FACULTY OF ENGINEERING

Scheme of Instruction & Examination

and

Syllabi

B.E III Year

of

Four Year Degree Programme

in

Mechanical Engineering

(With effect from the academic year 2016-17)

(As approved in Faculty Meeting held on 18 June 2016)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad

SCHEME OF INSTRUCTION & EXAMINATION

B.E. III YEAR

(MECHANICAL ENGINEERING)

SEMESTER – I

Sl. No.	Course Code	Course Title	Scheme of Instructions		Scheme of Examination		
			Periods per Week		Duration in Hours	Maximum Marks	
			L	T/D/P		Sessionals	University Exams
1.	ME 301	Applied Thermodynamics	4	-	3	25	75
2.	ME 302	Dynamics of Machines	4	1	3	25	75
3.	ME 303	Design of Machine Elements	4	-	3	25	75
4.	ME 304	Hydraulic Machinery & Systems	4	-	3	25	75
5.	ME 305	Manufacturing Processes	4	-	3	25	75
6.	ME 331	Thermodynamics Lab.	-	3	3	25	50
7.	ME 332	Hydraulic Machinery & Systems Lab.	-	3	3	25	50
8.	ME 333	Manufacturing Processes Lab.	-	3	3	25	50
		Total	**20**	**10**		**200**	**525**

L – Lecture, T – Tutorial, D – Drawing, P - Practical

ME 301

APPLIED THERMODYNAMICS

Instruction per Week	:	4 Periods
Duration of University Examination	:	3 Hours
Sessionals	:	25 Marks
University Examination	:	75 Marks

Course Objectives:

1. To familiarize with the types of air compressors, working principle of two stroke & four stroke IC engine
2. To know combustion phenomena in IC engine & various ignition systems and testing of IC engine
3. Analyze different types of steam cycles and estimate efficiency in a steam power plant

UNIT-I

Reciprocating Air Compressors: Uses of compressed air, Classification of compressors-single stage and multistage compressors, Derivation of work done with and without clearance volume, Work done of multistage compressors-effect of clearance volume on work done -Inter-cooling and After-cooling

UNIT-II

Internal Combustion Engines: Classification, working principle, Deviation of actual cycles from air standard cycles, Index of compression and expansion for variable specific heats, Battery and Magneto ignition systems, Multipoint fuel injection system, Lubrication systems, Cooling systems, Carburetors-Simple and Zenith carburetors-Valve and Port-timing diagrams. Performance of I.C. engines-Methods for Determination of Indicated power, brake power, frictional power, brake thermal efficiency, mechanical efficiency, indicated thermal efficiency, relative efficiency, and volumetric efficiency, specific fuel consumption based on brake power and indicated power, Wilson line, Heat balance sheet.

UNIT-III

Combustion & Combustion chambers of IC Engine: Introduction, Homogenous mixture, Heterogeneous mixture. Combustion in SI engine, stages of combustion in SI Engine. Factors influencing flame speed, abnormal combustion. Phenomena of knock in SI engine. Effects of engine variables on knock. Combustion in CI Engine, stages of combustion in CI engine, Factors effecting delay period. Phenomena of knock in CI engine. Combustion chambers for SI & CI engine. Air pollution, Effects and control of Exhaust.

UNIT-IV

Steam Boilers: Classification of boilers-Fire tube boilers- Cochran boiler, Locomotive boiler, Water tube boilers-Babcock and Wilcox boiler, super critical boilers-Benson, Fluidized bed combustion boilers, Boiler mountings and accessories. Boiler performance and boiler draught-Chimney design, Condition for maximum discharge Types of condensers Jet and Surface condensers, introduction to cooling towers.

UNIT-V

Steam power plant: Layout, Working Carnot and Rankin cycles, cycle analysis, Modified Rankin cycle, Cycle efficiency improvement methods, Reheating, Regeneration and Cogeneration.

Steam nozzles: Types of nozzles, Nozzle efficiency, Velocity of steam flowing through the nozzle. Mass of steam discharged from the nozzle, Condition for maximum discharge, Critical pressure ratio. Diameters of nozzle throat and exit for maximum discharge.

Suggested Reading:

1. Heywood. J.B, *"Internal Combustion Engine Fundamentals* ", Tata McGraw Education Pvt. Ltd., New Delhi 2011.
2. Chattopadhyay, "Engineering Thermodynamics" Oxford University Press, New Delhi, 2015
3. Ganeshan.V, *"Internal Combustion Engines*", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. Ballaney. P.L, *"Thermal Engineering"*, Khanna Publishers, New Delhi, 2010.
5. Rajput. R. K, *"Thermal Engineering"* Laxmi Publishers, New Delhi, 2004.
6. Mahesh M Rathor, *"Thermal Engineering"* Tata McGraw Education Pvt. Ltd., New Delhi 2010.

