parcel traffic - Theory of fares-Basic principles of fare charging- Differential rates for different types of services- Depreciation & debt charges- Operation Cost and Revenues- Economics & records
GOODS TRANSPORT OPERATION
L: 9 Hrs

MOTOR VEHICLE ACT
L: 9 Hrs
Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

TRAFFIC ENGINEERING & MANAGEMENT
L: 9 Hrs
Road user characteristics, human and vehicle characteristics, speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation, relation between speeds, flow, density, fundamental diagrams; Traffic volume Measurement, equipment for flow measurement, Density measurement, Travel time measurement, Automotive traffic measurement devices, Traffic signal design, Parking study, accident study, congestion study, toll operation, pedestrian study.

| Theory: 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 |

References:
Course Objective:
Provides knowledge on the application of hydraulic and pneumatic systems.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Identify the graphical representation of all the hydraulic and pneumatic components
CO2: Describe the concept used to design the systems
CO3: Illustrate the working of hydraulic components
CO4: Summarize the working of pneumatic components
CO5: Design and implement simple fluid power systems common in industrial applications using commercial components
CO6: Familiarize the actual fluid power circuits used in Automotive and Industrial Applications

Pre-requisite:
1 U17AUI4202 - Fluid Mechanics and Machinery

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INTRODUCTION TO FLUID POWER & PRINCIPLE
Introduction to fluid power control - Hydraulic and Pneumatics - Selection criteria, application of fluid power, Application of Pascal’s law, Equation, Transmission and Multiplication of force pressure losses - fluids, selection and properties - ISO symbols

FLUID POWER DRIVES
Fluid power drives – Pumps - working principle and construction details of gear, vane and piston pumps, hydraulic motor, Hydrostatic transmission drives and characteristics - Hydraulic supply components - Pneumatic power supply - Compressor, air distribution, air motors.
FLUID POWER ELEMENTS

L: 9 Hrs
Control valves - pressure, flow direction - working principles and construction - Special type valves - proportional and servo - Selection and actuation methods.

Actuators - Selection and specification, cylinders - mounting, cushioning - Fluid conditioning elements - Accumulators.

HYDRAULICS AND PNEUMATICS CIRCUITS DESIGN

L: 9 Hrs
Design of Hydraulic and Pneumatic circuits for automation, Selection and specification of circuit components, sequencing circuits, cascade and Karnaugh - Veitch map method - Regenerative, speed control, Synchronizing circuits

ELECTRO-PNEUMATICS

L: 9 Hrs
Use of electrical timers, switches, solenoid, relay, proximity sensors - Electro pneumatic sequencing Ladder diagram.

PLC: – elements, function and selection - PLC programming - Ladder and different programming methods - Sequencing circuits.

Theory : 45 Hrs  Tutorial: 0 Hrs  Total Hours: 45

References:
Course Objective:
Provides knowledge on basic principles of aerodynamics for the design of vehicle body.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Understand the fluid flow concepts for aerodynamic studies in vehicle.
CO2: Understand the importance of aerodynamics for automobiles.
CO3: Explain the aerodynamic drag concepts and aerodynamic development strategies for car.
CO4: Analyze various aerodynamic shapes of cars and commercial vehicles.
CO5: Explain the vehicle lateral stability due to side wind, wind noise and occurrence of dirt accumulation on vehicle.
CO6: Apply the concept of wind tunnel and numerical methods for aerodynamic design of automobiles.

Pre-requisite:
1 U17AUI4202 - Fluid Mechanics and Machinery

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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INTRODUCTION
L: 9 Hrs
Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

AERODYNAMIC DRAG OF CARS
L: 9 Hrs
Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.
SHAPE OPTIMIZATION OF CARS
L: 9 Hrs
Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners.

VEHICLE HANDLING
L: 9 Hrs
Design of Hydraulic and Pneumatic circuits for automation, Selection and specification of circuit components, sequencing circuits, cascade and Karnaugh - Veitch map method - Regenerative, speed control, Synchronizing circuits

WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS
L: 9 Hrs
Introduction, principle of wind tunnel technology, limitation of simulation, Tests with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

Theory: 45 Hrs  Tutorial: 0 Hrs  Total Hours: 45

References:
3 Automotive Aerodynamic: Update SP-706 - SAE – 1987
ONE CREDIT COURSES
Course Outcomes
On successful completion of the course the learner would be able to:

CO1: Classify various motorsport events across the globe
CO2: Identify the rules and regulation for the different motor sport events
CO3: Recognize the career opportunities in motorsport engineering

Pre-requisite:
1. Nil

**CO-PO/PSO Mapping**
(S/M/W indicates strength of correlation)     S-Strong, M-Medium, W-Weak

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INTRODUCTION TO MOTORSPORT ENGINEERING     2 Hours
The history of motorsport engineering - Review of motorsport engineering - Pioneers of Motorsport engineering - Motorsport technology evolution review.

LIST OF MOTORSPORT COMPETITIONS FOR STUDENTS     3 Hours
A brief look at all the events students can take part to develop their skills - Formula SAE - Baja SAE - SAE Super mileage.

