

**STATE COUNCIL OF TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA  
TEACHING AND EVALUATION SCHEME FOR DIPLOMA IN ENGINEERING COURSES**

<b>DISCIPLINE: AUTOMOBILE ENGINEERING</b>										<b>SEMESTER: 5<sup>TH</sup></b>			
SL NO	SUBJECT CODE	SUBJECT	PERIODS			EVALUATION SCHEME							
			L	T	P	SESSIONAL EXAM			END SEM EXAM	TERM WORK	PRACTICAL EXAM	TOTAL MARKS	
						TA	CT	Total					
<b>THEORY</b>													
1.	BST -501 OR HMT 601	ENVIRONMENTAL STUDIES OR ENTERPRENEURSHIP AND MANAGEMENT	5	0	-	10	20	30	70			100	
2.	AET 501	AUTOMOTIVE ENGINE	4	1	-	10	20	30	70			100	
3.	AET 502	AUTOMOTIVE TRANSMISSION	4	1	-	10	20	30	70			100	
4.	AET 503	AUTO ELECTRICITY	4	1	-	10	20	30	70			100	
5.	AET 504	AUTOMOBILE COMPONENT DESIGN	4	1	-	10	20	30	70			100	
<b>PRACTICAL/TERM WORK</b>													
5.	AEP 501	AUTO SERVICING & MAINTENANCE LAB-II	-	-	6					50	50	100	
6.	AEP 502	AUTO MACHINE SHOP-II	-	-	6					50	50	100	
7.	AEP 503	PROJECT SEMINAR & COMMUNICATION SKILL	-	-	2					25	25	50	
<b>GRAND TOTAL</b>			<b>21</b>	<b>4</b>	<b>14</b>	<b>50</b>	<b>100</b>	<b>150</b>	<b>350</b>	<b>125</b>	<b>125</b>	<b>750</b>	
Total Contact hours per week: 39													
Abbreviations: L-Lecture, T-Tutorial, P-Practical, TA- Teacher's Assessment, CT- Class test													
Minimum Pass Mark in each Theory Subject is 35% and in Practical subject is 50%													

**ENVIRONMENTAL STUDIES**  
(Common to all Branches of Engg.)  
**BST-501**

Period/Week: 05  
Total Periods: 75

Total Marks: 100  
Theory End Exams: 70; CT (20) +IA (10)

**Rationale:**

Due to various aspects of human developments including the demand of different kinds of technological innovations, most people have been forgetting that, the Environment in which they are living is to be maintained under various living standards for the preservation of better health. The degradation of environment due to industrial growth is very much alarming due to environmental pollution beyond permissible limits in respect of air, water industrial waste, noise etc. Therefore, the subject of Environmental Studies to be learnt by every Engineering student in order to take care of the environmental aspect in each and every activity in the best possible manner.

**OBJECTIVES:**

After completion of study of environmental studies, the student will be able to:

1. Gather adequate knowledge of different pollutants, their sources and shall be aware of solid waste management systems and hazardous waste and their effects.
2. Develop awareness towards preservation of environment.

**Unit 1: The Multidisciplinary nature of environmental studies**

**(04 periods)**

Definition, scope and importance, Need for public awareness.

**Unit 2: Natural Resources**

**(12 periods)**

**Renewable and non renewable resources:**

- a) Natural resources and associated problems.
  - Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction mining, dams and their effects on forests and tribal people.
  - Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.
  - Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources.
  - Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity, .
  - Energy Resources: Growing energy need, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
  - Land Resources: Land as a resource, land degradation, man induces land slides, soil erosion, and desertification.
- b) Role of individual in conservation of natural resources.
- c) Equitable use of resources for sustainable life styles.

### **Unit 3: Systems**

**(12 periods)**

- Concept of an eco system.
- Structure and function of an eco system.
- Producers, consumers, decomposers.
- Energy flow in the eco systems.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following eco system:
  - Forest ecosystem:
  - Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries).

