PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To prepare students to excel in I.C. Engineering profession.

II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve real time problems.

III. To train students with good scientific and engineering knowledge to develop innovative products.

IV. To inculcate students with professional and ethical attitude, and effective communication skills with an ability to relate engineering issues for societal transformation.

V. To train the students with academic excellence and good leadership qualities.

PROGRAMME OUTCOMES (POs):

On successful completion of the programme,

1. Graduates will demonstrate knowledge of mathematics, science and engineering.

2. Graduates will demonstrate ability to identify, formulate and solve engineering problems.

3. Graduates will demonstrate ability to experiment, analyze and interpret data.

4. Graduates will demonstrate ability to design a system, component, product and process as per needs and specifications.

5. Graduates will demonstrate skills to use modern engineering tools, software and equipments to analyze multidisciplinary problems.

6. Graduates will demonstrate knowledge of professional and ethical responsibilities.

7. Graduates will communicate effectively their technical knowledge.

8. Graduates will understand the impact of engineering solutions on societal transformation.

9. Graduates will develop ability for life-long learning.
## Mapping of PEOs with POs

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**TOTAL CREDITS : 71**

## FOUNDATION COURSES (FC)

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## PROFESSIONAL ELECTIVES (PE)

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**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

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OBJECTIVES:

- To impart knowledge on various alternate fuels for I.C. Engines
- Gain a working understanding of the engineering issues and perspectives affecting fuel and engine development
- Examine future trends and development, including hydrogen as an internal combustion engine fuel.
- Explore further fuel specification and performance requirements for advanced combustion systems.

UNIT I INTRODUCTION

UNIT II LIQUID FUELS FOR S.I. ENGINES

UNIT III LIQUID FUELS FOR C.I. ENGINES
Requirements, Utilisation techniques - Blends, Neat fuels, Bi-fuel, Reformed fuels, Emulsions, Dual fuelling, Ignition accelerators and Additives, Engine performance and emission characteristics.

UNIT IV GASEOUS FUELS FOR S.I. ENGINES

UNIT V GASEOUS FUELS FOR C.I. ENGINES
Hydrogen, Biogas, Liquefied Petroleum gas, Compressed Natural gas in CI engines. Dual fuelling, Engine performance and emission characteristics.

TOTAL: 45 PERIODS

OUTCOME

- On successful completion of this course the student will be able to understand the various alternative fuel options available for conventional fuels and their performance and emission characteristics.

REFERENCES:

OBJECTIVES:

- To demonstrate extensive mastery of the fundamental principles which govern the design and operation of internal combustion engines as well as a sound technical framework for understanding real world problems.
- Understand combustion in spark ignition and diesel engines.
- To identify the nature and extent of the problem of pollutant formation and control in internal combustion engines.

UNIT I  COMBUSTION PRINCIPLES 9

UNIT II  COMBUSTION IN S.I. ENGINES 10
Stages of combustion, normal and abnormal combustion, knocking, Variables affecting Knock, Features and design consideration of combustion chambers. Flame structure and speed, Cyclic variations, Lean burn combustion, Stratified charge combustion systems. Heat release correlations.

UNIT III  COMBUSTION IN C.I. ENGINES 10
Stages of combustion, vapourisation of fuel droplets and spray formation, air motion, swirl measurement, knock and engine variables, Features and design considerations of combustion chambers, delay period correlations, heat release correlations, Influence of the injection system on combustion, Direct and indirect injection systems.

UNIT IV  COMBUSTION IN GAS TURBINES 9
Flame stability, Re-circulation zone and requirements - Combustion chamber configurations, Cooling, Materials.

UNIT V  EMISSIONS IN SI AND CI ENGINES 7

TOTAL: 45 PERIODS

OUTCOME

- On successful completion of this course the student will be able to understand the concept of the combustion in engines.

REFERENCES:
OBJECTIVES

• To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.
• To analyse the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges.
• To achieve an understanding of the basic concepts of phase change processes and mass transfer.

UNIT I CONDUCTION AND RADIATION HEAT TRANSFER

One dimensional energy equations and boundary condition - three-dimensional heat conduction equations - extended surface heat transfer - conduction with moving boundaries - radiation in gases and vapour Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media – interaction of radiation with conduction and convection.