E 302

DYNAMICS OF MACHINES

Instruction per Week	:	4 Theory + 1Tutorial
Duration of University examination:	:	3 Hours
Sessionals	:	25 Marks
University Examination	:	75 Marks

Course Objectives:

1. To know effect of inertia of links, and external forces on the input torque, and forces developed at joints in typical mechanisms in motion; understand the gyroscopic couple and its effect on vehicles in motion.
2. To know the working principles and characteristics of typical governors, as also the function of flywheels
3. To know he concept of unbalance and methods of balancing rotating and reciprocating masses in single and multi-cylinder in-line and radial engines.
4. To understand the phenomena of free and forced, including the effect of damping for single d.o.f systems, and concepts of isolating vibration
4. To determine natural frequencies of undamped, damped and forced vibrating systems of one, two and multi degree freedom systems.

UNIT-I

Static and Dynamic Force Analysis: Force analysis of four bar and slider crank mechanisms. Study of Dynamically Equivalent system. Inertia forces on connecting rod.

Gyroscope: Gyroscopic couple, gyroscopic effects in vehicles.

UNIT-II

Governors: Classification of governors, Watt, Porter, Hartnell and Hartung governors, Controlling Force, Stability, Isochronism, Sensitivity, Power and Effort of governors.

Flywheels: Functions, Differences between flywheel and governor. Turning moment diagrams, flywheel analysis for I-C Engines and presses.

UNIT-IÍI

Balancing of Forces: Forces on bearings due to rotating shaft carrying several masses in several planes. Determination of balance masses from the forces on the bearings, Shaking forces in single cylinder engine, Partial balancing of reciprocating engine. Balancing of two cylinder locomotive engine. Balancing of multi cylinder in line engines. Balancing of radial engines by direct and reverse cranks method.

UNIT-IV

Vibrations: Vibrations of Single degree, freedom system (axial, transverse and torsional), Equivalent system of combination of springs, Stepped shaft, Whirling speed of shafts.

Damped vibrations: Types of damping, Vibrations with viscous damping.

Forced vibrations: Vibrating with harmonically applied force with viscous damping. Dynamic magnifier, Resonance, Vibration isolation and Transmissibility.

UNIT-V

Vibration Analysis of Multi Degree Freedom Systems: Torsional Vibrations of Two rotor, three rotor and Geared systems. Natural frequencies of two degree freedom systems. Modes of vibration. Approximate methods for determining natural frequencies: Dunkerley's method, Rayleigh's method and Holzer's method for multi rotor system.

Suggested Reading:

1. S.S. Rattan, *Theory of Machines*, McGraw Hill, 2010..
2. Thomas Bevan, *The Theory of Machines,* CBS Publishers & Distributors, 2004.
3. John J.Uicker, Jr., Gordon R. Pennock, Joseph E.Shigley, *Theory of Machines and Mechanisms,* Oxford University Press, 2003.
4. I.S. Rao and Gupta, T*heory and Practice of Mechanical Vibrations,* Prentice Hall, 1984.
5. R.L.Nortan, "Kinematics and Dynamics of Machinery", Tata McGraw Education Pvt.Ltd, New Delhi, 2009.
6. Ghosh and Mallik, *Theory of Mechanisms nd Machines,* Affiliated Est-West Press, 1988.

ME 303

DESIGN OF MACHINE ELEMENTS

Instruction per Week	:	4 Periods
Duration of University Examination	:	3 Hours
Sessionals	:	25 Marks
University Examination	:	75 Marks

Course Objectives:

1. To understand the basics of mechanics of materials and design of a machine for static and fatigue strength, rigidity and wear criterions, use of codes and standards.
2. To know the principles of ergonomic design and use of theories of failure for safe design.
3. To learn the principles to design shafts, keys, belt drives, joints and couplings.

UNIT-I

Design considerations of Machine Elements: Materials used in machine design and their specifications according to Indian Standards. Codes and standards used in design. Important mechanical properties of materials used in design. Preferred numbers. Manufacturing considerations in design. Review of types of loads and simple stresses. Stresses due to Biaxal and Triaxal loads. Factor of safety. Theories of failures. Design of components subjected to impact loading.

UNIT-II

Design for Fatigue: Fluctuating stresses, fatigue strength and endurance limit, Stress concentration factor and Notch sensitivity. Factor effecting fatigue strength. S-N diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue – Miner's rule.