### **Unit 4: Biodiversity and it's Conservation**

**(08 periods)**

- Introduction-Definition: genetics, species and ecosystem diversity.
- Biogeographically classification of India.
- Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and optin values.
- Biodiversity at global, national and local level.
- Threats to biodiversity: Habitats loss, poaching of wild life, man wildlife conflicts.

### **Unit 5: Environmental Pollution.**

**(18 periods)**

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, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

Disaster management: Floods, earth quake, cyclone and landslides.

### **Unit 6: Social issues and the Environment**

**(12 periods)**

- Form unsustainable to sustainable development.
- Urban problems related to energy.
- Water conservation, rain water harvesting, water shed management.
- Resettlement and rehabilitation of people; its problems nd concern.
- Environmental ethics: issue and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.
- Air (prevention and control of pollution) Act.

- Water (prevention and control of pollution) Act.
- Public awareness.

### **Unit 7: Human population and the environment**

**(09 periods)**

- Population growth and variation among nations.
- Population explosion- family welfare program.
- Environment and human health.
- Human rights.
- Value education
- Role of information technology in environment and human health.

### **Recommended Books:**

1. Textbook of Environmental studies, Erach Bharucha, #UGC
2. Fundamental concepts in Environmental Studies, D.D. Mishra, S.Chand & Co-Ltd,
3. Text book of Environmental Studies by K.Raghavan Nambiar, SCITECH Publication Pvt. Ltd.
4. Environmental Engineering by V.M.Domkundwar- Dhanpat Rai & Co.
5. Environmental Engineering & Safety by B.K.Mohapatra.

# ENTREPRENEURSHIP & MANAGEMENT

## (Code :HMT-601)

Period/Week: 05

Total Marks: 100

Total Periods: 75

Theory End Exams: 70; CT (20) +IA (10)

**(COMMON TO ALL BRANCHES OF ENGG EXCEPT CIVIL/ CSE/ IT)**

### **OBJECTIVES:**

On completion of the course, students will be able to :

1. Understand the concept of different forms of organization including MSME and various managerial functions.
2. Understand Entrepreneurship and choose it as a career option after study.
3. Learn about the basic financial accounting and cost control.
4. Know different areas of management relating to stores and purchase, finance, production, sales and marketing and human resources in an organization.
5. Learn about various reasons of industrial sickness and its remedial measures.
6. Have a comprehensive idea on important legislations relating to employment in Factory.

### **SYLLABUS**

#### **1. Concept of Organization & Enterprise Management:**

**12 periods**

- 1.1. Meaning, features and components of Business
- 1.2. Different forms of Business Organizations with features
- 1.3. Meaning, definitions and importance of management
- 1.4. Difference between Management & Administration
- 1.5. Functions of management- Planning, Organizing, Staffing, Directing (including Motivation, Leadership & Communication), Coordinating and Controlling.
- 1.6. Principles of Scientific Management.

#### **2. Entrepreneurship & Management of MSME:**

**12 periods**

- 2.1. Meaning & Need of Entrepreneurship
- 2.2. Qualities of an Entrepreneur
- 2.3. Relevance of Entrepreneurship of Socio-economic gain  
(Generating national wealth, creating wage & self employment, developing MSME enterprises, Optimizing human and national resources, building enterprising personalities and society)
- 2.4. Micro, Small and Medium Enterprises. (investment limits of MSME)
- 2.5. Project Report- PPR & DPR. (Preparation of a PPR)
- 2.6. Incentives available to MSME as per the latest IPR
- 2.7. Role of DIC, OSFC, OSIC, IDCO, SIDBI, IPICOL and Commercial Banks in the context of MSME.