UNIT II TURBULENT FORCED CONVECTIVE HEAT TRANSFER

Momentum and energy equations - turbulent boundary layer heat transfer - mixing length concept - turbulence model – k Є model - analogy between heat and momentum transfer – Reynolds, Colburn, Prandtl turbulent flow in a tube - high speed flows

UNIT III PHASE CHANGE HEAT TRANSFER

Condensation with shears edge on bank of tubes - boiling – pool and flow boiling, Heat transfer enhancement techniques

UNIT IV HEAT EXCHANGERS


UNIT V MASS TRANSFER AND ENGINE HEAT TRANSFER CORRELATION

Mass transfer - vaporization of droplets - combined heat and mass transfers - heat transfer correlations in various applications like I.C. engines - compressors and turbines

TOTAL = 60 PERIODS

OUTCOME

• On successful completion of this course the student will be able to apply the concept of heat transfer to thermodynamic engines and systems

REFERENCES

OBJECTIVES:

- To demonstrate the use of correlations for the important properties.
- To achieve an understanding of real gas equations and multi component systems.
- To predict the availability and irreversibility associated with the thermodynamic processes and Chemical availability of reactive systems.
- To analyse the actual cycles of SI and CI engines.
- To apply the first and second law of thermodynamics to reactive systems.

UNIT I  THERMODYNAMIC PROPERTY RELATIONS  12
Thermodynamic Potentials, Maxwell relations, Generalised relations for changes in Entropy, Internal Energy and Enthalpy, Generalised Relations for Cp and Cv, Clausius-Clayperon Equation, Joule- Thomson Coefficient, Bridgeman Tables for Thermodynamic Relations.

UNIT II  REAL GAS BEHAVIOUR AND MULTI-COMPONENT SYSTEMS  12
Equations of State (mention three equations), Fugacity, Compressibility, Principle of Corresponding States, Use of generalised charts for enthalpy and entropy departure, fugacity coefficient, Lee- Keslergeneralised three parameter tables. Fundamental property relations for systems of variable composition, partial molar properties, Real gas mixtures, Ideal solution of real gases and liquids, Equilibrium in multi-phase systems, Gibbs phase rule for non-reactive components.

UNIT III  CHEMICAL AVAILABILITY  12

UNIT IV  FUEL – AIR CYCLES AND THEIR ANALYSIS  12

UNIT V  THERMO CHEMISTRY  12

OUTCOME

- On successful completion of this course the student will be able to apply the law of thermodynamics to thermal systems.

REFERENCES:


MA7154 ADVANCED NUMERICAL METHODS

OBJECTIVE:
• To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.

UNIT I ALGEBRAIC EQUATIONS
12

UNIT II ORDINARY DIFFERENTIAL EQUATIONS
12
RungeKutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION
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 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
OUTCOME

- It helps the students to get familiarized with the numerical methods which are necessary to solve numerically the problems that arise in engineering.

REFERENCES:


IC7111 INTERNAL COMBUSTION ENGINES LABORATORY

OBJECTIVES:

- To impart knowledge on the practical aspects of Internal Combustion Engine Systems.
- To understand the behaviour of system at different operating conditions
- To understand the influence of individual components on the Overall performance of the system.

LIST OF EXPERIMENTS

1. Disassembly and Assembly of engines
2. Study and drawing of engine components with dimensions.
4. Experimental study on C.I. engine with alternative fuels
5. Experimental study on the effect of fuel injection pressure on the engine performance, combustion and emission characteristics.
6. Experimental study on the effect of preheating air and fuel on engine performance, combustion and emission characteristics.
8. Determination of Flash and Fire point of various fuel blends.
9. Determination of Viscosity of various fuel blends

LABORATORY REQUIREMENTS

1. S.I Engine Components
2. C.I Engine Components
3. Single/ Multi-cylinder S.I. Engines
4. Single/ Multi-cylinder C.I. Engines
5. Exhaust Gas Analyser (To measure HC,CO,NOx,O2,CO2)
6. Smoke Meter
7. Pressure Transducer
8. Charge Amplifier
9. Data Acquisition System
10. Flash and Fire Point Apparatus
11. Redwood Viscometer

TOTAL: 60
OUTCOME

- On successful completion of this course the student will be able to have hands on experience in Operation, testing and maintenance of engines.

