

**UNIT I****Chapter 1 : Introduction of Energy and Its Conversion****1-1 to 1-37**

| | | |
|---------|--|--------|
| 1.1 | Introduction to Energy | 1 - 2 |
| 1.1.1 | Forms of Energy | 1 - 2 |
| 1.1.2 | Grades of Energy | 1 - 2 |
| 1.1.3 | Conventional or Non-Renewable Sources of Energy and Non-Conventional OR Renewable Energy Sources | 1 - 3 |
| 1.2 | Thermal (Steam) Power Plants | 1 - 3 |
| 1.2.1 | Advantages and Disadvantages of Steam Power Plants | 1 - 5 |
| 1.3 | Hydro Power Energy | 1 - 5 |
| 1.3.1 | Principle of Operation of Hydro Power Plants | 1 - 5 |
| 1.3.2 | Schematic Layout of Hydro-Electric Power Plant | 1 - 6 |
| 1.3.2.1 | Operation of Hydro-Electric Power Plant | 1 - 7 |
| 1.3.3 | Advantages and Disadvantages of Hydro-electric Power Plants | 1 - 8 |
| 1.4 | Nuclear Energy from Nuclear Fuels | 1 - 8 |
| 1.4.1 | Advantages of Nuclear Energy | 1 - 8 |
| 1.4.2 | Disadvantages of Nuclear Energy | 1 - 8 |
| 1.5 | Nuclear Power Plants | 1 - 8 |
| 1.5.1 | Construction and Working (Energy Extraction Process) of Nuclear Power Plant | 1 - 9 |
| 1.5.2 | Advantages and Disadvantages of Nuclear Power Plants | 1 - 10 |
| 1.6 | Solar Energy | 1 - 10 |
| 1.6.1 | Limitations of Use of Solar Energy | 1 - 10 |
| 1.6.2 | Advantages of Solar Energy | 1 - 11 |
| 1.6.3 | Disadvantages of Solar Energy | 1 - 11 |
| 1.7 | Solar Collectors | 1 - 11 |
| 1.7.1 | Types of Solar Collectors | 1 - 11 |
| 1.8 | Power Generation from Solar Energy | 1 - 12 |
| 1.8.1 | Solar Photovoltaic (PV) Cell Panel Power Plant | 1 - 12 |
| 1.8.2 | Advantages, Disadvantages and Applications of Solar Power Plants | 1 - 13 |
| 1.9 | Geothermal Energy | 1 - 13 |
| 1.9.1 | Advantages of Geothermal Energy | 1 - 14 |
| 1.9.2 | Disadvantages of Geothermal Energy | 1 - 14 |
| 1.9.3 | Types of Geothermal Resources | 1 - 14 |
| 1.9.4 | Applications of Geothermal Energy | 1 - 14 |
| 1.9.5 | Binary Cycle Power Plant | 1 - 14 |
| 1.10 | Wind Energy | 1 - 15 |

| | | |
|----------|--|--------|
| 1.10.1 | Horizontal Axis Type Wind Turbine OR Wind Mill | 1 - 15 |
| 1.10.2 | Vertical Axis Wind Turbine (VAWT) OR Vertical Axis Wind Mill (VAWM) | 1 - 16 |
| 1.11 | Hydrogen Gas | 1 - 17 |
| 1.11.1 | Hydrogen-Oxygen (H ₂ -O ₂) Fuel Cell for Electric Power Generation | 1 - 17 |
| 1.11.1.1 | Chemical Reactions with Alkaline H ₂ - O ₂ Fuel Cell | 1 - 18 |
| 1.11.1.2 | Chemical Reaction with Acidic Electrolyte (H ₂ SO ₄) | 1 - 18 |
| 1.12 | Biomass and Biomass Energy | 1 - 18 |
| 1.12.1 | Energy Conversion from Biomass | 1 - 18 |
| 1.12.1.1 | Direct Combustion | 1 - 18 |
| 1.12.1.2 | Thermo Chemical Conversion | 1 - 19 |
| 1.12.1.3 | Biochemical Conversion | 1 - 19 |
| 1.12.2 | Biogas and it's uses | 1 - 19 |
| 1.12.3 | Biofuels | 1 - 20 |
| 1.13 | Tidal Energy | 1 - 20 |
| 1.13.1 | Limitations of Tidal Energy | 1 - 20 |
| 1.13.2 | Availability of Tidal Power in India and Locations | 1 - 20 |
| 1.13.3 | Tidal Power Generation | 1 - 20 |
| 1.14 | Pumps | 1 - 21 |
| 1.14.1 | Classification of Pumps | 1 - 21 |
| 1.15 | Reciprocating Pumps | 1 - 21 |
| 1.15.1 | Working of Double Acting Reciprocating Pump | 1 - 22 |
| 1.16 | Centrifugal Pumps | 1 - 23 |
| 1.17 | Air Compressors | 1 - 24 |
| 1.17.1 | Applications (Uses) of Compressed Air | 1 - 24 |
| 1.17.2 | Single Acting and Double Acting Reciprocating Air Compressors | 1 - 25 |
| 1.17.3 | Reciprocating Air Compressor | 1 - 25 |
| 1.18 | Hydraulic Turbines | 1 - 26 |
| 1.18.1 | Basic Classification of Hydraulic Turbines | 1 - 26 |
| 1.18.1.1 | Impulse Turbine | 1 - 26 |
| 1.18.1.2 | Reaction Turbines | 1 - 26 |
| 1.19 | Pelton Wheel or Pelton Water Turbine (Impulse Turbine) | 1 - 27 |
| 1.20 | Input Power, Output Power and Efficiency | 1 - 28 |

