1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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<tr>
<td>I.</td>
<td>Develop innovative automotive technologies to address specific needs of performance, comfort, safety and eco-friendliness.</td>
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<tr>
<td>II.</td>
<td>Apply computational tools for comprehensive understanding of the complex systems in automotive engineering.</td>
</tr>
<tr>
<td>III.</td>
<td>Update themselves to recent trends, technologies and industrial scenarios by pursuing lifelong learning.</td>
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2. PROGRAMME OUTCOMES (POs):

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<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
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<td>An ability to write and present a substantial technical report/document</td>
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<td>3</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
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<td>4</td>
<td>Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.</td>
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<tr>
<td>5</td>
<td>Become familiar with modern engineering tools and analyze the problems within the domains of Automobile Engineering as the members of multidisciplinary teams.</td>
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<td>6</td>
<td>Apply engineering knowledge, state-of-the-art tools and techniques to design and analyze automobile systems and sub-systems.</td>
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Note: Program may add up to three additional Pos.

4. PEO / PO Mapping:

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Every programme objectives must be mapped with 1,2,3,-, scale against the correlation PO’s
## MAPPING – PG- M.E. AUTOMOBILE ENGINEERING

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TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE - 74

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<td>AM4006</td>
<td>Design and Analysis of Experiments</td>
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## SEMESTER II, ELECTIVE – II

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<td>Two and Three Wheelers</td>
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<td>Engine Combustion Thermodynamics and Engine Heat Transfer</td>
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## SEMESTER III, ELECTIVE – III

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<td>Vehicle Maintenance and Diagnostics</td>
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### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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MA4154 ADVANCED NUMERICAL METHODS

COURSE OBJECTIVES:
- To study various numerical techniques to solve linear and non-linear algebraic and transcendental equations.
- To compare ordinary differential equations by finite difference and collocation methods.
- To establish finite difference methods to solve Parabolic and hyperbolic equations.
- To establish finite difference method to solve elliptic partial differential equations.
- To provide basic knowledge in finite elements method in solving partial differential equations.

UNIT I ALGEBRAIC EQUATIONS 12

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12

UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS 12

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 12
Laplace and Poisson’s equations in a rectangular region: Five point finite difference schemes, Leibmann’s iterative methods, Dirichlet's and Neumann conditions – Laplace equation in polar coordinates: Finite difference schemes – Approximation of derivatives near a curved boundary while using a square mesh.

UNIT V FINITE ELEMENT METHOD 12

TOTAL: 60 PERIODS

COURSE OUTCOMES:
After completing this course, students should demonstrate competency in the following skills:
- Solve an algebraic or transcendental equation, linear system of equations and differential equations using an appropriate numerical method.
- Solving the initial boundary value problems and boundary value problems using finite difference and finite element methods.
- Solving parabolic and hyperbolic partial differential equations by finite difference methods.
- Compute solution of elliptic partial differential equations by finite difference methods.
- Selection of appropriate numerical methods to solve various types of problems in engineering and science in consideration with the minimum number of mathematical operations involved, accuracy requirements and available computational resources.
REFERENCES:

AM4101 AUTOMOTIVE CHASSIS AND DRIVE LINE SYSTEMS L T P C
3 1 0 4

COURSE OBJECTIVES:
- To understand the basic knowledge about various vehicle frames, front axles, steering systems and understand the conditions for true rolling motion of wheels during steering.
- To recognize the construction and working principle of drive line, final drive, differential and suspension systems
- To review the knowledge about the constructional feature of rear axle, wheels, tyres and braking systems.
- To impart knowledge on detailed concept, construction and principle of operation of various types of mechanical transmission components
- To design and select Hydrodynamic Transmission for various applications

UNIT I CLUTCH & GEAR BOX 12
Different types of clutches and requirement of transmission system – Principle, construction, torque capacity and design aspects of friction clutches – Objective of the gear box -Different types of gear boxes-Determination of gear box ratios & design of gear box for different vehicle applications – Typical problems.

UNIT II DRIVE-LINE STUDY, FRONT AXLE & REAR AXLE 12

UNIT III STEERING, SUSPENSION, WHEELS AND BRAKING SYSTEM 12
Construction of wheels and tyres – Braking torque developed by leading and trailing shoes – Disc brake theory – Factors affecting brake performance – Engine Exhaust Brake – Power brake- Regenerative braking – ABS.
UNIT IV HYDRO-DYNAMIC, HYDRO-STATIC & ELECTRIC DRIVES


UNIT V AUTOMATIC TRANSMISSION, OVERDRIVE, HYDRAULIC CONTROL SYSTEMS AND APPLICATIONS


TOTAL= 60 PERIODS

COURSE OUTCOMES:
At the end of this course the student will be able to
- Identify the different types of frame and chassis used in Automotive.
- Relate different types of drive lines, drives and braking systems used in Automotive.
- Acquire knowledge about different types of front axle, rear axles and suspension systems used in motor vehicles.
- Examine the usage of Hydrodynamic devices, hydrostatic devices, automatic transmission system
- Understand Electric drive used in road vehicles automatic transmission system.

REFERENCES
3. SAE Transactions 900550 & 930910
5. Birch, Automotive Braking Systems, Thomson Asia, 1999
7. Birch, Automotive Suspension and Steering Systems, Thomson Asia, 1999
10. John Peter Whitehead, Donald Bastow, Car Suspension and Handling, 4th Edition, Allied publishers limited, SAE Department, 2004
COURSE OBJECTIVES:

- To impart knowledge on engine operation and its constructional details
- Understand various subsystems involved in engine operation
- To impart knowledge to design and analyse engine operating parameters like air fuel ratio, injection parameters etc
- Understand the concept of combustion and its effects under various conditions
- To impart knowledge on recent developments on IC engines.

UNIT I ENGINE BASIC THEORY

Introduction - Engine types – Operating cycle - otto, diesel, dual operating cycles – Fuel air cycle and actual cycles — Two and four stroke engines - Engine design and operating parameters - Typical performance and pollution curves for automobile engines.

UNIT II FUEL SUPPLY AND IGNITION SYSTEMS

Objective and theory of carburetion - carburetors, Types, Additional system and modern devices of carburetor — Calculation of air fuel ratio of carburetor - Diesel fuel injection objective and types - pumps and injectors, Introduction to Petrol Injection system - conventional ignition systems, advance mechanisms.

UNIT III AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS


UNIT IV ENGINE COOLING, LUBRICATING SYSTEMS AND SUPERCHARGING, TURBOCHARGING


UNIT V NEW ENGINE TECHNOLOGY


COURSE OUTCOMES:

- Students will have the basic knowledge on Automotive Engines and its various sub systems along with its functions.
- Student can able to design and solve engine related problems
- Student will have command knowledge over recent development in the area of internal combustion engines.
- Student can apply their knowledge to analyse and correlate the data with recent requirements of automobile industry
- Student to can explore new alternate fuels or energy system to run the automobile

TOTAL : 45 PERIODS
REFERENCES:

AM4103 AUTOMOTIVE ELECTRICAL AND ELECTRONICS

L T P C
3 0 0 3

COURSE OBJECTIVES:
- To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems.
- To understand the need for starter batteries, starter motor and alternator in the vehicle.
- To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols.
- To list common types of sensor and actuators used in vehicles.
- To understand dash – Board Instruments, various sensors and networking in vehicles.

UNIT I BATTERY AND STARTING SYSTEMS

UNIT II CHARGING AND LIGHTING SYSTEMS

UNIT III ELECTRONIC IGNITION AND INJECTION SYSTEMS

UNIT IV ELECTRICAL SYSTEMS
Warning and alarm instruments : Brake actuation warning system, traficators, flash system, oil pressure warning system, engine over heat warning system, air pressure warning system, speed warning system, door lock indicators, neutral gear indicator, horn design, permanent magnet horn, air & music horns. Wind shield wiper, window washer, instrument wiring system and electromagnetic interference suppression, wiring circuits for instruments, electronic instruments, dash board illumination.
UNIT V  SENSORS, ACTUATORS AND MICROPROCESSOR IN AUTOMOBILES  9
TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of this course the student should be able to
• Define the glossary related to vehicle electrical and electronic system
• Understand the need for starter batteries, starter motor and alternator in the vehicle.
• Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
• List common types of sensor and actuators used in vehicles.
• Understand networking in vehicles.

