UNIVERSITY OF MUMBAI

No. UG/259 of 2009

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and syllabi relating to the Master of Engineering degree course **vide** this office Circular No. UG/461 of 2003, dated 30th September, 2003 and the Principals of the affiliated collages in Engineering are hereby informed that the recommendation made by the Faculty of Technology at its meeting held on 1st April, 2009 has been accepted by the Academic Council at its meeting held on 27th May, 2009 **vide** item No. 4.21 and that, in accordance therewith, the syllabus for the Third Year Automobile Engineering (Sem. V and VI) of the B.E. degree course is revised as per **Appendix** and that the same has been brought into force with effect from the academic year 2009- 2010.

MUMBAI – 400 032
July, 2009

PRIN. K. VENKATARAMANI
REGISTRAR

To The Principals of the affiliated collages in Engineering .

AC/4.21/27/05/2009

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UG/259- A of 2009, MUMBAI-400 032 7th July, 2009

Copy forwarded with compliments for information to :-

1) The Dean, Faculty of Technology,
2) The Chairman, Board of Studies in Mechanical Engineering .
3) The Controller of Examinations,
4) The Co-Ordinator, University Computerization Centre,

(D. H. KATE)
DEPUTY REGISTRAR
U.G./P.G. Section.

****

Copy to :-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri, for information .

The Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section),Vidyanagari (2 copies), the Deputy Registrar, Examination Section (2 copies), the Director, Institute of Distance Education,(10 copies) the Director University Computer Centre, the Deputy Registrar,(PRO) . the Assistant Registrar, IDE Building,

Enclosure to Item No. 4.21
27.5.2009

UNIVERSITY OF MUMBAI

Revised Syllabus for the
Third Year Automobile Engineering
(Semester V & VI)

(With effect from the academic year 2009-2010)

COURSE: B.E. (AUTOMOBILE ENGINEERING)
YEAR: T.E., SEMESTER: V (R-2007)

Subjects	No. of periods of 1Hour			Duration of Theory Paper in Hours	Marks				
	Lecture	Practical	Tutorial		Theory Paper	Term Work	Practical	Oral	Total
Mechanical Measurement & Metrology*	4	2	-	3	100	25	--	25	150
Theory of Machines-II*	4	2	--	3	100	25	--	25	150
Fluid Mechanics*	4	2	--	3+2PE	100	25	25	25	175
Heat and Mass Transfer*	4	2	--	3	100	25	--	25	150
Environmental studies*	2	--	1 #	2	50	25	--	--	75
Vehicle System	4	2	--	3+2PE	100	25	25	-	150
TOTAL	22	10	1		550	150	50	100	850

* Common with Mechanical Engineering.
(PE) - Practical Examination
Class wise Tutorials

COURSE: B.E. (AUTOMOBILE ENGINEERING)
YEAR: T.E., SEMESTER: VI

Subjects	No. of periods of 1Hour			Duration of Theory Paper in Hours	Marks				
	Lecture	Practical	Tutorial		Theory Paper	Term Work	Practical	Oral	Total
Mechatronics*	4	2	--	3+2PE	100	25	25	--	150
Mechanical Vibrations*	4	2	-	3	100	25	-	25	150
Automotive Emission Technology	4	2	--	3	100	25	--	--	125
Machine Design – I*	4	2	--	4	100	25	--	25	150
Chassis & Body Engineering	4	2	--	3	100	25	--	--	125
Internal Combustion Engine*	4	2	--	3+2PE	100	25	25	--	150
TOTAL	24	12	-		600	150	50	50	850

* Common with Mechanical Engineering
(PE) - Practical Examination

CLASS: TE (Automobile / Mechanical)

SUBJECT: MECHANICAL MEASUREMENT & METROLOGY			Semester:-V
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
Evaluation System	Theory Examination	Hours 03	Marks 100
	Practical	--	--
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	1.1 Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs. 1.2 Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. 1.3 Errors in measurement: Types of errors, Effect of component errors on combination and distribution of combination errors on components, Probable errors.	8
Module 02	2.1 Displacement measurement: Transducers for displacement measurement, Potentiometers, LVDT, Capacitance type, Digital transducers (optical encoder), Nozzle flapper transducer. 2.2 Strain measurement: Theory of Strain Gauges, Gauge factor, Temperature compensation, Bridge circuit, Orientation of Strain Gauges for Force and Torque measurement, Strain Gauge based Load Cells and Torque Sensors.	9
Module 03	3.1 Measurement of angular velocity: Tachometers, Tachogenerators, digital tachometers and Stroboscopic methods 3.2 Pressure measurement: Pressure standards, Elastic pressure transducers viz. Bourdon Tubes, Diaphragm, Bellows and piezoelectric pressure sensors. High-pressure measurements, Bridgman gauges Calibration of pressure sensors. 3.3 Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges.	8
Module 04	4.1 Acceleration Measurement: Theory of accelerometers and vibrometers. Practical Accelerometers, strain gauge based and piezoelectric accelerometers. 4.2 Temperature measurement: Thermodynamic Temperature Scale and IPTS. Electrical methods, of temperature measurement, Resistance thermometers, Thermistors and Thermocouples, Pyrometers.	7

Module 05	5.1 Metrology: Standard of measurement, line and end standards wave length standard, working standards, requirements of interchangeability, allowance and tolerance, limits and fits, B.S. and I.S. specifications for limits and fits, limit gauging, automatic gauging, needs in semi-automatic, automatic production, principle of operation, features of in process gauging system.	7
Module 06	6.1 Use of comparators such as mechanical, optical, electrical, electronics and pneumatic. 6.2 Angular measurements, angle gauges, sine bar, levels, clinometers and taper gauges. 6.3 Metrology of screw threads, limits gauging of screw threads. 6.4 Gear measurements. 6.5 Measurement of flatness and square ness, surface finish definition and measurement of surface texture, study and use of profile projector and tool maker's microscope, dividing head and auto-collimator.	9

List of Experiments:

Laboratory Experiments: (At least 8 experiments from the list)

1. Calibration of Displacement sensors like LVDT, Potentiometers etc.
2. Calibration of Pressure Gauges
3. Calibration of Vacuum Gauges
4. Torque measurement using strain gauges
5. Calibration of tachometers
6. Vibration Measurement & Calibration of Accelerometers.
7. Angle measurement by sine bar.
8. Flatness and surface finish measurement.
9. Study and use of profile projector.
10. Screw thread measurement using floating carriage.
11. Gear measurement using Parkinson Gear Roll Tester.

Theory Examination:

1. Question paper will comprise of total seven questions, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3, then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of syllabus.

Term Work:

Term work shall consist of minimum **08** experiments, assignments on each module and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments): ..... (15) Marks.
- Test (at least one): ..... (10) Marks.

TOTAL: ..... **(25) Marks.**

Text Books:

1. Measurement Systems (Applications and Design) 5th ed.- E.O. Doebelin - *McGraw Hill.*
2. Dimensional Metrology, Connie Dotson, *CENGAGE Learning*
3. Mechanical Engineering Measurement - Thomas Beckwith, N.Lewis Buck, Roy Marangoni - *Narosa Publishing House, Bombay.*
4. Mechanical Engineering Measurements - A. K. Sawhney - *Dhanpat Rai & Sons, New Delhi.*
5. Instrumentation Devices & Systems - C.S. Rangan & G.R.Sarma - *Tata McGraw Hill.*
6. Instrumentation & Mechanical Measurements - A.K. Thayal.
7. Engg. Metrology, R.K. Jain,

References:

1. Experimental Methods for Engineers - J. P. Holman. - McGraw Hills Int. Edition.
2. Engineering Experimentation - E.O. Doebelin - McGraw Hills Int. Edition
3. Mechanical Measurements- S.P.Venkateshan, Ane books, India
4. Metrology for Engineers , J..F.W. Galyer & C.R. Shotbolt
5. Theory and Design for Mechanical Measurements, 3rd ed., Wiley
6. Principals of Engineering Metrology. Rega Rajendra,Jaico.Publication.

