SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with "A" Grade by NAAC
Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119.
Phone: 044 - 2450 3150 / 51 / 52 / 54 / 55 Fax: 044 - 2450 2344
www.sathyabama.ac.in

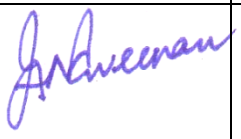
QUALITY SYSTEM CERTIFICATION DNV·GL ISO 9001:2015

SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF AUTOMOBILE ENGINEERING

BOARD OF STUDIES MEETING HELD ON 29.10.2018

Members present:

External Members	Signature	Internal Members	Signature
Dr.G.Sathiyaseelan General Manager-Ashok Leyland- External Member		Dr.S.Prakash Dean/School of Mechanical Engineering	
Mr.A.J.Naveenan Lawrence Chief training officer TVS Training and services Ltd Chennai		Dr.V.K.Bupesh Raja, Head/Automobile Engineering	
Er. Dinesh Deenadayalu (Alumni) Procurement Consultant Altron Deutschland S.A.S.& Co.KG, U.K		Dr.A.Karthikeyan Professor/ Automobile Engineering	

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Minutes of the Board of Studies meeting

Board of Studies meeting for the Department of Automobile Engineering held on 29th october 2018 with the following agenda:

1. Discussion on New Curriculum Structure for 2019 Regulations
2. Inclusions or exclusions of courses in the revised B.E Automobile Engineering.
3. Inclusions or exclusions of contents of the courses in the revised B.E Automobile Engineering.

Welcome Address

Dr.V.K.Bupesh Raja welcomed the members of BoS and placed the agenda for the deliberations of the members. The following decisions were made as per the items of the circulated agenda.

Agenda1: Discussion on New Curriculum Structure for 2019 Regulations

With reference to the regulation 2015, the following discussions are made for the new curriculum design – Regulations 2019

- No Credit for Environmental Sciences and Engineering course to be provided in the R2019 Curriculum. The total credits for Humanities and Social Sciences category subjects will be increased from six (6) to Nine (9).
- The total credits may be limited to 26 for Basic Science Course Category
- The total credits may be limited to 24 for Engineering Science Course Category
- The total Credits may be limited to 54 for Professional Core course category
- Two more courses (3 credits each) can be included in the Professional Elective Course Category

- Three (3) Credits to be provided for Mathematics 1 to Mathematics 4 courses. Total credits for Mathematics courses are 12.
- Reduce the credits for Project and Professional Training from 25 to 15.
- Project work to be started in the 7th semester, so Project credit of 10 should be split as 3 (for 7th sem) and 7 (for the 8th sem). This will facilitate projects to turn into publications and patents.
- Three Credits (3) for Professional Training and Two Credits (2) for Placement Training (Mandatory for all Students).
- All Lab Courses / Component credits to be increased from 1.5 to 2 Credits.
- The total credits should be in the range of 160 to 165 as per the new guidelines
- No Credit for Induction Programme / Indian Constitution / Essence of Indian tradition
- Comply with AICTE Norms

Agenda 2: Inclusions or exclusions of courses in the revised B.E Automobile Engineering Syllabus

Dr.G.Sathiyaseelan emphasized the need to introduce two separate courses namely Automotive petrol Engines and Automotive Diesel Engines instead of Automotive Engines course in the syllabus in order to impart in-depth knowledge on engines.

Dr.G.Sathiyaseelan also suggested shifting of Hybrid and Electric Vehicles course from elective to core course category since it is an emerging technology and shall be useful for placement.

As per the inputs received from Alumni, Finite element analysis course is introduced as core course as some foreign universities made it mandatory for admission to master degree.