PROFESSIONAL MOTORSPORT EVENTS     4 Hours
The various types of professional motorsport events that take place around the world - Cars – Formula One, World rally championship, Touring car championship, GP2, GP3, World Endurance Racing Championship, dirt track racing, NASCAR, Indy Car, Cross Country rallies, drag racing - Motorcycles – MotoGP, Superbike, Endurance, Motocross, Supermoto, Freestyle, Trials, Cross-country rallies, Speedway, Board track, drag racing

RULES AND REGULATIONS OF MOTORSPORTS     3 Hours
Introduction about the rule book - About - the world governing bodies of the sport - Why the rule book keeps changing - How to interpret the rule book - Rules for car races - Rules for bikes races

CAREER IN MOTORSPORTS ENGINEERING     3 Hours
Motorsport Engineer Race Driver / Rider - Test Driver / Rider - Design engineer - Race technician - Aerodynamics Engineer - Race official / steward

Total Hours: 15
Course Outcomes
On successful completion of the course the learner would be able to:

CO1: Understand the design trends of concept cars
CO2: Apply the concept of ergonomics in designing concept cars

Pre-requisite:
1. Nil

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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DESIGN EXPRESSIONS
4 Hours
Design methodology, Lifestyle board, Mood board, Theme board, Design trends, Design movements, Application of design principles and product aesthetics

INTRODUCTION TO CONCEPT CARS
4 Hours
Importance of concept cars, Blending technology, Form in concept cars

CAR DESIGN
4 Hours
Art and colour, Product styling, Introduction to human factors engineering, Digital design, Concept to reality, Auto show vehicles

VISUAL FACTORS IN DESIGN
3 Hours
Colour harmony, Colour in design, Artist’s spectrum, Basic color schemes

Total Hours: 15
U17AUC0003  ELECTRONIC ENGINE MANAGEMENT SYSTEMS

Course Outcomes
On successful completion of the course the learner would be able to:

CO1: Familiarize the importance of ECU for better performance of engines.

Pre-requisite:
1. Nil

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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Topics covered
- An overview of Engine Management System
- Current trends in automotive electronic engine management system
- Control of SI & CI engines for better performance and low emissions
- Closed loop control of engine parameters of fuel injection and ignition.
- Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation.
- Electronics emission control techniques

Total Hours 15
U17AUC0004 INTELLECTUAL PROPERTY RIGHTS

Course Outcomes
On successful completion of the course the learner would be able to:

CO1: Understand the IPR and its classification
CO2: Understand the Patents for Inventions

Pre-requisite:
1. Nil

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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Module:
1. Overview on IPR and its classification  3 Hours
2. Patents  4 Hours
3. International Conventions related to IPR  4 Hours
4. Patents for Inventions in Automotive Engineering - Case Studies  4 Hours

Total Hours: 15

References:
2. Ajit Parulekar and Sarita D’ Souza, Indian Patents Law – Legal & Business Implications; Macmillan India Ltd, 2006
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010
VEHICLE MAINTENANCE

Course Outcomes
On successful completion of the course the learner would be able to:

CO1: Understand the Basics of maintenance & workshop statements preparation

CO2: Understand the Engine, Chassis, Electrical Maintenance systems

Pre-requisite:
2. Nil

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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MAINTENANCE OF RECORDS AND SCHEDULES
2 Hours
Preventive (scheduled) and breakdown (Unscheduled) maintenance, requirements of maintenance, preparation of check Lists, Inspection schedule, maintenance of records, log sheets.

ENGINE MAINTENANCE
4 Hours
List of Engine components and cleaning methods, visual and Inspections, minor reconditioning of various components, Reconditioning methods, special tools used for maintenance.

CHASSIS MAINTENANCE
6 Hours
Maintenance of Automobile clutch, gear box, drive, suspension, Brake and Steering systems.

ELECTRICAL SYSTEM MAINTENANCE
3 Hours

Total Hours: 15

References:
Course Outcomes
On successful completion of the course the learner would be able to:

CO1: Understand the Concept of Six Sigma and Value Engineering
CO2: Understand the Concept of Reliability Engineering and Learn Manufacturing

Pre-requisite:
1. Nil

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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Course Description
Lean Manufacturing is about creating value. The Lean process starts with creating value for the ultimate customer, which requires providing the right product at the right time for the specified price. While all manufacturing attempts to do this, what makes Lean Manufacturing distinct is the relentless pursuit and elimination of waste. Students will learn the concepts and tools of Lean, which include types of waste, visual management, 5S, value stream mapping, A3, & flow.

Module:
1. Definition of Lean
2. Importance of Lean
3. Application of Lean Tools
4. Difference between Value-Added and Non-Value-Added
5. Preparing to Work in a Lean Environment
6. Dos and Don’ts for Lean Terms
7. Traditional Manufacturing
8. Introduction to New Advanced Lean Tools
9. Eight Wastes
10. Introduction to Key Terms
11. Visual Controls
12. 5S and Standardized Work

Total Hours: 15

Reference