JABALPUR ENGINEERING COLLEGE, JABALPUR (MP)
(An Autonomous Institute of Govt. of M.P.)

Affiliated to Rajiv Gandhi Technological University, Bhopal (MP)
Scheme of Study and Examination (w.e.f. July 2010)

B.E. Third Year   **Branch : Mechanical Engineering**   **Sem :Sixth**

Course Code	Subject	L	T	P	TA	CT	TOTAL	ESE	SUB TOTAL	Credits
					SESSIONAL EXAM					
ME-23A	Internal Combustion Engine	3	1	-	10	20	30	70	100	4
ME-35	Power Plant Engineering	3	1	-	10	20	30	70	100	4
ME-39	Heat & Mass Transfer	3	1	-	10	20	30	70	100	4
ME-41	Operation Management	3	1	-	10	20	30	70	100	4
ME-42	Metal Cutting & CNC Machines	3	1	-	10	20	30	70	100	4
(PRACTICAL/DRAWING/DESIGN)										
ME-24L	Internal Combustion Engine Lab	-	-	2	20	-	20	30	50	2
ME-40L	Heat & Mass Transfer Lab	-	-	2	20	-	20	30	50	2
ME-43L	Metal Cutting & CNC Machines Lab	-	-	2	20	-	20	30	50	2
ME-44L	Minor Project	-	-	2	20	-	20	30	50	2
ME-45L	Computer Aided Engg.			2	50	-	50	-	50	2
ME-66L	Seminar/Group Discussion			2	50	-	50	-	50	2
	Total	**15**	**5**	**12**	**230**	**100**	**330**	**470**	**800**	**32**

T.A. Teachers Assessment, CT- Class Test, ESE - End Semester Examination, Total Marks 800
Total Periods : 32, Total Credits : 32

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**INTERNAL COMBUSTION ENGINE**	ME-23A	Min "D"	Min "D"	5.0

INTERNAL COMBUSTION ENGINE

Unit I: Internal Combustion Engine: S.I. and C.I. engines of two and four stroke cycles, real cycle analysis of SI and CI engines, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, performance characteristics of SI and CI engines, cylinder arrangement, firing order, power balance for multi-cylinder
engines, valve timing.

Unit II: Combustion in SI engines: Flame development and propagation, ignition lag, effect of air density, temperature, engine speed, turbulence and ignition timings, physical and chemical aspects of detonation, effect of engine and fuel variables on knocking tendency, knock rating of volatile fuels, octane number, H.U.C.R., action of dopes, pre-ignition, its causes and remedy, salient features of various type combustion chambers, valve timing and firing order.

Unit III: Combustion in C.I. Engines: Times base indicator diagrams and their study, various stages of combustion, delay period, diesel knock, octane number, knock inhibitors, salient features of various types of combustion chambers, fuel, ignition, cooling, exhaust and lubrication systems; Simple problems on fuel injection, various types of engines, their classification and salient features. Rotary I. C. engines, their principles of working.

Unit IV: I.C. Engine System: Fuels, ignition systems, cooling, exhaust/scavenging and lubrication system. Fuel metering in SI engine: Fuel injection in SI engine (MPFI & TBI), Theory of carburetion, simple problems on carburetion. Fuel metering in CI engines: Fuel injection in CI engine and simple problems, various types of engines, their classification and salient features. Fuels: Conventional fuels and alternate fuels, engine exhaust emission, carbon monoxide, un-burnt hydro carbon, oxides of nitrogen, smoke, density, measurement and control, hydrogen as alternate fuel.

Unit V: Supercharging: Effect of attitude on mixture strength and output of S.I. engines, low and high pressure super charging, exhaust, gas turbo-charging, supercharging of two stroke engines.

References:
1. A. Course in IC engines by M.L. Mathur & R.P. Sharma
2. Internal Combusion engines by V. Ganeshan
3. Internal Combusion Engines Theory & Practice by G.F. Taylor
4. Introduction to IC Engines by Richard Stone.
5. Internal Combustion Engines by DomKundwar Dhanpat rai Publications

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	**P**	
BE	**POWER PLANT ENGINEERING**	ME-35	Min "D"	Min "D"	5.0

POWER PLANT ENGINEERING

Unit I: Introduction to methods of converting various energy sources to electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter.