UNIT-III

Design of shafts: Solid, hallow and splined shafts under torsion and bending loads. Design of keys.

Design of couplings – Muff, Split muff, Flange, Flexible, Marine type co ıplings.

UNIT-IV

Design of Joints: Cotter and Knuckle joints. Design of bolts and nuts, Locking devices for nuts, Bolts of uniform strength. Bolted joints under eccentric loads. Design of gasket joints.

Chain drives: Design of chains drives.

Pulleys: Design of Pulleys.

UNIT-V

Design of Screws: Design of Power screws and screw jack. Differential and Compound Screws.

Riveted & Welded Joints: Design of riveted and welded joints under direct and eccentric loads.

Suggested Reading:

1. M.F. Spotts, *Design of Machine Elements,* Pearson Edu, 7th Ed. 2003.
2. V.B. Bhandari, *Machine Design,* Tata McGraw – Hill Publ, 2010.
3. P.C. Sharma & D.K. Aggarwal, *Machine Design,* S.K. Kataria& Sons, 10th ed, 2003.
4. P. Kannaiah, *Machine Design,* Scu-Tech Publ., 2009.
5. J.E..Shigley & Charles R. Mischke, *Mechanical Engineering Design,* Tata McGraw-Hill, 6th ed., 2010.

ME 304

HYDRAULIC MACHINERY AND SYSTEMS

Instruction per Week	:	4 Periods
Duration of University Examination	:	3 Hours
Sessionals	:	25 Marks
University Examination	:	75 Marks

Course Objectives:

1. To learn the Fluid properties and fundamentals of Fluid statics and fluid flow
2. To introduce the concepts of flow measurements and flow through pipes
3. To introduce the concepts of fluid flow to solve fluid flow problems
4. To understand working principle of various hydraulic devices.

UNIT-I

Hydraulic Machines: Classification– Impulse momentum equation– Layout of hydraulic power plant – Working principle - Impact of jets on Flat & Curved plates – Force exerted by a jet striking on a i) Fixed:-flat, Curved plates(Symmetrical & Un Symmetrical) ii) Moving:-Flat, Hinged & Curved Plates (Symmetrical & Un Symmetrical).

UNIT-II

Reciprocating Pumps: Classification, working principle-single and double acting pumps-discharge, work done and power required to drive the pumps-slip, % slip and negative slip- variation of pressure head in the suction and delivery pipes due to acceleration of piston- variation of pressure head due to friction in the suction and delivery pipes. Indicator diagrams- Ideal and actual diagrams. Effect of piston acceleration and pipe friction on indicator diagram- Maximum speed at which the pump must run to avoid separation during suction and delivery strokes-Air vessels-Function of air vessels- Work saved by fitting air vessels to single and double acting pumps – Discharge of liquid into and out of air vessels-Performance characteristic curves.

Other types of pumps: Working principles and characteristics of gear pump and jet pump.

UNIT-III

Centrifugal pumps: Classification – Working principle – Comparison over reciprocating pumps, Velocity triangles, Manometric head – Work done per second – Head equivalent of work done – Manometric, mechanical and overall efficiencies – Pressure rise in the impeller. Minimum starting speed – Specific speed – Physical significance of specific speed – Model testing – Conditions of similarity of CF pumps – Priming – Performance characteristic curves – Troubles (operational difficulties), reasons and remedies in CF pumps – Cavitation – Effects of Cavitation – Precautions against Cavitation,

UNIT-IV

Hydraulic Turbines: Classification of impulse and reaction turbines – Construction and working of Pelton wheels, Francis turbine and Kaplan turbine – Velocity triangles – Work done (power developed) – Hydraulic, Mechanical and Overall efficiencies – Maximum efficiency – Comparison between Impulse and reaction turbines – Comparison between Francis and Kaplan turbines – Specific speed – Physical significance of specific speed – Unit quantities – Model testing of turbines – Conditions for similarity of turbines – Draft tubes – functions and types of draft tubes – Surge tanks – Functions and types of surge tanks – Performance characteristic curves.

UNIT-V

Industrial Hydraulics: Basic components of hydraulic circuits; Properties and types of hydraulic oils; Working principles of external Pumps - gear, lobe, vane, radial piston and axial piston; Construction details and actuating methods of sliding spool directional control valves. Specification of D.C. valve; Working of - flow control, pressure relief, pressure reducing and sequencing valves; Working and construction details of single acting and double acting actuator and hydraulic motor; Symbolic representation of various components; Circuit for control of single & double acting actuators; Regenerative circuit; Speed control methods of actuators: meter-in, meter-out, and bleed off; Working of various servo systems-hydro

mechanical, hydraulic – hydraulic, electro hydraulic; Construction details of oil reservoir and selection criteria for pumps and actuators.