CLASS: TE (Automobile / Mechanical)			
SUBJECT: **THEORY OF MACHINE-II**			Semester:-V
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
Evaluation System	Theory Examination	Hours	Marks
	Practical	03	100
	Oral Examination	--	--
	Term Work		25
	TOTAL		25
			150

Sr. No.	Details	Hrs.
Module 01	1.1. Clutches: Positive clutches, friction clutches, Friction Clutches - Analysis of frictional torque, power transmission .Power loss in Friction in single plate, multiple plate clutch, and cone clutch, Centrifugal Clutches - construction, working	8
Module 02	2.1 Brakes: Types of Brakes, Analysis of Block brakes - external and internal, Band brake -simple and differential, Band and block brake - simple and differential, Braking of vehicles - front wheels, rear wheels, all wheels on level and inclined roads, 2.2 Dynamometers - Absorption and transmission dynamometers, Study and analysis of absorption type dynamometer - Proney brake, Rope brake, dynamometers, Study and analysis of transmission type dynamometers - Belt transmission, epicyclical, torsion dynamometers, Froude hydraulic dynamometer	8
Module 03	**3.1. Governors:** Comparison between governors and flywheel, Types - centrifugal governors, inertia governors, **3.2. Force analysis of gravity loaded governors** - Watt, Porter, Proell, Force analysis of spring loaded governors - Hartnell, hartung, Wilson Hartnell, Force analysis of spring and gravity loaded governor, Performance characteristics of governors - stability, sensibility, isochronisms, Hunting, governor effort and governor power, coefficient of insensitiveness.	8
Module 04	**4. 1 Gyroscope:** Introduction - Gyroscopic couple and its effect on spinning bodies, Gyroscopic effect on naval ships during steering, pitching and rolling., Ship stabilization with gyroscopic effect 4.2 Two wheeler and four wheeler on curved path - effect of gyroscopic and centrifugal couples, maximum permissible speeds on curve paths, Gyroscopic effect due to lateral misalignment of rigid disc mounted on shaft.	8

Module 05	Gear Trains: Kinematics and dynamic analysis of - simple gear trains, compound gear trains, reverted gear trains, epicyclic gear trains with spur or bevel gear combination. Introduction to flexural Mechanism, Rigid link mechanism Vs flexural Mechanism	8
Module 06	Cam and Follower, classification, motion analysis and plotting of displacement-time , velocity-time, jerk-time for uniform velocity, UARM, SHM & Cycloid motion (combined motions during one stroke excluded), Motion analysis of simple Cams- R-R Cam, D-D-R Cam operating radial translating follower , Pressure angle & methods to control pressure angle.	8

List of Experiments:

1. Study of Clutches
2. Study of Brakes
3. Experiments on Dynamometers - Rope Brake Dynamometer, Torsion Dynamometer
4. Experiments on Governors - Proell Governor, Hartnell Governor,
5. Experiments on Gyroscope
6. Study of power transmission system in automobile
7. Study of Cams & Follower
8. Plotting of displacement-time , velocity-time, jerk-time for uniform velocity, UARM, SHM & Cycloid motion.
9. At least two numerical simulations using C^{++}/MATLAB based on systems discussed in syllabus
10. Experiments on flexural manipulator, force-deflection analysis.

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper **weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

Oral Examination:

Oral examination will be on maximum portion of syllabus.

Term Work:

Term work shall consist of experiments (at least 08), assignments (one on each module) and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments): ..... (15) Marks.
- Test (at least one): ..... (10) Marks.

TOTAL: ..... **(25) Marks.**

Text Books:

1. Theory of Machines - Thomas Bevan - *C. B. S. Publishers*
2. Theory of Machines - S. S. Ratan - *Tata McGraw Hill*
3. Theory of Machines - P. L. Ballaney, *Khanna Publishers, Delhi*
4. Mechanics of Machines - Elementary Theory and Examples - by J. Hannah and R. C. Stephens - *Arnold international Students Edition.*
5. Mechanics of Machines, Advanced Theory and Examples - J. Hannah and R. C. Stephens - *Arnold international Students Edition.*
6. Simulations of machines using MATLAB and SIMULINK-John Gardener, *Cengage Learning*
7. Kinematics and Dynamics of Machinery, Charles Wilson and Peter Sadler, *Pearson Education*

Reference Books:

1. Dynamics of Machines – Norton, *McGraw Hill Publication*
2. Theory of Mechanisms and Machines - A. Ghosh and A. Malik - *Affiliated East - West Press Pvt. Ltd., New Delhi*
3. Theory of Machines - W. G. Green - *Bluckie & Sons Ltd.*
4. Mechanics & Dynamics of Machinery - J. Srinivas, *Scitech*
5. Kinematics, Dynamics and Design of Machinery, 2nd ed., Kenneth Waldron, Gary Kinzel, *Wiley India Edition*
6. Essential MATLAB for Engineers and Scientist - Brian D. Hanhn, Daniel Valentine, *Elsevier*

CLASS: TE (Automobile / Mechanical)			
SUBJECT: **FLUID MECHANICS**			Semester:-V
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
Evaluation System	Theory Examination	Hours	Marks
	Practical	03	100
	Oral Examination	02(PE)	25
	Term Work		25
	TOTAL		25
			175

Sr. No.	Details	Hrs.
Module 01	**1.1** Fluid Definition and Properties: Concept of continuum, Newton's law of viscosity, classification of fluid **1.2** Fluid Statics: Definition of body forces and surface forces, static pressure, Pascal's law. Derivation of basic hydrostatic equation, Forces on surfaces due to hydrostatic pressure, Buoyancy and Archimedes' principle.	6
Module 02	**2** Fluid Kinematics: Understanding of Eulerian and Lagrangian- approach to solutions. Velocity and acceleration in an Eulerian flow field, Definition of streamlines, path lines and streak lines. , Definition of steady / unsteady, uniform / non-uniform, one two and three-dimensional flows. Understanding of differential and integral methods of analysis. Definition of a control volume and control surface, types of control volumes.	6
Module 03	**3.** Fluid Dynamics **3.1** Equations for the control volume Integral equations for the control volume; Reynolds transport theorem with proof. Application to mass, energy and momentum transport (linear and angular). Differential equations of the control volume: Conservation of mass (two and three dimensional) **3.2** Navier - Stokes equations (without proof) for rectangular and cylindrical co-ordinates. **3.3** Exact solutions of Navier - Stokes equations: viscous laminar flow of a fluid through a pipe, viscous laminar flow of a fluid through planes (both stationary, one plane moving with a uniform velocity), Fluid flow through concentric cylinders. **3.4** Euler's equations in two, three dimensions; Bernoulli's equation. **3.5** Kinetic energy correction factor and momentum energy correction factor.	10