REFERENCES:

RM4151  RESEARCH METHODOLOGY AND IPR  L T P C
2  0  0  2

UNIT I  RESEARCH DESIGN  6
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II  DATA COLLECTION AND SOURCES  6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods.
Data - Preparing, Exploring, examining and displaying.

UNIT III  DATA ANALYSIS AND REPORTING  6
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.
UNIT IV   INTELLECTUAL PROPERTY RIGHTS 6

UNIT V   PATENTS  6

TOTAL :30 PERIODS

REFERENCES

AM4111   ENGINE AND CHASSIS COMPONENTS LABORATORY  L T P C  0 0 4 2

COURSE OBJECTIVES:
• To assemble and disassemble the parts of an IC engine.
• To identify the various component of an IC engine.
• To identify the various components in transmission systems of an automobile.
• To assemble and disassemble the various components of transmission system.

LIST OF EXPERIMENTS
1. To assemble and disassemble 1000CC engine
2. To assemble and disassemble six cylinder engine
3. To assemble and disassemble V8 engine
4. To assemble and disassemble CRDI engine
5. To assemble and disassemble MPFI engine
6. To assemble and disassemble Single plate, Diaphragm Clutch.
7. To assemble and disassemble Constant mesh, Sliding mesh gear box
8. To assemble and disassemble Transfer case
9. To assemble and disassemble Differential, Rear axle
10. To assemble and disassemble Front axle.
11. To Study different chassis layouts
12. To Study braking system
13. To Study Steering system
14. To Study Suspension system

TOTAL: 60 PERIODS
COURSE OUTCOMES:
- Dismantle and Assemble the automobile chassis and Engine components
- Identify & differentiate components of SI & CI engines
- Understand working of braking, steering, clutch, transmission, Suspension systems.
- Differentiate various subsystems of two, three & Four wheeler vehicles
- Develop skills in Dismantling and assembling of chassis components.
- Correct minor repairs and trouble shoots the breakdowns.

AM4112  AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY  L  T  P  C  0 0 4 2

COURSE OBJECTIVE:
To import the knowledge in the area of automotive electrical system and electronic system associated in modern vehicles.

LIST OF EXPERIMENTS:
1. Testing of
   a. battery
   b. starting systems
   c. charging systems
   d. ignition systems
   e. body controller systems
2. Study of
   a. automotive lighting system and adjustment of head lights beam
   b. major electrical components used in modern vehicles
   c. diagnostic tool used in vehicle
3. Dismantling, testing and assembling of Starter system components
4. Dismantling, testing and assembling of charging system components
5. Basic Analog Experiments like
   a. Logic gates, Adders, Flip flops
   b. Amplifier, filter,
   c. Multiplexer and De-multiplexer
6. Interfacing seven segment displays
7. Microprocessor and microcontroller programming
   a. Arithmetic and Logic operation,
   b. Code conversion,
   c. Waveform generation,
   d. Look up table
8. Interfacing ADC and DAC for Data Acquisition and Control Application
9. Interfacing Sensors for Measurements of position, displacement, velocity, force, temperature, proximity/range

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to have the knowledge in
- Automotive electrical systems and electrical accessories
- Basic microprocessor / microcontroller programming
- Automotive sensor, transducer, actuator, virtual instrumentation, data acquisition
- Development of embedded systems for automobiles
OBJECTIVES:
- To discuss the harmful effects of major pollutants on living beings and the environment
- To analyse the formation of major pollutants like UBHC, CO, NOx, particulate matter and smoke.
- To design various control techniques to reduce pollutants in combustion
- To determine the various after treatment process to minimize emissions
- To demonstrate the various devices used to measure pollutants and discuss the Emission standards followed in various nations

UNIT I                EMISSIONS FROM AUTOMOBILES

UNIT II             EMISSIONS FROM SPARK IGNITION ENGINE AND ITS CONTROL
Emission formation in SI Engines- Carbon monoxide- Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants -Catalytic converters — Charcoal Canister — Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion.

UNIT III            EMISSIONS FROM COMPRESSION IGNITION ENGINE AND ITS
Formation of White, Blue, and Black Smokes, NOx, soot, Sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of Operating variables on Emission formation — Fumigation, EGR, HCCI, Particulate Traps, SCR — Cetane number Effect.

UNIT IV             NOISE POLLUTION FROM AUTOMOBILES

UNIT V             TEST PROCEDURES AND EMISSION MEASUREMENTS
Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dyno - Seven mode and thirteen mode cycles for Emission Sampling — Sampling problems — Emission analyzers —NDIR, FID, Chemiluminescent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

OUTCOMES:
By the end of this course, students will be able to
- Differentiate the various emissions formed in IC engines
- Analyze the effects of pollution on human health and environment
- Design the control techniques for minimizing emissions
- Categorize the emission norms
- Identify suitable methods to reduce the noise emissions.

REFERENCES

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**AM4202**  
**DYNAMICS OF ROAD VEHICLES**  
L T P C  
3 0 0 3

**OBJECTIVES:**
- To provide fundamental knowledge of the vibration,
- To impart knowledge on tyres
- To provide basic concepts on suspension design and function, ride modes
- To Evaluate the performance, longitudinal dynamics and control in an automobile
- To provide basic analysis on handling, cornering stability and control

**UNIT I  CONCEPT OF VIBRATION**  

**UNIT II  TYRES**  

**UNIT III  VERTICAL DYNAMICS**  

**UNIT IV  LONGITUDINAL DYNAMICS AND CONTROL**  
Aerodynamic forces and moments. Equation of motion. Load distribution for three-wheeler and four-wheeler. Calculation of maximum acceleration, tractive effort and reaction forces for

UNIT V  LATERAL DYNAMICS


OUTCOMES:
At the end of the courses, the students can able to
• Develop physical and mathematical models of a mechanical vibrating system
• Indicate the forces and moment acting on tyres
• Identify the suspension parameters that governs ride comfort
• Evaluate the vehicle performance in longitudinal direction
• Evaluate the lateral dynamics and control in an automobile

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OBJECTIVES:
- To acquire knowledge on Different aspects of car body,
- To acquire knowledge on bus body and commercial vehicle bodies.
- To acquire knowledge on Role of various aerodynamic forces and moments, measuring instruments in vehicle body design.
- To acquire knowledge on Material used in body building,
- To acquire knowledge on Tools used in body repairs and command over vehicle body engineering applications.

UNIT I CAR BODY DETAILS 10
Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car –
car body terminology - Visibility- regulations, driver’s visibility, improvement in visibility and
tests for visibility. Driver seat design -Car body construction-Various panels in car bodies.
Safety: Safety design, safety equipment for cars. AIS and SAE car body Regulations

UNIT II BUS BODY DETAILS 9
Types of bus body: based on capacity, distance travelled and based on construction.– Bus
body lay out, floor height, engine location, entrance and exit location. Types of metal
sections used –Constructional details: Conventional and integral. AIS and SAE bus body
Regulations

UNIT III COMMERCIAL VEHICLE DETAILS 8
Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of
Flat platform body, Tipper body and Tanker body – Dimensions of driver’s seat in relation to
controls – Drivers cab design.

UNIT IV VEHICLE AERODYNAMICS 9
Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces
and moments. Side wind effects on forces and moments. Various body optimization
techniques for minimum drag. Wind tunnels – Principle of operation, Types. Wind tunnel
testing such as: Flow visualization techniques, Airflow management test – measurement of
various forces and moments by using wind tunnel balance.

UNIT V BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR 9
Types and properties of materials used in body construction and insulation -Such as steel
sheet, timber, plastics and GRP, Insulation materials. Body trim items-body mechanisms.
Hand tools-power tools for body repair. Vehicle corrosion-Anticorrosion methods-Modern
painting process procedure.

