

**Mechatronics**  
T.E. Sem. VI [MECH/AUTO]

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**EVALUATION SYSTEM**

	<b>Time</b>	<b>Marks</b>
<b>Theory Exam</b>	4 Hrs.	100
<b>Practical Exam</b>	–	25
<b>Oral Exam</b>	–	–
<b>Term Work</b>	–	25

**SYLLABUS**

1. **Introduction** to Mechatronics, Mechatronics Systems in Factory, Home and Business Applications, Basic Components of Mechatronic Systems, Mechatronics Design process, Objectives, Advantages and Disadvantages of Mechatronics.
2. **Overview of Microprocessors and Microcontrollers**  
8051 microcontrollers: Functional block diagram and architecture, Instruction set and assembly language programming.  
Interfacing of : HEX – key boards, LCD display, ADC, DAC and stepper motor.
3. (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.
4. 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.
5. 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.
6. **Root Locus Concepts**  
*Frequency Response Analysis* : Frequency domain specifications, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Plots.

## Reference :

1. Mechatronics (*Kenji Uchino and Jayne R. Giniewicz*) Marcel Dekker Inc.
2. Mechatronics System Design (*Shetty and Kolk*) Cengage Learning (India Edition).
3. Design with Microprocessors for Mechanical Engineering (*Shiffler*) 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 – Electronics Control Systems in Mechanical Engineering (*Bolton*) Pearson Education.
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 Ltd.
13. Pneumatic Circuits and Low Cost Automation (*Fawcett J.R.*)
14. Control System Engineering (*Nagrath I.J. and Gopal M.*) Wiley Eastern Ltd.
15. Modern Control Engineering (*K. Ogata*) Prentice Hall.
16. The 8051 Microcontroller Architecture, Programming and Applications (*Kenneth J. Tayala*) Penram International Publishing (India).
17. The Art of Electronics (*Horowitz and Hill Cambridge*) University Press.
18. The 8051 Microcontroller and Embedded Systems using assembly and C (*M.A. Mazidi, J.C. Mazidi and R.D. McKinlay*) PHI (2<sup>nd</sup> Edition).
19. Electromechanical Design Handbook (*Walsh*) McGraw Hill.
20. Electromechanical Engineering – An Integrated Approach (*Fraser and Miline*).
21. Handbook of Electromechanical Product Design (*Hurricks, Longman*) John Wiley.
22. Principles and Applications of electrical Engineering (*Rizzoni*) Irwin Publishing.
23. Understanding Electro-Mechanical Engineering – An Introduction to Mechatronics (*Kamm*) IEEE.
24. Modeling and Control of Dynamic Systems (*Macia and Thaler*) Cengage Learning (India Edition).
25. Mechatronics (*A. Smaili, F. Mrad*) Oxford Higher Education.
26. Pneumatic and Hydraulic Control Systems (*Aizerman M.A.*)
27. Industrial Hydraulics (*Pippenge*).
28. Vickers Manual on Hydraulics.
29. Computer Numerical Control of Machine Tools (*Thyer G.R.*).
30. Pneumatic Applications (*Deppert Warner & Stoll Kurt*).
31. Mechanization by Pnematic Control : Volume 1 and 2 (*Deppert warner & Stoll Kurt*).
32. Hydraulics and Pneumatics for Production : Stewart.
33. Hydraulics Valves and Controls (*Pippenger*)
34. Automatic Control Engineering (*Francis. H. Raven*).
35. Mechatronics (*Nitaigour Mahalik*) Tata McGraw Hill.
36. Mechatronics, HMT.
37. System Identification : Theory for the User (*Lennart Ljung*) (2<sup>nd</sup> Edition).
38. Fundamentals of Pneumatics (*Festo Series*).
39. Fundamentals of Electro-Pneumatics (*Festo Series*).
40. Fundamentals of Hydraulics (*Festo Series*).
41. Fundamentals of Electro-Hydraulics (*Festo Series*).



# Hydraulic Machinery

T.E. Sem. VI [MECH]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	25

## SYLLABUS

### 1. Hydro Turbines

**General :** Advantages of a hydro power plant over other types of power plants, Elements of hydro power plant, types of hydro turbines – impulse and reaction, definition of various turbine parameters like gross head, discharge, work done, input power, output power, efficiencies etc., Euler's equation applied to a turbine, turbine velocities and velocity triangles, expression for work done.

