

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING
M.Tech. (Advanced I.C. Engines)

(4 SEMESTER COURSE STRUCTURE AND SYLLABUS)

EFFECTIVE FROM THE YEAR 2015-16

I- SEMESTER:

Subject Code	SUBJECT	L	P	C
15D31102	Advanced Thermodynamics	4	-	4
15D31103	Conduction and Radiation Heat Transfer	4	-	4
15D33101	Internal Combustion Engineering	4	-	4
15D33102	Alternative Fuels for I.C. Engines	4	-	4
	ELECTIVE-I	4	-	4
15D33103	Automotive Air Conditioning Systems			
15D33104	Alternative Fuels and Propulsion Systems			
15D33105	Turbo Machines			
15D33106	Theory of Fuels and Lubricants			
	ELECTIVE-II	4	-	4
15D33107	Automobile Air Pollution and Environment			
15D33108	Jet propulsion & Rocket Engineering			
15D33109	Electric and Hybrid Vehicles			
15D33110	Production of Automobile Components			
15D33111	“Performance Testing of Internal Combustion Engines” Lab	0	4	2
TOTAL		24	4	26

II - SEMESTER:

Subject Code	SUBJECT	L	P	C
15D33201	Combustion in I.C. Engines	4	-	4
15D31202	Convective Heat & Mass Transfer	4	-	4
15D31204	Advanced Fluid Mechanics	4	-	4
15D33202	Engine Emissions and Control	4	-	4
	ELECTIVE-III	4	-	4
15D33203	Super Charging & Scavenging.			
15D33204	Vehicle Maintenance			
15D33205	Engine Management Systems			
15D33206	Instrumentation and Experimental Techniques			
	ELECTIVE-IV	4	-	4
15D33207	Automotive Aerodynamics			
15D33208	Vehicle Control Systems			
15D33209	Manufacturing and Testing of I.C. Engines and Components			
15D33210	Automotive Safety			
15D54201	Research Methodology (Audit Course)			
15D33211	“Testing of Combustion & Emissions of Internal Combustion Engines” Lab	0	4	2
TOTAL		24	4	26

Code	Subject	T	P	C
15D33301	III Semester Seminar - I	0	4	2
15D33401	IV Semester Seminar - II	0	4	2
15D33302	III & IV Semester Project Work	--	--	44
	Total	24	8	48

Note : All End Examinations (Theory and Practical) are of Three Hours Duration.

T – Tutorial L – Theory P- Practical / Drawing C - Credits

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M.Tech - ADVANCED I.C. ENGINES

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**ADVANCED THERMODYNAMICS
(Common to R&A/C & Advanced I.C. Engines)
(15D31102)**

UNIT-I**THERMODYNAMIC RELATIONS:**

Introduction-Helmholtz free energy function-Gibbs free energy function-coefficient of volumetric expansion-isothermal compressibility-differential relation for U,H,G&F-Maxwell relations.

GENERALIZED RELATIONS:

Generalized relation for Cp,Cv,K,B-relations for internal energy and enthalpy-the various Tds equation-clapeyron equation-gas tables-enthalpy and internal energy- pressure ratio-volume ratio-change of entropy-Introduction to third law of thermodynamics.

UNIT-II**EXERGY:**

Introduction-availability of heat –availability of a closed system-availability function of the closed system-availability of steady flow system- availability function of open system.

IRREVERSIBILITY:

Introduction-irreversibility for closed and open system-steady flow process effectiveness-second law analysis of the power plant.

UNIT-III**NONREACTIVE GAS MIXTURES:**

Introduction-basic definitions for gas mixtures-PVT relations ship for mixtures of ideal gases-properties of mixtures of ideal gases-entropy change due to mixing – mixtures of perfect gases at different initial pressure and temperatures.

UNIT-IV**GAS SPOWER CYCLES:**

Introduction-air standard cycles-carnot cycle-ottocycle –diesel cycle-dual cycles-comparison between Otto, Diesel, dual cycles-variations between the air standard Otto cycle and actual cycle-Sterling cycle-Erickson cycle-Atkinson cycle-Brayton cycle- Lenoir cycle.

UNIT-V**VAPOUR POWER CYCLES:**

Introduction-the carnot vapor cycle-rankine cycle-effects of operation condition on efficiency-principles of increasing the thermal efficiency- method of increasing thermal efficiency.

DIRECT ENERGY CONVERSION:

Introduction-thermoelectric converters-thermo-ionic converters magneto hydrodynamics generators-solar power cells plant –fuel cell hydrogen –hydrogen fuel cells-direct and indirect oxidation fuel cells-biochemeical fuel cells.(no problems)

REFERENCE BOOKS:

1. Advanced Thermodynamics:Van Wyllan, TMGH
2. Engineering Thermodynamics:P.K.Nag,TMGH Advanced Thermodynamics:Ray & Sarao,Central Publishers.

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CONDUCTION AND RADIATION HEAT TRANSFER
(Common to R&A/C & Advanced I.C. Engines)
(15D31103)

CONDUCTION :**UNIT-I**

Introduction of three modes of heat transfer, steady, unsteady state heat transfer process, governing equations and boundary conditions

Two dimensional steady state conduction, semi-infinite and finite flat plate; temperature field in infinite and finite cylinders.

UNIT-II

Conduction through spherical shells, numerical methods, relaxation method and finite difference methods - simple problems.

UNIT-III

Heating and cooling of bodies with negligible internal resistance, sudden changes in the surface temperature of infinite plates, cylinders and semi-infinite bodies-simple problems.

RADIATION :**UNIT-IV**

Review of the thermal radiation - gas radiation, mean beam length exchange between gas volume and black enclosure, heat exchange between gas volume and gray enclosure, problems.

UNIT-V

Radiation network for an absorbing and transmitting medium, radiation exchange with specular surfaces, radiation exchange with transmissivity and reflecting absorbing medium. Formulation for numerical solution.

Solar radiation: Radiation properties of environment, effect of radiation on temperature measurement, the radiation heat transfer coefficient, problems.