TOTAL : 45 PERIODS

OUTCOMES:
The students will be able to
- Discuss the different aspects of car body and its safety features.
- Categorize the various bus body based on construction and correlate its safety features.
- Categorize the construction of commercial vehicle bodies.
- Calculate the various aerodynamic forces and moments, and relate the working of measuring instruments in calculating the aerodynamic forces.
- Demonstrate the tools used in body repairs and command over the usage of material in body building.
REFERENCES:

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AM4204 ELECTRIC AND HYBRID VEHICLES L T P C

OBJECTIVES:
The course should enable the students to:
1. General aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control.
2. Understand about vehicle dynamics,
3. Design the required energy storage devices,
4. Select the suitable electric propulsion systems and
5. Understand of hybrid electric vehicles.

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

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

UNIT III ENERGY SOURCES
UNIT IV        MOTORS AND CONTROLLERS
Types of Motors, Characteristic of DC motors, AC single phase and 3-phase motor, PM motors, Switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/DC converters.

UNIT V        SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES

TOTAL : 45 PERIODS

OUTCOMES:
The students will able to
• Understand working of different configurations of hybrid and electric vehicles
• Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
• Choose proper energy storage systems for vehicle applications
• Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
• Understand basic operation of power-split device in hybrid electric vehicle.

TEXT BOOKS:

REFERENCES:

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AM4211 ENGINE AND VEHICLE TESTING LABORATORY

OBJECTIVES:
- To impart knowledge in automotive Emission measurement and methods of testing engines.
- To categorize the different measuring techniques of pollutants like UBHC, CO, NOx, CO2 and smoke.
- To Investigate the performance and combustion parameters for different engine models
- To learn removal and fitting of automotive accessories
- To understand the adjustment of play in various automobile components.

LIST OF EXPERIMENTS ON ENGINE TESTING:
1. Performance test and study on SI engine.
2. Performance test and study on diesel engine.
3. Determine the Frictional power by motoring test on petrol engines.
4. Heat balance test on Diesel engine.
5. Determination of Volumetric efficiency on diesel Engine.
6. Retardation Test On 4-Stroke, Single Cylinder Diesel Engine Test Rig
7. Morse test to determine Indicated power for multi-cylinder SI Engine

LIST OF EXPERIMENTS ON VEHICLE TESTING:
1. Tightening and adjustment of wheel bearing.
2. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel orientation.
3. Wheel alignment in four wheelers.
4. Service of transmission, braking and suspension systems.
5. Fault diagnosis and service of Electrical system like battery, starting system, charging system, lighting system.
6. Work on body and paint shop.

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course the student will be able to
- Analysis of combustion parameters
- Differentiate the variation performance parameters of diesel engines
- Learn removal and fitting of automotive accessories
- Understand the adjustment of play in various automobile components.

AM4212 DESIGN AND MODELLING OF VEHICLE COMPONENTS LABORATORY

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

LIST OF ENGINE DESIGN EXPERIMENTS
1. Design and modelling of piston, piston pin and piston rings.
2. Design modelling of the connecting rod assembly.
3. Design of crankshaft, balancing weight calculations and modelling of the crankshaft assembly.
4. Design and modelling of flywheel
5. Design and modelling of the inlet and exhaust valves.
6. Design and modelling of cam and camshaft.
7. Design and modelling of combustion chamber.

LIST OF CHASSIS DESIGN EXPERIMENTS
8. Design and modelling of frame
10. Design and modelling of constant mesh gearbox
11. Design and modelling of sliding mesh gearbox
13. Design and modelling of rear axle

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to
• visualize the automotive components with the help of modelling software.
• make the modifications instantly if required at the initial stage itself
• synthesize, analyse and document the design of the various components

CO – PO Mapping

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AM4301 ENGINE MANAGEMENT SYSTEMS

OBJECTIVES:
• To impart knowledge on engine management systems viz fuel injection, ignition system.
• To understand various controlling system for emission control and engine operation
• To provide opportunities to discuss the fundamentals of engine control sensors and actuators.
• To identify and analyze electric and electronic related problems
• To distinguish various engine control algorithm used during engine operation.

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS
Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Switches, active resistors, Transistors, Current mirrors/amplifiers, Voltage and current references, Comparator, Multiplier. Amplifier, filters, A/D and D/A converters.
UNIT II  SENSORS AND ACTUATORS  9
Inductive, Hall Effect, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine speed sensor, exhaust oxygen level (two step, linear lambda and wideband), knock, manifold temperature and pressure sensors. Solenoid, relay (four and five pin), stepper motor

UNIT III  SI ENGINE MANAGEMENT  9
Layout and working of SI engine management systems. Group and sequential injection techniques. Advantages of electronic ignition systems. Types of solid-state ignition systems and their principle of operation, Contactless (BREAKERLESS) electronic ignition system, electronic spark timing control.

UNIT IV  CI ENGINE MANAGEMENT  9

UNIT V  DIGITAL ENGINE CONTROL SYSTEM  9
Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop and closed loop control – Integrated engine control system, Electromagnetic compatibility – EMI Suppression techniques – Electronic dash board instruments – Onboard diagnosis system.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should able to
• Explain the fundamentals, operation, function of various electronic components, control techniques in an engine management system.
• Explain the fundamentals, operation, function of various sensors and actuators in an engine management system.
• Explain the fundamentals, operation, function of various fuel injection system pertain to a SI Engine.
• Explain the fundamentals, operation, function of various fuel injection system pertain to a CI Engine.
• Explain the control algorithm during various engine operating conditions.

REFERENCES:
2. Tom Denton, Automobile Electrical and Electronic Systems, Taylor & Francis, 5th Edition, 2018
3. Automobile Electronics by Eric Chowanietz SAE

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COURSE OBJECTIVES:
- To understand the various steps involved in the design of automotive components
- To show their knowledge in designing engine components.
- To complete design exercise and arrive at important dimensions of chassis components.
- To learn the use of standard practices in design.
- To determine the dimensions of front and rear axles

UNIT I DESIGN OF CYLINDER, PISTON AND CONNECTING ROD
Choice of material for cylinder and piston, design of cylinder, design of piston, piston pin, piston rings and piston assembly. Material for connecting rod, design of connecting rod assembly. Case study on design of piston for passenger car.

UNIT II DESIGN OF CRANK SHAFT AND VALVES

UNIT III DESIGN OF CLUTCHES AND GEAR

UNIT IV DESIGN OF VEHICLE FRAME AND SUSPENSION
Study of loads-moments and stresses on frame members. Design of frame for passenger and commercial vehicle - Design of leaf Springs-Coil springs and torsion bar springs. Case study on development of frame for ATV.

UNIT V DESIGN OF FRONT AND REAR AXLE

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The students will be able to
- Analyse the stress and strain imparted on automotive components
- Compute the design and find the dimension of the vehicle components.
- Identify optimal design solutions to real-world problems in compliance with industry standards.
- Demonstrate the design skill by creating new design strategy with the application of the knowledge.
- Interpret the modern system in vehicle and would help in developing the system with less impact to the environment.

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AM4002 AUTOMOTIVE MATERIALS L T P C
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COURSE OBJECTIVES
The course should enable the students to:
- Select suitable materials for design
- Understand the concepts of heat treatment and surface modification techniques
- Gain knowledge on materials and their applications in automotive applications
- Analyze the properties of different materials used for automotive structures, engine and transmission systems.
- Gain knowledge on advanced metallic and non-metallic materials.

UNIT I INTRODUCTION
9
Elasticity-forms - Stress and strain relationship in engineering materials - Deformation mechanism - Strengthening material - Strain hardening, alloying, polyphase mixture, martensitic precipitation, dispersion, fiber and texture strengthening - iron carbon diagram.

UNIT II METALLIC MATERIALS
9
Cast irons - types, properties, structures, compositions and applications, plain carbon steels, low alloy steels and effects of alloying elements, high alloy steels, stainless steel types, castability, formability, machinability, hardenability and weldability of the material, high temperature steels and super alloys. Decorative and functional coating materials for automotive parts - Electro less Nickel, Hard Chrome, and, Zirconium Phosphate, Zinc flake, Metal oxides.