Module 04	**4.1 Ideal Fluid Flow Theory:** Definition of stream functions and velocity potential functions, rotational and irrotational flows in two dimensions, definition of source, sink, vortex, circulation. Combination of simple flow patterns - e.g. flow past Rankine full body and Rankine half body, Doublet, flow past cylinder with and without circulation, Kutta - Joukowsky law. **4.2 Real Fluid Flows:** Definition of Reynolds number, Turbulence and theories of turbulence - Prandtl's mixing length theory, Eddy viscosity theory, k - epsilon theory. Velocity profiles for turbulent flows: one - seventh power law, universal velocity profile, velocity profiles for smooth and rough pipes, Darcy's equation for head lost in pipe flows, pipes in series and parallel, hydraulic gradient line, Moody's diagram.	9
Module 05	**5. Boundary Layer Flows:** Concept of boundary layer and definition of boundary layer thickness, displacement thickness, momentum thickness, energy thickness. Growth of boundary layer, laminar and turbulent boundary layers, laminar sub-layer, Von-Karman momentum integral equations for the boundary layers, analysis of laminar and turbulent boundary layers, calculation of drag., separation of the boundary layer and methods to control it, concept of streamlined and bluff bodies. Aerofoil theory: definition of an aerofoil, lift and drag on aerofoils, induced drag.	9
Module 06	**6. Introduction to Computational Fluid Dynamics:** Basic concepts, Basic aspects of discretization. Grids with appropriate transformation, some simple CFD techniques. Finite volume method of analysis, solutions to simple flow problems. Numerical solution by means of an implicit method and pressure correction method.	8

List of Experiments: (At least 6 experiments)

1) Determination of Metacentric height and stability of floating bodies.
2) Verification of Bernoullis theorem.
3) Calibration of Venturimeter.
4) Calibration of orifice meter.
5) Verification of Energy equation.
6) Verification of momentum equation.
7) Determination of friction factor for a pipe.
8) Determination of head loss in bends, valves etc.
9) Identification and verification of fluid flow (Laminar and turbulent).

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Practical and Oral Examination:

Practical examination will be based on one experiment performed from the list of experiment given in the syllabus. Oral examination will be on maximum portion of syllabus.

Term Work:

Term work shall consist of minimum 06 experiments, assignments (at least one on each module), solution of Fluid dynamic problem (at least two) using computational techniques executed through C/C++ program or any application software like MSC NASTRAN ANSYS etc and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments, assignments, CFD solution): (15) Marks.
- Test (at least one): ..... (10) Marks.

TOTAL: ..... (25) Marks.

Text Books:

1. Fluid Mechanics – Streeter and Wylie, *McGraw Hill*
2. Mechanics of Fluid 3rd edition — Merle Potter, David Wiggert, *CengageLearning*
3. Fundamentals of Fluid Mechanics 5th edition – Munson, *Wiley*
4. Fluid Mechanics - Frank M. White, *McGraw Hill*
5. Fluid Mechanics.. Cengel, Yunus, Bhattacharya, Souvik, *McGraw Hill*
6. Fluid Mechanics - K. L. Kumar
7. Introduction to Computational Fluid Dynamics—Niyogi, *Pearson Eduction*
8. An Introduction to Computational Fluid Dynamics The Finite Volume Method, 2nd edition—Versteeg, *Pearson Eduction*
11. Introduction to Fluid Mechanics 5th edition – Fox, *Wiley*
12. Introduction to Fluid Mechanics, Shaughnessy, et al, *Oxford*
13. Introduction to Fluid Mechanics and Fluid Machines, 2nd ed., *Tata McGraw Hill.*
14. Fluid Mechanics, Yunus Cengel and John Cimbala, *Tata McGraw Hill.*

References:

1. Advanced Fluid Dynamics - Muralidhar and Biswas
2. Fluid Mechanics – Douglas et.al. 5th, *Pearson Education*
3. Computational Fluid Dynamics – John Anderson, *McGraw Hill.*
4. Fluid Mechanics with Engineering Applications—John Finnemore, Joseph Franzini, *McGraw Hill.*
5. 1000 Solved Problems in Fluid Mechanics, K.Subramanya, *Tata McGraw Hill.*

CLASS: TE (Automobile / Mechanical)			
SUBJECT: **HEAT AND MASS TRANSFER**			Semester:-V
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
Evaluation System	Theory Examination	Hours	Marks
	Practical	03	100
	Oral Examination	--	--
	Term Work		25
	TOTAL		25
			150

Sr. No.	Details	Hrs.
Module 01	1. Conduction: 1.1 Mechanism of heat transfer by Conduction. 1.2 Fourier's three-dimensional differential equation for Conduction with heat generation in unsteady state in the Cartesian co-ordinates. 1.3 Solution of Fourier's equation for one-dimensional steady state Conduction through isotropic materials of various configurations such as plane wall, plane composite wall, cylindrical and spherical composite walls. (For cylindrical and spherical walls, derivation of Fourier's three-dimensional equation is NOT included.) 1.4 Critical thickness of insulation and its importance.	06
Module 02	2.1 Unsteady state Conduction through a plane wall having no internal resistance. Users of Heisler charts. 2.2 Extended surfaces. Solutions for heat transfer through rectangular fins. Types of fins and their applications. Effectiveness and efficiency of fins.	06
Module 03	3. Convection: 3.1 .Mechanism of heat transfer by convection. Natural and Forced convection. 3.2 Hydrodynamic and thermal boundary layers. Similarity between velocity profile and temperature profile. 3.4 Heat transfer coefficient (film coefficient) for Convection. Effect of various parameters such as physical properties of the fluid, system geometry, fluid flow etc. on heat transfer coefficient. 3.5 Heat pipe- Introduction and application. 3.6 Principle of dimensional analysis. Application of dimensional analysis to Convection for finding heat transfer coefficient. 3.7 Empirical relations for Convection. Physical significance of dimensionless numbers such as Nusselt's Number, Grashoff s Number, Prandtl's Number, Reynolds Number and Stanton's Number. 3.8 Reynolds analogy between momentum and heat transfer. 2.8.Heat transfer in condensation. Nusselt's theory of laminar film Condensation. Heat transfer in boiling Curve & critical heat flux.	10

Module 04	4. Radiation: 4.1 Mechanism of heat transfer by Radiation. 4.2 Concept of black body and grey body. Emissive power and Emissivity. 4.3 Basic laws of Radiation: Planck's law, Kirchoff s law, Stefan-Boltzman law, Wien's.-.displacement law and Lambert's Cosine law. Intensity of Radiation Radiosity. 4.4 Radiation heat exchange between two black bodies. Electrical network analogy for radiation heat exchange between two and three grey bodies. 4.5 Shape factor for simple geometries. Properties of shape factor.	10
Module 05	5. Heat Exchangers: 5.1 Classification of heat exchangers. 5.2 Logarithmic Mean Temperature Difference, Correction factor and effectiveness of heat exchangers. 5.3 Effectiveness as a function of Number of Transfer Units and heat capacity ratio. 5.4 Overall heat transfer coefficient, Fouling factor.	10
Module 06	5. Mass Transfer: 5.1 Mechanism of mass transfer. Importance of mass transfer in engineering. 5.2 Fick's law of diffusion. Steady State diffusion of gases and liquids through plane, cylindrical and spherical walls. Equimolal diffusion. 5.3 Isothermal evaporation of water into air. 5.4 Convective mass transfer and mass transfer coefficient. Empirical relations for mass transfer, in terms of Sherwood Number, Reynolds Number and Schmidt's number.	06

List of Experiments:

(At least 8 experiments from the list)

1) Thermal Conductivity of metal bar/ composite wall
2) Thermal conductivity of liquid
3) Thermal conductivity of insulating material.
4) Unsteady state heat transfer.
5) Heat pipe.
6) Emissivity of a surface.
7) Free Convection.
8) Forced Convection.
9) Heat Exchanger.
10) Determination of coefficient of mass diffisivity.
11) Simulation of anyone of the above mentioned experiment using any application software such as MSC.Nastran/CATIAV5 etc. or developed codes in C, C++ etc.

Theory Examination:

1. Question paper will comprise of total seven questions, each of 20 Marks
   Question one will be compulsory and based on maximum part of syllabus.
2. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
3. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Term Work:

Term work shall consist of minimum **08** experiments, assignments one on each module and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments): ..... (15) Marks.
- Test (at least one): ..... (10) Marks.