REFERENCE BOOKS :

- | | |
|---|---|
| 1) Heat Transfer | -Gibhart - Mc. Graw Hill. |
| 2) Conduction Heat Transfer- | -Schneider Addition Wieselthy |
| 3) Conduction of Heat in Solids | -Carslaw & Jaeger. |
| 4) Heat transfer | -J.P. Holman, International student edition |
| 5) Fundamentals of heat and mass transfer | -R.C. Sachdev New Age International |
| 6). Heat Transfer by | - R. K. Rajput Lakshmi Publishers |

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**INTERNAL COMBUSTION ENGINEERING
(15D33101)**

UNIT –I

Basic characteristics of engines : Compression ratio – energy supply to an engine – power developed by engine – specific weight and specific volume – cylinder pressures – IMEP determination – torque characteristics – cylinder arrangement and their relative merits. Engine cooling systems: types of cooling – cooling of critical engine components – recooling the coolant – comparison of air cooled and liquid cooled engines.

UNIT –II

Fuel delivery in SI engines: Classification of fuel delivery systems – fuel transfer pumps – fixed jet carburetor – computer controlled carburetor – gasoline injection systems. Ignition systems in SI engines: Battery ignition system – requirements for satisfactory operation of the ignition system – ignition timing and advancing mechanisms – magneto ignition system – electronic ignition system.

UNIT – III

Combustion and combustion systems in CI engines: Air motion in CI engines – delay period in CI engines – types of diesel combustion systems. Scavenging and super charging in CI engines : types of scavenging systems in two stroke SI engines – improved and modified scavenging systems – super charging and engine performance – methods of super charging.

UNIT – IV

Engine emissions, control systems and engine developments: SI engine pollutants – exhaust gas analyzer – SI engine emission control systems – particulate emissions – diesel pollution control methods – low heat rejection engines.

UNIT – V

Conventional and alternate fuels for IC engines: desirable characteristics of gasoline – desirable characteristics of diesel fuel – alternative fuels for SI engines and CI engines.

TEXT BOOKS:

1. Internal combustion engines fundamentals by JohnB. Heywood. McGraw – Hill international editions.
2. Internal combustion engines by V. Ganesan, Tata McGraw Hill book cop. 1995
3. Internal combustion engines and air pollutions by Edward F. Obert, Intext education publishers.
4. Introduction to internal combustion engines by Richard stone 3rd edition , society of automotive engineers .

REFERENCES:

1. A course Internal combustion engines by V.M.A. Domkundwar, Dhanapat Rai publications.
2. A course internal combustion engines by M.L.Mathur and R.P.Sharma, Dhanapat Rai publications.
3. Internal combustion engines by K.k Ramalingam, Scitech Publications (India) Pvt.Ltd, 2000
4. A Text Book of Internal combustion engines by R.K. Rajput, Laxmi Pub, Pvt., 2006

**JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING****M.Tech - ADVANCED I.C. ENGINES****I- SEMESTER**

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**ALTERNATIVE FUELS FOR I.C. ENGINES
(15D33102)****UNIT-I**

Introduction: solid fuels, gases fuels, liquid fuels, chemical structure of petroleum, petroleum refining process, important requisite qualities of engine fuels, SAE rating of fuels.

UNIT-II

FUELS: Availability and Suitability to Piston Engines, Concept of conventional fuels, potential alternative fuels - Ethanol, Methanol, DEE/DME - Hydrogen, LPG, Natural gas, Producer gas, Bio gas and Vegetable oils - Use in I.C.Engines-Merits and Demerits of various fuels.

UNIT-III

ALCOHOL FUELS: Properties as engine fuels - Performance in S.I.Engines - Alcohol & Gasoline blends - Flexible Fuel Vehicle -Reformed alcohols.

Alcohols in C.I. Engines - Emulsions - Dual fuel systems -Spark assisted diesel engines - Surface ignition engines - Ignition accelerators - Manufacture of alcohol fuels.

UNIT-IV

GASEOUS FUELS: Hydrogen - Properties - Use in C.I Engines - Use in S.I Engines - Storage methods - Safety precautions -Production methods.

Production of Producer gas and bio gas - Raw materials - Gasification - Properties - Cleaning up the gas -Use in S.I. and fuel engines, LPG & Natural gas - Properties - Use in S.I. and C.I. Engines.

UNIT-V

VEGETABLE OILS: Properties - Esterification - Performance in Engines.

FUEL QUALITY: Fuel quality standards for Automotive Engines - Lead free gasolines, low and ultra -low sulphur diesels, LPG, CNG, and Biodiesels.

TEXT BOOKS:

1. Internal combustion engines by V . Ganesan, Tata McGraw Hill book cop. 2007
2. Richard L.Bechtold, Automotive Fuels Guide Book, SAE Publications,1997.

REFERENCES:

1. Osamu Hirao and Richard K.Pefley, Present and Future Automotive Fuels, John Wiley and sons, 1988.
2. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications, 1990.

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M.Tech - ADVANCED I.C. ENGINES

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**AUTOMOTIVE AIR CONDITIONING SYSTEMS (Elective –I)
(15D33103)**

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 etc. – HVAC equipment , recovery and charging. Air routing system service.

TEXTBOOK:

- 2) Tom Birch, “Automotive Heating and Air Conditioning” Pearson Education Inc., 2003.
- 3) Boyce H. Dwiggin, Jack Erjavec., “Automotive Heating and Air-Conditioning”, Delmer publisher.,2001.
- 4) William H Crouse and Donald L Anglin, “Automotive air conditioning”, McGraw - Hill Inc., 1990

REFERENCES

- 1) Goings. L.F., “Automotive air conditioning”, American Technical services, 1974
- 2) Paul Weiser, “Automotive air conditioning”, Reston Publishing Co Inc., 1990.
- 3) MacDonald, K.L., “Automotive air conditioning”, Theodore Audel series, 1978.
- 4) James D. Halderman, “Automotive Heating, Ventilation, and Air Conditioning Systems”, Pearson Education Inc., 2004.
- 5) SAE paper No: 931121,900084, 850040,931137,870029 etc.
- 6) Vehicle service manuals.