**Pelton Turbines :** Components of a Pelton turbine, definition of design parameters like speed ratio, jet ratio, estimation of various parameters like head, discharge, and efficiency etc., determination of number of buckets.

### 2. Reaction Turbines

Types of reaction turbines - inward and outward flow, radial mixed and axial; elements of the turbine, estimation of various parameters.

### 3. Similarity Relations in turbines, definition of unit quantities and specific quantities, selection of turbines. Prediction of results of prototypes from the model test. Cavitation in turbines – causes, effects and remedies, Thoma's cavitation parameter $\sigma$ . Use of $\sigma$ Vs specific speed graphs. Determination of safe height of installation for the turbine. Characteristics of turbines, governing of turbines.

### 4. Pumps

**General :** Classification of pumps – positive displacement and non – positive displacement.

**Positive – Displacement pumps :** Types and applications, general features of rotary pumps like gear pumps, vane pumps etc., general feature of reciprocating pumps, definition of head, discharge, work done and efficiency, types of reciprocating pumps, indicator diagram, use of air vessel.

### 5. Centrifugal Pump

Types – radial flow, mixed flow and axial flow, Priming of pumps, components of the pump, Euler's equation and velocity triangles, correction factors for the head, design constant eg., head constant, flow constant etc., Types of blade profiles, aerofoil theory of axial flow pumps; Pressure recuperating devices, Radial thrust and axial thrust and methods used to balance them; Trouble shooting in centrifugal pumps.

### 6. Concept of system and system characteristics, priming of pumps; Series and parallel operation of pumps. System curve for branch network. Determination of operating point; Similarity relations and affinity laws, characteristics of pumps; Cavitation and NPSH (NPSHA, NPSHR), Determination of available and required NPSH; Case studies using CFD (exclusively on Hydraulic Machinery).

**Reference :**

1. Hydraulic Machinery (*Jagdish Lal*).
2. Hydraulic Machinery (*Vasandani*).
3. Centrifugal Pumps and Blowers (*Church and Jagdish Lal*).
4. Fluid Mechanics and Machinery (*BCS Rao*) McGraw Hill.
5. Fluid Mechanics and Hydraulic Machines (*Gupta*) Pearson Education.
6. Fluid Mechanics (*Douglas*) Pearson (5<sup>th</sup> Edition).
7. Impellar Pumps (*Troskolansky and Lazerkiwicz*).
8. Centrifugal and Axial Flow Pumps (*A.J. Stepanoff*).
9. Pump Handbook (*Karassik et al*).
10. Hydraulic Turbines (*Nechleba*)



# Mechanical Vibration

T.E. Sem. VI [MECH/AUTO]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	25
Term Work	–	25

## SYLLABUS

### 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.

#### 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 bearing on natural frequency.

### 2. 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.

#### 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

### 3. Free Undamped Multi Degree of Freedom Vibration System

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

#### 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)

### 4. Vibration Measuring Instruments

Principle of seismic instruments, vibrometer, accelerometer– undamped, damped.

#### Vibration Isolation

Force isolation, motion isolation, isolators.

### 5. Rotor Dynamics : Critical speed of single rotor, undamped and damped

**CAM Dynamics :** Cam Dynamics: Mathematical Model, Differential Equation, Response Follower Jump Phenomenon

### 6. Balancing

Static and dynamic balancing of multi rotor system, Balancing of reciprocating masses In – line engines, V – engines (excluding radial engines)

**Reference :**

1. Mechanical Vibrations (*S.S. Rao*) Pearson Education (4<sup>th</sup> Edition).
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*) McGraw Hill Book Company Inc.
10. Introduction to Dynamics and Control (*Leonard Meirovitch*) Wiley – New york.
11. Elements of Vibration Analysis (*Leonard Meirovitch*) McGraw Hill – New York..
12. Dynamics and Control of Structures (*Leonard Meirovitch*) Wiley – New York.
13. Matrices and Transformations (*Antoy J. Pettofrezzo*) Dover, New York.
14. Principles of Vibration (*Benson H. Tongue*) Oxford University Press.
15. Theory of Vibrations with Applications (*W. Thomson*) Pearson Education (2<sup>nd</sup> Edition).
16. Vibrations (*Balakumar Balachandan, Edward Margrab*) CENGAGE Learning.