- 3. Financial Accounting & Cost Control: 12 periods**
- 3.1. Double- entry System of Book –keeping and types of accounts
  - 3.2. Journal, Ledger, Cash Book (different types), Trial balance
  - 3.3. Components of Final Accounts- Trading A/c, Profit & Loss A/c and Balance Sheet
  - 3.4. Elements of Cost and Preparation of Cost Sheet
  - 3.5. Break-even Analysis
- 4. Financial Management: 04 periods**
- 4.1. Meaning & Importance
  - 4.2. Finance Functions
  - 4.3. Types of Capital- Fixed & Working Capital
  - 4.4. Components of Working Capital, Working Capital Cycle
- 5. Stores & Purchase Management: 05 periods**
- 5.1. Inventory Control : Importance & Techniques
  - 5.2. Purchase management-Principles & Procedures
  - 5.3. Important Store Records (Bin Card, Stores Ledger & GRN)
- 6. Production Management: 04 periods**
- 6.1. Production & Productivity
  - 6.2. Production , Planning & Control- (meaning & steps)
- 7. Sales & Marketing Management: 08 periods**
- 7.1. Sales & Marketing Management- Meaning & Importance
  - 7.2. Selling Methods
  - 7.3. Product Policy- (Branding, Packaging, Labeling)
  - 7.4. Product-mix, Pricing methods and Sales Promotion including its techniques.
  - 7.5. Advertising & its media
- 8. Human Resource management: 06 periods**
- 8.1. Need & Importance
  - 8.2. Recruitment & its sources
  - 8.3. Selection- Methods
  - 8.4. Training- Need, & Methods
  - 8.5. Need of Performance Appraisal
- 9. Industrial Sickness: 04 periods**
- 9.1. Meaning & Symptoms of Sickness
  - 9.2. Causes of Industrial Sickness
  - 9.3. Remedial measures of Sickness

**10. Industrial Legislation:**

**08 periods**

- 10.1. Major Provisions of Factories Act relating to Health, Welfare, Safety, Accidents, Hours of Work, employment of Women
- 10.2. Duties and Power of Factory Inspector
- 10.3. Major Provisions of Employee's Compensation Act.

**Books Recommended**

- 1. Industrial Engineering & Management : O.P.Khanna
- 2. Entrepreneurship for Engineers : B.Badhei
- 3. Principles & Practice of Management : L.M.Prasad
- 4. Industrial Engineering & Management: Banga & Sharma
- 5. Mercantile Law: N.D.Kapoor
- 6. Industrial Engineering & production Management: M.Mahajan
- 7. Industrial Policy Resolution ( latest)

**AUTOMOTIVE ENGINE**  
**AET-501**

Period/Week:4+1  
Total period: 60

Examination: 3Hrs  
End exams: 70 marks  
CT:20 marks  
TA: 10 marks

**TOPICE WISE DISTIBUTION OF PERODS**

<u>Sl. No.</u>	<u>Topic</u>	<u>Periods</u>
1.	Petrol engines & its constructional details	10
2.	Diesel engine & its constructional details.	08
3.	Fuel & Combustion	08
4.	Fuel feed system for petrol & diesel engine	20
5.	Cooling system	04
6.	Lubrication system	05
7.	Engine development testing & performance	<u>05</u>
		60

**RATIONALE:**

Automobile engineers must have the knowledge of auto engines which is the heart of any automobile. The subject deals with function & constructional details of automobile engines, properties of fuel, lubricants and cooling system.

**OBJECTIVES:**

On completion of the subject students will be able to explain

1. Principle and working of petrol engine.
2. Principle and working of diesel engine.
3. Properties of fuel, details of combustion and control of knocking.
4. Process of fuel being supplied to petrol & Diesel engine.
5. Types of engine cooling and working principle of cooling system.
6. Types, properties, requirement of lubricants & process of lubrication.
7. Performance of engine.

**COURSE CONTENTS:**

- 1 Petrol engines and its constructional details (10 periods)

1.0 Working principle of two stroke & four stroke petrol engine.

1.1 Constructional details of petrol engine with materials. Engine components like piston, cylinder block, valve, connecting rod, crank shaft, crank slot.