IC7201 ELECTRONIC ENGINE MANAGEMENT SYSTEMS

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OBJECTIVES:

- To learn the various sensors and engine management systems used in petrol and diesel engines
- To give an in-depth knowledge of various sensors used in engine management
- To give an overview of different types of fuel injection and ignition systems
- To know the latest technological advancements in vehicle power plant

UNIT I BASICS OF ELECTRONICS

Semiconductors, Transistors, Amplifiers, Integrated circuits – Analog and Digital, Logic Gates, Microcontrollers, Analog to Digital and Digital to Analog Converters.

UNIT II SENSORS AND ACTUATORS

Actuators – Pneumatic, EGR Valve, Waste Gate.

UNIT III IGNITION SYSTEMS

Ignition fundamentals, Solid state ignition systems, High energy ignition systems, Electronic spark timing and control. Combined ignition and fuel management systems. Dwell angle calculation, Ignition timing calculation.

UNIT IV GASOLINE INJECTION SYSTEMS

Open loop and closed loop systems, Single-point, Multi-point, Direct injection systems and Air assisted systems – Principles and Features, Types of injection systems, Idle speed, lambda, knock and spark timing control.

UNIT V DIESEL INJECTION SYSTEMS

Heat release, control of fuel injection, Inline injection pump, Rotary Pump and Injector—Construction and principle of operation, Electronic control, Common rail and unit injector systems – Construction and principle of operation.

TOTAL: 45 PERIODS

OUTCOME

- On successful completion of this course the student will be able to understand about Electronic Engine Management Systems

REFERENCES:

2. Bosch Technical Instruction Booklets.
OBJECTIVES:

- To impart the basic engine design skills to the learners such that there is seamless transition to advanced design concepts.
- To provide the basic grounding on the piston engine design philosophy.

UNIT I  GENERALIA
Principle of similitude, Choice of material, Stress, Fatigue and Noise, Vibration and Harshness considerations (NVH)

UNIT II  DESIGN OF MAJOR COMPONENTS
Piston system, Power Cylinder System, Connecting rod assembly, Crankshaft system, Valve Gearing, Stress analyses.

UNIT III  DESIGN OF OTHER COMPONENTS / SUBSYSTEMS
Inlet and exhaust manifolds, cylinder block, cylinder-head, crankcase, engine mountings, gaskets, bearings, flywheel, turbocharger, supercharger, computer controlled fuel injection system, Basics of ignition, lubrication and cooling system design. Introduction to design of catalytic converters, particulate traps and EGR systems.

UNIT IV  DESIGN SPECIFICS OF TWO-STROKE ENGINE SYSTEMS
Arrangement and sizing of ports, piston assembly, intake and exhaust system, scavenging, application to automotive gasoline and marine diesel engines.

UNIT V  CONCEPTS OF COMPUTER AIDED DESIGN
Preparation of working drawings of designed components using CAD system.

OUTCOME
- The pupils would have gained an insight /understanding on the rudiments of piston engine design philosophy as a prelude to higher level design activities for varied applications.

REFERENCES:
1. Vehicular Engine Design, Kevin L. Hoag, SAE International USA /
3. Internal Combustion Engine Handbook: Basics, Components, Systems and Perpectives,
OBJECTIVES:
- To understand the working of measuring instruments and errors associated with them
- To carry out error analysis and uncertainty of measurements
- To develop skills on the measurement and control applicable to a thermal systems

UNIT I MEASUREMENT CHARACTERISTICS
Introduction to measurements, Errors in measurements, Statistical analysis of data, Regression analysis, correlation, estimation of uncertainty and presentation of data, design of experiments – Experimental design factors and protocols

UNIT II MEASUREMENTS IN THERMAL SYSTEMS
Basic Electrical measurements, Transducers and its types, Signal conditioning and processing - Measurement of temperature, pressure, velocity, flow – basic and advanced techniques, and radiation properties of surfaces