# E-Commerce and Industrial Finance

T.E. Sem. VI [MECH]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	25

## SYLLABUS

### E-Commerce

- 1. Introduction :** Understanding E-Commerce, Emergence of the internet. Emergence of the worldwide web. Advantage and disadvantages of E-Commerce, E-Commerce in action, Reality and myth.

**Enabling Technologies of E-Commerce :** Internet client/server application, Networks and internets, Software agents, Internet standards and specifications, Internet service providers, Staffing for E-Commerce.

- 2. E-Commerce Business Solutions**

E- Marketing, Online marketing, advantages of online marketing, E- advertising : various means, Efficiency of E-Advertising, E-branding, Marketing strategies, E-Security, Security on Net, E-business Risk management issues, E-Payment systems, Online payment categories, Digital token based E-Payment systems, Risk and E-Payment systems, Designing E-Payment Systems. E-Customer relationship management, E-CRM toolkit, CRM capabilities and the customer life cycle. E-Supply Chain Management. Strategic advantages and benefits Components and architectures, Major trends in E- SCM, E-strategy server dimensions, value chain and E-strategy, Planning the E-Commerce project, Brand management strategies.

- 3. Transaction to E- Commerce In India**

E-Transition challenges to India corporate, The information technology Act 2000, Positive aspects for corporate sector, Some Indian case studies, E-Commerce best practices, Modern trends in E-Business.

### Industrial Financing

- 4. The Scope of Industrial Finance :** Introduction, Finance defined, Microfinance v/s Macrofinance, Corporate finance, profit maximization and traditional goal, Improving open tradition through value maximization.

**Financial Markets :** The other form of organization Capital, cash money and Govt. securities, Financial market overview, How new securities are issued, Public issue: General cash offer, Public issue: Rights offering, Private placement. Types of financial markets.

The common stock market, the bond market, The money market, International financial market, Efficiency of financial market, interest rates, the term structure of interest rates, The risk structures of interest rates.

- 5. An Overview of Investment Appraisal Methods :** Time value of money, The accounting rate of return method, The net present value method, The internal rate of return method, a comparison of NPV and RR method, Discounted payback method, Annual capital charge.

**Sources of Long Term Finance :** Equity finance, The new issues market, Right issues, Script issues, preference shares, DEBT finance, Hybrid finance, Sources of intermediate term finance, term loans and leases, Short term financial markets, Managing corporate liquidity, The concept of circulating resources, The impact on risk and return, Managing current assets, Manage financial structure.

**Working Capital Management :** Objectives, Working capital policies, Working capital and cash conversion cycle, Overtrading, The management of stock, Management of costs.

6. **Mergers and Takeovers :** Terminology, Justification for acquisition, Trends in takeover activities, Valuation of the target company, The financing of acquisition, Strategies and tactical issues.

**International Financial Management :** Exchange rates, Fixed versus floating exchange rates, Spot rates, forward rates, Future rates, Factor affecting exchange rates, Foreign exchange exposure managing foreign exchange, Exposure Recent trends.

**Reference :**

1. E-commerce A management perspective (*P.T. Joseph*) Prentice Hall of India P. Ltd.
2. E-commerce Strategies (*Charles Trepper*) Prentice Hall of India P. Ltd.
3. E-Business and ERP, Transforming the Enterprise (*Grant Morris, James R. Hurley*) John Willey & Sons Inc.
4. Fundamentals of Financial Management (*Prasanna Chandra*) Tata McGraw Hill Publishing Co. Ltd. (4<sup>th</sup> Edition).
5. Introduction to Corporate Finance (*terry's Maness*) McGraw Hill Series in Finance.
6. Corporate Finance Principles and Practices (*Denzil Watson & Tong Heads*) Financial Time Pitman Publisher.
7. Handbook of Corporate Finance (*Edward I. Altmass*) Willy Professional Banking & Finance services.
8. Introduction to Financial Management (*Bidil Dickerson, Eudere F.B.*) The Dryden Press.
9. E-commerce (*Kenneth C. Laudon, Carol G.*) Traver Pearson Education.