UNIT III COMPOSITES
9
UNIT IV  ELECTRICAL AND MAGNETIC MATERIALS  

UNIT V  RUBBER AND PLASTICS MATERIALS  

TOTAL: 45 PERIODS

COURSE OUTCOMES
The student will be able to:
- Understand failure mechanisms.
- Gain knowledge on different class of materials and their applications
- Understand the Selection criteria for various components and importance.
- Select proper material for Automobile applications
- Understand different materials used for sensors in a vehicle

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COURSE OBJECTIVES:

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

UNIT I  EARTH MOVING EQUIPMENTS  9
Construction layout, capacity, specification and applications of dumpers, articulated haulers, front-end loaders, backhoe loaders, bulldozers, scrapers, motor graders, skid steer loaders, excavator, hydraulic shovels, bucket conveyors, surface miners – highwall Miners. Selection criteria for prime mover.

UNIT II  CONSTRUCTIONAL EQUIPMENTS  10
Construction layout, capacity, specification and applications of cranes – types, Articulated Trucks, concrete ready mixer, trenchers, Asphalt Pavers, road reclaimers, General description, specification and functions of smooth wheeled rollers, pneumatic tired rollers, sheep’s foot rollers, vibrating compactors, draglines, drillers, borewell machine.

UNIT III  FARM EQUIPMENTMS  9
Classification of tractors – Main components of tractor. Working attachment of tractors – Auxiliary equipment — Top lifting harvesters. General description, working, specification and functions of paddy harvesting machines, Sugarcane harvesting, feller bunchers, forest machines.

UNIT IV  INDUSTRIAL VEHICLE  9
General description, specification, capacity and working of fork lifts - attachment, Utility vehicles, towing vehicles, man-lift chassis, scissor lift trucks, material handlers, fire fighting vehicle, reclaimers, Street sweepers.

UNIT V  MILITARY AND COMBAT VEHICLES  8
Special features and constructional details of Main Battle tank, gun carriers, truck-mounted missile launchers, transport vehicles, armoured vehicle-launched bridge, amphibious bridging vehicle, and communication vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The students will be able to
- Demonstrate their understanding about the operation of the various special purpose vehicle.
- Understand the construction layout of earth moving equipment’s.
- Have the ability to apply the knowledge to design a new concept for construction application.
- Demonstrate their skill in developing modern techniques for future farming vehicles.
- Distinguish the various military vehicle and infer their particular technology.

REFERENCES:
4. B. Geleman and M. Moskovin, Farm tractors, MIR publishers, Moscow.

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AM4004 INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES

COURSE OBJECTIVES:
- To Study the theory, construction and operation of different measurement technology for automobiles
- To understand working principle of various instruments, transducers and their application in automotive industry.
- To acquire knowledge on various mechanical measurement instruments techniques
- To study different types of instruments used for engine testing and its working principle
- To acquire knowledge in experimental methods for testing the vehicle with different instruments

UNIT I MEASUREMENT SYSTEMS
Static and Dynamic Measurement systems-importance of measurement system – methods of measurement -applications - characteristics of measuring system-static and dynamic characteristics of measuring system – Analysis of experimental detail, Error analysis-types of errors-limiting errors

UNIT II TRANSUDCERS, MODIFIERS AND TERMINATING DEVICES
Transducers for Automotive Applications – Amplifiers-Classifications and application in automobile – filters -types – Data Acquisition system - analog and digital type DAS-Indicators, Printers and display device –Signal Analyzing with example of automobile applications.
UNIT III MECHANICAL MEASUREMENT 10
Instrumentation for Measuring Weight, Force, torque, pressure, power, temperature, fluid flow and special methods, vibration piezo electric effect, rotational speed. Measuring Velocity, acceleration and angular motion with respect to automobile applications.

UNIT IV ENGINE EXPERIMENTAL TECHNIQUES 10

UNIT V VEHICLE EXPERIMENTAL TECHNIQUES 9

COURSE OUTCOMES:
At the end of this course the student should be able to
- Understand the components of the automotive instruments and their functions and the latest developments in this field
- Understand transducers, modifiers and terminating devices
- Understand mechanical measurement
- Grasp the basics of engine experimental techniques
- Grasp the basics of vehicle experimental techniques

TOTAL: 45 PERIODS

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COURSE OBJECTIVES:
- To identify the processes behind fuel extraction system.
- To understand the theory behind lubrication
- To study the properties of lubricants.
- To elaborate the properties of fuels used in IC engines.
- To understand the need of fuel rating.

UNIT I MANUFACTURE OF FUELS AND LUBRICANTS
Structure of petroleum, refining process, fuels, thermal cracking, catalytic cracking, polymerization, alkylation, isomerisation, blending, products of refining process. Manufacture of lubricating oil basestocks, manufacture of finished automotive lubricants.

UNIT II THEORY OF LUBRICATION
Engine friction: introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system.

UNIT III PROPERTIES AND TESTING OF LUBRICANTS
Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, synthetic lubricants, classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease, classification, properties, test used in grease.

UNIT IV PROPERTIES AND TESTING OF FUELS AND COMBUSTION
Thermo-chemistry of fuels, properties and testing of fuels, relative density, calorific value, flash point, fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion etc. combustion in SI and CI Engine

UNIT V ADDITIVES FOR LUBRICANTS AND FUELS
Additive - mechanism, requirements of additive, petrol fuel additives, diesel fuel additives Additives and additive mechanism, for lubricants. Introduction to Nano fluids

OUTCOMES:
At the end of this course the student should be able to
- Identify the processes behind fuel extraction system.
- Understand the theory behind lubrication
- Study the properties of lubricants.
- Elaborate the properties of fuels used in IC engines.
- Understand the need of fuel rating.

REFERENCES
COURSE OBJECTIVES:
- To identify the key factors in designing experiments
- To develop appropriate experimental design
- To analyse the data to derive valid conclusions.
- To optimize process conditions by developing empirical models.
- To Design robust products and processes using parameter design approach.

UNIT I  FUNDAMENTALS OF EXPERIMENTATION  9
Role of experimentation in rapid scientific progress, Historical perspective of experimental approaches, Steps in experimentation, Principles of experimentation.

UNIT II  SIMPLE COMPARATIVE EXPERIMENTS  9
Basic concepts of probability and statistics, Comparison of two means and two variances, Comparison of multiple (more than two) means & ANOVA.

UNIT III  EXPERIMENTAL DESIGNS  9
Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data.

UNIT IV  RESPONSE SURFACE METHODOLOGY  9
Concept, linear model, steepest ascent, second order model, regression

UNIT V  TAGUCHI’S PARAMETER DESIGN  9
Concept of robustness, noise factors, objective function & S/N ratios, inner-array and outer-array design, data analysis

TOTAL : 45 PERIODS

COURSE OUTCOMES:
- Formulate objective(s) and identify key factors in designing experiments for a given problem.
- Develop appropriate experimental design to conduct experiments for a given problem.
- Analyze experimental data to derive valid conclusions.
- Optimize process conditions by developing empirical models using experimental data.
- Design robust products and processes using parameter design approach.

REFERENCES
OBJECTIVES:

- To equip the students with the Finite Element Analysis fundamentals.
- To enable the students to formulate the design problems into FEA.
- To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions.
- To understand the assembly of global arrays, and solution of the resulting algebraic systems.
- Understand how to use finite element analysis in engineering problems and application areas including stress, heat transfer, and vibration analysis.