UNIT III MEASUREMENT OF FUEL PROPERTIES AND POLLUTANTS
Thermo / Physical / Chemical and transport properties of solids, liquids and gaseous fuels, Analysers – Flame Ionisation Detector, Non-Dispersive Infrared Analyser, Chemiluminescent detector, Smoke meters, and Gas chromatography

UNIT IV CONTROL SYSTEMS, COMPONENTS AND CONTROLLERS
Introduction, Open and closed loop control systems, Transfer function. Types of feedback and feedback control system characteristics – Control system parameters – DC and AC servomotors, servo amplifier, potentiometer, synchro transmitters, synchro receivers, synchro control transformer, stepper motors - Continuous, Discontinuous and Composite control modes – Analog and Digital controllers

UNIT V DESIGN OF MEASUREMENT AND CONTROL SYSTEMS
Data logging and acquisition - Sensors for error reduction, elements of computer interfacing, Timers, and Counters, Designing of measurement and control systems for specific applications - Fault finding – Computer based controls

TOTAL: 45 PERIODS

OUTCOME
- On successful completion of this course the student will be able to plan their experiments and understand the suitability, accuracy and uncertainty associated with the instrument used for measuring thermal system parameters.

REFERENCES:
IC7211 ANALYSIS AND SIMULATION LAB FOR INTERNAL COMBUSTION ENGINEERING

COURSE OBJECTIVE:
Use of standard application software for solving engine flow and combustion problems
1. Engine intake flow analysis using different Port shapes
2. Engine exhaust flow analysis
3. Engine in-cylinder cold flow analysis for the given engine sector model
4. Fuel spray studies
5. Combustion and emission analysis
6. Engine hood cooling analysis

NOTE: The above exercises are only guidelines to maintain the standard for teaching and conduct of examination.

SIMULATION LAB – REQUIREMENT:
1. Software - Modeling software like Gambit, Star-CD es-ice, Star-CD enabled CFM, CCM+,DARS BASIC, DARS CFD, STAR-CDEquation solving software like Matlab, Engg equation solver
2. Every students in a batch must be provided with a terminal
3. Hardware is compatible with the requirement of the above software.

TOTAL: 60 PERIODS

IC 7212 TECHNICAL SEMINAR

COURSE OBJECTIVES:
- During the seminar session each student is expected to prepare and present a topic on Energy related issues / technology, for a duration of about 30 minutes.
- In a session of three periods per week, 4 students are expected to present the seminar.
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- Students are encouraged to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

TOTAL: 30 PERIODS

IC7311 PROJECT WORK PHASE I

OBJECTIVES
- A research project topic may be selected either from published lists or from the creative ideas of the students themselves in consultation with their project supervisor.
- To improve the student research and development activities.

EVALUATION
Project work evaluation is based on Regulations of Credit system University Departments - Post graduate programmes of Anna University

TOTAL : 90 PERIODS

OUTCOME
The students’ would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated in their project work phase – II.
OBJECTIVES

- The objective of the research project work is to produce factual results of their applied research idea in the thermal Engineering, from phase – I.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Division.
- A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Division based on oral presentation and the project report.
- To improve the student research and development activities.

EVALUATION

- Project work evaluation is based on Regulations of Credit system University Departments - Post graduate programmes of Anna University.

TOTAL = 180 PERIODS

OUTCOME

The students’ would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated project outcome of the aimed work.

OBJECTIVES:

- To design and analyse the performance of Turbo machines for engineering applications.
- To understand the energy transfer process in Turbo machines and governing equations of various forms.
- To understand the structural and functional aspects of major components of Turbo machines.
- To design various Turbo machines for power plant and aircraft applications.

UNIT I INTRODUCTION


UNIT II CENTRIFUGAL AND AXIAL FLOW COMPRESSORS


UNIT III COMBUSTION CHAMBER


UNIT IV AXIAL AND RADIAL FLOW TURBINES

UNIT V GAS TURBINE AND JET ENGINE CYCLES
Gas turbine cycle analysis – simple and actual. Reheated, Regenerative and Intercooled cycles for power plants. Working of Turbojet, Turbofan, Turboprop, Ramjet, Scramjet and Pulsejet Engines and cycle analysis – thrust, specific impulse, specific fuel consumption, thermal and propulsive efficiencies.