Unit II: Fossil fuel steam stations: Basic principles of sitting and station design, effect of climatic factors on station and equipment design, choice of steam cycle and main equipment, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, element of feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment., instrumentation, testing and plant heat balance.

Unit III: Nuclear Power Station: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction, fissionable and fertile materials, thermal neutron fission, important nuclear fuels, moderators and coolants, their relative merits, thermal and fast breeder reactors, principles of reactor control, safety and reliability features.

Unit IV: Hydro-Power Station: Elements of Hydrological computations, rainfall run off, flow and power duration curves, mass curves, storage capacity, salient features of various types of hydro stations, component such as dams, spillways, intake systems, head works, pressure tunnels, penstocks, reservoir, balancing reservoirs, Micro and pico hydro machines, selection of hydraulic turbines for power stations, selection of site.

Unit V: Power Station Economics: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

References:
1- Nag PK; Power plant Engg; TMH
2- Al-Wakil MM; Power plant Technology; TMH
3- Sharma PC; Power plant Engg; Kataria and sons, delhi
4- Domkundwar; Power Plant Engg; Dhanpatrai & sons.
5- Rajput RK; A text book of Power plant Engg.; Laxmi Publications.
6- Yadav R; Steam and gas turbine and power plant engg by

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**HEAT & MASS TRANSFER**	ME-39	Min "D"	Min "D"	5.0

HEAT & MASS TRANSFER

Unit-I : Basic Concepts: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzman law; thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process; **Conduction:** Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, effect of variable thermal conductivity.

Unit II : Extended surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications; **Unsteady heat conduction:** Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

Unit III : Convection: Introduction, free and forced convection; principle of dimensional analysis, Buckingham 'pie' theorem, application of dimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

Unit IV : Heat exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, long-mean temperature difference (lmtd), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method;
Mass transfer: Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.

Unit V : Thermal radiation: Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields.

Boiling and condensation: Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

References:
1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad
2. Holman JP; Heat transfer; TMH
3. Dutta Binay K; Heat Transfer; PHI
4. Kumar DS; Heat and mass transfer; SK Kataria and Sons Delhi
5. Kreith; Heat transfer,
6. Sachdeva RC; Fundamentals of engineering heat and mass transfer,.
7. Gupta & Prakash; Engineering heat transfer,

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	**P**	
BE	**OPERATION MANAGEMENT**	ME-41	Min "D"	Min "D"	5.0

OPERATION MANAGEMENT

Unit –I : **Operations Management (OM):** Definition, history, industrial and IT revolution (ERP); tangible and service products continum, employment shift from agriculture, manufacturing to service; customer orientation; basic process formats on product volume-variety graph; concept of raw process time, critical WIP, bottle neck thruput and cycle-time with example of Penny-Fab-1,2; Littles law, best and worst case performance, thruput and cycle time formula in practical-worst-case; criteria of performance, decision area, business strategy, environment scan, SWOT, Porters' five forces, core competency,
competitive priorities of cost, quality, time and flexibility, order winners; production strategy of Make To Order-MTO, MTS and ATO (assemble to order); productivity, standard of living and happiness.

Unit - II : Product:-Life Cycle and PLC management; design steps, evolution and innovation, traditional v/s concurrent design, form and functional design, simplification and standardization, differentiation/ mass customization, modular design, design for mfg and environment (DFM, DFE), technologies used in design. Service characteristics and classification based on people-things v/s direct-indirect service actions, service triangle of customer, provider and system; technical and functional (delivery) service quality and other service performance factors, Valerie's service quality model; globalization of services.

Unit – III : Processes: transformation and value addition, selection based on cost, quality and flexibility considerations; reliability, bath-tub curve, series and parallel components, MTBF; availability and maintainability, preventive maintenance, TPM; value analysis; replacement models; Quality-definition, Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; product and process specs; the funnel-marble experiment and variance reduction, process capability, six sigma and its implementation by DMAIC, QFD, TQM and ISO-9000.