TOTAL: ..... **(25) Marks.**

Text Books:

1) Heat Transfer ,9th ed.- J.P. Holman, *Mc Graw Hill*
2) Principles of Heat Transfer, 6th ed., Frank Kreith, *CENGAGE Learning*
3) Heat and Mass Transfer - C.P. Arora., Dhanpatrai and Co.
4) Heat and Mass Transfer - Prof. Sachdeva
5) Heat and Mass Transfer - R.Yadav.
6) Heat Transfer - Y. V. C. Rao, *University Press*
7) Heat and Mass Transfer- R.K.Rajput - *S.Chand & Company Ltd.*
8) Fundamentals of Heat and Mass Transfer—Incropera, *Wiley India*
9) Heat and Mass Transfer – Domkundwar, Dhanpatrai and Co.
10) Heat and Mass Transfer 2nd ed.—Nag P.K., *Tata McGraw Hill*
11) Introduction to Thermodynamics and Heat Transfer with ESS Software, 2nd ed.— Yunus A. Cengel, *Mc Graw Hill International.*
12) Fundamentals of Heat and Mass Transfer, Thirumaleshwar, *Pearson Eduacation.*

References:

1. Elements of Heat Transfer - Jakole and Hawkins.
2. Heat Transfer - James Sucec - *JAICO Publishing House*
3. Heat Transfer - Donald Pitts & L.E. Sisson Schaums Series - *Mc Graw Hill International.*
4. Engineering Heat Transfer - James R. Weity.
5. Engineering Heat Transfer - Shao Ti Hsu.
6. Heat and Mass Transfer - Eckert and Drake.
7. Heat Transfer – M. Necati Ozisik, Mcgraw hill int. edition
8. Heat Transfer - Incropera and Dewitt – *Wiley india*
9. Fundamentals of Momentum, Heat and Mass Transfer 4th ed.—Welty, *Wiley India*
10. Engineering Heat Transfer ,N.V.Suryanarayana Penram publication.
11. Heat Transfer, S.P.Sukhatme,University Press.
12. Heat Transfer – Ghosdastidar, Oxford university press.

University of Mumbai

CLASS: T.E. **Semester - V**
Automobile Engineering
SUBJECT: Environmental Studies

Periods per week (each of 60 min.)	Lecture	2	
	Practical	-	
	Tutorial	1*	
		Hours	Marks
Evaluation System	Theory Examination	2	50
	Practical examination	-	-
	Oral Examination	-	-
	Term Work	-	25
	Total		75
* Class wise Tutorial			

Objective: This course is to create environmental awareness, of variety of environmental concerns.

Module	Contents	Hrs
1	The Multidisciplinary nature of environmental studies Definition, scope and importance Need for public awareness	1
2	Natural resources Renewable and non-renewable resources Natural resources & associated problem. a. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. b. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d. Food resources: World food problems overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e. Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. f. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.	4
3	• Ecosystems • Concepts of an ecosystem. • Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem.	3

	• Ecological succession. • Food chains, food webs and ecological pyramids. • Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)	
4	Biodiversity and its conservation • Introduction-Definition: genetic species and ecosystem diversity • Bio-geographical classification of India • Value of biodiversity : Consumptive use, productive use, social, ethical, aesthetic and option values • Bio-diversity at global, national, local levels • India as a mega diversity nation • Hot spots of bio-diversity • Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts • Endangered and endemic species of India • Conservation of biodiversity: In- situ and Ex-situ conservation of biodiversity	4
5	Environmental Pollution Definition – • Causes, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear Hazards • Solid waste management: Causes, effect and control measures of urban and industrial wastes • Role of an individual in prevention of pollution • Pollution case studies • Disaster management: floods, earthquake, cyclone and land slides	4
6	Social issues and environment • From unsustainable to sustainable development • Urban problems related to energy • Water conservation, rain water harvesting, watershed management • Re-settlement and rehabilitation of people: Its problems and concerns. Case studies. • Environmental ethics: issues and possible solution • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. • Wasteland reclamation • Consumerism and waste products • Environment protection act • Air(Prevention and control of pollution) act • Water (Prevention and control of pollution) act • Wildlife protection act	4

	• Forest conservation act • Issues involved in enforcement of environmental legislation • Public awareness	
7	Human population and the environment • Population growth, variation among nations • Population Explosion- family welfare program • Environment and human health • Human rights • Value education • HIV/AIDS • Women and child welfare • Role of information technology in environment and human health • Case studies	4
8	**Understanding Existence and Co-existence** Interrelation and Cyclicity between Material order, Bio-order, Animal order and Human order **Understanding the human conduct:** Relationship in Family, Justice in Relationship, Relationship of Human with Nature (Environment), Human Behavior, Human Values, Nature and Morality **Understanding the human society** Dimensions of Human Endeavor and Objectives, Interrelationship in Society, Mutual Fulfillment and Cyclicity in Nature.	6

Theory Examination:

1. Question paper will be comprising of total 7 questions, each of 10 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and covering the all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Term work:

Term work shall consist of minimum five projects (PROJECTS SHALL BE DESIGNED ON THE SAME GUIDE- LINE OF GIVEN TEXT BOOK) and a written test.

The distribution of marks for term work shall be as follows,

Laboratory work (Tutorial/Project and Journal) : 15 marks.

Test (at least one) : 10 marks.

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Recommended Books:

1. Erach Bharucha, text book of environmental studies, Universities Press/Orient Blackswan
2. Jagdish Krishnaswami, R J Ranjit Daniels, 'Environmental Studies", Wiley India Private Ltd. New delhi
3. Anindita Basak, 'Environmental Studies", Pearson
4. Deeksha Dave, "Text book of , 'Environmental Studies", Cengage learning, Thomason India edition
5. Benny Joseph , 'Environmental Studies", Tata McGRAW HILL
6. D L Manjunath, , 'Environmental Studies",Pearson
7. R Rajgopalan, , 'Environmental Studies", Oxford
8. Alok Debi, 'Environmental science and Engineering", University press
9. A. Nagraj, Jeevan Vidya- A Primer.

CLASS: TE Automobile

SUBJECT: VEHICLE SYSTEM			Semester:-V
Periods per week 1Period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	--	
Evaluation System	Theory Examination	Hours	Marks
	Practical	3	100
	Oral Examination	--	25
	Term Work	--	--
	TOTAL	--	25
			150

Sr. No.	Details	Hrs.
Module 01	**1.** CLUTCHES 1.1 Function requirements 1.2 Components of clutch assembly & constructional features 1.3 Linkages & clutch operating mechanisms 1.4 Clutch efficiency 1.5 Types of clutches 1.6 All types of clutch used in heavy must be covered in detail.	06
Module 02	**2.** Transmission 2.1 Purpose and element of gear box 2.2 Constant – mesh gear boxes 2.3 Sliding mesh gear box 2.4 Synchromesh gear box 2.5 Gear selector mechanism 2.6 Fluid coupling and torque convertors 2.6.1 Fluid coupling 2.6.2 Torque converters 2.6.3 Epicyclic gear box operation 2.7 Semi – Automatic and Automatic transmission 2.7.1 Hydraulic controls system 2.7.2 Automatic transmission fluid 2.7.3 Continuously variable transmissions	10

