University of Engineering & Technology Taxila

Mechanical Engineering Department

Scheme of Studies for 7th Semester

Course No.	Course Title	Credit hours		Marks	
		Part I	Part II	Part I	Part II
ME-401	Internal Combustion Engines	2	1	100	50
ME-402	Mechanical Vibration	3	1	100	50
ME-403	Refrigeration & Air-conditioning	3	1	100	50
ME-404	Industrial Engineering-II	2	1	100	50
ME-405	Advanced Manufacturing System	2	1	100	50
Total		12	5	500	250
Term Total for Part-I & II		17		750	

Time Table for 7th Semester

Monday	Tuesday	Wednesday	Thursday	Friday	
7th Semester (2009).w.e.f 03/09/2012					
Section A-A1(01-37), A2(39-75), A3(77-115), A4(117-onwards)					
1-3(MV / R&AC) A1 / A2 4-6 (MV / R&AC) A3 / A4 4-6 (ICE) A1 / A2	1-3 R&AC 4-5 ICE 6-7 IE II	1-3 (ICE) A3 / A4 4-5 I&C	1-3 (IE II / I&C) A1 / A2 4-6 (IE II / I&C) A3 / A4	1-3 MV	
Section B-B1(02-32,42,111,113,142), B2(34-72), B3(74-110), B4(112-onwards)					
1-3 (ICE) B1 / B2 1-3 (IE II / I&C) B3 / B4 4-6 (IE II / I&C) B1 / B2	1-2 IE II 3-4 I&C 6-7 ICE	1-3 R&AC 4-6 ICE B3/B4	1-3 (MV / R&AC) B1 / B2 4-6 (MV / R&AC) B3 / B4	4-6 MV	

Proposed Curriculum for 7th Semester by PEC

➤ Internal Combustion Engines:

Engine classification, Combustion reaction of engine fuels, real engine cycle. Working principles of SI and CI engines, Ignition delay and combustion phases of SI and CI engines. Testing and performance characteristics of petrol and diesel engines under variable condition of load and speed. Knocking characteristics, Octane and Cetane numbers, engine valve timing and ignition advance and retard, Pressure-crank angle diagram. Working principle of turbo- charged engine, its performance characteristics and comparison with naturally aspirated engine of equal power. Engine emissions and their control through in cylinder and out-cylinder techniques. Exhaust gas recirculation (EGR) system. Thermal reactor and catalytic converters. Trade off of NOx and HC emissions. Fuel injected petrol engine and its performance, advantages over conventional petrol engine. Engine performance under part cut-out conditions and fuel savings Introduction to duel fuel / multi fuel engines, CNG engines. Engine lubrication and lubricants, fuel additives.

Classification, configuration and working principles of IC Engines.

Analysis of Intake and Exhaust. Measurement of fuel and air consumption, volumetric efficiency, super-charging, effect of air-fuel ratio and compression ratio on engine power & efficiency, pumping work, effect of residual gases on intake temperature, injection of fuel, carburetors/fuel injector, ignition system development, exhaust gas analysis and air pollution, control of exhaust gas contents, energy emissions.

Fuels and Combustion. Gasoline characteristics, alcohol refining and octane & cetane rating, diesel fuel oil classification, gas turbine & jet fuel, additives, combustion equation, CNG. Theoretical flame temperature, reaction rate and flame propagation, methods of igniting fuel, auto ignition, knock and the engine variable detonation, combustion theories, ignition delay, chemical equilibrium and dissociation, energy charts for unburned air mixtures, stratified charge engine, combustion chamber requirement.

Lubricants. Engine lubrication systems, additives for lubricants.

Engine Characteristics. Valve timing, torque & mean effective pressure, comparison of real cycles with the ideal cycle, indicated power, brake power, specific fuel consumption, heat balance sheet, relation between indicated thermal efficiency and load, SI & CI engines comparison, speed and load control in SI & CI engine, high output engines, and turbocharged engines.

Recommended Books

1. Internal Combustion Engine Fundamentals **2nd Edition** *By J.B.Heywood* McGraw Hill
2. Introduction to I. C. Engines **3rd Edition** By Richard StonePalgrave Macmillan
3. Internal combustion engines By C-F Taylor. MIT Press

➤ Instrumentation & Control:

Instrumentation & Measurementation:- Significance of measurement, planning of experiments, general measurement system, calibration, static and dynamic measurement sensitivity, range, accuracy precision, repeatability, and uncertainty of instruments, measurement errors.

Instruments for measurement of length, force, torque, frequency, pressure, flow and temperature.

Introduction to data acquisition through computers. A/D and D/A converters.

Control Engineering:- Basic Concepts. System, control system, input, output, open-loop and closed loop control systems, elements of a general control system, examples of control system.

Mathematical Modeling of Physical System. Free body diagram and Newton's law of motion, operational notation, grounded chair representation, series parallel laws, equations of motion for spring mass damper systems, levered system, rotational system, geared system, electrical components and R.L.C circuits, electrical analogies for mechanical systems, scale factors, thermal systems and fluid system.