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**ALTERNATIVE FUELS AND PROPULSION SYSTEMS (Elective -I)
(15D33104)**

UNIT I ALCOHOLS AS FUELS

Alternative fuels. Availability of different alternative fuels for engines. Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Issues & limitation in alcohols

UNIT II VEGETABLE OILS AS FUELS

Vegetable oils and their important properties. Methods of using vegetable oils – Blending, preheating, Transesterification and emulsification – Performance, combustion and emission Characteristics in diesel engines. Issues & limitation in Vegetable Oils

UNIT III HYDROGEN AS ENGINE FUEL

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

UNIT IV BIOGAS, NATURAL GAS AND LPG AS FUELS

Biogas, Natural gas and LPG – Properties and production methods. CO₂ and H₂S scrubbing in Biogas, Modifications required for use in Engines- Performance, combustion and emission Characteristics in engines. Issues & limitation in Gaseous fuels.

UNIT V HYBRID AND ELECTRIC VEHICLES

Hybrid and Electric vehicle – Layout, Merits, demerits and components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. Energy regeneration. High energy and power density batteries – Introduction to PEM Fuel cell.

REFERENCES

1. Ayhan Demirbas, ‘ **Biodiesel A Realistic Fuel Alternative for Diesel Engines**’, Springer-Verlag London Limited 2008,ISBN-13: 9781846289941
2. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, **The Biodiesel Handbook**, AOCS Press Champaign, Illinois 2005.
3. Richard L Bechtold P.E., **Alternative Fuels Guide book**, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.
4. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).
5. Science direct Journals (**Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy**, etc.) on biofuels.

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**TURBO MACHINES (Elective –I)
(15D33105)**

Unit – I:

Fundamentals of Turbo machines: Classification, Applications Thermodynamic analysis; Isentropic flow, Energy transfer; Efficiencies; static and Stagnation conditions; continuity equation; Euler's flow through variable cross sectional area; unsteady flow in turbo machines.

Unit –II:

Steam Nozzles: Effect of back – pressure on the analysis; Design of nozzles.

Steam Turbines of C & C –D nozzles : Impulse Turbines: work done and velocity triangles; Efficiencies; Constant Reaction Blading; Design of blade passages, angles and height; Secondary flow; leakage losses; Thermodynamic analysis of steam turbines.

Unit – III:

Gas Dynamics: Fundamentals thermodynamic concepts; Isentropic conditions; Mach number and Area – Velocity relation; Dynamic pressure; normal shock relations for perfect gas; supersonic flow, oblique shock waves ; normal shock recovery ; detached shocks ; Aerofoil theory.

Centrifugal Compressor: Types; Velocity triangles and efficiencies; Blade passage design; Diffuser and pressure recovery; slip factor; stanitz and stodolas formulae; Effect of inlet mach number; Prewirl; performance.

Unit – IV:

Axial Flow Compressors: Flow analysis, work and velocity triangles ; Efficiencies; Thermodynamic analysis; stage pressure rise ; Degree of reaction ; stage loading ; general design, effect of velocity incidence ; performance.

Cascade Analysis: Geometry and Terminology; Blade forces, Efficiency; losses; free and forced vortex blades.

Unit – V:

Axial Flow Gas Turbines: Work done; velocity triangles and efficiencies; thermodynamic flow analysis; degree of reaction; Zweifel's relation; Design cascade analysis – Soderberg – Hawthorne – ainley-correlations; secondary flow; Free-vortex blades; Blade angles for variable degree of reaction; Actuator disc theory; stresses in blades; Blade assembling; materials and cooling of blades; performance; Matching of compressor and turbine; off-design performance.

REFERENCES:

- 1) Fundamentals of Turbo machines – Shephard
- 2) Practise on Turbomachines – G. Gopalakrishnan & D. Prithviraj, SciTech Publishers, Chennai.
- 3) Theory and practice of steam turbines – Kearton
- 4) Gas Turbines – Theory and practice – Zucrow
- 5) Elements of Gas Dynamics – Liepman and Roshkow
- 6) Elements of Gas Dynamics – Yahya
- 7) Turbines, Pumps, Compressors – Yahya
- 8) Axial Flow Compressors – Horlock.
- 9) Gas Turbines- Cohen, Roger & Sarvanamuttu

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DEPARTMENT OF MECHANICAL ENGINEERING****M.Tech - ADVANCED I.C. ENGINES****I- SEMESTER****L P C**
4 - 4**THEORY OF FUELS AND LUBRICANTS (Elective –I)
(15D33106)****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 base stocks, 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

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.

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

TEXT BOOKS:

1. Ganesan.V., “Internal Combustion Engineering”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. M.L. Mathur, R.P.Sharma “A course in internal combustion engines”, Dhanpatrai publication, 2003.
3. Obert.E.F “Internal Combustion Engineering and Air Pollution”, International book Co., 1988.

REFERENCES

1. Brame, J.S.S. and King, J.G. – Fuels – Solids, Liquids, Gaseous.
2. Francis, W – Fuels and Fuel Technology, Vol. I & II
3. Hobson, G.D. & Pohl.W- Modern Petroleum Technology
4. A.R.Lansdown – Lubrication – A practical guide to lubricant selection – Pergamon press – 1982.
5. Raymond.C.Gunther – Lubrication – Chilton Book Co., - 1971.

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**AUTOMOBILE AIR POLLUTION AND ENVIRONMENT (Elective –II)
(15D33107)**

UNIT-I

Introduction: Vehicle population assessment in metropolitan cities and contribution to pollution, effects on human health and environment, global warming, types of emission, transient operational effects on pollution.

UNIT-II

Pollutant Formation in SI Engines: Pollutant formation in SI Engines, mechanism of HC and CO formation in four stroke and two stroke SI engines, NO_x formation in SI engines, effects of design and operating variables on emission formation, control of evaporative emission. Two stroke engine pollution.

UNIT-III

Pollutant Formation in CI Engines: Pollutant formation in CI engines, smoke and particulate emissions in CI engines, effects of design and operating variables on CI engine emissions. No_x formation and control.-Noise pollution from automobiles, measurement and standards.

UNIT-IV

Control of Emissions from SI and CI Engines: Design of engine, optimum selection of operating variables for control of emissions, EGR, Thermal reactors, secondary air injection, catalytic converters, catalysts, fuel modifications, fuel cells, Two stroke engine pollution control.

UNIT-V**Measurement Techniques Emission Standards and Test Procedure:**

Orsat Apparatus, NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, emission standards, driving cycles - USA, Japan, Euro and India. Test procedures - ECE, FTP Tests. SHED Test - chassis dynamometers, dilution tunnels.