# Internal Combustion Engines

T.E. Sem. VI [MECH/AUTO]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	02 (PE)	25
Oral Exam	–	–
Term Work	–	25

## SYLLABUS

### 1. Constructional Features of Reciprocating I.C. Engines

Four stroke and two stroke engines; Types of engines – Stationary, Automotive, and Marine engines; Comparative study of Two stroke and Four stroke engines. Different methods of Scavenging and scavenging blowers; Cycle Analysis of I.C. Engines; Variable specific heat and its effect on Air Standard Cycles, Fuel Air Cycles. Dissociation and other losses. Actual cycles.

### 2. Carburetion

Theory of Carburetion, Simple carburetor, various systems of actual Carburetor, Types of Carburetors. Ignition System – Battery and Magnetic Ignition Systems. Electronic Ignition System. *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. Petrol Injection – MPFI etc.

### 3. C.I. Engines

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. Necessity of Governor in Diesel engines. Governor characteristics. 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.

### 4. Supercharging / Turbo charging

Objectives of Supercharging / Turbo charging. Effect of Supercharging / Turbo charging on power output and efficiency of the engine. Methods of Supercharging / Turbo charging. Types of Superchargers / Turbochargers SA Limit of Supercharging / Turbo charging. Performance characteristics of S.I. & C.I. Engines, 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. Method of determining indicated power of the engine.

### 5. Exhaust Gas Analysis and Air Pollution

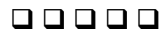
Necessity of exhaust gas analysis. Constituents of exhaust gas, Orsat apparatus for carrying out exhaust gas analysis. Different methods of determining Air/Fuel ratio. **Fuels of I.C. Engines** : Requirement of fuels; Classification of hydrocarbon fuels; Physical and Chemical properties of fuels; Rating of Fuels – Octane No., Cetane No. & Performance No., Determination of Octane and Cetane Nos.. Non–Conventional Fuels for I.C. Engines. CNG, LPG, Hydrogen, Bio- fuels, alcohol etc., Air pollution due to engine exhaust, Pollution control devices and EURO standards.

### 6. Engine Lubrication

Types of lubricants used in I.C. Engines; Properties of Lubricants; SAE Ratings of Lubricants; Types of Lubrication Systems; **Engine Cooling** : Systems of Cooling – Air, Water-cooling. General arrangements. Introduction to Stratified Charge and Wankel engines. Recent developments in I.C. Engines.

**Reference :**

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.
5. Internal Combustion Engine (*Richard Stone*) Palgrave Publications.
6. Internal Combustion Engine (*S.L. Beohar*).
7. Internal Combustion Engine (*Gills and Smith*).
8. Internal Combustion Engine (*P.M. Heldt*).
9. Power Plant Engineering (*Morse*).
10. Internal Combustion Engines (*V.L. Maleeve*).
11. Internal Combustion Engines (*Taylor*).
12. Internal Combustion Engines Fundamentals (*John B. Heywood*).
13. Internal Combustion Engines (*S.S. Thipse*) JAICO.
14. Internal Combustion Engines (*Willard W. Pulkrabe*) Pearson Education.



**Machine Design - I**  
T.E. Sem. VI [MECH/AUTO]

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**EVALUATION SYSTEM**

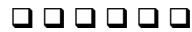
	<b>Time</b>	<b>Marks</b>
<b>Theory Exam</b>	4 Hrs.	100
<b>Practical Exam</b>	–	–
<b>Oral Exam</b>	–	25
<b>Term Work</b>	–	25

**SYLLABUS**

- 1. 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.
- 2. 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.
- 3. 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
- 4. 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.
- 5. Design of Springs**  
Helical compression, tension springs under static and variable loads, Laminated Springs.
- 6. Design of Belts**  
Flat and V belt with Pulley construction. Selection of Standard Roller chains.