Module 03	**3.** Over drive gears & drive lines 3.1 Purpose and position of an overdrive 3.2 Automatic transmission overdrive 3.3 Drive Lines 3.3.1 Universal joints 3.3.2 Constant velocity joints 3.3.3 Propeller shaft construction 3.3.4 Drive line arrangement 3.3.5 Tandem axle drive for heavy vehicles	08
Module 04	**4.** Final drive and rear axles 4.1 Differential gears 4.2 Adjusting the final drive gears 4.3 Non slip differential 4.4 Rear axle construction 4.5 Final drive lubrication and sealing 4.6 Heavy vehicle rear axle 4.7 Four wheel drive systems 4.7.1 Basic consideration of four wheel drive 4.7.2 Part time four wheel drive 4.7.3 Full time four wheel drive	08
Module 05	**5.** Automotive braking systems and suspension systems 5.1 Braking system 5.1.1 Principle of braking 5.1.2 Types-drum, disc, parking, mechanical. hydraulic, air braking and power braking, Exhaust brakes . Electric brakes 5.1.3 Brake lining material 5.2 Requirements of suspension 5.2.1 Types of suspension systems- Independent suspension. Air suspension, Shock absorbers-types. Leaf springs-types.	08
Module 06	**6.** Steering and Tyres 6.1 Steering requirements 6.1.1 Types of steering gear box- used for passenger cars and heavy vehicles 6.1.2 Wheel alignment, steering geometry-necessity 6.1.3 Power steering 6.2 Tyres 6.2.1 Tyres requirement 6.2.2 Tyres characteristics and constructional details. Latest trends 6.2.3 Road wheels and hubs-types **6.2.4** Latest trends in vehicle systems	08

List of Experiments:

1. Dismantling and reassembling of Clutch.
2. Dismantling and reassembling of Gear box.
3. Dismantling and reassembling of Propeller Shaft.
4. Dismantling and reassembling of Differential.
5. Dismantling and reassembling of Steering gear linkages and steering gear box.
6. Steering adjustment procedure.
7. Dismantling and reassembling of all types of braking systems.

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Practical Examination:

Practical examination of 2 hours duration based on the laboratory experiments. Viva-voce can be conducted during practical examination.

Term Work:

Term work shall consist of 7 experiments, six assignments, one automobile industry visit report and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments, assignments, visit report): . (15) Marks.
- Test (at least one). ..... (10) Marks.

TOTAL: ..... (25) Marks.

Text Books:

1. Motor vehicle by Newton and Steeds.
2. Automotive Engineering by Cules.
3. Automotive Brakes by T.P. Newcomb and R.T. Spur.
4. Automotive Chasis by P.M. Heldt.
5. Automotive Technology by Nummy.

References:

1. Automotive Braking by Thomas W. Birch.
2. Motor Automotive technology by Anthony E. Schwaller(third edition)
3. Automotive Technology by Jack Erjavec.
4. Automotive Mechanics by Dr. N K Giri.
5. SAE Transactions.
6. Automotive suspension and steering systems third edition by Thomas W. Birch.

CLASS: T.E. (Automobile / Mechanical)			Semester:- VI
MECHATRONICS			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	04	100
	Practical	--	25
	Oral Examination	--	-----
	Term Work	--	25
	TOTAL		150

Sr. No.	Details	Hrs.
Module 01	Introduction to Mechatronics, Mechtronics Systems in Factory, Home and Business Applications, Basic Components of Mechatronic Systems, Mechatronics Design process, Objectives, Advantages and Disadvantages of Mechatronics.	02
Module 02	Overview of micro processors and micro-controllers. 8051 microcontrollers: Functional block diagram and architecture, Instruction set and assembly language programming, Interfacing of: HEX-keyboards, LCD display, ADC, DAC and stepper motor	14
Module 03	(a) Pneumatic and Hydraulic actuation systems: Pneumatic and hydraulic systems. Electro-Pneumatic systems Electro-Hydraulic systems. Development of circuits for Industrial Automation. (b)PLC in Automation: Basic structure, I/O processing, Ladder logic diagram, Selection of PLC.	14
Module 04	Introduction to control systems, open loop and closed loop systems, Mathematical modeling of control systems, concept of transfer function, Block diagram algebra, State space modeling, Process control systems, ON-OFF control, P-I-D Control. Control system components: servomotor, stepper motors.	08
Module 05	Transient Response Analysis of First and Second order system, Time domain specifications. Step response of second order system. Classification of control systems according to 'TYPE' of systems, steady-state errors, static error constants, steady state analysis of different type of systems using step, ramp and parabolic inputs.. Stability analysis: Introduction to concepts of stability, The Routh and Hurwitz stability criteria, Relative stability analysis.	08
Module 06	Root locus concepts. Frequency Response Analysis: Frequency domain specifications, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Plots,	08

List of Experiments:

(At least 6 experiments from the list given below)

1. Study of basic principles of sensing and actuation techniques used in Mechatronics systems
2. Study of Electro-pneumatic Logic Trainer kit. and experiments on Electro-pneumatic circuits
3. Study of Electro-hydraulic Logic Trainer kit. and experiments on Electro-hydraulic circuits
4. Experiments on Ladder programming for Mechatronics system (e.g. bottle filling plant)
5. Experiments on interfacing of Mechanical system
6. Experiments on feedback control systems and servomechanisms
7. Experiments using Microprocessor kits. ADC/DAC on voltage Measurements.
8. Experimental Identification by frequency response approach of Mechanical, Electrical, Chemical system
9. Experimental Identification of flexural mechanism, Development of transfer function based on experimentally identified data. Stability analysis of predicted transfer function. and PID tuning and implementation on experimental setup
10. Experiment based on Waveform generation, Interfacing and control of motors etc.

(Institutes shall use standard setup like VIKERS hydraulic and electrohydrolic test rigs , FESTO pneumatic and electro-pneumatic test-rig. d space microcontroller system etc. for carrying out experiments)

Theory Examination:

1. Question paper will comprise of total seven question. each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Practical Examination:

Practical examination will be based on one experiment performed from the list of experiment given in the syllabus.

Course Project

In course project students shall integrate and apply the knowledge gained during the course. The projects will be developed by teams of maximum four students and shall consist of the design, setup and implementation of a simple mechatronics system.

Term Work:

Term work shall consist of minimum 06 experiments, assignments and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments Course project):(15) Marks.
- Test (at least one): ..... (10) Marks.

TOTAL: ..... (25) Marks.

Text Books:

1. Mechatronics, Kenji Uchino and Jayne R. Giniewicz, publication: Marcel Dekker, Inc.
2. Mechatronics System Design . Shetty and Kolk *CENGAGE Learning, India Edition*
3. Design with Microprocessors for Mechanical Engineers, Stiffler *McGraw-Hill*

4. Introduction to Mechatronics and Measurement Systems , Alciatore and Histand *Tata McGraw-Hill*
5. Mechatronics, Necsulescu, *Pearson education.*
6. Mechatronics - Electromechanics and Control Mechanics , Mill *Springer-Verlag*
7. Mechatronics - Electronic Control Systems in Mechanical Engineering , Bolton *Pearson eduaction*
8. Mechatronics - Electronics in products and processes , Bradley, et al. *Chapman and Hall*
9. Mechatronics - Mechanical System Interfacing , Auslander and Kempf, *Prentice Hall*
10. Introduction to Mechatronics, Appu Kuttan K.K., *OXFORD Higher Education*
11. Applied Mechatronics- A. Smaili and F. Mrad, *OXFORD university press.*
12. Microprocessor Architecture, Programming and Applications with 8085, Gaonkar. R.S., *Wiley Eastern Limited.*
13. Pneumatic Circuits and Low Cost Automation: by Fawcett J.R.
14. Control System Engineering: by Nagrath IJ. and Gopal .M., *Wiley Eastern Ltd.*
15. Modem Control engineering: by K.Ogata, *Prentice Hall*
16. The 8051 microcontroller Architecture, Programming and Applications by Kenneth J TAyala, Penram International Publishing, (India).