UNIT I INTRODUCTION


UNIT II 1D ELEMENTS


UNIT III 2D ELEMENTS


UNIT IV STRUCTURAL AND DYNAMIC ANALYSIS


UNIT V HEAT TRANSFER ANALYSIS AND FLOW ANALYSIS

1D & 2D problems in fluid mechanics and heat transfer by conduction and convection. Transient thermal analysis. Case Studies like Heat transfer analysis of piston, fins.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completing this course, the students will be able to:

- Identify mathematical model for solution of common engineering problems.
- Formulate simple problems into finite elements.
- Solve structural, thermal, fluid flow problems.
- Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
- Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.
AM4008  NOISE, VIBRATION AND HARSHNESS FOR AUTOMOBILES  L  T  P  C
3  0  0  3

OBJECTIVES:
The course should enable the students to:
1. To introduce source of noise and vibration
2. To broaden the understanding of sound measurement and human sensitivity
3. To underline the importance of simulation, anechoic chamber and acoustic holography
4. To broaden the importance of statistical and frequency analysis
5. To introduce active control techniques

UNIT I  NVH IN THE AUTOMOTIVE INDUSTRY  9

UNIT II  SOUND AND VIBRATION THEORY  9

UNIT III  TEST FACILITIES AND INSTRUMENTATION  9
Laboratory simulation: rolling roads (dynamometers), road simulators, semi-anechoic rooms, wind tunnels, etc. Transducers, signal conditioning and recording systems. Binaural head recordings. Sound Intensity technique, Acoustic Holography, Statistical Energy Analysis

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REFERENCES
UNIT IV       SIGNAL PROCESSING

UNIT V       NVH CONTROL STRATEGIES & COMFORT

OUTCOMES:
Upon completion of this course the student will be able to:
1. Identify sources of noise and vibration
2. Measure sound intensity and human sensitivity
3. Carryout statistical energy analysis and simulators
4. Determine active control techniques
5. Carryout statistical and frequency analysis barrier.

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The objective of this course is to make the students to
- analyse various two wheelers and their dynamics
- design the power unit of two and three wheelers
- apply the design aspects of transmission system
- understand different frames and suspension system used in two wheelers.
- Emphasize the knowledge on three wheelers and its sub systems

UNIT I  INTRODUCTION  9
Classifications of different two wheelers based on usage - design considerations – weight and dimension limitations –requirements, stability problems, gyroscopic effect- pendulum effect of two and three wheelers. Introduction to All-terrain vehicles.

UNIT II  POWER UNITS, IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS  10

UNIT III  CLUTCHES AND TRANSMISSION  10

UNIT IV  FRAMES, SUSPENSION, WHEELS, TYRES AND BRAKES  8

UNIT V  THREE WHEELERS  8
Case study on Auto rickshaw - different types, Pick-Ups and delivery type vehicles, frames and transmission in three wheelers, wheel types, wheel mountings attachment, tyre types. Brake systems.

TOTAL : 45 PERIODS

OUTCOMES
At the end of the course the students will be able to
- Analyse various two wheelers and its technology along with its functions.
- Design power plant for different two and three wheelers.
- Design and analyse transmission units used in two wheelers.
- Analyse different frames and suspension system used in two wheelers.
- Analyse and design the frames and suspension of three wheelers.

REFERENCES:
7. Build Your Own Electric Motorcycle, By Carl Vogel,2009
OBJECTIVES:
The course should enable the students:
- To Describe the different production and storage methods of hydrogen.
- To Explain the methods related to usage of hydrogen in SI Engines.
- To Explain the methods related to usage of hydrogen in CI Engines.
- To Illustrate the technical features of fuel cells for automotive applications
- To Outline the design concepts of hydrogen fuel cell systems for road vehicles

UNIT I  HYDROGEN AS FUTURE ENERGY CARRIER

UNIT II  HYDROGEN IN S.I. ENGINE SYSTEM

UNIT III  HYDROGEN IN C.I. ENGINE SYSTEM

UNIT IV  FUEL CELLS FOR AUTOMOTIVE APPLICATIONS
Basic Concepts of Electrochemistry - Proton Exchange Membrane Fuel Cells: Membrane-Electrocatalysts- GDL- Bipolar Plates - Sensitivity of PEM Stacks to Operating Conditions: Polarization Curve- Effect of Operative Parameters on the Polarization Curve - Durability of PEM Fuel Cells

UNIT V  DESIGN OF HYDROGEN FUEL CELL SYSTEMS

TOTAL : 45 PERIODS
OUTCOMES
At the end of the course the students will be able to
• Describe the different properties- production and storage methods of hydrogen.
• Explain the concept- methods and various features related to usage of hydrogen in SI Engines.
• Explain the concept- methods and various features related to usage of hydrogen in CI Engines.
• Illustrate the technical features of fuel cells for automotive applications
• Outline the design concepts of hydrogen fuel cell systems for road vehicles

REFERENCES:
5. Hydrogen Fuel Cells for Road Vehicles- April 2010- Springer

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COURSE OBJECTIVES:
- This course aims to introduce numerical modeling and its role in the field of heat, fluid flow and combustion. It will enable the students to understand the various discretisation methods and solving methodologies and to create confidence to solve complex problems in the field of heat transfer and fluid dynamics.
- To develop finite volume discretised forms of the governing equations for diffusion processes.
- To develop finite volume discretised forms of the convection-diffusion processes.
- To develop pressure-based algorithms for flow processes.
- To introduce various turbulence models, Large Eddy Simulation and Direct Numerical Simulation.

UNIT – I  GOVERNING DIFFERENTIAL EQUATIONS AND DISCRETISATION TECHNIQUES

UNIT – II  DIFFUSION PROCESSES: FINITE VOLUME METHOD

UNIT – III  CONVECTION-DIFFUSION PROCESSES: FINITE VOLUME METHOD
One dimensional convection – diffusion problem, Central difference scheme, upwind scheme – Hybrid and power law discretization techniques – QUICK scheme.

UNIT – IV  FLOW PROCESSES: FINITE VOLUME METHOD
Discretisation of incompressible flow equations – Pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms.

UNIT – V  TURBULENCE MODELS
Turbulence – RANS equation - Algebraic Models, One equation model, Two equation models – k & standard k – ε model, Low Reynold number models of k- ε, Large Eddy Simulation (LES), Direct Numerical Simulation (DNS) - Introduction. Solving simple cases using standard CFD codes.

COURSE OUTCOMES:
On successful completion of this course the students will be able to:
- Analyse the governing equations and boundary conditions.
- Analyse various discretization techniques for both steady and unsteady diffusion problems.
- Analyse the various convection-diffusion problems by Finite-Volume method.
- Analyse the flow processes by using different pressure bound algorithms.
- Select and use the different turbulence models according to the type of flows.
REFERENCES:

AM4011             ENGINE COMBUSTION THERMODYNAMICS AND engine heat transfer
                   3 0 0 3

OBJECTIVES
1. To develop the students, understand the thermodynamic principles of general and engine combustion.
2. To acquire knowledge in chemical kinetics involved in general and engine combustion.
3. To study different types of flames, their structures and analyze the factors affecting on them.
4. To demonstrate the importance of engine heat release rate and heat transfer models for engine combustion analysis.
5. To acquire knowledge in experimental methods for combustion and heat transfer calculations to apply in engines analysis.

UNIT – I  INTRODUCTION TO COMBUSTION PROCESSES

UNIT – II  THERMODYNAMICS OF COMBUSTION
UNIT – III  NORMAL, ABNORMAL COMBUSTION IN SI ENGINES

Stages of combustion – Flame propagation — Flame Limits – Flame Extinction - Rate of pressure rise – Cycle to cycle variation – Abnormal combustion – Theories of detonation – Effect of engine operating variables on combustion – Example problems.

UNIT – IV  COMBUSTION AND HEAT TRANSFER IN IC ENGINES


UNIT – V  EXPERIMENTAL INVESTIGATION OF COMBUSTION AND HEAT TRANSFER IN IC ENGINES

Photographic studies of combustion processes – P-θ diagrams in SI and CI engines, Assembly – Temperature measurement in piston – cylinder liner – Cylinder head and engine valves.