As prescribed by AICTE the credits in the new curriculum are reduced from 195 to 165. In this context as per the suggestions received from faculty members, the following courses were ratified without any lacuna in contents of curriculum

i. Strength of materials, and Fluid mechanics and machinery course contents are consolidated into a single course titled Solid and Fluid mechanics.

ii. Engineering thermodynamics and Thermal Engineering course contents are consolidated into a single course titled Applied Thermodynamics.

iii. Kinematics of Machines and Dynamics of machines course contents are consolidated into a single course titled Mechanics of machines.

As suggested by Mr.A.J.Naveenan Lawrence the laboratory course tilted "Fuels, lubricants and Engine testing lab" is reframed into two individual lab courses namely, Fuels and lubricants lab and Thermal Engineering lab. This shall facilitate in-depth understanding of the core concepts. He also emphasized the need to introduce computer aided design lab in first semester.

Agenda3: Inclusions or exclusions of contents of the courses in the B.E-Automobile Engineering Syllabus

Mr.A.J.Naveenan Lawrence emphasized to include Alternate fuels topics in the syllabus of the course titled "Fuels and lubricants"

Dr.G.Sathiyaseelan suggested modifying the syllabus of the course titled "Vehicle dynamics" so as to include the major topics vertical, Lateral and longitudinal dynamics.

Dr.G.Sathiyaseelan also suggested modifying the syllabus of the course titled "Heat and mass transfer" so as to include the topics relevant to engine heat transfer. Further he suggested reframing the title of the course as "Heat transfer applied to I.C engines".(Annexure-1)

Vote of Thanks

Dr.S.Prakash thanked the expert members for accepting the invitation for attending the BOS meeting in a short notice. He thanked them for their valuable suggestions on the agenda items presented. He also thanked Dr.V.K.Bupesh Raja, Professor and HoD, Dr.A.Karthikeyan, Professor for their contribution towards the conduct of this BOS meeting.

SAUA1201	MATERIALS AND MESEAUREMENTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the design, selection and processing of materials for a wide range of applications in
- engineering and other applications
- To understand how and why the properties of materials are controlled by structure and bonding at the atomic
- scale and by features at the microscopic and macroscopic levels.
- To understand how and why the structure and properties of a material may be controlled by processing.
- To understand the basic principles of measurements
- To learn the various linear and angular measuring equipments, their principle of operation and applications.

UNIT 1 INTRODUCTION TO MATERIALS **9 Hrs.**

Basic Principles: Crystal structure: BCC –FCC –HCP –Methods to determine crystal structure – Atomic radius – Atomic Packing Factor – Allotropy –Solid solutions, Intermetallic compounds, Atomic Diffusion – Laws of diffusion –Factors affecting diffusion. Phase diagrams: Solidification of metals, phase rules, construction of phase diagram, Isomorphous diagram, Eutectic diagram showing partial solid solubility, Peritectic system.

UNIT 2 FERROUS AND NON – FERROUS ALLOYS **9 Hrs.**

Iron – Iron carbide equilibrium diagram, Cooling curves of pure Fe, Critical points in Fe – Fe3C equilibrium diagrams, Steels – types of plain carbon steels, stainless steels – their typical compositions, properties and applications, effects of alloying elements on steel, IS designation of steels – Cast iron and its types – their typical compositions, properties and applications. Aluminium and its alloys, Ti & its alloys, Nickel & its alloys – Composition, Properties & applications.

UNIT 3 HEAT TREATMENT OF STEEL **9 Hrs.**

Annealing – Full annealing – Stress relief – Recrystallization – Spheroidizing, Normalizing, Hardening, Tempering, Austempering, Martempering – Hardenability and its determination, TTT diagram and CCT diagram. Case hardening techniques - Carburizing, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening, Age hardening, Precipitation hardening

UNIT 4 INTRODUCTION TO METROLOGY AND LINEAR MEASUREMENT **9 Hrs.**

Accuracy, precision, resolution and sensitivity of measuring instruments, classification of errors in measurements, alignment errors. Linear Measuring Instruments – Evolution – Types – Classification – gauge design – concepts of interchangeability and selective assembly – Comparators, slip gauges – Types – Angular measuring instruments – Sine bar, angle gauges, autocollimator, angle dekkor, tool maker's microscope, Bevel protractor, clinometers, spirit levels– Alignment telescope – Applications, Surface roughness measurement.