1.2 Cylinder arrangement: inline and v-type engine firing order of multi cylinder engine.

1.3 Side valve actuating mechanism over head valve actuating mechanism.

- 1.4 I, F & T type valve arrangement, valve clearance.
- 1.5 Timing gear, vibration damper, inlet & exhaust manifold.

## **2. Diesel engine and its constructional details (8 Periods)**

- 2.0 Working principle two strokes & four stroke diesels engine.
- 2.1 Types, advantages & limitations of diesel engine over petrol engine.
- 2.2 Function & types of combustion chamber.
- 2.3 Direct injection type combustion chamber, pre combustion chamber, turbulence chamber. Their advantages & disadvantages.

## **3. Fuel & combustion (8 periods)**

- 3.0 Properties & additive of fuel.
- 3.1 Cetane & Octane nos.
- 3.2 Combustion stages in S. I. Engine. Flame Propagation, pre-ignition, detonation & its control.
- 3.3 Combustion stages in C. I. Engine, delay period, diesel knock & its control.
- 3.4 Methods of Scavenging & super charging, super charging of CI & SI engines.
- 3.5 Super charger blower, turbo charger.

## **4. Fuel feed system for petrol & diesels engine (20 periods)**

- 4.0 Line diagram of petrol engine fuel supply system.
- 4.1 Components of petrol engine fuel supply system like fuel tanks, fuel lines, fuel pumps, (mechanical & electrical) fuel filter.
- 4.2 Requirements and working principle of carburetors. Air fuel ratios for different conditions in carburetors.
- 4.3 Circuits of various types of carburettor, like down draught carburettor side draught carburettor.
- 4.4 Description of motorcycle carburettor
- 4.5 line diagram of diesel engine fuel supply system.
- 4.6 Requirements and types of fuel injection system.
- 4.7 Air injection, solid injection individual pump system injection common rail system injection TBL system MPFI system PFI system ECM control functions
- 4.8 Constructional details of fuel pump.
- 4.9 Fuel injectors.
- 4.10 Governing system of fuel: Mechanical governor pneumatics governor. Hydraulic governor.

## **5. Cooling System (4 Periods)**

- 5.0 Necessity & types of engine cooling.
- 5.1 Constructional details of air cooling & water cooling ( thermo siphon & pump air circulation)
- 5.2 Advantages and limitations of air cooling.
- 5.3 Water pump thermostat, radiator.
- 5.4 Anti-freezing and anti-corrosive additives.

## **6. Lubrication System (5 Periods)**

- 6.0 Types, requirements and properties (flash point & fire points) of lubricants.

6.1 Types of lubrication system gravity types splash type pressure type, dry sump type, semi pressure type etc.

6.2 Parts of lubricating system like oil sump , oil cooler, oil filter, oil pressure gauge oil pressure indicating light oil level indicator.

6.3 Oil filters and its types – full flow filter and bypass filter.

6.4 Crank case ventilation.

## **7. Engine development testing & performance (5 periods)**

7.0 Principle, advantages and disadvantages of WANKEL engine.

7.1 Clearance volume swept volume stroke bore, compression ratio, efficiency.

7.2 Mechanical efficiency, volumetric efficiency, thermal efficiency, thermal efficiency.

7.3 Specific fuel consumption BHP,IHP.

7.4 Morse – test and preparation of heat balance sheet.

## **BOOKS RECOMMENDED**

1. Automobile engineering Vol, Vol-II by Kirpal Singh std . Publishers.
2. Automobile engineering by N.H. Crouse. Mc. Graw Hills.
3. Automobile engineering by G.B.S. Narangs, Khanna pub.
4. The automobile- by H.S.Reyat. S. Chand & Co.
5. Automobile engineering by W.H. Course. Mc Graw Hill
6. I.C. engine by Mathur and Sharma.
7. Automobile engineering by R.B. Gupta. Satya Prakashan.
8. Automobile engineering by C.P. Nakra.