OUTCOME:
When a student completes this subject, he/she can
• Understand the design principles of the turbo machines
• Analyze the turbo machines to improve and optimize their performance

REFERENCES:
UNIT V  ROCKET STAGING AND PERFORMANCE  8
Rocket equations – Escape and Orbital velocity – Multi-staging of Rockets – Space missions – Performance characteristics – Losses and efficiencies, Advances in Rocket Propulsion.

TOTAL: 45 PERIODS

OUTCOME
- On successful completion of this course the student will be able to understand the working of different types of aircraft and rocket propulsion systems and their performance characteristics.

REFERENCES:

IC 7002  AUTOMOTIVE TECHNOLOGY  L T P C
3 0 0 3

OBJECTIVES:
- To enhance the students’ knowledge on Automobiles, Recent advancements and its working.

UNIT I  VEHICLE STRUCTURE  6
Basic construction of chassis, Types of Chassis layout, with reference to Power Plant location and drive, various, types of frames, Loads acting on vehicle frame, materials for frames, testing of frames.

UNIT II  ADVANCES IN ENGINE TECHNOLOGY  11

UNIT III  VEHICLE DYNAMICS  10
Vehicle Dynamics – Steady state handling characteristics, Types of forces acting on a vehicle body, Roll center, Roll axis, Vehicle under side forces, Calculation of Maximum acceleration, Reaction forces for different drives, Stability Control.

UNIT IV  AUTOMOTIVE AERODYNAMICS  8
UNIT V  ALTERNATIVE POWER PLANT  

OUTCOME:
• On successful completion of this course the student will be able to understand the working of an automobile.

REFERENCES:

IC7003  BOUNDARY LAYER THEORY AND TURBULENCE  
L T P C  3 0 0 3 
OBJECTIVES:
• To enhance the students’ knowledge on boundary layer theory and turbulence
• To understand the theory of turbulent flow and its modeling, structure types and a detailed insight about turbulence.

UNIT I  FUNDAMENTALS OF BOUNDARY LAYER THEORY  
Boundary Layer Concept, Laminar Boundary Layer on a Flat Plate at zero incidence, Turbulent Boundary Layer on a Flat plate at zero incidence, Fully Developed Turbulent Flow in a pipe, Boundary Layer on an airfoil, Boundary Layer separation.

UNIT II  TURBULENT BOUNDARY LAYERS  

UNIT III  TURBULENCE AND TURBULENCE MODELS  

UNIT IV  STATISTICAL THEORY OF TURBULENCE  

UNIT V  TURBULENT FLOWS  

TOTAL: 45
OUTCOME

- On successful completion of this course the student will be able to apply the concepts of boundary layer theory and turbulence.

REFERENCES:

IC7004 COMBUSTION AND REACTION KINETICS IN I.C. ENGINES

OBJECTIVES:

- To develop the knowledge about combustion kinetics in SI and CI engines.
- To understand the combustion reaction kinetics in SI and CI engines.

UNIT I INTRODUCTION

UNIT II CHEMICAL KINETICS OF COMBUSTION

UNIT III MODELLING
Calculation of equilibrium composition. Enthalpy and Energy, Coefficients for reactions and adiabatic flame temperature, Modeling of CO, HC NO reactions in SI and CI Engines – Soot Modeling

UNIT IV GASOLINE ENGINE COMBUSTION

UNIT V DIESEL ENGINE COMBUSTION

TOTAL: 45 PERIODS

OUTCOME

- On successful completion of this course the student will be able to understand the combustion and reaction kinetics in IC Engines

REFERENCES:
IC 7005 ENGINE AUXILIARY AND ANCILLARY SYSTEMS  

OBJECTIVES:
- This course aims to impart the knowledge about engine auxiliaries like fuel supply and distribution, ignition, lubrication and cooling systems.
- To provide an overview of engine auxiliary and ancillary systems like fuel supply, cooling, lubrication and after treatment systems.
- To impart knowledge on Gasoline and Diesel fuel injection system, requirement, Components and types of ignition.