References:

1. The Art of Electronics, Horowitz and Hill Cambridge, *University Press*
2. The 8051 microcontroller and embedded systems using assembly and C by M.A.Mazidi, J. C. Mazidi and R. D. McKinlay, PHI, second edition
3. Electromechanical Design Handbook , Walsh, *McGraw-Hill*
4. Electro-mechanical Engineering - An Integrated Approach , Fraser and Milne
5. Handbook of Electromechanical Product Design , Hurricks Longman, John Wiley, *Addison Wesley*
6. Principles and Applications of Electrical Engineering , Rizzoni *Irwin Publishing*
7. Understanding Electro-Mechanical Engineering - An Introduction to Mechatronics , Kamm *IEEE*
8. Modeling and control of Dynamic Systems, Macia and Thaler, *CENGAGE Learning, India Edition*
9. Mechatronics, A.Smaili, F.Mrad, *OXFORD Higher Education.*
10. Pneumatic and Hydraulic Control Systems: Aizerman. M.A.
11. Industrial Hydraulics: Pippenger
12. Vickers Manual on Hydraulics
13. Computer Numerical Control of Machine Tools: Thyer. G.R.
14. Pneumatic Applications: Deppert Warner & Stoll Kurt
15. Mechanization by Pnematic Control: Vol. 1 & 2 Deppert Warner & Stoll kurt
16. Hydraulics and Pneumatics for Production: Stewart
17. Hydraulic Valves and Controls: Pippenger
18. Automatic Control Engineering: Francis. H. Raven.
19. Mechatronics, Nitaigour Mahalik, *Tata McGraw-Hill*
20. Mechatronics, *HMT*
21. *System Identification*: Theory for the User (2nd Edition) , Lennart Ljung
22. Fundamentals of Pneumatics: Festo Series
23. Fundamentals of Electro-Pneumatics :Festo Series
24. Fundamentals of Hydraulics: Festo Series
25. Fundamentals of Electro-Hydraulics: Festo Series

CLASS: TE (Automobile / Mechanical)			Semester:-VI
SUBJECT: **MECHANICAL VIBRATION**			
Periods per week. 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
Evaluation System		Hours	Marks
	Theory Examination	03	100
	Practical	--	--
	Oral Examination	--	25
	Term Work	--	25
	TOTAL	--	**150**

Sr. No.	Details	Hrs.
Module 01	**1.1 BASIC CONCEPTS OF VIBRATION:** Vibration and oscillation, causes and effects of vibrations, Vibration parameters - spring, mass, damper, Damper models, Motion - periodic, non periodic, harmonic, non – harmonic, Degree of freedom, static equilibrium position, Vibration classification, Steps involved in vibration analysis. **1. 2 FREE UNDAMPED SINGLE DEGREE OF FREEDOM VIBRATION SYSTEM:** Longitudinal, transverse, tensioned system, Methods for formulation of differential equations' by Newton, Energy, Lagrangian (Rayleigh's method), Effect of springs mass and shaft inertia on natural frequency, Effect of flexible bearings on natural frequency.	8
Module 02	**2.1 FREE DAMPED SINGLE DEGREE OF FREEDOM VIBRATION SYSTEM:** Viscous damped system - under damped, critically damped, over damped Logarithmic decrement. Coulomb's damping Combined viscous and coulomb's damping **2.2 EQUIVALENT SINGLE DEGREE OF FREEDOM VIBRATION SYSTEM:** Conversion of multi-springs, multi masses, multi - dampers into a single spring and damper with linear or rotational co-ordinate system	8
Module 03	**3.1 FREE UNDAMPED MULTI DEGREE OF FREEDOM VIBRATION SYSTEMS:** Eigen values and Eigen vectors for linear system and torsional two degree of freedom Holzer method for linear and torsional unbranched system Two rotors, Three rotors and geared system. Dunkerley and Rayleigh method for transverse vibratory system	8

	3.2 FORCED SINGLE DEGREE OF FREEDOM VIBRATORY SYSTEM: Analysis of linear and torsional systems subjected to harmonic force excitation and harmonic motion excitation (excluding elastic damper)	
Module 04	**4.1 VIBRATION MEASURING INSTRUMENTS:** Principle of seismic instruments, vibrometer, accelerometer - undamped, damped. **4.2 VIBRATION ISOLATION:** Force isolation, motion isolation, isolators	8
Module 05	**5.1 ROTOR DYNAMICS:** Critical speed of single rotor, undamped and damped **5.2 CAM DYNAMICS:** Cam Dynamics: Mathematical Model, Differential Equation, Response Follower Jump Phenomenon	8
Module 06	**6. BALANCING:** Static and dynamic balancing of multi rotor system, Balancing of reciprocating masses In - line engines, V - engines (excluding radial engines)	8

List of Experiments:: (Minimum 8 experiments)

1. Experimental prediction of natural frequency of compound pendulum, prediction of equivalent simple pendulum system.
2. Experimental prediction of natural frequency for longitudinal vibrations of helical springs, and springs in series and parallel
3. Experimental prediction of natural frequencies, and nodal points for single-rotor and two-rotor vibratory system, and comparison with theoretical results
4. Experimental and theoretical investigation of whirling of shaft (i.e. comparison of experimental and theoretical natural frequency and justification of discrepancy between experiment and theory)
5. Experimental investigation of viscous and coulomb damping, prediction of system parameters (spring stiffness, damping coefficient) from damped oscillations
6. Experimental and theoretical investigation of frequency response of mechanical system, and comparing both and justification of discrepancy between theory and experiments
7. Experiments on distributed parameter system: Transverse vibrations of beam (Dunkerley's Rule Expt.)
8. Experimental balancing of single and multi-rotor system
9. Introduction to FFT analyzer, and prediction of spectral response of vibrating machine from workshop
10. Experiments on vibration isolation system and prediction of force transmissibility, motion transmissibility of system
11. Vibration analysis of mechanical system using MATLAB.

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Oral Examination:
Oral examination will be on maximum portion of syllabus.

Term Work:
Term work shall consist of minimum 08 experiments, assignments and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments): ..... (15) Marks.
- Test (at least one): ..... (10) Marks.

TOTAL: ..... (25) Marks.

Text Books:

1. Mechanical Vibrations 4th ed- S. S. Rao – *Pearson Education*
2. Mechanical Vibrations - G. K. Grover
3. Fundamentals of Mechanical Vibration – S.Graham Kelly - *Tata McGraw Hill*
4. Mechanical Vibration Analysis - P. Srineevasan - Tata McGraw Hill
5. Mechanical Vibrations - Schaum's outline series - S.Graham Kelly- *McGraw Hill*
6. Mechanical Vibrations - Schaum's outline series – William W. Seto- *McGraw Hill*
7. Theory and Practice of mechanical vibrations - J. S. Rao, K. Gupta - *New Age International Publications.*
8. Mechanical Vibrations - Den, Chambil, Hinckle
9. Mechanical Vibrations, J.P.Den Hartog, McGrawhill Book Company Inc.