REFERENCES:

1. Paul Degobert, Automobiles and Pollution, SAE International ISBN-1-56091-563-3, 1991.
2. Ganesan, V- Internal Combustion Engines- Tata McGraw-Hill Co - 2003.
3. SAE Transactions-Vehicle Emission - 1982 (3 volumes).
4. Obert. E.F.- Internal Combustion Engines, 1988.
5. Marco Nute- Emissions from two stroke engines, SAE Publication-1998.

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**JET PROPULSION & ROCKET ENGINEERING (Elective-II)
(15D33108)**

UNIT-I**Turbo Jet Propulsion System:**

Gas turbine cycle analysis – layout of turbo jet engine. Turbo machinery- compressors and turbines, combustor, blade aerodynamics, engine off design performance analysis.

Flight Performance:

Forces acting on vehicle – Basic relations of motion – multi stage vehicles.

UNIT-II**Principles of Jet Propulsion and Rocketry:**

Fundamentals of jet propulsion, Rockets and air breathing jet engines – Classification – turbo jet , turbo fan, turbo prop, rocket (Solid and Liquid propellant rockets) and Ramjet engines.

Nozzle Theory and Characteristics Parameters:

Theory of one dimensional convergent – divergent nozzles – aerodynamic choking of nozzles and mass flow through a nozzle – nozzle exhaust velocity – thrust, thrust coefficient, A_c / A_t of a nozzle, Supersonic nozzle shape, non-adapted nozzles, summer field criteria, departure from simple analysis – characteristic parameters – 1) characteristic velocity, 2) specific impulse 3) total impulse 4) relationship between the characteristic parameters 5) nozzle efficiency, combustion efficiency and overall efficiency.

UNIT-III**Aero Thermo Chemistry of the Combustion Products:**

Review of properties of mixture of gases – Gibbs – Dalton laws – Equivalent ratio, enthalpy changes in reactions, heat of reaction and heat of formation – calculation of adiabatic flame temperature and specific impulse – frozen and equilibrium flows.

Solid Propulsion System:

Solid propellants – classification, homogeneous and heterogeneous propellants, double base propellant compositions and manufacturing methods. Composite propellant oxidizers and binders. Effect of binder on propellant properties. Burning rate and burning rate laws, factors influencing the burning rate, methods of determining burning rates.

UNIT-IV

Solid propellant rocket engine – internal ballistics, equilibrium motor operation and equilibrium pressure to various parameters. Transient and pseudo equilibrium operation, end

burning and burning grains, grain design. Rocket motor hardware design. Heat transfer considerations in solid rocket motor design. Ignition system, simple pyro devices.

Liquid Rocket Propulsion System:

Liquid propellants – classification, Mono and Bi propellants, Cryogenic and storage propellants, ignition delay of hypergolic propellants, physical and chemical characteristics of liquid propellant. Liquid propellant rocket engine – system layout, pump and pressure feed systems, feed system components. Design of combustion chamber, characteristic length, constructional features, and chamber wall stresses. Heat transfer and cooling aspects. Uncooled engines, injectors – various types, injection patterns, injector characteristics, and atomization and drop size distribution, propellant tank design.

UNIT-V**Ramjet and Integral Rocket Ramjet Propulsion System:**

Fuel rich solid propellants, gross thrust, gross thrust coefficient, combustion efficiency of ramjet engine, air intakes and their classification – critical, super critical and sub-critical operation of air intakes, engine intake matching, classification and comparison of IRR propulsion systems.

TEXT BOOKS:

1. Mechanics and Dynamics of Propulsion – Hill and Peterson
2. Rocket propulsion elements – Sutton

REFERENCES BOOKS:

1. Gas Turbines – Ganesan (TMH)
2. Gas Turbines & Propulsive Systems – Khajuria & Dubey (Dhanpatrai)
3. Rocket propulsion – Bevere
4. Jet propulsion – Nicholas Cumpsty

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4 - 4****ELECTRIC AND HYBRID VEHICLES (Elective-II)
(15D33109)****UNIT I NEED FOR ALTERNATIVE SYSTEM**

Need of electric vehicles hybrid vehicles – comparative study of diesel, petrol, pure electric and hybrid vehicles. Limitations of electric vehicles. Specification of some electric and hybrid vehicles

UNIT II ENERGY SOURCES : BATTERIES AND FUEL CELLS

Battery Parameters-Power requirement of electric vehicles- Different types of batteries - Lead acid-Nickel based-Sodium based-Lithium based- Metal Air based. Battery charging- Charger design- Quick charging devices- Battery Modeling. Different type of energy storage – Solar, wind, compressed fluid.

Fuel Cell- Fuel cell characteristics- Fuel cell types-Hydrogen fuel cell- Connecting cell in series-water management in the PEM fuel cell- Thermal Management of the PEM fuel cell

UNIT III PROPULSION MOTORS AND CONTROLLERS

Characteristic of permanent magnet and separately excited DC motors. AC single phase and 3-phase motor – inverters – DC and AC motor speed controllers.

UNIT IV VEHICLE DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES

Aerodynamic-Rolling resistance- Transmission efficiency- Vehicle mass- Electric vehicle chassis and Body design considerations- Heating and cooling systems- Controllers- Power steering- Tyre choice- Wing Mirror, Aerials and Luggage racks

UNIT V HYBRID VEHICLES

Types of Hybrid- Series, parallel, split – parallel, series - parallel - Advantages and Disadvantages. Power split device – Energy Management System - Design consideration - Economy of hybrid vehicles

TEXT BOOKS:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “ John Wiley & Sons,2003
2. Iqbal Husain, “ Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2003
3. Mehrdad Ehsani, “ Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press,2005

REFERENCES:

1. Ron HodKinson, “ light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication,2005
2. Lino Guzzella, “ Vehicle Propulsion System” Springer Publications,2005

**JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING**

M.Tech - ADVANCED I.C. ENGINES

I- SEMESTER

L	P	C
4	-	4

**PRODUCTION OF AUTOMOBILE COMPONENTS (Elective-II)
(15D33110)**

UNIT I CASTING

Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburetor and other small auto parts. Melting practice of alloys

UNIT II MACHINING

Special consideration of machining of various components such as flywheel, piston rings, bearing bushes, and liners. Machining of connecting rods - crank shaft - cam shaft - piston - piston pin - valve - front and rear axle housing - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

UNIT III FORMING PROCESS

Forging materials - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, steering column. Extrusions: Basic process steps, extrusion of transmission shaft, housing spindle, steering worm blanks, piston pin and valve tappets. Hydro forming - Process, hydro forming of manifold and comparison with conventional methods- Hydro forming of tail lamp housing - forming of wheel disc and rims. Stretch forming - Process, stretch forming of auto body panels - Super plastic alloys for auto body panels.