UNIT II**Chapter 2 : Introduction to Thermal Engineering****2-1 to 2-48**

| | | |
|-----|------------------------------------|-------|
| 2.1 | Definition of Thermodynamics | 2 - 2 |
|-----|------------------------------------|-------|



| | | | | | |
|--------|---|--------|--------|---|--------|
| 3.2.4 | Classification Based on Capacity | 3 - 4 | 4.2.2 | Functions (Objectives) of Suspension System | 4 - 4 |
| 3.2.5 | Classification Based on Fuel Source | 3 - 4 | 4.2.3 | Types of Suspension Systems | 4 - 4 |
| 3.2.6 | Classification Based on Type of Transmission | 3 - 4 | 4.3 | Front Axle..... | 4 - 5 |
| 3.2.7 | Classification Based on Side of Drive | 3 - 4 | 4.4 | Steering System (Ackermann Steering Mechanism) | 4 - 6 |
| 3.2.8 | Classification Based on Wheels of Drive | 3 - 5 | 4.5 | Braking System..... | 4 - 7 |
| 3.2.9 | Classification Based on Type of Car | 3 - 5 | 4.6 | Cooling System..... | 4 - 9 |
| 3.3 | Components of I.C Engine | 3 - 6 | 4.6.1 | Need of Cooling of Automobile Engine | 4 - 9 |
| 3.4 | Automobile Engine Specifications | 3 - 8 | 4.6.2 | Methods of Cooling | 4 - 9 |
| 3.4.1 | Automobile Engine Specifications Parameters | 3 - 8 | 4.7 | Fuel Supply and Fuel Injection System in Petrol Engine..... | 4 - 11 |
| 3.4.2 | Example of Automobile Engine Specifications | 3 - 11 | 4.8 | Fuel Supply and Fuel Injection System in Diesel Engine | 4 - 12 |
| 3.5 | Vehicle Specifications of Two Wheelers | 3 - 11 | 4.9 | Power Transimssion System | 4 - 13 |
| 3.5.1 | Vehicle Specification Parameters for Two Wheelers | 3 - 11 | 4.10 | Clutch..... | 4 - 13 |
| 3.5.2 | Practical Example of Vehicle Specifications of Two Wheeler | 3 - 13 | 4.10.1 | Introduction to Clutch | 4 - 13 |
| 3.6 | Vehicle Specifications of Light Motor Vehicles (Cars)..... | 3 - 14 | 4.10.2 | Types (Classification) of Clutches | 4 - 13 |
| 3.6.1 | Vehicle Specification Parameters for Light Motor Vehicles (Car) | 3 - 14 | 4.10.3 | Single Plate (Disk) Clutch | 4 - 14 |
| 3.6.2 | Practical Example of Vehicle Specifications of Light Motor Vehicle (Car) | 3 - 16 | 4.11 | Gear Box..... | 4 - 15 |
| 3.7 | Specifications of Multi-Axle Heavy Motor Vehicle (Bus)..... | 3 - 17 | 4.11.1 | Introduction to Gear Box | 4 - 15 |
| 3.8 | Comparison of Specifications of Vehicles | 3 - 18 | 4.11.2 | Functions of Gear Box | 4 - 15 |
| 3.8.1 | Need of Comparison of Specifications of Vehicles | 3 - 18 | 4.11.3 | Types of Gear Boxes | 4 - 15 |
| 3.8.2 | Categories of Parameters for Comparison of Vehicles | 3 - 18 | 4.11.4 | Construction and Working of Gear Box | 4 - 16 |
| 3.8.3 | Technical Specification Parameters for Comparison of Vehicles | 3 - 18 | 4.11.5 | Gear Ratio (Speed Ratio) of Gear Box | 4 - 18 |
| 3.8.4 | Cost, Safety and Comfort Parameters for Comparison of Vehicles | 3 - 19 | 4.11.6 | Power Transmission Capacity of Gear Box | 4 - 18 |
| 3.9 | Electric Vehicles | 3 - 19 | 4.12 | Propeller Shaft and Universal Joint | 4 - 20 |
| 3.10 | Battery Electric Vehicles (BEV)..... | 3 - 20 | 4.13 | Differential Gear Box..... | 4 - 20 |
| 3.11 | Hybrid Electric Vehicle (HEV)..... | 3 - 22 | 4.14 | Vehicle Safety | 4 - 21 |
| 3.12 | Cost Analysis of Vehicle..... | 3 - 24 | 4.14.1 | Active (Primary) Safety Systems | 4 - 21 |
| 3.12.1 | Types of Costs of Vehicle | 3 - 24 | 4.14.2 | Passive (Secondary) Safety Systems | 4 - 22 |
| 3.12.2 | Case Study of Cost Analysis of Vehicle | 3 - 25 | 4.15 | Electric Vehicles..... | 4 - 23 |