UNIT I CARBURETION
Gasoline - air mixtures. Mixture requirements - Mixture formation - Carburettor, Choke, Carburettor systems for emission control- Secondary Air Injection.

UNIT II FUEL INJECTION AND IGNITION SYSTEMS

UNIT III ENGINE STARTING AND AFTER TREATMENT SYSTEMS
Engine Starting systems, CATCON, SCR, LNT, Diesel Oxidation Catalyst system, Particulate Traps and Filters.

UNIT IV INTAKE AND EXHAUST MANIFOLDS
Intake system components, Air filter, Intake manifold, Manifold Tuning, VGT, VNT, Exhaust manifold and exhaust pipe, Exhaust mufflers & Resonators.

UNIT V LUBRICATION AND COOLING SYSTEMS
Lubricating systems- Theory, requirements and types, Lubrication - piston rings, crankshaft bearings, camshaft, Cooling systems – Need, Engine heat transfer, liquid and air cooled engines, Oil cooling, Additives and lubricity improvers.

OUTCOME
- On successful completion of this course the student will be able to understand the need and working various auxiliaries of engine systems.

REFERENCES:
OBJECTIVES:
• To educate the students about pollution formation in engines, and importance of its control.
• To educate the ways and means to protect the environment from various types of engine Pollution.
• To create an awareness on the various environmental pollution aspects and issues.
• To give a comprehensive insight into the pollution in engine and gas turbines.
• To impart knowledge on pollutant formation and control.
• To impart knowledge on various emission instruments and techniques.

UNIT I  AIR POLLUTION - ENGINES AND TURBINES 6
Atmospheric pollution from Automotive and Stationary engines and gas turbines, Global warming – Green-house effect and effects of engine pollution on environment.

UNIT II  POLLUTANT FORMATION 10

UNIT III  EMISSION MEASUREMENT TECHNIQUES 9
Non dispersive infrared gas analyzer, gas chromatography, Chemiluminescent analyzer and flame ionization detector, smoke meters, Particulate measurements, Noise measurement and control.

UNIT IV  EMISSION CONTROL TECHNIQUES 12
Engine Design modifications, fuel modification, evaporative emission control, EGR, air injection, thermal reactors, Water Injection, catalytic converters, Application of microprocessor in emission control. Common rail injection system, Particulate traps, NOx converters, SCR systems. GDI and HCCI concepts

UNIT V  DRIVING CYCLES AND EMISSION STANDARDS 8
Transient dynamometer, Test cells, Driving cycles for emission measurement, chassis dynamometer, CVS system, National and International emission standards.

TOTAL: 45 PERIODS

OUTCOME
• On successful completion of this course the student will be able to understand about the emission formation and its control in engines.

REFERENCES:
OBJECTIVES:

- To enhance students’ knowledge on flow visualisation techniques applied to ICE engine flow processes
- To understand the significance of flow visualisation techniques in IC engine flow processes.

UNIT I  INSTRUMENTATION FOR FLOW VISUALISATION

Schlieren photography – Laser Velocimetry – Illuminated Particle Visualisation Holography – ParticleImage Velocimetry.

UNIT II  FLOW VISUALISATION OF INTAKE PROCESS

Engine optical access, Design of optical engine, Thermal properties of materials used for optical engine, processing of materials – Optical techniques.

UNIT III  IN-CYLINDER FLOW

Visual Experiment of In-cylinder flow by Laser sheet method. Intake flow visualization by light colour layer examination of principle and photographic measurement techniques.

UNIT IV  COMBUSTION VISUALISATION

Endoscopes, Advanced cameras, Fiber Optic Tools, Laser diagnostics of Flames.

UNIT V  NUMERICAL FLOW VISUALISATION

Direct, Geometric and texture based flow visualization, Dense Geometric Flow visualization – Surface flow visualisation.

TOTAL: 45 PERIODS

OUTCOME:

- On successful completion of this course the student will be able to apply concept of flow visualisation techniques to IC engines.

REFERENCES:


OBJECTIVES:

- To enrich the students’ knowledge engines fluid flow and heat transfer
- To understand the fluid flow in an IC engine, aspects of heat transfer and cooling of components.