UNIT IV POWDER METALLURGY AND PROCESSING OF PLASTICS

Powder metallurgy process, process variables, Manufacture of friction lining materials for clutches and brakes - plastics-raw material - automobile components - molding - injection, compression and blow - PU foam molding - Machining of plastics.

UNIT V RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS

Powder injection molding - Production of aluminum MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming - Squeeze Casting of pistons - aluminum composite brake rotors. Sinter diffusion bonded idler sprocket - gas injection molding of window channel - cast con process for auto parts.

TEXT BOOK

1. Heldt.P.M., " High Speed Combustion Engines ", Oxford Publishing Co., New York, 1990.

REFERENCES

1. Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990.
2. Rusinoff, " Forging and Forming of metals ", D.B. Taraporevala Son & Co. Pvt Ltd., Mumbai, 1995.
3. Sabroff.A.M. & Others, "Forging Materials & Processes ", Reinhold Book Corporation, New York, 1988.
4. Upton, "Pressure Die Casting ", Pergamon Press, 1985.
5. High Velocity "Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990
6. HMT handbook

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DEPARTMENT OF MECHANICAL ENGINEERING****M.Tech - ADVANCED I.C. ENGINES****I- SEMESTER**

L	P	C
0	4	2

**“Performance Testing of Internal Combustion Engines” Lab
(15D33111)**

1. Heat balance sheet on comet engine
2. Performance test on NIYO engine.
3. Retardation test on Black stone engine
4. Optimum cooling water rate on Texvel engine.
5. Morse test on 4-stroke multi cylinder Ambassador Engine.
6. Performance test on the Tata-sumo engine.
7. Measurements of octane number.
8. Measurement of exhaust emission by using five Exhaust gas analyzers.

**JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
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EFFECTIVE FROM THE YEAR 2015-16

M.Tech - ADVANCED I.C. ENGINES

II - SEMESTER:

Subject Code	SUBJECT	L	P	C
15D33201	Combustion in I.C. Engines	4	-	4
15D31202	Convective Heat & Mass Transfer	4	-	4
15D31204	Advanced Fluid Mechanics	4	-	4
15D33202	Engine Emissions and Control	4	-	4
	ELECTIVE-III	4	-	4
15D33203	Super Charging & Scavenging.			
15D33204	Vehicle Maintenance			
15D33205	Engine Management Systems			
15D33206	Instrumentation and Experimental Techniques			
	ELECTIVE-IV	4	-	4
15D33207	Automotive Aerodynamics			
15D33208	Vehicle Control Systems			
15D33209	Manufacturing and Testing of I.C. Engines and Components			
15D33210	Automotive Safety			
15D54201	Research Methodology (Audit Course)			
15D33211	“Testing of Combustion & Emissions of Internal Combustion Engines” Lab	0	4	2
TOTAL		24	4	26

**JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS): ANANTAPURAMU
DEPARTMENT OF MECHANICAL ENGINEERING****M.Tech - ADVANCED I.C. ENGINES****II- SEMESTER****L P C
4 - 4****COMBUSTION IN I.C. ENGINES****(15D33201)****UNIT-I**

Combustion Principles: Thermodynamics, concepts of combustion - Combustion equations, heat of combustion Theoretical flame temperature, chemical equilibrium and dissociation. Chemical Kinetics: Theories of Combustion, Pre-flame reactions, Reaction rates, Laminar and Turbulent Flame Propagation in engines.

UNIT-II

Measurement of Thermo- Physical properties, instruments for measuring temperature, pressure and flow, use of intelligent instruments for physical variables.

UNIT-III

Combustion in S.I. Engines: Initiation of combustion, flame velocities, normal and abnormal combustion, knocking combustion, pre-ignition, knock and engine variables. Features and design consideration of combustion chambers in S.I. Engines, stratified charge combustion, concepts of lean burn engines, heat release correlations.

UNIT-IV

Combustion in C.I. Engines: Various stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl, squish, tumble flow, velocities, swirl measurement, and delay period correlations. Diesel knocks and engine variables in C.I. Engines, features and design considerations of combustion chambers, heat release correlations.

UNIT-V

Combustion in Gas Turbine Flame stability, re-circulation zone and requirements. Combustion chamber configuration, materials.

TEXT BOOKS:

1. Ramalingam, K.K., Internal Combustion Engines, Scitech Publications (India) Pvt.Ltd, 2000
3. Internal combustion engines by V . Ganesan, Tata McGraw Hill book cop. 2007
4. Mathur M.L., and Sharma, R.P., A course in Internal Combustion Engines, Dhanpat Rai Publications Pvt.

REFERENCES:

1. John B.Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Book, 1998. New Delhi -2,1993.
2. Obert, E.F.,Internal Combustion Engine and Air Pollution, International Text Books: Publishers, 1983.
3. Cohen, H,Rogers,G,E.C. and Saravanamutto, H.I.H., Gas Turbine Theory, Longman Group Ltd.,1980.
4. Khajuria & Dubey - Gas Turbines and jet Propulsive system, Dhanpat Rai Publications Pvt.Ltd., New Delhi - 2.
5. Doebelin, measurements system application and design, McGraw Hill, 1978.

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DEPARTMENT OF MECHANICAL ENGINEERING**

M.Tech - ADVANCED I.C. ENGINES

II- SEMESTER

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4	-	4

CONVECTIVE HEAT & MASS TRANSFER
(Common to R&A/C & Advanced I.C. Engines)
(15D31202)

CONVECTIVE HEAT TRANSFER:

UNIT-I

Introduction to convection, review of conservation equations - Forced convection in laminar flow - Exact and approximate solutions of Boundary layer energy equation for plane isothermal plate in longitudinal flow - problems.