References:

1. Leonard Meirovitch, Introduction to Dynamics and Control. *Wiley, New York,*
2. Leonard Meirovitch, Elements of Vibration Analysis. *McGraw-Hill, New York,*
3. Leonard Meirovitch, Dynamics and Control of Structures. *Wiley, New York.*
4. Antony J. Pettofrezzo, Matrices and Transformations. Dover, New York.
5. Benson H. Tongue, Principles of Vibration. *Oxford University Press.*
6. W. Thomson, Theory of Vibrations With Applications, Second Edition, *Pearson Education*
7. Vibrations—Balakumar Balachandan, Edward Magrab, *CENGAGAE Learning.*

CLASS: TE /(Automobile)			
SUBJECT: **Automotive Emission Technology**			Semester:-VI
Periods per week 1Period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	-	
Evaluation System		Hours	Marks
	Theory Examination	3	100
	Practical	-	
	Oral Examination	-	-
	Term Work	-	25
	TOTAL	3	**125**

Sr. No.	Details	Hrs.
Module 01	**1. Introduction** The atmosphere and atmospheric pollution, Pure air, Sources of pollution, Constituents of pure air, Atmospheric interactions and processes, Acid Rain, Reasons for acid rain and its effects. **1.2. Air Pollution Effects On Physical And Economic Syste.u** a) Effects on visibility b) Effects on Economic materials and structures c) Effects on Indoor air quality **1.3. Effect Of Following Elements On Human Being & Their Control Concepts** a) Sulphur Oxides and black suspended particulate matter b) Ozone and oxidants c) Oxides of nitrogen d) Carbon monoxide e) Unburnt hydrocarbon f) Lead	08
Module 02	**2. Sources Of Pollutants & Basic Constituents Of The Exhaust In I. C. Engine** Evaporative losses, crank case blowby, Exhaust Emissions. Constituents: Carbon monoxide, Unburnt hydrocarbon, Oxides of nitrogen, Particulate matter. Methods o measurement of vehicle emissions C.V.S., Driving cycles, Details of the measurement of CO, HC, and NOx by infrared , FID, and Chemi-luminiscence methods	08
Module 03	**3.Control Of Engine Emissions** By injection parameters, Lubricating oil, Compression ratio, Crankcase ventilation, Fuel composition, Injection/ Ignition timing, Charcoal canister, Exhaust gas Recirculation(EGR), load, air injection Thermal reactors, Catalytic converter	08

Module 04	**4. Exhaust Gas Analysis** Numerical calculations to determine constituents of exhaust gas by mass basis and by volume basis, smoke meter, Exhaust gas analyzer, Orsat apparatus. Total Hydrocarbon measurement/analysis by Flame Ionisation Detector(FID). Carbon dioxide/carbon monoxide measurements/ analysis by Non Dispersive infrared analyzer and NOx Measurement.	08
Module 05	**5. Electronic Engine Control Technologies** Electronic throttle control, Closed loop canister purge control system, EGR mass flow rate estimation, Air-fuel ratio control. Exhaust emission regulations	08
Module 06	**6. Noise Reduction And Control** Fundamental of noise Propagation of noise / sound Measurement of sound Noise control Effect of noise	08

List of Experiments:

(At least 8 experiments from the list given below)

1. Exhaust gas analysis of 4 stroke petrol engine by using exhaust gas analyser
2. Exhaust gas analysis of 4 stroke diesel engine by using exhaust gas analyser
3. Exhaust gas analysis of 2 stroke petrol engine by using exhaust gas analyser
4. Exhaust gas analysis of 4 stroke petrol engine by using Orsat apparatus
5. Exhaust gas analysis of 4 stroke diesel engine by using Orsat apparatus
6. Exhaust gas analysis of 2 stroke petrol engine by using Orsat apparatus
7. Study of exhaust gas mass emission equipment at research institution like ARAI.
8. Evaporative emission measurement.
9. Study of Catalytic converters
10. Study of particulate traps
11. Study of particulate measurements

Theory Examination:

5. Question paper will comprise of total seven question, each of 20 Marks
6. Question one will be compulsory and based on maximum part of syllabus.
7. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
8. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Term Work:

Term work shall consist of minimum ..... experiments, assignments and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments): ..... (15)Marks.
- Test (at least one): ..... (10)Marks.

TOTAL: ..... (25)Marks.

Text Books:

1. Internal combustion Engines by Mathur and P. L. Sharma
2. Air pollution By Rao & Rao
3. Electronic Engine Control Technologies by Ronald K. Jurgen

REFERENCE BOOKS

1. Internal combustion Engines & Air pollution by Edward F. Obert
2. Pollution control and conservation by Dr. m. Kovacs
3. Air pollution Volume I to Volume XII by Arthur C. Stern
4. Air pollution by Henry C. Perkins
5. Air pollution by Spedding
6. I.C.Engine fundamentals by J.B. Heywood

CLASS: T.E. (Automobile / Mechanical)			Semester:- **VI**
SUBJECT: **MACHINE DESIGN - I**			
Periods per week. 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	04	100
	Practical	--	
	Oral Examination	--	25
	Term Work	--	25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design Material properties and their uses in design Manufacturing considerations in design: tolerances, types of fits, selection of fits Design considerations of casting and forging Basic principles of Machine Design, Modes of failures, Factor of safety, Design stresses, Principle Stresses, Theories of failures Standards, I. S. codes, Preferred Series and numbers.	06
Module 02	Design against static Loads: Cotter joint, knuckle joint, Turn Buckle Bolted and welded joints under eccentric loading. Power Screw - Screw Presses along with the Frame	12
Module 03	Design against Fluctuating Loads Variables stresses, reversed, repeated, fluctuating stresses Fatigue Failure Static and fatigue stress concentration factors Endurance limit - estimation of endurance limit Design for finite and infinite life Soderberg and Goodman design criteria Fatigue design under combined stresses	06
Module 04	Design of shaft - power transmitting, power distribution shafts (excluding crank shaft) under static and fatigue criteria. Keys – Types of Keys and their selection based on shafting condition. Couplings- Classification of coupling. Selection of Standard Bush Pin coupling	10
Module 05	Design of springs- Helical compression, tension springs under static and variable loads, Laminated Springs.	06
Module 06	Design of Belts - Flat and V belt with Pulley construction Selection of Standard Roller chains.	08

Oral Examination:
Oral examination will be on maximum portion of syllabus.

TERM WORK:
Term work shall comprise of

1) Exercises on the above topics in the form of design calculations with sketches and or drawings.
2) At least four A-2 size drawing sheets shall be submitted.
3) Class Test based on above syllabus.
4) Class Assignments
5) Stress analysis of any machine element mentioned in the syllabus using any application software like ANSYS/MSC.NASTRAN/ABACUSS, etc.

The distribution of marks for term work shall be as follows:

Class Assignments, Drawing Sheets and software exercise	:	15 Marks
Class test	:	10 Marks
Total	:	25 Marks

NOTE:
Use of standard design data books like PSG Data Book , Design Data by Mahadevan is permitted at the examination and shall be supplied by the college.

Theory Examination:

1) Question paper will comprise of total seven question, each of 20 Marks
2) Question one will be compulsory and based on maximum part of syllabus.
3) Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4) Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

TEXT BOOKS:

1) Design of machine elements -- V. B. Bhandari, *Tata McGraw Hill Pub.*
2) Design of machine elements -- Sharma,Purohit, *Prentice Hall India Pub.*
3) Machine Design - An Integrated Approach -- Robert L. Norton - *Pearson Education.*
4) Machine Design - Pandya & Shah - *Charotar Publishing.*
5) Mechanical Engineering Design - J. E. Shigley - *McGraw Hill*
6) Recommended Data Books - PSG, K. Mahadevan

REFERENCES:

Machine Design - Reshetov - *Mir Publication*
Machine Design - Black Adams - *McGraw Hill*
Fundamentals of Machine Elements - Hawrock, Jacobson - *McGraw Hill*
Machine Design - Patel, Pandya, Sikh, Vol. – I & II, *C. Jamnadas & Co. Educational & Law Publishers*
Design of Machine Elements - V.M. Faires.
Design of Machine Elements - Spotts.