TOTAL 45 PERIODS

OUTCOMES:
1. Upon completion the students summarize the thermodynamic principles of general and engine combustion.
2. They understand the principle of engine combustion and the various heat transfer models and measuring methods of engine heat transfer in detail
3. They will have comment over on different flames and their importance in combustion applications
4. They will understand thermodynamics of combustion, grasp the knowledge of normal, abnormal combustion and heat transfer in engines
5. They also understand and apply the experimental techniques in investigating the combustion and heat transfer processes in IC engines

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REFERENCES:
OBJECTIVES

- To acquire knowledge on availability of renewable fuels in the world and the technologies used for biofuel production
- To understand the challenges and difficulties involved in using alternative fuels in internal combustion engines
- To acquire complete knowledge on availability of possible alternate fuels and their properties to use as fuel in CI and SI engines
- To explore the possible methods of using all the renewable fuels in SI and CI engines and analyze the engines behavior with different fuels and methods
- To develop a complete understanding of changing the engine system, modifying the fuel for efficient use in engines

UNIT I ALTERNATIVE FUELS, PROPERTIES AND PRODUCTION METHODS OF FUELS

Need for alternative fuels. World and Indian energy scenario on alternative fuels. Production technologies for biofuels for internal combustion engines - Pyrolysis, gasification, digestion.

UNIT II ALCOHOLS


UNIT III VEGETABLE OILS

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils - Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines. Role of Nano fluids, additives and cetane improvers for performance improvement of vegetable oils as fuel.

UNIT IV HYDROGEN


UNIT V BIOGAS, LPG AND NATURAL GAS

Production methods of Biogas, Natural gas and LPG. Properties studies. CO₂ and H₂S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines.

TOTAL 45 PERIODS

OUTCOMES

- Upon completion the course the students will have the complete knowledge on possible bio fuel production methods and their properties in detail.
- They will be able to apply their knowledge in making changes in engine design and fuel modification for the utilizing liquid alternative fuels effectively in the engines.
- They will be able to demonstrate the engines operation with new fuels and methods
- They further will innovate methods and design changes for optimal use of liquid alternative fuels in conventional engines
- They will be able to apply knowledge in using all the renewable gaseous fuels in IC engines with superior engine operation.
REFERENCES
5. Technical papers of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).

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AM4013 HYDRAULIC AND PNEUMATIC SYSTEMS L T P C 3 0 0 3

OBJECTIVES:
- To understand the basics of hydraulic and pneumatic systems
- To examine the working of hydraulic power drives
- To apply knowledge on fluid power elements
- To design hydraulic and pneumatic systems.
- To evaluate the concept of programming in PLC circuits.

UNIT I INTRODUCTION 9

UNIT II PNEUMATIC SYSTEMS 9
UNIT III  HYDRAULIC SYSTEMS  9

UNIT IV  SERVO AND PLC SYSTEMS  9
Electro pneumatics, ladder diagram for Basic Logic gates Servo and Proportional valves – types, operation, application. Hydro-Mechanical servo systems. PLC - construction, types, operation, programming. Comparison of PLC system over Relay Logic.

UNIT V  AUTOMOTIVE APPLICATIONS  9
Hydraulic tipping mechanism, power steering, forklift hydraulic gear, hydro-pneumatic suspension, air brake, Fluid Coupling and Torque converter. Maintenance and trouble shooting. Design and analysis of a hydraulic/Pneumatic system – Case Study.

TOTAL : 45 PERIODS

OUTCOMES:
- Understand the basics of hydraulic and pneumatic systems
- Examine the working of hydraulic power drives
- Apply knowledge on fluid power elements
- Design hydraulic and pneumatic systems.
- Evaluate the concept of programming in PLC circuits.

REFERENCES:
2. Werner Deppert and Kurt Stoll, “Pneumatic Controls : An introduction to principles”, Vogel-Druck Wurzburg, Germany, 1975

AM4014  IC ENGINE PROCESS MODELING  L T P C
3 0 0 3

OBJECTIVES
1. To impart knowledge in modeling the Internal combustion engine processes and acquire knowledge in different types of engine models and their importance
2. To understand the calculation of heat of reaction, air fuel ratio and flame temperature for developing a thermodynamic engine model.
3. To acquire knowledge on the detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation of SI engine.
4. To understand the gas exchange process and develop models for the intake and exhaust processes.
5. To develop a complete theoretical engine model for the SI engine and differentiate the model from CI engine model.
UNIT I INTRODUCTION TO SIMULATION

UNIT II STOICHIOMETRY AND ADIABATIC FLAME TEMPERATURE
Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air, excess air and stoichiometric air required for combustion. 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.

UNIT III SI ENGINE SIMULATION
SI Engine simulation with air as working medium, deviation between actual and ideal cycle. Fuel air cycle analysis - Temperature drop due to fuel vaporization, full throttle operation, work output and efficiency calculation, part-throttle operation, engine performance at part throttle, super charged operation. SI Engines simulation with progressive combustion. Models for mass burnt fraction.

UNIT IV SI ENGINE SIMULATION WITH GAS EXCHANGE PROCESS
Introduction, gas exchange process, Heat transfer process, friction calculations, comparison of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram, brake power, brake thermal efficiency, effect of speed on performance and analysis of the data.

UNIT V ENGINE SIMULATION FOR CI AND ADVANCED ENGINES

TOTAL: 45 PERIODS

OUTCOMES
1. Students will understand the classifications and applications of engine cycle simulation model and grasp the major modeling and simulation methods and the influence of model parameters on engine performance.
2. They will be able to calculate the heat of reaction, fuel air ratio and flame temperature for developing a thermodynamic engine model
3. They will acquire knowledge on the detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation of SI engine.
4. Students will become familiar with the modeling of progressive combustion and gas exchange processes and ability to build up control-oriented simulation model of internal combustion engines
5. They will get familiarized with the essential models of engine cycle simulation and theoretical knowledge to control the calculation accuracy and calculation efficiency of engine performance, combustion and emission.

REFERENCES


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**AM4015 VEHICLE CONTROL SYSTEMS**

**OBJECTIVES**
- To understand the basics of control system used in automobiles
- To recognize the electronically controlled system used in driving mechanics.
- To understand the working principle of driver modelling and power train control systems.
- To identify the control system used in hybrid and electrical vehicles.
- To illustrate the need of automated transport systems

**UNIT I INTRODUCTION**
Components of chassis management system – role of various sensors and actuators pertaining to chassis system – construction – working principle of wheel speed sensor, steering position, tyre pressure, brake pressure, steering torque, fuel level, Engine and vehicle design data.

**UNIT II DRIVELINE CONTROL SYSTEM**

**UNIT III SAFETY AND SECURITY SYSTEM**
Airbags, seat belt tightening system, collision warning systems, child Lock, anti lock braking systems, Vision enhancement, road recognition system, Anti theft technologies, smart card system, number plate coding, central locking system.

**UNIT IV COMFORT SYSTEM**
Active suspension systems, requirement and characteristics, different types, Vehicle Handling and Ride characteristics of road vehicle, pitch, yaw, bounce control, power windows, thermal management system, adaptive noise control.

**UNIT V INTELLIGENT TRANSPORTATION SYSTEM**
Traffic routing system - Automated highway systems - Lane warning system – Driver Information System, driver assistance systems - Data communication within the car, Driver conditioning warning - Route Guidance and Navigation Systems – vision enhancement system - In-Vehicle Computing –Vehicle Diagnostics system – Hybrid / Electric and Future Cars – Case studies

**TOTAL: 45 PERIODS**
OUTCOMES:
- Understand the basics of control system used in automobiles
- Recognize the electronically controlled system used in driving mechanics.
- Understand the working principle of driver modelling and power train control systems.
- Identify the control system used in hybrid and electrical vehicles.
- Illustrate the need of automated transport systems.

REFERENCES:

OBJECTIVES:
To import knowledge on
- To give knowledge on the importance of vehicle maintenance
- To impart knowledge on sub systems of engine and chassis and its maintenance
- To understand different transmission systems and its maintenance
- To understand vehicle body structure and its maintenance
- To understand the function of various electrical and electronic units and its maintenance

UNIT I MAINTENANCE RECORDS, BASIC TOOLS AND INSTRUMENTS

UNIT II POWER PLANT REPAIR AND OVERHAULING

UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS
Maintenance, servicing and repair of clutch, gearbox, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY
Body panel tools for repairing. Tinkering and painting. Minor and major repairs. Door lock and window glass actuating system maintenance.

UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL AND ELECTRONIC SYSTEMS
Maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator, regulator, lighting system, horn and dash board instruments. Introduction to OBD.

TOTAL : 45 PERIODS
OUTCOMES:
Upon the completion of the course student can able to understand
- The importance of maintenance
- Various sub systems of vehicle and its maintenance Understand Transmission
- Functions of transmission and its maintenance
- The importance of vehicle body structure
- Basic functional principle of electrical and electronic gadgets in automobile and its maintenance

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3. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B.
4. Taraporevala Sons, Bombay, 1963

AM4017 INTELLIGENT TRANSPORT SYSTEMS L T P C 3 0 0 3

OBJECTIVES:
To impor knowledge on
- To describe the digital map database module
- To describe the working of the positioning module.
- To describe the working of direction module
- To describe the working of wireless communication module.
- To describe the working of autonomous location and navigation module.

UNIT I DIGITAL MAP DATABASE MODULE
UNIT II  POSITIONING MODULE
Introduction-Dead Reckoning-Global Positioning System - Sensor fusion - Conventional map matching - Fuzzy logic Based Map matching - Other Map matching algorithms - Map aided Sensor calibration.

UNIT III  DIRECTION MODULE
Shortest Path - Heuristic Search - Bidirectional Search - Hierarchical search - other algorithms - Guidance while En Route - Guidance while off Route - Guidance with dynamic information.

UNIT IV  WIRELESS COMMUNICATION MODULE
Introduction - Communication Subsystem Attributes - Existing Communication Technologies - Communication Subsystem Integration.

UNIT V  AUTONOMOUS LOCATION AND NAVIGATION

TOTAL : 45 PERIODS

OUTCOMES:
Upon the completion of the course student can able to understand
• the digital map database module
• the working of the positioning module.
• the working of the direction module
• the working of wireless communication module.
• the working of autonomous location and navigation module

REFERENCES:

CO – PO Mapping

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OBJECTIVES:
To import knowledge on
- To understand the forces & moments influencing drag
- To solve exercises related to fuel economy & drag.
- To appraise upon the techniques of shape based optimization practiced in industry
- To identify the influence of rider position in motorcycle aerodynamics.
- To understand fundamentals of Experimental testing

UNIT I SCOPE OF ROAD VEHICLE AERODYNAMICS

UNIT II AIR RESISTANCE ON PASSENGER CARS

UNIT III AERODYNAMIC DRAG ON COMMERCIAL VEHICLES

UNIT IV MOTORCYCLE AERODYNAMICS

UNIT V WIND TUNNELS, MEASUREMENT AND TEST TECHNIQUES

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of this course the students should be able to
1. Understand the forces & moments influencing drag.
2. Solve exercises related to fuel economy & drag.
3. Appraise upon the techniques of shape based optimization practiced in industry.
4. Identify the influence of rider position in motorcycle aerodynamics.
5. Expose to fundamentals of Experimental testing.

REFERENCES:
2. R.H.Barnard - “Road vehicle aerodynamic design, An Introduction” , Mechaero publications, Third edition, 2010

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**OBJECTIVES:**
- To import knowledge on
- To compare and analyse the different casting process
- To design various machining process according to the requirement
- Analysis of suitable process related to forming
- To differentiate the effect of powder metallurgy on selective components
- To impart knowledge on recent trends of automotive components

**UNIT I CASTING**

**UNIT II MACHINING**
Special consideration of machining of various components such as flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston

**UNIT III FORGING AND EXTRUSION PROCESS**

**UNIT IV POWDER METALLURGY AND PROCESSING OF PLASTICS**
UNIT V  RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS


TOTAL: 45 PERIODS

OUTCOMES:
By the end of this course, students will be able to
- Identify the methods to manufacture the vehicle components
- Analyze the requirements of each component and material
- Differentiate between the casting and forming process
- Design the process for manufacturing vehicle components
- Understand the advanced techniques used for manufacturing Automobile components

REFERENCES
6. High Velocity "Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990
7. HMT handbook

AM4020  THERMAL MANAGEMENT OF HYBRID SYSTEMS

OBJECTIVES:
The course should enable the students:
- To understand the concepts of fluid mechanics and heat transfer
- To Design concepts for Heat Extraction in Motors
- To identify the thermal management of battery systems and power electronics
- To apply the concepts of thermal management in various automotive systems.

UNIT I  REVIEW OF THERMODYNAMICS, FLUID MECHANICS, AND HEAT TRANSFER
First Law of Thermodynamics for open and closed systems; internal energy, enthalpy, and specific heat - Second Law of Thermodynamics for closed systems; Tds equations, Gibbs function - Fluid mechanics: laminar vs. turbulent flow, internal flow relationships, Navier Stokes equations - Heat transfer: simple conduction, convection, and radiation relationships; Nusselt number relationships for convective heat transfer; energy equation.

UNIT II  THERMAL MANAGEMENT OF MOTORS
UNIT III THERMAL MANAGEMENT FOR BATTERIES
Thermal control in vehicular battery systems: battery performance degradation at low and high temperatures - Passive, active, liquid, air thermal control system configurations for HEV and EV applications - Battery Heat Transfer

UNIT IV THERMAL MANAGEMENT FOR POWER ELECTRONICS
Introduction to battery modeling: tracking current demand, voltage, and State of Charge as functions of time for given drive cycles - Development of thermodynamic relationships for cell heat generation - Lumped cell and pack models for transient temperature response to drive cycles - Model parametric study results

UNIT V THERMAL MANAGEMENT SYSTEMS
Overall energy balance to determine required flowrates - Determination of convection and friction coefficients for air and liquid systems in various geometric configurations: flow around cylinders, flow between plates, flow through channels - Development of a complete thermal system model and parametric study results - Temperature control and heat transfer using phase change materials - Thermal Management of Power Electronics.

TOTAL: 45 PERIODS

OUTCOMES:
The students should be able to:
• Understand the concepts of fluid mechanics and heat transfer
• Design concepts for Heat Extraction in Motors
• Identify the thermal management of battery systems and power electronics
• Apply the concepts of thermal management in various automotive systems.

REFERENCES:

AM4021 VEHICLE AIR CONDITIONING SYSTEMS

OBJECTIVES
• To impart the knowledge on automotive air-conditioning and its components functions
• To understand the Psychometric concepts, refrigerant characteristics,
• To understand the range of techniques that can be used in diagnosing
• To identify faults which affect automotive air-conditioning system performance
• To provide adequate knowledge in safe working practice, understanding the correct procedures for A/C service and repair
UNIT I FUNDAMENTALS
Terminology, design factors and concepts related to air conditioning system – Construction and Working principles of Thermostatic Expansion valve and Orifice tube based system- Heating system types -detailed study of HVAC components like compressor, evaporator, condenser, TXV, orifice tube, Receiver-drier, heater core etc. Location of air conditioning components in a vehicle.

UNIT II REFRIGERANTS & AIR MANAGEMENT SYSTEMS
Refrigerants: Temperature and pressure relation, Properties of R-12 and R134a- refrigerant oil. Simple problems -Containers - Handling refrigerants - Tapping into the refrigerant container - Ozone Layer Depletion. Air management system: Air routing for manual, semi and automatic system- cases and ducts- Air distribution, control head and doors- Defrost system

UNIT III AUTOMATIC CLIMATE CONTROL SYSTEM
Block diagram - types of Sensors and Actuators, - Control Logic Electrical wiring diagram of manual and automatic system - multiplexing between BCM and PCM- control of compressor clutch, blower motor etc.- diagnostics tools and features.