Suggested Reading:

1. Bansal, R.K., *"A text book of Fluid Mechanics and Hydraulic Machines"*, Laxmi Publication (P) Ltd., New Delhi, 2004
2. Modi, P.N., and Seth, S.M., "*Hydraulic and Fluid Machines*", Standard Book House, New Delhi, 2004
3. Ramamrutham, S., *"Hydraulics, Fluid Mechanics and Fluid machines"*, Dhanpat Rai & Sons, New Delhi, 2004
4. Kumar, D.S, *"Fluid Mechanics and Fluid Power Engineering"*, S.K. Kataria & Sons, 2008
5. Majumdar, S.R., *"Oil Hydraulic Systems – Principles and Maintenance"*, Tata McGrawHill, 2004, New Delhi.
6. Kaleem Khan, : Fluid mechanics and machinery", Oxford University Press, 2015

ME 305

MANUFACTURING PROCESSES

Instruction per Week	: 4 Periods
Duration of University Examination	: 3 Hours
Sessionals	: 25 Marks
University Examination	: 75 Marks

Course Objectives:

1. To understand the basic principles of the major manufacturing processes such as metal casting, welding and forming of engineering materials
2. To know the advantages and limitations of each process.
3. To be able to select the optimal process to produce a product.
4. To know the basic principles of advanced forming processes.

UNIT-I

Casting Process : Casting terms, pattern materials, types of patterns, pattern allowances, colour code for patterns, Moulding sands, core sands, properties of moulding sand and its ingredients, different types of moulding machines, Directional solidification, use of chaplets, chills, riser and gating design.

UNIT-II

Special Casting Processes: Shell moulding, Co_2 moulding, die casting, centrifugal casting, investment or lost wax process; Casting defects, causes and remedies, Inspection and testing of casting.

Processing of Plastics: Extrusion, Injection moulding, Blow moulding and Thermoforming, Introduction to Ceramics and MEMS.

UNIT-III

Welding Processes: Introduction, Classification of welding processes, Principle of Gas welding, equipment and techniques, Types of flames and applications, advantages, limitations and applications of gas welding; Arc welding- equipment, electrode materials and specifications, polarity, types of arc welding- SMAW, SAW,

GMAW, GTAW, , Atomic hydrogen welding, principle of Electro slag welding; Soldering and Brazing, Gas cutting.

Advanced Welding Processes: Laser beam welding, Electron beam welding, PAW and Ultrasonic welding.

UNIT-IV

Solid State Welding Processes - Forge welding, Friction welding, Friction stir welding and Explosive welding

Resistance welding processes - Spot welding, Seam welding, Projection welding, percussion welding, Butt welding, weldability, Welding defects.

UNIT-V

Forming Processes: Cold & Hot working, Yield criteria, Process description of Forging, Rolling, Extrusion, Wire drawing.

Sheet Metal Operations: Blanking, Piercing, Bending, Deep drawing, Stretch forming, Spinning.

Introduction to unconventional forming processes: Explosive forming, Electro-magnetic forming, Electro-hydraulic and rubber pad forming.

Suggested Reading:

1. P.N.Rao, "*Manufacturing Technology*," Vol. 1, Tata McGraw Hill Publ., 3nd Ed., 2011.
2. Amitabh Ghosh & Mallick, "*Manufacturing Science*", Assoc. East west Press Pvt. Ltd. 4th Ed., 2011.
3. Roy A. Lindberg, "*Materials & Process of Manufacturing*", Prentice Hall of India, 5th Ed.l992.
4. Serope Kalpakjian, "*Manufacturing Engineering and Technology*", Addison, Wesley Publishing Company, 2006
5. George.E. Dieter, "*Mechanical Metallurgy*", SI Metric Edition McGraw-Hill Book Company
6. Pakirappa, "Production Technology", Durga Publishing House, Hyderabad

ME 331

THERMODYNAMICS LAB.