**AUTOMOTIVE TRANSMISSION**  
**AET-502**

Period/Week:4+1  
Total period: 60

Examination: 3Hrs  
End exams: 70 marks  
CT:20 marks  
TA: 10 marks

**TOPIC WISE DISTRIBUTION OF PERIODS**

<u>Sl.No.</u>	<u>Topic</u>	<u>Periods</u>
1.	Clutch	08
2.	Gear Box	08
3.	Propeller Shaft	08
4.	Differential	08
5.	Rear Axle	08
6.	Two Wheeler	08
7.	Performance of automobile	<u>12</u>
		60

**RATIONALE:**

The power developed by automobile engine is transmitted to the rear axle through many parts & mechanism such as clutch gear Box, propeller shaft and differential. The entire system is called power transmission mechanism in automobile. Knowledge of automobile transmission is of vital importance for an automobile engineer.

**OBJECTIVES:**

1. Functions, types requirements & adjustment of clutch.
2. Function, types & operation of gear box.
3. Functions of propeller shaft & types of joints
4. Functions & types of differentials.
5. Types & operation of rear axle.
6. Transmission of power in two wheelers.
7. Various resistances for vehicles & calculation of attractive effort.

**COURSE CONTENTS:**

1. Clutch (8 periods)
  - 1.0 Introduction, requirement of clutch, types of clutch.
  - 1.1 Clutch operation.
  - 1.2 Clutch components, clutch facing.
  - 1.3 Clutch problem & adjustment.
  - 1.4 Flywheel & coupling.
2. Gear Box (8 periods)
  - 2.0 Introduction, functions & types of transmission.
  - 2.1 Sliding mesh & constant mesh gear box.

- 2.2 Epicyclic gear box over drive.
- 2.3 Free-wheel drive, selector mechanism.
- 2.4 Fluid torque converter.

**3. Propeller shaft ( 8 periods)**

- 3.0 Introduction definition & types of propeller shaft.
- 3.1 Universal joints & its types.
- 3.2 Sliding joint.

**4. Differential ( 8 periods)**

- 4.0 Function of differential gear box.
- 4.1 Types of differential.
- 4.2 Constructional details of a differential.
- 4.3 Study & inspection of differential.

**5. Rear Axle (8 Periods)**

- 5.0 Definition of rear axle, supporting of rear axle.
- 5.1 Rear axle drives such as Hotchkiss drive, torque tube drive etc.
- 5.2 Types of rear axle.
- 5.3 Rear axle casing.

**6. Two wheeler (8 periods)**

- 6.0 Power transmission system of moped.
- 6.1 Power transmission system of scooter.
- 6.2 Power transmission system of motor cycle.
- 6.3 Power transmission system of bullet.

**7. Performance of Automobile (12 periods)**

- 7.0 Power for propulsion resistances for vehicle.
- 7.1 Traction & tractive effort, road performance curves.
- 7.2 Acceleration gradability & draw-bar pull.
- 7.3 Calculation of equivalent weight.
- 7.4 Calculation of maximum traffic effort.

**RECOMMENDED BOOKS:**

1. Automotive mechanics by Heitner. CBS publishers.
2. The automobile by Harbans Singh Reyat, S. Chand & Co.
3. Automobile Engineering by G.B.S. Narang, Khanna publishers.
4. Automobile Engineering Volume-1 by Dr. Kipal singh, std Publisher.
5. Automobile Engineering & power Yrain by W.H.Crouse. Mc Graw Hills.
6. Motor manual (Transmission) by A.N. Judge.
7. Motor manual (Car mechanism) by A. N. Judge.

**AUTO ELECTRICITY**  
**AET-503**

Period/Week:4+1  
Total period: 60

Examination: 3Hrs  
End exams: 70 marks  
CT:20 marks  
TA: 10 marks

**TOPIC WISE DISTRIBUTION OF PERIODS**

<b><u>Sl. No.</u></b>	<b><u>Topic</u></b>	<b><u>Periods</u></b>
1.	Storage battery	06
2.	Starting System	06
3.	Generating System	10
4.	Alternator	05
5.	Ignition System	15
6.	Light	06
7.	Accessories & Control	06
8.	Wiring System	<u>06</u>
		60

**RATIONALE:**

Electrical system in automobile is necessary for starting and generating power for ignition and lighting purposes. Automobile students should know about the operation maintenance of wiring systems for automobiles.