UNIT IV DESIGN OF AIR-CONDITIONING COMPONENTS
Modeling of Fixed and variable Displacement type compressor, evaporator modeling – heat transfer correlations for the fluids inside the evaporator, analysis of evaporator frosting-condenser modeling - improvement of refrigerant flow control method.

UNIT V AIR CONDITIONING DIAGNOSIS AND SERVICES
AC system diagnosis based on temperature and pressure measurements, sight glass, sound etc. - refrigerant leak detection- Trouble shooting and Servicing of compressor, evaporator, condenser, heater core – HVAC equipment , recovery and charging. Air routing system service.

TOTAL: 45 PERIODS

OUTCOMES:
• Solve the simple problems related to psychrometry and refrigerant
• Understand the operation of the individual components of the A/System, sensors, actuators and electronic control
• Understand the range of techniques that can be used in diagnosing
• Identify faults which affect system performance
• Provide adequate knowledge in safe working practice. understanding the correct procedures for A/C service and repair

REFERENCES:
OBJECTIVES:
The course should enable the students:
- To introduce vehicle structural crashworthiness and crash testing
- To introduce pedestrian safety
- To get the knowledge in sensors provided in the vehicle to avoid the crash and to detect the obstacles around the vehicle.
- To understand the fundamentals of sensor data fusion as it relates to ADAS.
- To Understand the concept of the connected vehicle and its role in ADAS and automated vehicles.

UNIT I   CONCEPTS OF AUTOMOTIVE SAFETY

UNIT II   PASSIVE SAFETY EQUIPMENTS AND CONVENIENCE SYSTEM
Seat belt, Seat belt tightener system and importance, collapsible steering column. Air bags and its activation. Designing aspects of automotive bumpers and materials for bumpers. Steering and mirror adjustment, central locking system, Tire pressure control system, rain sensor system, Automated wiper system.

UNIT III   ACTIVE SAFETY
Antilock braking system, Stability Control. Adaptive cruise control, Lane Keep Assist System, Collision warning, avoidance system, Blind Spot Detection system, Driver alertness detection System. ADAS

UNIT IV   VEHICLE INTEGRATION AND NAVIGATION SYSTEM

UNIT V   AUTONOMOUS VEHICLE

TOTAL: 45 PERIODS

OUTCOMES:
The students should be able to:
- Know about the design of the bumper for safety.
- Know about the concept of crumble zone, and also the effect of acceleration and deceleration of the vehicle in the compartment of the vehicle.
- Know the various types of safety aspects such as active and passive safety, the active safety components and the working passive safety components such as air bags, seatbelts
- Understand the fundamentals of sensor data fusion as it relates to ADAS.
- Understand the concept of the connected vehicle and its role in ADAS and automated vehicles.
REFERENCES:
1. ARAI Safety standards

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AM4023 INDUSTRY 4.0 AND IoT L T P C
3 0 0 3

OBJECTIVES:
The course should enable the students:
- To explore how Industry 4.0 will change the current manufacturing technologies and processes by digitizing the value chain.
- To Understand the drivers and enablers of Industry 4.0.
- To Learn about various IoT-related protocols
- To Build simple IoT Systems using Arduino and Raspberry Pi..

UNIT I INTRODUCTION TO INDUSTRY 4.0

UNIT II INTRODUCTION TO IOT
Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.
UNIT III  ELEMENTS OF IOT  9
Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API"s (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP

UNIT IV  IOT APPLICATION DEVELOPMENT  9

UNIT V  IOT APPLICATION IN AUTOMOBILES  9
Fleet Management: Real-time location monitoring of the fleet, Weight/Volume tracking of cargo that the fleet is carrying, Trucks’ performance statistics like fuel and mileage, Tracking traffic conditions on the road, Route management, Time and Driver management, connected cars: Vehicle to vehicle, Vehicle to infrastructure ,Vehicle to pedestrians, Vehicle to network, Automotive Maintenance System: Autonomous vehicle: In-vehicle Infotainment and Telematics:

OUTCOMES:
The students should be able to:
• Explore how Industry 4.0 will change the current manufacturing technologies and processes by digitizing the value chain.
• Understand the drivers and enablers of Industry 4.0.
• Learn about various IoT-related protocols
• Build simple IoT Systems using Arduino and Raspberry Pi.

REFERENCES:
2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs, 2017
AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING L T P C 2 0 0 0

COURSE OBJECTIVES
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

UNIT III TITLE WRITING SKILLS 6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES
COURSE OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

UNIT III DISASTER PRONE AREAS IN INDIA 6
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches
REFERENCES
1. Goel S. L., Disaster Administration And Management Text And Case Studies”, Deep &
2. Nishitha Rai, Singh AK, “Disaster Management in India: Perspectives, issues and
3. Sahni, Pardeep Et. Al., "Disaster Mitigation Experiences And Reflections", Prentice Hall
Of India, New Delhi, 2001.

AX4093 CONSTITUTION OF INDIA L T P C 2 0 0 0

OBJECTIVES
Students will be able to:
• Understand the premises informing the twin themes of liberty and freedom from a civil
rights perspective.
• To address the growth of Indian opinion regarding modern Indian intellectuals’
constitutional Role and entitlement to civil and economic rights as well as the
emergence nation hood in the early years of Indian nationalism.
• To address the role of socialism in India after the commencement of the Bolshevik
Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I  HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II  PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III  CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to
Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies,

UNIT IV  ORGANS OF GOVERNANCE
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions,
Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of
Judges, Qualifications, Powers and Functions.

UNIT V  LOCAL ADMINISTRATION
District’s Administration head: Role and Importance, Municipalities: Introduction, Mayor and
role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI:
Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block
level: Organizational Hierarchy (Different departments), Village level: Role of Elected and
Appointed officials, Importance of grass root democracy.

UNIT VI  ELECTION COMMISSION
Election Commission: Role and Functioning. Chief Election Commissioner and Election
Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

OUTCOMES

TOTAL: 30 PERIODS
Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party (CSP) under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

**SUGGESTED READING**

- The Constitution of India, 1950 (Bare Act), Government Publication.
1. சிறுபொணொற்றுபகட
- பாரி பல்லவாக்காட் என்ற கதாக்கத்துடன் புனரமைத்து வருகையுடைய கதாக்கம். ஆனால் வேண்டும் என்பது கதாக்கத்துடன், ஆனால் பலூநில்க
2. துணிதவம்
- அல்லதுகக் கதிரியப் புலமல் ஒன்மை
3. முதல்வரம் (617, 618)
- தர்மெம் திருவல் மீதிகள்
4. தாசாசாகாக்கம் திருமகியம் வணர்வு
5. புறனொனூறு
- திருமல் பழலகைப்பாணன்
6. அகநொனூறு (4)
- வடைக்க
முதலிகண்ட (11)
- வேலா
கலித்ததொகை (11)
- மற்றை, வேலா
தொசிக்கள 50 (27)
- வர்ண
ஆனால் புனரமைத்தைகளை

UNIT V
தமிழ் தொக்கியவை
1. தமிழன் நூற்றாண்டு
- தமிழ்நல்வாதி புனரமைத்தை, தமிழ்வாதி, கல்கடி, கல்கடி விளக்கம், புனரமைத்தை
- வர்ணம் தொக்கியவை, வேலா
2. தமிழ் விளக்கம் புனரமைத்தை தமிழ் தொக்கியவை, தமிழ் விளக்கம்
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5. தமிழ் விளக்கம்
6. தமிழ் விளக்கம்
7. தமிழ் விளக்கம்

TOTAL: 30 PERIODS

தமிழ் தொக்கியவை வைப்புடன் / புனரமைத்தை
1. தமிழ் விளக்கம் தமிழ்வாதிகள் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விளக்கம் விளக்கம் (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. தமிழ் விளக்கம் விளக்கம்
4. தமிழ் விளக்கம் தமிழ்வாதிகள்
   - தமிழ் பல்லவாக்காட், தமிழ்வாதிகள்
5. தமிழ் விளக்கம் தமிழ்வாதிகள்
6. அறிவியல் களாட்டியம்
   - குறிப்பு: பல்கலைக் கழகம், கல்வியம்