UNIT-II

Forced convection heat transfer in laminar tube flow - forced convection in turbulent flow – Internal Flows-Correlations-Problems. Approximate analysis of laminar free convective heat transfer on a vertical plate-external flows-correlations-problems.

UNIT-III

Boiling and condensation: Analysis of film condensation on a vertical surface – pool boiling - forced convection boiling inside tubes - problems.

MASS TRANSFER:

UNIT-IV

Definitions of concentration and velocities relevant to mass transfer, Fick's law, species conservation equation in different forms. Steady state diffusion in dilute solutions in stationary media, transient diffusion in dilute solutions in stationary media, one dimensional non dilute diffusion in gases with one component stationary.

UNIT-V

Convective mass transfer - governing equations-forced diffusion from flat plate- Dimensionless correlation's for mass transfer. Simultaneous heat and mass transfer - analogy between heat, mass and momentum transfer.

REFERENCES BOOKS:

1. Heat transfer - J. P. Holman.
2. Heat and Mass transfer- R.C. Sachdeva
3. Convective Heat and Mass transfer-Kays.
4. Heat and Mass transfer - V.Gupta and I.Srinivasan - Tata Mc.Graw Hill

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DEPARTMENT OF MECHANICAL ENGINEERING**

M.Tech - ADVANCED I.C. ENGINES

II- SEMESTER

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**ADVANCED FLUID MECHANICS
(Common to R&A/C & Advanced I.C. Engines)
(15D31204)**

UNIT - I

Basic concepts: Continuum hypothesis – Eulerian and Lagrangian descriptions. Derivation of general differential equations – continuity momentum and energy of incompressible flow- Navier Stokes equation for Viscous Fluids (Rectangular Co-Ordinate Systems)-Euler's equations for ideal fluids-Bernoulli's equations (one dimensional) – applications

UNIT - II

Laminar Flow Viscous Incompressible Fluids: Flow similarity – Reynolds number, flow between parallel flat plates, couette-flow, plane poiseuille flow, Hagen – poiseuille flow.

Laminar boundary layer: Boundary layer concept, Prandtl's approximations, Blassius solution for a flat plate without pressure gradient – momentum integral equation – Von-Kerman integral relation – Pohlhausen method of obtaining approximate solutions. Displacement thickness, momentum thickness and energy thickness. Boundary layer separation and control, Kerman's integral equation.

UNIT - III

Introduction to turbulence: Origin of turbulence, nature of turbulent flow – Reynolds equations and Reynolds stresses, velocity profile.

Compressible Fluid Flow Basics: Mach number, Flow pattern in compressible flow, classification of compressible flow, isentropic flow, stagnation properties.

UNIT - IV

Gas Dynamics: Compressible flow through ducts and nozzles – area velocity relations. Flow through convergent and convergent divergent nozzles. Real nozzles flow at design conditions. Introduction to normal compression shock – normal shock relations. Introduction to Fanno Raleigh equations.

UNIT - V

Flow in ducts with friction: Fanno line, adiabatic constant area- Flow of perfect gas, chocking due to friction in constant area flow- Introduction to constant area flow with heat transfer (Raleigh line)

REFERENCE:

1. Yuan S.W. "Foundations of Fluid Mechanics", Prentice Hall – Eastern economy edition 1983
2. Zucrow M.J. and Hoffman J.D. "Gas Dynamics", Vol-I & Vol-II, John Wiley and Sons Inc. 1977
3. Yahya S.M. "Fundamentals of Compressible Flow", - Wiley Eastern
4. Young, Munson and Okiisiyi, " A Brief Introduction to Fluid Mechanics" 2nd Edition, John Wiley 2000.
5. Frank.M.White, " Fluid Mechanics 5th Edn – McGraw Hill 2005.

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DEPARTMENT OF MECHANICAL ENGINEERING**

M.Tech - ADVANCED I.C. ENGINES

II- SEMESTER

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**ENGINE EMISSIONS AND CONTROL
(15D33202)**

UNIT-I

Pollution - Engines and Turbines: Atmospheric pollution from piston engines and gas turbines, global warming. Pollutant Formation: Formation of oxides of nitrogen, carbon monoxide, hydrocarbon, aldehydes and Smoke Particulate emission, effects of pollutions on environment.

UNIT-II

Pollution Measurements: Non dispersive infrared gas analyzer, gas chromatography, chemiluminescent analyzer and flame ionization detector, smoke measurement, noise pollution, measurement and control.

UNIT-III

Control of Engine Pollution: Engine component, fuel modification, evaporative emission control, EGR, air injection thermal reactors, in cylinder control of pollution, catalytic converters, application of microprocessor in emission control.

UNIT-IV

Driving Cycles and Emission Standards: Use of driving cycles for emission measurement, chassis dynamometer, CVS system, National and International emission standards. Steady state and test cycle - Transient test cycle.

UNIT-V

Effect of High Pressure Injection on Soot Formation Process: High Pressure Injection - Experimental apparatus and measuring principles - Measurement of Non-Evaporating spray - Measurement of Evaporating sprays and flame. Diesel Soot Suppression: Soot Suppression by kind and content of fuel additives - Under various operating conditions - Effect of combustion chamber type and swirl ratio. Simultaneous Reduction of Soot and NO_x

TEXT BOOKS:

1. Ernest, S., Starkman, Combustion Generated Air Pollutions, Plenum Press, 1980.
2. Crouse William, Automotive Emission Control, Gregg Division 10/e, (SIE) 2006.
3. A Text Book of Air Pollution by M.N. Rao Tata McGraw Hill book cop.

REFERENCES:

1. Obert, E.F., Internal Combustion Engines and air Pollution, in text Educational Publishers, 1980.
2. George, Springer and Donald J.Patterson, Engine emissions, Pollutant Formation and Measurement, Plenum Press, 1972.
3. Satora, Yasuhiro Iton Gutaka Higuchi and Tateo Nagai, SAE - 901608.
4. SW Cootes and G.G.Lassanska, SAE - 901597.
5. G.Greeves and CHT Wang, SAE - 810260.