UNIT IV**Chapter 4 : Vehicle Systems****4-1 to 4-23**

| | | |
|-------|---|-------|
| 4.1 | Layout of Chassis (Components Of Automobile Vehicle) | 4 - 2 |
| 4.2 | Suspension System..... | 4 - 4 |
| 4.2.1 | Suspension System | 4 - 4 |

UNIT V**Chapter 5 : Introduction to Manufacturing****5-1 to 5-57**

| | | |
|-----|---|-------|
| 5.1 | Introduction to Manufacturing Processes | 5 - 2 |
| 5.2 | Classification of Manufacturing Processes | 5 - 2 |
| 5.3 | Casting Process..... | 5 - 4 |



| | | | | | |
|--------|---|--------|--|---|--------|
| 5.3.1 | Casting Process | 5 - 4 | 5.14.5 | Types (Classification) of Drilling Machines | 5 - 43 |
| 5.3.2 | Terminology used in Casting Process | 5 - 4 | 5.15 | Milling Machine | 5 - 44 |
| 5.3.3 | Types of Casting Processes | 5 - 5 | 5.15.1 | Milling Process And Milling Machine | 5 - 44 |
| 5.3.4 | Sand Casting Process | 5 - 5 | 5.15.2 | Principle of Operation of Milling Machine | 5 - 44 |
| 5.3.5 | Advantages of Casting Process | 5 - 7 | 5.15.3 | Basic Elements of Milling Machine | 5 - 44 |
| 5.3.6 | Disadvantages (Limitations) of Casting Process | 5 - 7 | 5.15.4 | Types of Operations Performed on Milling Machine | 5 - 45 |
| 5.3.7 | Applications of Casting Process | 5 - 7 | 5.15.5 | Types (Classification) of Milling Machines | 5 - 48 |
| 5.4 | Metal Forming Processes..... | 5 - 7 | 5.16 | Computer Numerical Controlled (CNC) Machines.... | 5 - 49 |
| 5.4.1 | Forging Process | 5 - 7 | 5.16.1 | Computer Numerical Control (CNC) Machines | 5 - 49 |
| 5.4.2 | Extrusion | 5 - 10 | 5.16.2 | Elements and Working of CNC Machine Tool | 5 - 49 |
| 5.4.3 | Wire Drawing | 5 - 11 | 5.16.3 | Introduction to G-Codes and M-codes..... | 5-50 |
| 5.4.4 | Comparison between Casting Processes and Forging Processes | 5 - 12 | 5.16.4 | Advantages of CNC Machine Tools | 5 - 51 |
| 5.5 | Sheet - Metal Working (Press Working) | 5 - 13 | 5.16.5 | Limitations of CNC Machine Tools | 5 - 51 |
| 5.5.1 | Advantages of Sheet-Metal Working | 5 - 14 | 5.16.6 | Applications of CNC Machine Tools | 5 - 51 |
| 5.5.2 | Limitations of Sheet-Metal Working | 5 - 14 | 5.17 | Additive Manufacturing | 5 - 52 |
| 5.5.3 | Applications of Sheet-Metal Working | 5 - 14 | 5.17.1 | Categories of Manufacturing Processes | 5 - 52 |