Instruction per Week	:	3 Periods
Duration of University Examination	:	3 Hours
Sessionals	:	25 Marks
University Examination	:	50 Marks

Course Objectives:

1. To provide knowledge in testing of properties of fuels and lubricating oils
2. To demonstrate and conduct experiments, interpret and analyze data and report results of IC engine testing

List of Experiments:

1. To determine volumetric efficiency, isothermal efficiency and mass flow rate of a two stage reciprocating air compressor.
2. To determine valve/ port timing diagram of a Petrol/Diesel engine.
3. To conduct performance test on single cylinder Diesel engine.
4. To conduct heat balance test on a Diesel engine.
5. To conduct Morse test on multi cylinder Petrol engine.
6. To conduct performance test on multi cylinder Petrol engine.
7. To conduct performance test on a two-stroke Petrol engine.
8. To conduct performance test on multi cylinder Diesel engine.
9. To study the performance of a Petrol engine under different compression ratios.
10. Exhaust gas analysis of Petrol engine for carbon-monoxide and unburnt hydrocarbons.
11. Exhaust gas analysis of Diesel engine for carbon deposits using smoke meter.
12. Determination of viscosity of lubricating oil.
13. Determination of flash and fire points of a fuel.
14. Study of IC Engine parts by using Cut Sections.
15. Study of boilers by using models.

Note: Minimum 12 experiments are to be conducted in a semester

Suggested Reading:

1. Ganeshan.V, *"Internal Combustion Engines"*, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
2. Ballaney. P.L, *"Thermal Engineering"*, Khanna Publishers, New Delhi, 2010.
3. Rajput. R. K, *"Thermal Engineering"* Laxmi Publishers, New Delhi, 2004.

ME 332

HYDRAULIC MACHINERY AND SYSTEMS LAB

Instruction per Week	:	3 Periods
Duration of University Examination	:	3 Hours
Sessionals	:	25 Marks
University Examination	:	50 Marks

Course Objectives:

1. To provide knowledge on performance testing and drawing characteristic curves of various pumps.
2. To provide knowledge on performance testing and drawing characteristic curves of various Turbines 3) to provide knowledge on hydraulic & pneumatic circuits

List of Experiments:

1. Determining the coefficient of discharge of venturimeter, orificemeter.
2. Performance and characteristic curves of reciprocating pump.
3. Performance and characteristic curves of centrifugal pump.
4. Performance and characteristic curves of self priming pump.
5. Performance and characteristic curves of gear pump
6. Impact of jet on fixed flat vanes and curved vanes
7. Performance and characteristic curves of Pelton wheel
8. Performance and characteristic curves of Francis Turbine
9. Performance and Characteristic curves of Kaplan turbine.
10. Study of hydraulic circuits
11. Study of pneumatic circuits.
12. Study of positive displacement and roto dynamic pumps with the help of models.

Suggested Reading:

1. Bansal, R.K., *"A text book of Fluid Mechanics and Hydraulic Machines"*, Laxmi Publication (P) Ltd., New Delhi, 2004
2. Modi, P.N., and Seth, S.M., *"Hydraulic and Fluid Machines"*, Standard Book House, New Delhi, 2004
3. Majumdar, S.R., *"Oil Hydraulic Systems – Principles and Maintenance"*, Tata McGrawHill, 2004, New Delhi.

ME 333

MANUFACTURING PROCESSES LAB.

Instruction per Week	:	3 Periods
Duration of University Examination	:	3 Hours
Sessionals	:	25 Marks
University Examination	:	50 Marks

Course Objectives:

1. To gain knowledge and skill in various manufacturing processes such as casting, welding and forming.
2. To understand and perform operations like pattern making, sand testing and casting.
3. To join metal pieces by various welding techniques and gain hands on experience.
4. To understand the working principle and produce some components by various metal forming techniques.

List of Experiments:

Foundry

1. Single piece pattern making with wood as material considering allowances (Draft, Shrinkage and Machining)
2. Testing of green sand properties
3. Green sand mould making processes with complete sprues, gates, riser design.
4. Melting and casting of aluminum metal

Welding

I. Evaluation of strength and hardness of a

1. Butt joint prepared by gas welding using different types of flames.
2. Lap joint by resistance welding process
3. V-joint by Arc welding process

II. Exercises using TIG and MIG welding processes

Forming

1. Evaluation of formability using Erichsen cupping test
2. Performing wire drawing operation on different materials (ex. Cu, Al etc)
3. Performing blanking and piercing operations using hydraulic / fly presses
4. Manufacturing of a simple component using Plastic Injection moulding machine

Suggested Reading:

1. P.N.Rao, "*Manufacturing Technology*," Vol. 1, Tata McGraw Hill Publ., 3nd Ed., 2011.
2. Serope Kalpakjian, "*Manufacturing Engineering and Technology*", Addison, Wesley Publishing Company, 2006
3. Harvey D Miner and John G Miller, "Exploring pattern making & Foundry ", East West Press Pvt. Ltd, New Delhi