UNIT 5 TEMPERATURE, FLOW AND ADVANCED MEASUREMENT TECHNIQUES **9 Hrs.**

Temperature – thermo couple, RTD, thermistor-electrical resistance thermometer- pyrometers. Flow – Turbine type flow meter, magnetic flow meter, ultra sonic flow meter, thermal flow meter and hot wire anemometer. : Venturimeter, Orifice meter, Rotameter, Pitot tube – Temperature: bimetallic strip. Interferometry – laser interferometers – types – applications – Computer Aided Inspection-Basic concept of Coordinate Measuring Machines(CMM)– Types of CMM – Constructional features–Probes– laser interferometer, working principle, applications, alignment and errors; Machine Vision, elements of vision system, applications in manufacturing.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire knowledge of physical and mechanical properties of materials including heat treatment, destructive and non-destructive testing of materials.

CO2 - Recognize and state the Iron-Carbide phase diagram and TTT Diagrams sufficiently to visualize them in discussions of heat treatment of steels and cast irons.

CO3 - Select appropriate materials for specific engineering applications considering manufacturing and working conditions

CO4 - Describe structures of metallic materials and their effects on mechanical properties

CO5 - Understand the significance of measurement system, errors.

CO6 - Check alignment of various components in various mechanisms using advanced measurement tools.

TEXT / REFERENCE BOOKS

1. Avener S.H, "Introduction to Physical Metallurgy", 2nd Edition, McGraw Hill, Indian Edition, 2017.
2. Raghavan V, "Material Science and Engineering", 5th Edition, Prentice Hall, 2005.
3. William D Callister "Material Science and Engineering", John Wiley and Sons 2007.
4. Khurmi.R.S, Sedha R.S, "Material Science", 4th Edition, S.Chand & Co., 2009
5. Dieter.G.E, "Mechanical Metallurgy", 3rd Edition, McGraw Hill, 1988.
6. Beckwith T.G. and Marangoni, "Mechanical Measurements", Addison Wesley, 2000.
7. Gupta I C, "Text Book of Engineering Metrology", Dhanpat Rai Publishers, 2003.

8. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each - No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SMEA2101	COMPUTER AIDED DESIGN LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To gain practical experience in engineering modeling through computer aided systems.
- To understand the functioning of 2D drafting and 3D modeling software systems.

INTRODUCTION TO CAD

Basics, Fundamentals of feature-based modeling

TWO DIMENSIONAL OBJECTS

Create basic drawing objects: Points, Lines, Circles, Arcs, Planes and their combinations.
Layout and sketching
Setup a drawing with correct scales. Draw with precision using Coordinate input and object Snaps,
Isometric drawings, Orthographic projections, Auxiliary views.
Dimensioning, Dimension styles
Various other AutoCAD commands and relevant keyboard shortcuts

THREE DIMENSIONAL OBJECTS

Creating and editing 3D solid objects.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - Understand the fundamentals of computer aided design.
CO2 - Implement their knowledge in designing a model.
CO3 - Understand the various limits and tolerances.
CO4 - Understand various dimensioning styles.
CO5 - Implement their knowledge to model various 2D and 3D models.
CO6 - Understand various commands and keyboard shortcuts for faster modelling skills.

SAUA1301	APPLIED THERMODYNAMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basic concepts of thermodynamics
- To understand the air standard cycles and working principles of four stroke and stroke engines
- To familiarize with the types of air compressors and their working principle
- To understand the working principles of refrigeration and air conditioning systems

UNIT 1 FIRST LAW OF THERMODYNAMICS **9 Hrs**.

Concepts - concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics - concept of temperature and heat. Concept of ideal gas. First law of thermodynamics - application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNIT 2 SECOND LAW OF THERMODYNAMICS **9 Hrs**.

Second law of thermodynamics - Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed Carnot cycle, efficiency, COP, Clausius inequality, concept of entropy, change of property of ideal gas, principle of increase of entropy.

UNIT 3 GAS POWER CYCLES AND INTERNAL COMBUSTION ENGINES **9 Hrs.**

Air standard cycles - Otto, Diesel and Dual cycles. Derivation of expression for air standard efficiency and mean effective pressure .IC Engines- Introduction-Classification, Comparison between four stroke and two stroke, petrol & diesel engines Performance testing on internal combustion engines, Performance curves.

UNIT 4 AIR COMPRESSORS **9 Hrs.**

Positive displacement compressor - reciprocating air compressor, work done, volumetric efficiency, Effect of clearance volume- for qualitative treatment- rotary compressors - vane type, roots blower-centrifugal compressor

UNIT 5 REGRIGERATION AND AIR CONDITIONING **9 Hrs**.

Simple vapour compression refrigeration cycle, cycle with superheat & subcooling, Performance calculations, Working principle of basic vapour absorption system (Qualitative treatment only). Psychrometry and psychrometric properties, Psychrometric processes, Air conditioning systems- winter and summer. (Qualitative treatment only).

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the thermodynamic systems and thermodynamic properties.
CO2 - Apply first law of thermodynamics in engineering applications.
CO3 - Understand the second law of thermodynamics and concept of entropy.
CO4 - Analyze gas power cycles and develop understanding of I.C engines.
CO5 - Analyze the performance of reciprocating and rotary compressors.
CO6 - Understand the concepts of refrigeration cycles and air conditioning systems.

TEXT / REFERENCE BOOKS

1. Nag P.K., "Engineering Thermodynamics", Tata McGraw Hill Education, 2009.
2. Yunus A. Cengel, Michael A. Boles, "Thermodynamics: An Engineering Approach", McGraw Hill Education, 2014.
3. Rajput R.K., "Thermal Engineering", Laxmi Publications, 2010.
4. Khurmi R.S., Gupta J.K, "Thermal Engineering", S Chand, 2006.
5. P.L. Ballaney,"Thermal Engineering", Khanna Publisher, 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each - No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SAUA1302	AUTOMOTIVE PETROL ENGINES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn the fundamental principles and operation of Engine.
- Understand SI engine fuel feed system.
- Understand the ignition system in SI Engine
- Gain knowledge on cooling and lubrication system in SI Engine
- Understand the combustion system in SI Engines.
- Understand the abnormal combustion in SI engine

UNIT 1 ENGINE CONSTRUCTION AND OPERATION **9 Hrs.**

Constructional details of four stroke petrol engine, working principle, air standard Otto cycle, actual indicator diagram, fuel air analysis, two stroke engine construction and operation, comparison of four stroke and two stroke engines operation, firing order and its significance. Theoretical and actual Port Timing, Valve Timing of petrol engines.

UNIT 2 SI ENGINE FUEL SYSTEM **9 Hrs.**

Carburetor working principle, requirements of an automotive carburetor, Solex, S.U, Carter carburetor. starting, idling, acceleration and normal circuits of carburetors. Compensation, maximum power devices, constant choke and constant vacuum carburetors, fuel feed systems; mechanical and electrical fuel feed pumps. Petrol injection, GDI, MPFI.

UNIT 3 IGNITION SYSTEM **9 Hrs.**

Types and working of battery coil and magneto ignition systems, relative merits and demerits, centrifugal and vacuum advance mechanisms. Types and construction of spark plugs, electronic ignition systems- Transistorized coil ignition system Capacitive discharge ignition system.

UNIT 3 COOLING AND LUBRICATION SYSTEM **9 Hrs.**

Need for cooling system, Types of cooling system: air cooling system, liquid cooling system, Comparison, forced circulation system, pressure cooling system. Lubrication system- Requirements, mist, wet sump lubrication system, properties of lubricants.

UNIT 4 COMBUSTION AND COMBUSTION CHAMBERS **9 Hrs.**

Combustion in SI engine; stages of combustion, flame propagation, rate of pressure rises, abnormal combustion, detonation, effect of engine variables on knock, knock rating. Combustion chambers; different types, factors controlling combustion chamber design.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the operational principle of two stroke & four stroke engine and recall the Otto cycle process in details
CO2 - Explain the SI engine fuel feed system.
CO3 - Explain the battery, magneto & electronic ignition system in SI engine.
CO4 - Explain the principle of cooling & various lubrication system in SI engine.
CO5 - Analyse the combustion phenomena in SI engine & explain types of SI engine combustion chamber.
CO6 - Analyse the effect of engine variables on knocking in SI engine.

TEXT / REFERENCE BOOKS

1. Ganesan V, “Internal Combustion Engines”, 4th Edition, Tata McGraw Hill Publication, 2017.
2. Rajput R. K, “A textbook of Internal Combustion Engines”, 3rd Edition Laxmi Publications, 2016.
3. Mathur and Sharma “Internal Combustion Engines” “Dhanpat Rai and Sons Publication, 2012.
4. John B. Heywood, “Fundamentals of Internal Combustion Engine, 2nd Edition, McGraw Hill Education; 2018.
5. Heinz Heisler, “Advanced Engine Technology“, 2nd Edition SAE Publication, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 2 Questions from each unit, each carrying 2 marks **20 Marks**

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

SAUA1304	SOLID AND FLUID MECHANICS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To familiarize with the behaviour of structural components under different loading conditions
- To understand effect of component dimensions and shape on stresses and deformations.
- To understand fluid properties, flow characteristics and basic governing equations-mass, momentum, energy.
- To understand the analysis of rotor dynamic machines and Velocity Triangles.

UNIT 1 STRESS STRAIN AND DEFORMATION OF SOLIDS, STATES OF STRESS **9 Hrs.**

Rigid bodies and deformable solids - stability, strength, stiffness - tension, compression and shear stresses - strain, elasticity, Hooke's law, limit of proportionately, modules of elasticity, stress-strain curve, lateral strain - temperature stresses deformation of simple and compound bars - shear modulus, bulk modulus, relationship between elastic constants - bi axial state of stress - stress at a point - stress on inclined plane - principal stresses and principal planes – Mohr's circle of stresses

UNIT 2 BENDING AND SHEAR STRESS DISTRIBUTION, TORSION AND BEAMS **9 Hrs.**

Stresses in Beams - Simple bending theory - Composite Beams - Combined bending and Direct stress – Shear stress distribution for Rectangular and I section - Simple Torsion theory - Stresses and deformations in Solid and Hollow circular shafts- Double integration method - Macaulay's method - Moment area method - Conjugate method for simply supported and cantilever beams, (only point loads & Uniformly distributed loads.)

UNIT 3 FLOW THROUGH ORIFICE AND PIPE **9 Hrs.**

Flow through orifices: Classification - Hydraulic co-efficient - Flow through rectangular orifice, Notches and weirs. Laminar and Turbulent flow: Reynolds experiment - Major and minor losses in pipes - Darcy Weisbach's equation, Chezy's formula - pipes in series and pipes in parallel - total energy line - hydraulic gradient line - Equivalent pipe

UNIT 4 FLUID PROPERTIES & EQUATIONS OF MOTION **9 Hrs.**

Fluid Properties: Density - Specific Weight - Specific Gravity - Viscosity - Surface tension - Capillarity - compressibility. Fluid Statics: Hydrostatic Law - Pressure Variation in static fluid - Hydrostatic force on submerged plane-surfaces - Location of hydrostatic force. Manometers - Simple U tube and differential manometers - Buoyancy - Meta-centric height - determination of stability of floating bodies and submerged bodies- Basic equations of motion: Types of fluid flow - Continuity, momentum and energy equations - Euler's and Bernoulli's Equation and its applications.-Flow Measurement: Orifice meter, Venturi meter, Piezometer, Pitot Tube.

UNIT 5 PUMPS & TURBINES **9 Hrs.**

Centrifugal Pumps: Definition - Operations - Velocity Triangles - Performance curves - Cavitations - Multistaging. Reciprocating Pumps: Operation - Slip - indicator Diagram - Separation - Air vessels. Hydraulic Turbines: Classification of hydraulic turbines - Working principle of Pelton wheel, Francis and Kaplan turbines - velocity triangles - draft tube - hydraulic turbine characteristics. Dimensional Analysis: Buckingham's Theorem, Non-Dimension Numbers, Similarities of Flow- Model studies

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze material strength using Stress-Strain relationships.
CO2 - Aquire knowledge about principal stress and strain
CO3 - Analyze Beam strength using Shear Force and Bending Moment Diagram.
CO4 - Acquire knowledge on properties of fluids.
CO5 - Understand the concept of kinematics and dynamics of fluids
CO6 - Understand the concept of incompressible flow

TEXT / REFERENCE BOOKS

1. Cengel,Y.A. ,Fluid mechanics: fundamentals and applications, McGraw Hill Publishing, New Delhi, India, 2006.
2. Rajput.R.K. "Strength of Materials", 4th Edition, S.Chand & Co., New Delhi, 2002.
3. Khurmi, R.S, "Strength of Materials", 23rd Edition, S.Chand & Co, 2008.
4. Bansal.R.K,. "Fluid Mechanics & Hydraulics Machines", 9th Edition, Laxmi Publications, 2005.
5. Kumar K. L., "Engineering Fluid Mechanics", 8th Edition, Eurasia Publication, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Mark: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each- No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks **80 Marks**

SAUA1401	AUTOMOTIVE DIESEL ENGINES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Understand the diesel engine construction and its operation.
- Understand the fuel injection system in CI Engine.
- Gain knowledge on air motion & combustion phenomena in CI Engine.
- Understand turbo charging and engine management system in IC Engines.
- Understand CI engine performance.
- Understand the principle of modern engine technology.

UNIT 1 BASIC THEORY **9 Hrs.**

Diesel engine construction and operation, two stroke and four stroke diesel dual cycle engines, diesel cycle, fuel-air and actual cycle analysis, diesel fuel, ignition quality, cetane number, laboratory tests for diesel fuels, standards and specifications.

UNIT 2 FUEL INJECTION SYSTEM **9 Hrs.**

Requirements, air and solid injection, functions of components, jerk and distributor type pumps common rail system, PTFI system pressure waves, injection lag, unit injector, mechanical and pneumatic governors, fuel injector, types of injection nozzle, nozzle tests, spray characteristics, injection timing, pump calibration.

UNIT 3 AIR MOTION, COMBUSTION AND COMBUSTION CHAMBER **9 Hrs.**

Importance of air motion, swirl, squish and turbulence, swirl ratio, fuel air mixing, stages of combustion, delay period, factors affecting delay period, knock in CI engines. Combustion chamber: design requirements, direct and indirect injection combustion chambers, M type combustion chamber.

UNIT 4 AUXILLARY SYSTEM **9 Hrs.**

Necessity and limitations, types of supercharging and turbocharging, relative merits, matching of turbocharger, exhaust gas recirculation, charge cooling. Introduction to engine electronics, Engine Management systems, Types of Sensorspiezoelectric, thermistor, hot wire, vortex, Exhaust oxygen, knocking sensor

UNIT 5 PERFORMANCE TESTING AND MODERN ENGINE TECHNOLOGY **9 Hrs.**

Necessity and limitations, charge cooling, basic performance parameters, performance characteristics, factors affecting performance characteristics, performance maps - CI engines, heat balance test, morse test, introduction to modern engine technologies - lean burn engines, stratified charged engines, low heat rejection engines, homogeneously charged compression ignition engines engine management systems.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the operational principle of CI engine and recall the Diesel cycle & Dual cycle in detail.
CO2 - Explain the working principle of fuel injection pump, governor in CI engine.
CO3 - Analyse the combustion phenomena in CI engine & explain types of CI engine combustion chamber.
CO4 - Explain the principle of turbocharging, Engine management systems.
CO5 - Analyse the performance characteristic of IC engine.
CO6 - Familiarize with modern engine technologies.