| 5.6 | Types of Sheet Metal Working | 5 - 14 | 5.17.2 | Rapid Prototyping | 5 - 52 |
| 5.6.1 | Sheet-Metal Shearing(Cutting) Processes | 5 - 15 | 5.18 | Three Dimensional (3d) Printing | 5 - 53 |
| 5.6.2 | Sheet-Metal Forming Processes | 5 - 19 | 5.19 | Reconfigurable Manufacturing System..... | 5 - 56 |
| 5.7 | Metal Joining Processes..... | 5 - 25 | 5.20 | Micromachining..... | 5 - 56 |
| 5.7.1 | Types of Metal Joining Processes | 5 - 25 | 5.21 | Industry 4.0 | 5 - 57 |
| 5.8 | Welding..... | 5 - 25 | 5.22 | IoT in Manufacturing (Industrial Internet of Things OR IIoT) | 5 - 57 |
| 5.9 | Electric Arc Welding (Shielded Metal Arc Welding) | 5 - 27 | 5.22.1 | Internet of Things (IoT) | 5 - 57 |
| 5.10 | Brazing | 5 - 28 | 5.22.2 | IoT in Manufacturing (Industrial Internet of Things or IIoT) | 5 - 57 |
| 5.11 | Soldering | 5 - 30 | UNIT VI | | |
| 5.11.1 | Comparison between Brazing and Soldering | 5 - 31 | Chapter 6 : Engineering Mechanics and Their Applications in Domestic Appliances | | |
| 5.11.2 | Comparison of Welding, Brazing and Soldering | 5 - 31 | 6-1 to 6-50 | | |
| 5.12 | Machine Tools | 5 - 32 | 6.1 | Terminology of Equipment (Product) | 6 - 2 |
| 5.13 | Lathe Machine | 5 - 33 | 6.1.1 | Technical Specifications | 6 - 2 |
| 5.13.1 | Principle of Operation of Lathe Machine | 5 - 33 | 6.1.2 | Input | 6 - 2 |
| 5.13.2 | Basic Elements of Lathe Machine(Centre Lathe) | 5 - 33 | 6.1.3 | Output | 6 - 3 |
| 5.13.3 | Summary of Basic Elements of Lathe Machine (Centre Lathe) | 5 - 35 | 6.1.4 | Efficiency | 6 - 4 |
| 5.13.4 | Specifications of Lathe Machine | 5 - 36 | 6.2 | Machine Elements used in Household Appliances..... | 6 - 4 |
| 5.13.5 | Types of Operations Performed on Lathe Machine | 5 - 36 | 6.3 | Belt Drives (Belt and Pulley) | 6 - 4 |
| 5.14 | Drilling Machine | 5 - 40 | 6.3.1 | Working of Belt Drive | 6 - 4 |
| 5.14.1 | Drilling Process and Drilling Machine | 5 - 40 | 6.3.2 | Speed Ratio (Velocity Ratio) of Belt Drive | 6 - 4 |
| 5.14.2 | Principle of Operation of Drilling Machine | 5 - 40 | 6.3.3 | Power Transmission Capacity of Belt Drive | 6 - 5 |
| 5.14.3 | Basic Elements of Drilling Machine | 5 - 40 | 6.3.4 | Types of Belts | 6 - 6 |
| 5.14.4 | Types of Operations Performed on Drilling Machine | 5 - 41 | | | |



| | | | | | |
|--------|--|--------|--------|--|--------------------|
| 6.3.5 | Comparison (Differentiation) Between Flat and V-Belt Drives | 6 - 7 | 6.12.1 | Door Latch | 6 - 30 |
| 6.3.6 | Types (Classification) of Flat Belt Drives | 6 - 8 | 6.12.2 | Brake Pedal | 6 - 30 |
| 6.3.7 | Advantages and Limitations of Belt Drives | 6 - 10 | 6.13 | Valves | 6 - 31 |
| 6.4 | Applications of Belt Drive (Belt and Pulley) | 6 - 11 | 6.13.1 | Introduction to Valves | 6 - 31 |
| 6.4.1 | Photocopier | 6 - 11 | 6.13.2 | Applications of Valves | 6 - 31 |
| 6.4.2 | Air Compressor | 6 - 12 | 6.14 | Water Tap | 6 - 32 |
| 6.5 | Chain Drives (Chain and Sprocket) | 6 - 13 | 6.15 | Electric Motor | 6 - 32 |
| 6.5.1 | Working of Chain Drive | 6 - 13 | 6.16 | Applications of Electric Motors in Domestic Appliances..... | 6 - 32 |
| 6.5.2 | Types (Classification) of Power Transmission Chains | 6 - 13 | 6.16.1 | Fans | 6 - 33 |
| 6.5.3 | Advantages, Limitations and Applications of Chain Drives | 6 - 13 | 6.16.2 | Exhaust Fans | 6 - 33 |
| 6.5.4 | Comparison between Belt and Chain Drives | 6 - 14 | 6.16.3 | Washing Machine | 6 - 34 |
| 6.6 | Applications of Chain Drive (Chain and Sprocket) ... | 6 - 14 | 6.17 | Pumps..... | 6 - 35 |
| 6.6.1 | Bicycles | 6 - 14 | 6.17.1 | Introduction to Pumps | 6 - 35 |
| 6.6.2 | Motorcycles | 6 - 14 | 6.17.2 | Classification of Pumps | 6 - 35 |
| 6.7 | Gears..... | 6 - 14 | 6.17.3 | Reciprocating Pumps | 6 - 35 |
| 6.7.1 | Introduction to Gears | 6 - 14 | 6.17.4 | Centrifugal Pumps | 6 - 36 |
| 6.7.2 | Pitch Line Velocity of Gears | 6 - 15 | 6.18 | Applications of Pumps in Domestic Appliances..... | 6 - 38 |
| 6.7.3 | Speed Ratio or Gear Ratio | 6 - 15 | 6.18.1 | Water Pump-Set for Overhead Tanks | 6 - 38 |
| 6.7.4 | Power Transmission Capacity of Gear Pair | 6 - 15 | 6.18.2 | Water Purifier (Filtration) Unit | 6 - 39 |
| 6.7.5 | Functions of Gears | 6 - 15 | 6.19 | Air Compressors | 6 - 41 |
| 6.7.6 | Types (Classification) of Gears | 6 - 16 | 6.19.1 | Introduction to Air Compressor | 6 - 41 |
| 6.7.7 | Parallel Axes Gears | 6 - 16 | 6.19.2 | Reciprocating Air Compressor | 6 - 41 |
| 6.7.8 | Gears Trains | 6 - 18 | 6.19.3 | Applications (Uses) of Compressed Air | 6 - 42 |
| 6.7.9 | Advantages and Limitations of Gear Drives | 6 - 19 | 6.20 | Applications of Compressor in Domestic Appliances | 6 - 42 |
| 6.7.10 | Comparison between Belt Drives, Chain Drives and Gear Drives | 6 - 22 | 6.20.1 | Refrigerator | 6 - 42 |
| 6.8 | Applications of Gears | 6 - 23 | 6.20.2 | Split Air Conditioner | 6 - 43 |
| 6.8.1 | Wall Clocks | 6 - 23 | 6.20.3 | Water Cooler | 6 - 43 |
| 6.9 | SPRINGS | 6 - 24 | 6.21 | Blowers | 6 - 44 |
| 6.9.1 | Introduction to Springs | 6 - 24 | 6.22 | Applications of Blowers in Domestic Appliances | 6 - 46 |
| 6.9.2 | Types of Springs | 6 - 24 | 6.22.1 | Kitchen Chimney | 6 - 46 |
| 6.10 | Applications of Springs In Domestic Appliances | 6 - 26 | 6.22.2 | Vaccume Cleaner | 6 - 46 |
| 6.10.1 | Door Closure | 6 - 26 | 6.23 | Use of Electric and Solar Energy in Domestic Applications..... | 6 - 47 |
| 6.10.2 | Door Lock | 6 - 27 | 6.23.1 | Electric Iron | 6 - 47 |
| 6.11 | Levers..... | 6 - 28 | 6.23.1 | Electric Geyser | 6 - 48 |
| 6.11.1 | Introduction to Levers | 6 - 28 | 6.23.3 | Solar Water Heater | 6 - 49 |
| 6.11.2 | Types of Levers | 6 - 28 | | ➤ Solved Model Question Paper of End Sem. Examination | E-1 To E-2 |
| 6.12 | Applications of Levers in Domestic Appliances..... | 6 - 30 | | ➤ Summary For End Sem. Examination..... | S-1 to S-49 |