**Reference :**

1. Design of Machine Elements (*V.B. Bhandari*) Tata McGraw Hill Publication.
2. Design of Machine Elements (*Sharma, Purohit*) Prentice Hall India Publication.
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*)
7. Machine Design (*Reshetov*) Mir Publication.
8. Machine Design (*Black Adams*) McGraw Hill.
9. Fundamentals of Machine Elements (*Hawrock, Jacobson*) McGraw Hill.
10. Machine Design (*Patel, Pandya, Sikh*) C. Jamnadas & Sons. Co. Educational & Law Publishers (Vol. I and II).
11. Design of Machine Elements (*V.M. Faires*).
12. Design fo Machine Elements (*Spotts*).



# Automotive Emission Technology

T.E. Sem. VI [AUTO]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	25

## SYLLABUS

### 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.

**Air Pollution Effects on Physical and Economic System :** Effects on visibility, Effects on Economic materials and structures, Effects on Indoor air quality.

**Effect of following Elements on Human Being and their Control Concepts :** Sulphur oxides and block suspended particulate matter; Ozone and oxidants; Oxides of nitrogen; Carbon monoxide; Unburnt hydrocarbon; Lead.

### 2. Sources of Pollutants and 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 of measurement of vehicle emissions C.V.S., Driving cycles, Details of the measurement of CO, HC and NO<sub>x</sub> by infrared, FID and Chemi-luminescence methods.

### 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.

### 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 NO<sub>x</sub> Measurement.

### 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.

### 6. Noise Reduction and Control

Fundamental of noise, Propagation of noise/sound, Measurement of sound, Noise control, Effect of noise.

**Reference :**

1. Internal Combustion Engines (*Mathur & P.L. Sharma*).
2. Air Pollution (*Rao & Rao*).
3. Electronic Engine Control Technologies (*Ronald K. Jurgen*).
4. Internal Combustion Engines & Air Pollution (*Edward F. Obert*).
5. Pollution Control and Conservation (*Dr. M. Movacs*).
6. Air Pollution (*Arthur C. Stem*) Volume I and XII.
7. Air Pollution (*Henry C. Perkins*).
8. Air Pollution (*Spedding*).
9. I.C. Engine Fundamentals (*J.B. Heywood*).



# Chassis and Body Engineering

T.E. Sem. VI [AUTO]

## EVALUATION SYSTEM

	Time	Marks
<b>Theory Exam</b>	3 Hrs.	100
<b>Practical Exam</b>	2 (PE)	25
<b>Oral Exam</b>	–	–
<b>Term Work</b>	–	25

## SYLLABUS

### 1. Fundamentals

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; Classification of motor vehicle, Location of power plant, Location of different chassis components; terminology and overview of structural surface types, history and Overview of structural types, Basic concept of design; terms related with vehicle coach building and window. Various assembly process involved in coach building. *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.

### 2. Basic Dimensions and Aerodynamics

Visibility; *Design and Requirements* : Driver's seat, Passenger Seat, Child seat; Fundamental vehicle loads and their estimation; *Aerodynamic drag* : Aerodynamic lifts and pitching moments, Side force, Yawing moments and rolling moments.

### 3. Load Paths

Introduction, Bending load, Torsion load, Lateral load, Breaking load, Summary and discussions; Calculation of loading cases : Static loading case, Asymmetric loading case, Longitudinal loads, Side loads, Calculation of different cases.

### 4. Principals of Thin Walled Structure

Shear centre principal of shear flow and shear lag application design. Alternative Constructions for body sub-assemblies.

### 5. Preliminary Design and Analysis of Body Sub-assemblies

Introductory discussions, Steering column mounting, engine component bracket, front suspension mounting.

### 6. Latest Trends in Design, Manufacturing and Materials

ULSAB Design, Tailored blanks; Manufacturing Process : Hydro forming tubular, Sheet Stamping, CAE Analysis, Crash Analysis and Economic Analysis.

### Reference :

1. Vehicle Body Engineering (*J. Powlowski*).
2. Vehicle Body Layout and Analysis (*John Fenton*).
3. Automotive Mechanics (*Josephy Heitner*).
4. Automotive Mechanics (*William Crouze*).
5. Modern Vehicle Design (*Jullian Happians Smith*).
6. SAE Transaction and Proceedings.
7. Motor Vehicle Structures Concept and Fundamentals (*Jason C. Brown*).
8. (*Robertson, Stan T. Serpetito*) Allied Publications.