TEXT / REFERENCE BOOKS

1. Ganesan V, “Internal Combustion Engines”4th edition, Tata McGraw Hill publication 2017.
2. Rajput R. K, “A textbook of Internal Combustion Engines”, Third editionLaxmi Publications, 2016.
3. Mathur and Sharma “Internal Combustion Engines” “Dhanpat Rai and Sons Publication, 2012
4. John B. Heywood, “Fundamentals of Internal Combustion Engine, 2nd edition, McGraw-Hill Education; 2018.
5. Heinz Heisler “Advanced Engine Technology", 2nd edition SAE Publication, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each- No choice **20 Marks**

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

SMEA1402	MECHANICS OF MACHINES	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Provide the insights of the fundamentals of knowledge Mechanisms and Cams.
- Provide basic of Flywheels and Balancing of Rotating and Reciprocating unbalance systems.
- Enhance knowledge in fundamentals of Single degree Free and Damped Vibrations.
- Provide the detailed overview of Forced Vibrations.
- Discuss the fundamentals of Gears, Gyroscopes and Governors.

UNIT 1 MECHANISMS AND CAMS **9 Hrs.**

Mechanisms – Terminology and definitions – Kinematics inversions of 4 bars and slider crank chain – Kinematic analysis in simple mechanisms. Types of cams and followers - Terminology and definitions – Displacement diagrams – SHM, uniform velocity, uniform acceleration and retardation. Graphical constructions of cam profiles – Disc cam with knife edge follower, roller follower and flat-faced follower.

UNIT 2 FLY WHEELS AND BALANCING **9 Hrs.**

Turning moment diagrams – Fluctuation of Energy and speed – Energy stored in Flywheel – Mass of Flywheel – Dimensions of Flywheel. Balancing – Static and Dynamic Balancing of Rotating Masses - Balancing of several masses rotating in same plane and in different planes- Partial Balancing of locomotives – Variation of tractive force, Hammer blow and swaying couple.

UNIT 3 FUNDAMENTALS OF VIBRATION **9 Hrs.**

Basic features of vibratory systems - Lumped mass systems - Degrees of freedom - Free vibration of Longitudinal, Transverse and Torsional systems of Single degree of freedom - Equations of motion - Natural frequency – Whirling of shafts and critical speed - Dunkerley's Method – Torsional vibration of Two and Three rotor system. Damped free vibration - Types of Damping –Critical damping coefficient - Damping Factor – Logarithmic Decrement.

UNIT 4 FORCED VIBRATION **9 Hrs**

Forced vibration of single degree freedom system with damping - Response to periodic forcing- Harmonic Forcing - Force transmissibility and amplitude transmissibility - Reciprocating and rotating unbalance - vibration isolation and transmissibility - Support motion - self excited vibration with examples.

UNIT 5 GEARS, GOVERNORS AND GYROSCOPES **9 Hrs.**

Spur gear terminology – law of toothed gearing – Involutes gearing – Path of contact, arc of contact and contact ratio. Interchangeable gears – Gear tooth action – interference and undercutting – Gear trains – Epicyclic gear train – tabular method of finding velocity ratio. Governors - Types - Centrifugal governors – Porter– Characteristics –Sensitivity – Stability – Hunting – Isochronisms – equilibrium speed - Controlling Force- Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Aeroplanes.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamentals of Mechanisms and Cams.
CO2 - Understand the basic of Flywheels, balancing of Rotating and Reciprocating unbalance systems.
CO3 - Conceive the fundamentals of Single degree Free and Damped Vibrations.
CO4 - Conceive the fundamentals of Forced Vibrations.
CO5 - Apply the fundamentals of Gears.
CO6 - Apply the fundamentals of Gyroscopes, Governors.