**OBJECTIVES:**

On completion of the subject students will be able to understand and explain:

1. Types, construction, charging, testing and maintenance of battery.
2. Construction, drive arrangement, principle and operation of starter.
3. Principle, construction and maintenance of generator.
4. Principle construction and maintenance of alternator.
5. Types and components of ignition system.
6. Setting and mechanism of light.
7. Mechanism of several electrical accessories.
8. Types of wiring and wiring diagram.

**COURSE CONTENTS:**

**1. Storage Battery (6 Periods)**

- 1.0 Purpose and types of battery.
- 1.1 Construction capacity and charging of battery.
- 1.2 Testing servicing and maintenance of battery.

**2. Starting System (6 periods)**

- 2.0 Principle and construction of starter motor.
- 2.1 Drive arrangement and control.
- 2.2 Servicing and maintenance of starter motor.

### **3. Generating system (10 periods)**

- 3.0 Flemings right hand rule and lenz's law.
- 3.1 Principle and constructional details of generator.
- 3.2 Current and voltage regulator.
- 3.3 Cut-out relay, routine maintenance of generator.

### **4. Alternator (5 periods)**

- 4.0 Principle and construction of alternator.
- 4.1 Maximum R.M.S. and average value.
- 4.2 Maintenance of alternator.

### **5. Ignition System (15 periods)**

- 5.0 Principle and components (induction coil, contact breaker, spark plug, distributor, condenser) of spark ignition system.
- 5.1 Electronics spark timing computer controlled coil ignition system operation
- 5.2 Electronics ignition system with distributor/distributor less.
- 5.3 Types of ignition system such as:- Coil ignition system magnet ignition system electronics ignition system, transistorised ignition system.
- 5.4 Ignition system servicing and fault diagnosis.

### **6. Light (6 periods)**

- 6.0 Setting of head lights.
- 6.1 Tail and stop lights.
- 6.2 Indicator and dim deeper mechanism.

### **7. Accessories & Control (6 Periods)**

- 7.0 Electric horn and screen wiper.
- 7.1 Fuel gauge oil pressure gauge and water temperature gauge.

### **8. Wiring system (6 Periods)**

- 8.0 Types of wiring such as :-
  - Earth return and insulated return system.
- 8.1 Wiring diagram of four wheelers and two wheelers.
- 8.2 Elective wiring layout in a four wheeler.
- 8.3 Inspection and maintenance of electrical systems.

### **RECOMMENDED BOOKS:**

1. Electrical equipment of automobiles by Parker Singh.
2. Automobile electrical equipment by Kohil.
3. Basic automobile electricity by C.P. Nakra.
4. Automobile electrical engineering by Aroar & Das.
5. Automobile electrical system and equipments By M.R. Khatawata.
6. Motor manual (modern automobile electrical equipment) by A.W.Judge.
7. Automobile electrical equipments by W.H.Crouse, MC Graw Hill.

## AUTOMOBILE COMPONENT DESIGN

AET-504

Period/Week:4+1  
Total period: 60

Examination: 3Hrs  
End exams: 70 marks  
CT:20 marks  
TA: 10 marks

### Topic wise distribution of period.

<u>Sl. No.</u>	<u>Topic</u>	<u>Period</u>
1.	Basic concepts of design	12
2.	Design of machine elements	06
3.	Design of shafts keys & components	10
4.	Design of levers	06
5.	Design of chassis component	10
6.	Design of engine components	16
		60

### **Aim:**

To gain the knowledge and skills needed in automotive design and production to develop skills in CAD/CAM. To study the process of engineering problem solving.

### **Objective:**

On completion of subject the students will be able to.

1. Analyze the loads type of induced stresses resisting areas & hence the modes of failure.
2. Identity modes of failure & relevant theory for problem solving.
3. Analyza practical problem & make use of material, strength equations, factor of safety etc.
4. Use design data book to standardize component dimonsions & to select.

### **COURSE CONTENTS.**

#### **1. Basic concepts of design**

- 1.1 Introduction to design
- 1.2 Classification of design
- 1.3 Design Consideration
- 1.4 Design procedure

#### **1.5 Stress analysis**

- 1.5.1 Types of external loads
- 1.5.2 Types of induced stresses: tensile, compressive, shear crushing & bearing pressure, bending, torsion, thermal stresses, creep, proof stresses resilience principal stresses.
- 1.5.3 Stress- strain diagram for ductile & brittle material and its importance/
- 1.5.4 Variable stresses machine parts, fatigue & endurance limit, stress-time diagrams for variable stresses.
- 1.5.5 Working stresses for static load, variable or fatigue load.
- 1.5.6 Factor of safety, selection of factor of safety.
- 1.5.7 Stress concentration causes and remedies.

- 1.5.8 Introduction to theories of failure-maximum principal theory. Maximum shear stress theory, Distribution energy theory.
- 1.5.9 Selection of material and justifications of automobile components, advanced materials for automotive components.
- 1.6.0 Concept of standardization, preferred numbers & inter changeability in design practice.
- 1.6.1 Common types of fasteners with their applications-through bolts, tap bolts, top bolts, studies cap screws and machine screws, designation of screw thread according to 1.5, stresses in screw fasteners, bolts of uniform strength.
- 1.6.2 Bearings – classification, location in automobiles systems & selection of bearings.
- 1.6.3. Post design aspects ergonomic aspect aesthetic consideration (shape, colour, surface finish) for automobile.

## **2. Design of machine elements.**

- 2.1 Design of socket & spigot type cotter joint
- 2.2 Design of knuckle joint
- 2.3 Design of turn buckle.
- 2.4 Application of above machine elements in an automobile.

## **3. Design of shafts, keys & couplings**

- 3.1 Conceptual understanding of shaft, axles & spindles.
- 3.2 Design of shaft for torsion, rigidity, bending, combined bending & torsion..
- 3.3 Compression of solid & hollow shafts
- 3.4 Design of propeller shaft, whirling & critical speed.
- 3.5 Design of near axle.
- 3.6 Types of keys design of sunk rectangular key, woodruff key.
- 3.7 Effect of keyways on shaft.
- 3.8 Design of coupling-muff, flange and bush pin type flexible

## **4. Design of levers.**

- 4.1 Types of levers
- 4.2 Design of
  - 4.2.1 Rocker arm
  - 4.2.2 Bell crank lever
  - 4.2.3 Hand leave
  - 4.2.4 Pedals for rectangular crosssection & fulcrum Pin only.

## **5. Design of chassis component**

- 5.1 Design of cloth- single plate & multi plate.
- 5.2 Teeth calculation of gears for sliding mesh/constant mesh gear box of given data.
- 5.3 Design of semi elliptical leaf spring, helical spring-torsion & compression

## **6. Design of engine components.**

- 6.1 Data of engine specifications & calculation of cylinder dimensions for given power.
- 6.2 Design of cylinder head thickness & bolts.
- 6.3 Design of valve seat & valve lift.

- 6.4 Design of piston crown by bending strength & thermal considerations
- 6.5 Design of piston rings & skirt length
- 6.6 Design of piston pin for bearing, bending & shear considerations.
- 6.7 Design of connecting rod cross-section (I-section)
- 6.8 Design of big end, cap & bolt.
- 6.9 Design of over hung crank shaft.

**Test books**

1. Machine Design by R.K. Jain, Khanna Publisher.
2. Machine Design by P.C. Sharma, D.K. Agrawal, S.K. Kataria & sons
3. Machine Design by R.S. Khurmi & J.K. Gupta, Eurasia Publication House.