UNIT I  INTRODUCTION

UNIT II  LAMINAR AND TURBULENT FLOWS  9

UNIT III  LUBRICATION, SURFACE TENSION EFFECTS, MICROSCALE EFFECTS  5
Lubrication, Surface tension effects, Micro scale effects.

UNIT IV  COMPRRESSIBLE FLOW  10

UNIT V  CONVECTIVE HEAT TRANSFER – MASS TRANSFER AND HEAT TRANSFER IN POROUS MEDIA  12

TOTAL: 45 PERIODS

OUTCOME
• On successful completion of this course the student will be able to apply the fluid flow and heat transfer concepts in engine system.

REFERENCES:

IC 7009  HOMOGENEOUS CHARGE COMPRESSION IGNITION L T P C COMBUSTION IN ENGINES  3 0 0 3

OBJECTIVES:
• This course aims to introduce fundamentals of HCCI and its benefits in IC Engines
• To develop the knowledge on HCCI combustion and its benefits and applications.

UNIT I  HCCI ENGINE FUNDAMENTALS  8
Conventional Gasoline Combustion, Effects of EGR, Techniques to HCCI operation in gasoline engines, Conventional Diesel Combustion, Overview of diesel HCCI engines, Techniques – Early Injection, Multiple injections, Narrow angle direct injection (NADI™) concept.

UNIT II  GASOLINE AND DIESEL HCCI COMBUSTION ENGINES  9
Conventional Gasoline Combustion, Effects of EGR, Techniques to HCCI operation in engines, Conventional Diesel Combustion, Overview of diesel HCCI engines, Tec
Early Injection, Multiple injections, Narrow angle direct injection (NADI™) concept.

UNIT III    HCCI CONTROL  10
Control Methods, Combustion timing sensors, HCCI/SI switching, Transition between operating modes (HCCI-SI-HCCI), Fuel effects in HCCI - gasoline, diesel, auto-ignition requirement, combustion phasing, Influence of equivalence ratio, auto-ignition timing, combustion duration, auto-ignition temperature and auto-ignition pressure, Combustion limits, IMEP and indicated efficiency, other approaches to characterising fuel performance in HCCI engines.

UNIT IV    HCCI FUEL REQUIREMENTS & COMBUSTION WITH ALTERNATIVE FUELS  9
Introduction, Background, Diesel fuel HCCI, HCCI fuel ignition quality, Gasoline HCCI, HCCI fuel Specification, Fundamental fuel factors. Natural gas HCCI engines, CNG HCCI engines, methane/n- butane/air mixtures. DME HCCI engine - chemical reaction model, Combustion completeness, Combustion control system, Method of combining DME and other fuels, ‘unmixed-ness’ of DME/air mixture

UNIT V    LOW-TEMPERATURE AND PREMIXED COMBUSTION  9
Basic concept, Characteristics of combustion and exhaust emissions, modulated kinetics (MK) combustion – First and Second generation of MK combustion, Emission, performance improvement.

TOTAL: 45 PERIODS

OUTCOME
- On successful completion of this course the student will be able to understand the concept of HCCI, its benefits and challenges.

REFERENCES:

IC7010    MANUFACTURING AND TESTING OF ENGINE COMPONENTS  L  T  P  C
COMPONENTS  3  0  0  3

OBJECTIVES:
- To provide a comprehensive module on the aspects of materials, manufacture and testing of piston engine assemblies, components and subsystems.
- To equip the learners with necessary domain inputs such that they can pursue research, consultancy, academics or other avocation.

UNIT I    MATERIALS  7

UNIT II    ENGINE COMPONENTS  15
Cylinder Block, Cylinder Head, Crankcase and Manifolds, Piston Assembly, Connecting Rod, Crankshaft, Camshaft and Valve Train - Production methods – Casting, Forging, Metallurgy – Machining – Testing Methodologies.
UNIT III ENGINE AUXILIARIES 7
Carburettors, fuel injection system components, radiators, fans, coolant pumps, ignition system, intake and exhaust systems, Catalytic converters

UNIT IV COMPUTER INTEGRATED MANUFACTURING 7
Integration of CAD, CAM and CIM- Networking, CNC programming for machining of Engine Components.