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M.Tech - ADVANCED I.C. ENGINES

II- SEMESTER

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**SUPER CHARGING & SCAVENGING (Elective-III)
(15D33203)**

UNIT – I

SUPERCHARGING

Objectives-Effects on engine performance-engine modification required-Thermo dynamics of Mechanical supercharging and Turbocharging-Turbocharging methods Engine exhaust manifolds arrangements.

UNIT-II

SUPERCHARGERS

Types of compressors – Positive displacement blowers – Centrifugal compressors – Performance characteristic curves – Suitability for engine application – Surging Matching of supercharger compressor and Engine Matching of compressor, Turbine Engine

UNIT-III

SCAVENGING OF TWO STROKE ENGINES

Peculiarities of two stroke cycle engines – Classification of scavenging systems-Mixture control through Reed valve induction – Charging Processes in two stroke cycle engine Terminologies-Shankey diagram-Relation between scavenging terms-scavenging terms scavenging modeling-perfect displacement, Perfect mixing-Complex scavenging models.

UNIT-IV

PORTS AND MUFFLER DESIGN

Porting – Design considerations-Design of intake and Exhaust Systems-Tuning.

UNIT-V

EXPERIMENTAL METHODS

Experimental techniques for evaluating scavenging-Firing engine tests-Non firing engine tests – Port flow characteristics-Kadenacy systems-Orbital engine combustion system, Sonic system.

REFERENCES:

1. Orbet, E.F., Internal Combustion Engines and Air Pollution, Intext Education Publishers, 1980.
2. Richard Stone, Internal Combustion Engines, SAE, 1992.
3. Vincent, E.T., Supercharging the I.C.Engine, McGraw-Hill
4. Waston, N. and Jonota, M.S., Turbocharging the I.C. Engine, MacMillan Co., 1982.
5. Schweitzer, P.H., Scavenging of Two Stroke Cycle Diesel Engine, MacMillan Co.,
6. John B.Heywood, Two Stroke Cycle Engine, SAE Publications, 1997.

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DEPARTMENT OF MECHANICAL ENGINEERING**

M.Tech - ADVANCED I.C. ENGINES

II- SEMESTER

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**VEHICLE MAINTENANCE (Elective-III)
(15D33204)**

UNIT I MAINTENANCE TOOL, SHOP, SCHEDULE, RECORDS

Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

UNIT II POWER PLANT REPAIR AND OVERHAULING

Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system,- lubrication system. Power plant trouble shooting chart.

UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS

Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems.

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY

Body panel tools for repairing. Tinkering and painting. Use of soldering, metalloid paste. Tyre maintenance, metallic, plastics

UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS 7

Care, maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

TEXTBOOK:

1. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London , 1969.
2. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi, 1986.
3. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay, 1963

REFERENCES:

1. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.
2. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953.
3. John Dolce, Fleet maintenance, Mcgraw Hill, Newyork, 1984
4. A,W.Judge, Maintenance of high speed diesel engines, Chapman Hall Ltd., London, 1956.
5. V.L.Maleev, Diesel Engine operation and maintenance, McGraw Hill Book CO., Newyork, 1995.
6. Vehicle servicing manuals.
7. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B. Taraporevala

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DEPARTMENT OF MECHANICAL ENGINEERING**

M.Tech - ADVANCED I.C. ENGINES

II- SEMESTER

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**ENGINE MANAGEMENT SYSTEMS (Elective-III)
(15D33205)**

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

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

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

Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Electronically controlled Unit Injection system. Common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve.

UNIT V DIGITAL ENGINE CONTROL SYSTEM

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.

TEXT BOOKS:

1. Understanding Automotive Electronics William B Ribbens, SAE 1998
2. Automobile Electronics by Eric Chowanietz SAE

REFERENCES:

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

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DEPARTMENT OF MECHANICAL ENGINEERING****M.Tech - ADVANCED I.C. ENGINES****II- SEMESTER****L P C
4 - 4****INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES (Elective-III)****(15D33206)****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 TRANSDUCERS, 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

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

I.S Code for Engine testing – Instrumentation for performance testing of engine, Instrumentation for Research and development, Instrumentation for noise, vibration, in cylinder gas flow, flame temperature Dynamic Cylinder pressure measurements.

UNIT V VEHICLE EXPERIMENTAL TECHNIQUES

Laboratory tests- test tracks - Endurance Tests- crash tests- wind tunnel tests- Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations. Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements.

TEXTBOOK:

1. J.G. Giles, 'Engine and Vehicle Testing', Illiffe books Ltd., London,1968.
2. T.G. Beckwith and Buck, 'Mechanical Measurements', Oxford and IBH Publishing House, New Delhi, 1995

REFERENCES

1. A.W. Judge, 'Engineering Precision Measurement', Chapman and Hall Ltd, Essex Street W.C.,1951,
2. D.Patambis, 'Principle of Industrial Instrumentation', Tata McGraw Hill Publishing Co, New Delhi, 1990.
3. Rangan, Sharma and Mani, 'Instrumentation Devices and systems', Tata McGraw Hill Publishing Co., Ltd., 1990

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DEPARTMENT OF MECHANICAL ENGINEERING**

M.Tech - ADVANCED I.C. ENGINES

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**AUTOMOTIVE AERODYNAMICS (Elective-IV)
(15D33207)**

UNIT I INTRODUCTION

Scope – historical development trends – Fundamentals of fluid mechanics – Flow phenomenon related to vehicles – External & Internal flow problems – Resistance to vehicle motion – Fuel consumption and performance – Significance of vehicle aerodynamics.

UNIT II AERODYNAMIC DRAG OF CABS

Car as a bluff body – Flow field around car – drag force – types of drag force – analysis of aerodynamic drag – drag coefficient of cars – strategies for aerodynamic development – low drag profiles.

UNIT III SHAPE OPTIMIZATION OF CABS

Front end modification – front and rear wind shield angle – Boat tailing – Hatch back, fast back and square back – Dust flow patterns at the rear – Effect of gap configuration – effect of fasteners

UNIT IV VEHICLE HANDLING

Force and moments – Origin, calculation, effects and characteristics. Side wind problems – vehicle dynamic under side winds – Dirt accumulation on the vehicle – wind noise – drag reduction in commercial vehicles.

UNIT V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS

Principles of wind tunnel technology – Types, Stress with scale models – full scale wind tunnels – measurement techniques – Equipment and transducers – road testing methods. Introduction to CFD.

TEXTBOOK:

1. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co. Ltd., 4th Edition, SAE 1998.

REFERENCES:

1. Pope, A, Wind Tunnel Testing, John Wiley & Sons, 2nd Edn., New York, 1994.
2. Automotive Aerodynamics: Update SP-706, SAE, 1987.
3. Vehicle Aerodynamics, SP-1145, SAE, 1996.

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DEPARTMENT OF MECHANICAL ENGINEERING**

M.Tech - ADVANCED I.C. ENGINES

II- SEMESTER

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**VEHICLE CONTROL SYSTEMS (Elective-IV)
(15D33208)**

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

Speed control – cylinder cut - off technology, Gear shifting control – Traction / braking control, brake by wire – Adaptive cruise control, throttle by wire. Steering - power steering, collapsible and tilt table steering column – steer by wire.

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.

TEXT BOOKS:

1. U. Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer-Verlag, 2000.
2. Ljubo Vlacic, Michel Parent, Fumio Harashima, “Intelligent Vehicle Technologies”, Butterworth-Heinemann publications, Oxford, 2001.

REFERENCES:

1. Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9th edition, TMH, New Delhi, 2002.
2. William B. Ribbens - Understanding Automotive Electronics, 5th edition, Butter worth Heinemann Woburn, 1998.
3. Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.
4. Internet References

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DEPARTMENT OF MECHANICAL ENGINEERING****M.Tech - ADVANCED I.C. ENGINES****II- SEMESTER**

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**MANUFACTURING AND TESTING OF I.C. ENGINES AND COMPONENTS
(Elective-IV)
(15D33209)****UNIT-I****CYLINDER BLOCK AND CYLINDER HEAD**

Casting practice and special requirements, materials, machining, methods of testing.

UNIT-II**PISTON ASSEMBLY**

Types, requirement, casting, forging, squeeze casting, materials, machining, testing, manufacture and testing of fuel and ignition system, bimetallic pistons, articulated pistons.

UNIT-III**CONNECTING ROD, CRANKSHAFT AND CAMSHAFT**

Requirements, materials, forging practice, machining, balancing of crankshaft, testing, Manufacturing of fuel system parts such as carburetor, gasoline injection system and diesel injection parts.

Unit-IV**COMPUTER INTEGRATED MANUFACTURING**

Integration of CAD, CAM and Business function CIM – Networking, CNC Programming for machining of I.C. Engines Components.

Unit-V**QUALITY AND TESTING**

Introduction to ISO 9000, ISO 14000, QS9000. its importance, BIS codes for testing various types of engines, equipments, required, instrumentation, computer aided engine testing, metrology for manufacturing I.C. Engine Components

REFERENCES :

1. Grover, M.P., CAD/CAM, Prentice Hall of India Ltd., 1985.
2. Heldt, P.M.High speed internal combustion engines, Oxford & IBH Publishing Co., 1960.
3. Judge, A.W. Testing of High speed internal combustion engines, Chapman & Hall., 1960.
4. Richard, W., Heine Carl R.Loper Jr.and Philip, C., Rosenthal, Principles of Metal Casting, McGraw Hill Book Co., 1980.

5. IS: 1602 – 1960 Code for testing of variable speed internal combustion engines for Automobile Purposes, 1966.
6. SAE Handbook, 1994.
7. P.Radhakrishnan and S.Subramaniayn, CAD/CAM/CIM, New Age International(P) Limited Publishers, 1977.
8. Mikett P.Groover, Automation, production systems and Computer-integrated Manufacturing Printice Hall of India Private Limited, 1999.

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DEPARTMENT OF MECHANICAL ENGINEERING****M.Tech - ADVANCED I.C. ENGINES****II- SEMESTER**

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**AUTOMOTIVE SAFETY (Elective-IV)
(15D33210)****UNIT I INTRODUCTION**

Automotive safety – Introduction, Types. Active safety: driving safety, conditional safety, perceptibility safety, operating safety- Passive safety: exterior safety, interior safety-Advantages

UNIT II PASSIVE SAFETY CONCEPTS

Design of body for safety, engine location, deceleration of vehicle, passenger compartment, deceleration on impact with stationary and movable obstacles. Deformation behavior of vehicle body. Concept of crumple zone, Safety Cage.

UNIT III PASSIVE SAFETY EQUIPMENTS

Regulations, Seat belt, automatic seat belt tightener system and importance , collapsible steering column, tiltable steering column with advantages , air bags, Designing aspects of automotive bumpers and materials for bumpers.

UNIT IV ACTIVE SAFETY AND CONVENIENCE SYSTEM

Antiskid braking system, Secondary braking system. Stability Control. Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system, manual and automated wiper system, Driver alertness detection system.

UNIT V VEHICLE INTEGRATION AND NAVIGATION SYSTEM

Intelligent vision system, Adaptive cruise control, Warning systems, Collision Avoidance systems Vehicle Network system. Global Positioning System. Road Network, Navigation System. Telematics.

TEXT BOOK:

1. Bosch, “Automotive HandBook”, 6th edition, SAE, 2004.

REFERENCES:

1. J.Powloski - “Vehicle Body Engineering” - Business books limited, London - 1969.
2. Ronald.K.Jurgen - “Automotive Electronics Handbook” - Second edition- McGraw-Hill Inc., - 1999.
3. ARAI Safety standards

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DEPARTMENT OF MECHANICAL ENGINEERING****M.Tech - ADVANCED I.C. ENGINES****II- SEMESTER****L P C
0 4 2****“Testing of Combustion & Emission of Internal Combustion Engines” Lab
(15D33211)**

1. Performance test on computer controlled single cylinder 4 – stroke Diesel engine test rig.
2. Performance test on P- θ Diagram on computer controlled single cylinder 4- stroke Diesel Engine.
3. Heat balance sheet on Computerized controlled – stroke diesel Engine.
4. P-V Diagram on computerized controlled single cylinder 4 – stroke Engine.
5. Performance test on 2 – stroke reciprocating Air compressor.
6. Engine performance characteristics on Anil engine.
7. Performance test on Black stone Engine.
8. Valve timing Diagram on 2-stroke C.I. Engine.