Transfer Functions and Systems Response. Review of Laplace transform, impulse, step and ramp functions, concept of transfer functions of common components, block diagram algebra, signal flow graphs, impulse, step, and ramp response of first and second order systems, characterization of response (time constant, gain, overshoot, rise time, setting time, steady state error, etc.) relation of system response to location of system poles and zeros.

Stability of Control System. Concept of stability, Routh Hurwitz criterion.

Root locus Methods and its Use in Control System Design

Introduction to Digital Control

Recommended Books

1. Measurement Systems Applications and Design, by E. Doeblin, McGraw Hill
2. Theory and Design for Mechanical Measurements, by R. Figliola, And D.Beasley, John Wiley.
3. Automatic Control, by Francis H. Raven
4. Modern Control System, by Richard C. Dorf
5. Automatic Control, by J.J Distofano et al.
6. Automatic Control Systems, by B. B. Kuo

➢ Industrial Engineering II:

Operations Functions: Historical Evolution of Production and Operations Management (P.O.M). Production vs Service. A system View, Strategic Management Contemporary P.O.M Role of Models in P.O.M. Productivity Improvement

Product and Process Design: Product Life Cycle, Design Procedure, Choice of Technology, Equipment Selection Procedure. Learning Curves. Forecasting the Production Levels. Useful Forecasting Models. Capacity Planning. Expansion of Productive Systems.

Industrial Management: Labour Relations. Salary and Wages. Industrial Safety and Environment.

Production Planning & Control: Fundamentals. Mathematical Models. Make vs Buy. Inventory Control Practices. Aggregate Planning. Disaggregation Project Management Operations Scheduling Performance Measures for Shop Floor Control, Dispatching Rules. Requirement Planning MRP-II.

Modern Trends: Just In Time (JIT) and Group Technology (GT) Japanese P.O.M. Automated Factories of Year 2000.

Recommended Books

1. Production & Operations Management (5th Ed.) By: Everett E. Adam, Jr. and Ronald J. Ebert
2. Analysis and Control of Production System By: Elashed and Boucher.
3. Production and Operations Management (2nd Ed.) By: Thoums and McClain (Prentice Hall)

➢ Refrigeration & Air Conditioning:

Brief History of Refrigeration, the refrigeration cycle, Air Cycle and Heat Pumps, Reverse Carnot cycle, the vapor-compression cycles, coefficient of performance, introduction to pressure-enthalpy charts. Refrigerants. Components of a refrigerating system, leakage, domestic and commercial applications. Air cycle refrigeration, Steam jet refrigeration, Vapor absorption refrigeration, Low temperature refrigeration and their applications. Psychometry, basic airconditioning processes, load calculation, systems of air conditionings, humidification & economics of system dehumidification, humidifiers, air distribution systems, insulation materials. Industrial air-conditioning.

Recommended Books

1. Refrigeration and Air Conditioning by : W.F. Stoecker & Jones
2. Refrigeration and Air Conditioning by K. L. Dossat
3. Refrigeration and Air-conditioning by Arora

➢ Mechanical Vibrations:

Oscillatory motion. Harmonic motion, periodic motion, vibration terminology.

Free vibrations. Equation of motion, energy method, viscously damped free vibration, logarithmic decrement, harmonically excited vibration, forced harmonic vibration, vibration isolation, vibration measuring instruments.

Single degree of freedom systems. Equation of motion: Newton's method, energy method, undamped free vibration, viscously damped free vibration, logarithmic decrement, harmonically excited vibration, vibration isolation, vibration measuring instruments.

Two degree of freedom system. Normal modes of vibration, coordinate coupling, forced harmonic vibration, vibration absorber, vibration damper. Orthogonality.

Vibration of Elastic Bodies. Free and forced vibration of cables and uniform bars, free and forced lateral vibrations of simply supported thin beams, torsional vibration of circular shafts with single rotor and two rotors, critical speed of rotating shafts.

Finding natural frequencies: Rayliegh method and Holzer method.

Measurement of Vibrations.

Recommended Books

1. Mechanical Vibrations : Theory & Applications 5th Edition by W.T. Thompson [Prentice Hall]
2. Mechanical Vibrations by S. S. Rao 3rd Edition. [McGraw Hill]
3. Elements Of Vibration Analysis by L. Meirovitch, McGraw Hill 2001
4. Vibrations for Engineers by Andrew Dimargonas, Prentice Hall 1996

THIS COURSE CONTENT HAS BEEN TAKEN FROM:
- Curriculum of Mechanical Engineering (2003), HEC Pakistan
- Revised Curriculum of Mechanical Engineering (2008), HEC Pakistan
- Courses of Reading for B.Sc. Mechanical Engineering (1996), FM&AE, UET Taxila

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Have a Salubrious semester ahead.
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