TEXT / REFERENCE BOOKS

1. Khurmi R.S& Gupta J.S, "Theory of Machines", 16th Edition, S.Chand & Company, 2005, Reprint 2016.
2. Singh V.P, "Mechanical Vibrations", 3rd Edition, Dhanpatrai & Co., 2006.
3. Ghosh A. and Malik A.M, "Theory of Mechanism and Machines", 4th Edition, Affiliated East West Press (P) Ltd. 2009.
4. Ashok G. Ambekar, "Mechanism and Machine Theory", First Edition,PHI Learning Private limited, 2009.
5. Rattan S. S, Theory of Machines, 3rd Ed., Tata Mcgraw Hill, 2009.
6. Gordon R Pennock, Joseph E Shigley, "Theory of Machine and Mechanisms SI Edition, 4th Edition, Oxford University Press, 2014

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 2 Questions from each unit, each carrying 2 marks **20 Marks**

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

SAUA2301	FUELS AND LUBRICANTS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To gain in depth knowledge of properties of fuels and lubricants
- To impart the skill of testing fuels and lubricants for their properties using various testing equipments.

SUGGESTED LIST OF EXPERIMENTS

1. Study of International and National standards for fuels and lubricants.
2. Study of Octane and Cetane Number of fuels.
3. ASTM distillation test of liquid fuels
4. Aniline point test of diesel.
5. Calorific value of liquid fuel.
6. Calorific value of gaseous fuel.
7. Reid vapour pressure test.
8. Flash and fire points of petrol and diesel.
9. Copper strip corrosion Test
10. Cloud & pour point Test.
11. Temperature dependence of viscosity of lubricants & fuels by Redwood Viscometer.
12. Viscosity Index of lubricants & fuels by Saybolt Viscometer.
13. Ash content and carbon residue Test.
14. Drop point of grease and mechanical penetration in grease.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the International and National standards for fuels and lubricants.
CO2 - Understand distillation of liquid fuels.
CO3 - Understand the different properties of fuels and lubricants.
CO4 - Determine the properties of fuels and lubricants using various testing equipments.
CO5 - Analyze important fuel and lubricant properties for the application in specific conditions.
CO6 - Compare the values of important physical properties of fuels and lubricants.

SAUA2401	THERMAL ENGINEERING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To conduct experiments and report result on I.C. Engine performance.
- To understand the importance of heat balance sheet in I.C. Engines.
- To study the performance of Refrigeration cycle

SUGGESTED LIST OF EXPERIMENTS

1. Valve timing diagram of a four stroke engine, Port timing diagram of a two stroke engine.
2. Performance test on a four stroke diesel engine.
3. Heat balance test on a four stroke diesel engine.
4. Performance test on a multi cylinder diesel engine
5. Performance characteristics of a two stroke petrol engine.
6. Performance characteristics of a four stroke multi -cylinder petrol engine.
7. Determination of mechanical efficiency using retardation test.
8. Determination of indicated power of multi cylinder petrol engine - Morse test.
9. Determination of mechanical efficiency using negative horse power method
10. Performance test on refrigeration test rig
11. Performance test on air-conditioning test rig

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Demonstrate the significance of valve timing and port timing in I.C. Engine working.
CO2 - Calculate performance parameters I.C. Engines by conducting experiments.
CO3 - Develop heat balance sheet for I.C.Engine.
CO4 - Determine the friction power of I.C Engine.
CO5 - Determine indicated power of multi cylinder petrol engine.
CO6 - Estimate the COP of vapour compression refrigeration cycle.