UNIT V QUALITY ASSURANCE AND TESTING 9
TS 16949, ISO and BIS codes for testing. Instrumentation, computer aided engine testing, metrology for manufacture of engine components, engine tribological aspects.

TOTAL: 45 PERIODS

OUTCOME
- A course work, of this kind would have equipped a graduate student with the requisite skills needed for a practicing engineer.

REFERENCES:

IC 7011 MARINE DIESEL ENGINES
L T P C
3 0 0 3

OBJECTIVES:
- To provide a first-hand knowledge about the marine diesel and allied engine systems.
- To give a broad outline about marine diesel and allied piston engine systems

UNIT I ENGINE RUDIMENTS 10
Engine Operation; Operating Cycles; Performance factors; Supercharging and Scavenging Systems for two stroke and four stroke cycle engines, Submarine Engine Systems, Fuels and Lubricants, Engine Pollution and their Controls.

UNIT II MECHANICS 10
Dynamics of crank gear, Engine Vibration, Design, Engine Systems, Speed governors and Accessory equipment's.

UNIT III INSTRUMENTATION AND CONTROL 10
Automatic instruments and remote control of marine engines, Testing - Standard codes - Rating.

UNIT IV AUXILIARY SYSTEMS 10
Starting and reversing gears, Fuel systems, cooling and Lubrication systems.

UNIT V TYPICAL MODERN MARINE PROPULSION ENGINE SYSTEMS 5
Starting and reversing gears, Fuel systems, cooling and Lubrication systems.

TOTAL: 45 PERIODS

OUTCOME
- On successful completion of this course the student will be able to understand Marine engine systems.
REFERENCES:
5. Akber Ayub, Marine Diesel Engines, Ane Books Pvt. Ltd., New Delhi, 2010..

IC 7012 SIMULATION OF I.C. ENGINE PROCESSES  L T P C
3 0 0 3

OBJECTIVES:
- To impart knowledge on simulation of various engine processes used in prime movers and power plants.
- To learn the simulation of engine combustion based on first and second law of thermodynamics.

UNIT I SIMULATION PRINCIPLES

UNIT II SIMULATION OF COMBUSTION IN SI ENGINES

UNIT III SIMULATION OF COMBUSTION IN CI ENGINES

UNIT IV SIMULATION OF TWO STROKE ENGINES

UNIT V SIMULATION OF GAS TURBINE COMBUSTORS

TOTAL: 45 PERIODS

OUTCOME
- On successful completion of this course the student will be able to simulate the different engine processes.
REFERENCES:

IC 7013 SUPERCHARGING AND SCAVENGING

OBJECTIVES:
- To gain knowledge in the field of turbo charging, supercharging and scavenging.
- To understand the supercharging and turbocharging effect on I.C engine performance and emissions, scavenging of two stroke engines and design aspects of muffler and port design.

UNIT I SUPERCHARGING

UNIT II TURBOCHARGING

UNIT III SCAVENGING OF TWO STROKE ENGINES

UNIT IV PORTS AND MUFFLER DESIGN
Porting – Port flow characteristics-Design considerations – Design of Intake and Exhaust Systems – Tuning- Kadenacy system.

UNIT V EXPERIMENTAL METHODS AND RECENT TRENDS IN TWO STROKE ENGINES

TOTAL: 45 PERIODS
OUTCOME
- On successful completion of this course the student will be able to match turbochargers with engines and design two stroke cycle engines.

REFERENCES:

IC7071 COMPUTATIONAL FLUID DYNAMICS

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 CFD equations.
- To formulate explicit & implicit algorithms for solving the Euler Equations & Navier-strokes Equations.

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 MODELLING OF COMBUSTION AND TURBULENCE
Mechanisms of combustion and Chemical Kinetics, Overall reactions and intermediate reactions, Reaction rate, Governing equations for combusting flows. Simple Chemical Reacting System (SCRS), Turbulence - Algebraic Models, One equation model, $k - \varepsilon$ & $k - \omega$ models - Standard and High and Low Reynolds number models.

TOTAL: 45 PERIODS
OUTCOME:

- On successful completion of this course the student will be able to apply concept of CFD to analyse the fluid flow and heat transfer in thermal systems.

REFERENCES: