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)

BE (PTDC) **Branch : Mechanical Engineering** **Sem: Sixth**

Course Code	Subject	Periods			EVALUATION SCHEME					Credits
		L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
					TA	CT	TOTAL			
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-46	Automobile Engineering	3	1	-	10	20	30	70	100	4
ME-48	Mechanical Vibration & Noise Engineering	3	1	-	10	20	30	70	100	4
(PRACTICAL/DRAWING/DESIGN)										
ME-40L	Heat & Mass Transfer Lab	-	-	2	20	-	20	30	50	2
ME-47L	Automobile Engineering Lab	-	-	2	20	-	20	30	50	2
ME-49L	Vibration Lab	-	-	2	20	-	20	30	50	2
ME-44AL	Minor Project	-	-	2	50	-	50	-	50	2
	Total	**12**	**4**	**8**	**150**	**80**	**230**	**370**	**600**	**24**

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

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COURSE CONTENTS (w.e.f. July 2010)

Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
PTDC	HEAT & MASS TRANSFER	ME-39	3	1	2	Max. Marks-70 Min. Marks - 22 Duration-3 hours

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,

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COURSE CONTENTS (w.e.f. July 2010)

Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
PTDC	OPERATION MANAGEMENT	ME-41	3	1	2	Max. Marks-70 Min. Marks - 22 Duration-3 hours

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

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COURSE CONTENTS (w.e.f. July 2010)

Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
PTDC	AUTOMOBILE ENGINEERING	ME-46	3	1	2	Max. Marks-70 Min. Marks - 22 Duration-3 hours

AUTOMOBILE ENGINEERING

Unit-I: Chassis & Body Engg: Types, Technical details of commercial vehicles, types of chassis, lay out, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, driver's cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive.

Unit-II: Steering System: front axle beam, stub axle, front wheel assembly, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe-out, condition for true rolling motion, centre point steering, directional stability of vehicles, steering gear, power steering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears.

Unit-III: Transmission System: Function and types of clutches, single plate, multi-plate clutch, roller & spring clutch, clutch lining and bonding, double declutching, types of gear Boxes, synchroniser, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction.

Unit-IV: Suspension system : Basic suspension movements, Independent front & rear suspension, shock absorber, type of springs: leaf spring, coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque & mechanical efficiency at different vehicle speeds, weight transfer, braking systems, disc theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-energisation, air bleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and material properties of tyres & tubes.

Unit-V: Electrical and Control Systems: storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, Lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers. importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems.

Unit-VI: Emission standards and pollution control: Indian standards for automotive vehicles-Bharat I and II, Euro-I and Euro-II norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine efficiency and emission control.

References:

1. Crouse , Automotive Mechanics TMH.
2. Srinivasan S; Automotive engines; TMH
3. Gupta HN; Internal Combustion Engines; PHI;
4. Joseph Heitner, Automotive Mechanics, Principles and Practices, CBS Pub.
5. Kripal Singh, Automotive Engineering Khanna Pub.
6. Newton & Steeds , Automotive Engineering
7. Emission standards from BIS and Euro –I and Euro-III

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Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
PTDC	MECHANICAL VIBRATION & NOISE ENGINEERING	ME-48	3	1	2	Max. Marks-70 Min. Marks - 22 Duration-3 hours

MECHANICAL VIBRATION & NOISE ENGINEERING

Unit 1: Fundamental Aspects of Vibrations: Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems.

Undamped Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton s second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: the compound pendulum.

Unit 2: Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio;under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous andCoulomb damping; solid and structural damping; slip or interfacial damping.

Unit 3: Harmonically excited Vibration: One degree of freedom- forced harmonic vibration; vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments).

Whirling Motion and Critical Speed : Whirling motion and Critical speed : Definitions and significance Critical –speed of a vertical , light –flexible shaft with single rotor : with and without damping .Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Unit 4: Systems With Two Degrees of Freedom : Un-damped free vibration of 2 d.o.f and Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation ; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Unit 5: Noise Engineering – Subjective response of sound: Frequency and sound dependent human response; the decibel scale; relationship between, sound pressure level (SPL), sound power level and sound intensity scale; relationship between addition, subtraction and averaging, sound spectra and Octave band analysis; loudness; weighting networks; equivalent sound level, auditory effects of noise; hazardous noise, exposure due to machines and equipments; hearing conservation and damage risk criteria, daily noise doze.

Noise: Sources, Isolation and Control: Major sources of noise on road and in industries, noise due to construction equipments and domestic appliances, industrial noise control, strategies- noise control at source (with or without sound enclosures), noise control along the path (with or without partitions and acoustic barriers); noise control at the receiver, ear defenders, earplugs, semi-insert protectors.

References:

1- Ambekar A.G.,' Mechanical Vibrations and Noise Engineering; PHI
2- Meirovitch Leonard; Element of Vibration Analysis; TMH
3- Dukikipati RV Srinivas J Text book of Mechanical Vibrations; PHI
4- Kelly SG and kudari SK; Mechanical Vibrations; Schaum Series;TMH
5- Thomson , W.T., Theory of Vibration with Applications , C.B.S Pub & distributors .
6- Singiresu Rao, 'Mechanical Vibrations ' , Pearson Education .
7- G.K. Grover, ' Mechanical Vibration , Nem chand and Bross , Roorkee .

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COURSE CONTENTS (w.e.f. July 2010)

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

HEAT & MASS TRANSFER LAB
(Suggested Exercise)

List of Experiments (Expandable):

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

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Course	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
PTDC	AUTOMOBILE ENGINEERING LAB	ME-47L	Min "D"	Min "D"	5.0

AUTOMOBILE ENGINEERING LAB
(Suggested Exercise)

List of Experiments (Expandable):

Study of chassis, suspension, steering mechanisms, transmission, gear-box, differential systems, and electrical systems of various light and heavy automotive vehicles;

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Course	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
PTDC	VIBRATION LAB	ME-49L	Min "D"	Min "D"	5.0

VIBRATION LAB

(Suggested Exercise)

List of Experiments :

1. To verify the relation
2. To determine the radius of gyration 'K' of given compound pendulum. To verify the relation.
3. To determine the radius of gyration of given bar by using Bi-Filar suspension.
4. To study the longitudinal vibrations of helical spring and to determine the frequency or period of vibration (Oscillation) theoretically and actually by experiment.
5. To study the undamped free vibration of equivalent spring mass system.
6. To study the Forced Vibrations of Equivalent Spring Mass System.
7. To study the Torsional vibration (undamped of single Rotor shaft system.
8. To study the free vibrations of two rotor system and to determine the natural frequency of vibration theoretically and experimentally.
9. Study the damped torsional oscillations & determine the damping co-efficient Ct.
10. To verify the Dunkerley's Rule viz;
11. To study the forced lateral vibrations of the beam for different damping.
12. Study of "Whirling Phenomenon" Under various conditions of loading with different end conditions. (Equipment – " Whirling of shaft Apparatus")

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COURSE CONTENTS (w.e.f. July 2010)

Category of Course	Course Title	Course Code	Credits-2			Sessional
			L	T	P	
PTDC	MINOR PROJECT	ME-44AL			2	Max. Marks-50 Min. Marks - 25

The exercises in this component shall be designed to demonstrate the basic principles outlined in different units of the theory paper. After completing the exercises the student should have developed a good grasp of the practical utilities of the theory content.

(Suggested Exercise)

Developing research/practical ability and finding solution of any application oriented problem. Project problems may be implemented in any hardware or software or solutions.

There will be a term work presentation/ Seminar . A group students will work in form of batches which may be approved by head of the department.