CLASS: TE Automobile			Semester:-VI
SUBJECT: **Chassis and Body Engineering.**			
Periods per week 1Period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	--	--
	Oral Examination		--
	Term Work		25
	TOTAL		**125**

Sr.No	Details	Hrs.
Module 01	1. Fundamentals: 1.1 Chassis types and structure types: Open, Semi integral and integral bus structure Frames: functions and types of frames, Loads on frames, Load distribution of structure, 1.2 Classification of motor vehicle, Location of power plant, Location of different chassis components, 1.3 Terminology and overview of structural surface types, history and Overview of structural types. Basic concept of design. 1.4 Terms related with vehicle coach building and window. Various assembly process involved in coach building. 1.5 Vehicle body materials: Detail study of materials used in vehicle body building (including passenger cars and heavy vehicles). Materials for interiors, Properties and their relative comparison.	12
Module 02	2.Basic Dimensions And Aerodynamics 2.1 Visibility 2.2 Design and Requirements-- Driver's seat, Passenger Seat ,Child seat 2.3 Fundamental vehicle loads and their estimation 2.4 Aerodynamic drag- Aerodynamic lifts and pitching moments, Side force, Yawing moments and rolling moments.	09
Module 03	3. Load Paths 3.1 Introduction, 3.2 Bending load, Torsion LOAD, Lateral load, Breaking load Summary and discussions 3.3 Calculation of loading cases Static loading case, Asymmetric loading case, Longitudinal loads, Side Loads, Calculation of different cases.	09

Module 04	4. Principals of thin walled structure 4.1 Shear centre Principal of shear flow and shear lag application Design 4.2 Alternative Constructions for body sub-assemblies.	06
Module 05	5. Preliminary Design and Analysis of body sub-assemblies 5.1 Introductory Discussions, 5.2 Steering column mounting, engine component bracket, front suspension mounting	04
Module 06	6. Latest Trends in Design, Manufacturing and Materials. 6.1 ULSAB Design, Tailored blanks. 6.2 Manufacturing Process: Hydro forming tubular, Sheet Stamping, CAE Analysis, Crash Analysis, and Economic Analysis.	04

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weight age of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Term Work:

Term work shall consist of minimum 6 assignments, two sheets one automobile industry visit report and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (assignments and visit report): ..... (15) Marks.
- Test (at least one): ..... (10) Marks.

TOTAL: ..... (25) Marks.

Text Books:

1. Vehicle Body Engineering By J Powlowski
2. Vehicle Body Layout And Analysis By John Fenton
3. Automotive Mechanics By Joseph Heitner
4. Automotive Mechanics By William Crouze.

References:

1. Modern Vehicle Design By Jullian Happians Smith
2. SAE Transation and proceedings
3. Motor Vehicle Structures concept and fundamentals By Jason C. Brown
4. Robertson, Stan T. Serpetito, Allied Publications.

CLASS: TE (Automobile /Mechanical)			Semester:-VI
SUBJECT: **INTERNAL COMBUSTION ENGINES**			
Periods per week. 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical	02 (PE)	25
	Oral Examination	--	--
	Term Work	--	25
	TOTAL	--	**150**

Sr. No.	Details	Hrs.
Module 01	1. Constructional Features of Reciprocating I.C. Engines: 1.1. Four stroke and two stroke engines. 1.2. Types of engines - Stationary, Automotive, and Marine engines. 1.3. Comparative study of Two stroke and Four stroke engines. Different methods of Scavenging and scavenging blowers. 1.4 Cycle Analysis of I.C. Engines: 1.5 Variable specific heat and its effect on Air Standard Cycles, Fuel Air Cycles. Dissociation and other losses. Actual cycles.	06
Module 02	2.1. Carburetion - Theory of Carburetion, Simple carburetor, various systems of actual Carburetor, Types of Carburetors. 2.2. Ignition System - Battery and Magnetic Ignition Systems. Electronic Ignition System 2.3. Combustion: Combustion phenomenon in S.I. Engines, Ignition delay, Velocity of flame propagation, pressure - crank angle diagram, detonation, factors affecting combustion and detonation, types of combustion chambers. 2.4. Petrol Injection - MPFI etc.	08
Module 03	3. C. I. Engines: 3.1 Requirement of Fuel Injection Systems, Types of fuel injection system viz. Common rail, individual pump, distributor and unit injector systems. High pressure fuel injection pump, Types of Nozzles. 3.2 Necessity of Governor in Diesel engines, Governor characteristics. 3.3 Combustion: Combustion phenomenon in C.I. Engines, Stages of combustion, Delay period, Knocking, Pressure-Crank angle diagram, Factors affecting combustion and knocking, Types of combustion chambers.	08

Module 04	Supercharging /Turbo charging: 4.1 Objectives of Supercharging / Turbo charging. 4.2.Effect of Supercharging / Turbo charging on power output and efficiency of the engine 4.3 Methods of Supercharging / Turbo charging. Types of Superchargers / Turbochargers SA Limit of Supercharging / Turbo charging. 4.4 Performance Characteristics of S.I. & C.I. Engines 4.4.1 Effect of load and speed on mechanical, indicated, brake thermal and volumetric efficiencies. Brake mean effective pressure and Brake specific fuel consumption, Heat balance test. 4.4.2 Method of determining indicated power of the engine.	10
Module 05	5. Exhaust Gas Analysis and Air Pollution: 5.1 Necessity of exhaust gas analysis. Constituents of exhaust gas, Orsat apparatus for carrying out exhaust gas analysis. 5.2. Different methods of determining Air/Fuel ratio. 5.3 Fuels of I.C. Engines: 5.3.1 Requirement of fuels. 5.3.2 Classification of hydrocarbon fuels. 5.3.3 Physical and Chemical properties of fuels. 5.3.4 Rating of Fuels - Octane No., Cetane No. & Performance No. Determination of Octane and Cetane Nos. 5.4 Non-Conventional fuels for I.C. Engines. CNG, LPG, Hydrogen, Bio- fuels, alcohol etc. 5.5. Air Pollution due to engine exhaust 5.5.1 Pollution control devices and EURO standards	08
Module 06	6. Engine Lubrication: 6.1 Types of lubricants used in I.C. Engines. 6.2 Properties of Lubricants. 6.3 SAE Ratings of Lubricants. 6.4 Types of Lubrication Systems 6.5 Engine Cooling: 6.5.1 Systems of Cooling - Air, Water-cooling. General arrangements. 6.6 Introduction to Stratified Charge and Wankel engines. 6.7. Recent developments in I. C. Engines.	08

List of Experiments:

1) Study of carburetor.
2) Study of ignition system.
3) Study of fuel injection system.
4) Morse Test on petrol engine.
5) Speed Test on petrol or/and diesel engine.
6) Load Test on diesel engine (engines).
7) Heat Balance test on diesel or petrol engines.
8) Experimental determination of Air fuel ratio.
9) Exhaust Gas/Smoke analysis of S.I. / C.I. engines
10) Effect of Supercharging on Performance Characteristics of an engine.

Practical Examination:
Practical examination of 2 hours duration based on the laboratory experiments. Viva-voce can be conducted during practical examination.

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Term Work:
Term work shall consist of minimum 08 experiments, assignments and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments): ..... (15) Marks.
- Test (at least one): ..... (10) Marks.

TOTAL: ..... (25) Marks.

Text Books:

1. Internal Combustion Engine - Mathur and Sharma
2. Internal Combustion Engine - E.F. Obert.
3. Internal Combustion Engine - Domkundwar
4. Internal Combustion Engine - V. Ganesan - *Tata McGraw Hill*

References:

1. Internal Combustion Engines - Richard Stone - *Palgrave Publications.*
2. Internal Combustion Engine - S.L. Beohar
3. Internal Combustion Engine - Gills and Smith.
4. Internal Combustion Engine - P.M. Heldt.
5. Power Plant Engineering - Morse
6. Internal Combustion Engines - V.L. Maleeve
7. Internal Combustion Engines - Taylor.
8. Internal Combustion Engines Fundamentals - John B. Heywood
9. Internal Combustion Engines S.S.Thipse,JAICO.
10. Internal Combustion Engines Willard w.pulkrabek, Pearson Education.