Unit – IV : Plant-facilities: Impact of organization strategies on choice of region and site, existing or new organization, decision-affecting factors for location, load distance, dimensional and factor analysis methods, Brown-Gibson model, foreign locations, non-profit govt. services (health, school) locations. facility layout objectives and factors, basic layouts, merits and optimization; subjective relationship ranking method, computer programs CRAFT and 3-d modeling; problems of inventories flow and operators in process layout and inflexibility in product layout, flexible cellular layout, group technology; capacity and equipment selection, importance of spare capacity to reduce Q-length and cycle time.

Unit – V : Programs/ procedures of production control (PPC): corporate and production planning process, aggregate plan, master production schedule and material planning; matching supply to demand fluctuations over time horizon, Forecasting elements, time series, regression, causal and Delphi methods; use of LP in aggregate plan and HMMS model, assembly line balancing, elemental task, station time and cycle time, balance delays; sequencing, Johnson method for n-job 2/3 m/c, NP hard job-shop sequencing, heuristic dispatch rules; synchronous mfg, TOC, drum-buffer-rope and focus on bottleneck as control point; JIT lean mfg, Kanban and CONWIP shop floor controls, Kaizen.

References:
1. Chary SN; Production and Operations Management; TMH
2. Hopp W and Spearman M; Factory Physics; TMH
3. Gitlow Howard et al; Quality Management; TMH
4. Khanna RB; Production and Operations Management; PHI
5. Vollman, berry et al; Manufacturing planning and control for SCM; TMH.
6. Chase Richard B et al; Operations management; SIE-TMH

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	**P**	
BE	**METAL CUTTING & CNC MACHINES**	ME-42	Min "D"	Min "D"	5.0

METAL CUTTING & CNC MACHINES

Unit I: Lathe: Classification of machine tools and their basic components; lathe- specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature

Unit II: Grinding: Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.

Unit III: Milling: Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, gear cutting, milling cutters.

Drilling & Broaching: Fixed spindle, radial and universal drilling machines, drilling time, broaching principle, broaches and broaching machines.

Unit IV: Shapers: Classification and specifications, principle parts, quick return mechanism, shaper operations, speed feed, depth of cut, machining time. Surface qualities, equipment used for rating surfaces, rms. CLA value, causes for surface irregularities.

Gear Cutting: Die casting, methods of forming gears, generating process, Gear shaping, gear shaving, gear grinding gear testing.

Unit V: Mechatronics: Introduction to control systems, analog control, transfer function, procedure for writing transfer function, signal flow diagram, introduction to electronic components like switches, magnetic type, electromagnetic type, transducers and other sensors, servo motors, basics of CD-ROM players, PLC, applications, CNC machines.

References:
1. Boston; Metal Processing.
2. Hazra Chadhary; Workshop Tech.II
3. Lindberg – Materials & Processes of Manufacture.
4. Work shop technology by Raghuvanshi-Vol-II
5. Production Processes by HMT

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	**P**	
BE	**INTERNAL COMBUSTION ENGINE LAB**	ME-24L	Min "D"	Min "D"	5.0

INTERNAL COMBUSTION ENGINE LAB

LIST OF EXPERIMENTS :

1. Determination of Valve timing diagram
2. Load test on Petrol Engine
3. Heat Balance of SI engine
4. Heat Balance of CI Engine
5. Study of Battery Ignition system and Electronic Ignition System
6. Study of Diesel fuel pump
7. Study of Diesel fuel injectors
8. Study of a Carburetors
9. Study of Fuel Injection system in SI Engine
10. Study of lubricating system in CI Engines

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	**P**	
BE	**HEAT & MASS TRANSFER LAB**	ME- 40L	Min "D"	Min "D"	5.0

HEAT & MASS TRANSFER LAB

LIST OF EXPERIMENTS :

1 Conduction through a rod to determine thermal conductivity of material
2 Forced and free convection over circular cylinder
3 Free convection from extended surfaces
4 Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
5 Calibration of thermocouple
6 Experimental determination of Stefen-Boltzman constant

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	**P**	
BE	**METAL CUTTING & CNC MACHINES LAB**	ME-43L	Min "D"	Min "D"	5.0

METAL CUTTING & CNC MACHINES LAB

LIST OF EXPERIMENTS :

1. To make a complicate job on lathe machine with all operations like turning, step turning, drilling , tapper turning , thread cutting and knurling .
2. Study of center less grinding machine/ tool and cutter type grinding machine.
3. Study of horizontal/ universal milling machine, diving head and indexing mechanism of it.
4. To cut a spur gear on milling machine using rapid indexing method.
5. Study of radial drilling machine and preparing a job on it.
6. To study a sapping machine to learn about working of quick return mechanism.

COURSE CONTENT & GRADE   (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	**P**	
BE	**MINOR PROJECT**	ME- 44L	Min "D"	Min "D"	5.0

Study regarding field data/Laboratory investigating Analysis /Design of the subject related to Mechanical Engineering.

Course	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	**P**	
PTDC	**COMPUTER AIDED ENGG.**	ME-45L	Min "D"	Min "D"	5.0

COMPUTER AIDED ENGG.
Practical in CAD/CAM lab covering following topics:

Unit 1 Methods to solve engineering problems- analytical, numerical, experimental, their merits and comparison, discretization into smaller elements and effect of size/ shape on accuracy, importance of meshing, boundary conditions, Computer Aided Engineering (CAE) and design, chain-bumping-stages vs concurrent-collaborative design cycles, computer as enabler for concurrent design and Finite Element Method (FEM), degree of freedom (DOF), mechanical systems with mass, damper and spring, stiffness constant K for tensile, bending and torsion; Practical applications of FEA in new design, optimization/ cost-cutting and failure analysis,

Unit 2 Types of analysis in CAE, static (linear/ non linear), dynamic, buckling, thermal, fatigue, crash NVH and CFD, review of normal, shear, torsion, stress-strain; types of forces and moments, tri-axial stresses, moment of inertia, how to do meshing, 1-2-3-d elements and length of elements; force stiffness and displacement matrix, Rayleigh-Ritz and Galerkin FEM; analytical and FEM solution for single rod element and two rod assembly.

Unit 3 Two-dimension meshing and elements for sheet work and thin shells, effect of mesh density and biasing in critical region, comparison between tria and quad elements, quality checks, jacobian, distortion, stretch, free edge, duplicate node and shell normal.

Unit 4 Three-dimension meshing and elements, only 3 DOF, algorithm for tria to tetra conversion, floating and fixed trias, quality checks for tetra meshing, brick meshing and quality checks, special elements and techniques, introduction to weld, bolt, bearing and shrink fit simulations, CAE and test data correlations, post processing techniques

Unit 5 Review of linear optimization, process and product optimization, design for manufacturing (DFM)
aspects in product development, use of morphing technique in FEA, classical design for infinite life and design for warranty life, warranty yard meetings and functional roles, climatic conditions and design abuses, case studies.

References:
1.Gokhle Nitin; et al; Practical Finite Element Analysis; Finite to Infinite, 686 Budhwar Peth, Pune.
2.Krishnamoorthy; Finite Element Analysis, theory and programming; TMH
3.Buchanan; Finite Element Analysis; Schaum series; TMH
4.Seshu P; Textbook of Finite Element Analysis; PHI.
5.Desai Chandrakant S et al; Introduction to finite element Method ,
6.Zienkiewicz; The finite element Method; TMH
7.Reddy an introduction to finite element method; TMH
8.Martin and Grahm; Introduction to finite element Analysis (Theory and App.)

COURSE CONTENT & GRADE (w.e.f. July 2010)

Course	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	**P**	
BE	**SEMINAR/GROUP DISCUSSION**	ME-66L	Min "D"	Min "D"	5.0

Objectives of Group Discussion & Seminar is to improve the Mass Communication and Convincing/ understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves.

Evaluation will be done by assigned faculty based on group discussion and power point presentation.