

**SIXTH SEMESTER :**

| Sr. No.                             | SUBJECTS                                     | STUDY SCHEME |           | Credits (C)<br>L+P = C | MARKS IN EVALUATION SCHEME |            |            |                     |            |            | Total Marks of Internal & External |
|-------------------------------------|--|--------------|-----------|------------------------|----------------------------|------------|------------|---------------------|------------|------------|------------------------------------|
|                                     |  | Periods/Week |           |                        | INTERNAL ASSESSMENT        |            |            | EXTERNAL ASSESSMENT |            |            |                                    |
|                                     |  | L            | P         |                        | Th                         | Pr         | Tot        | Th                  | Pr         | Tot        |                                    |
| 6.1                                 | Automobile Engineering                       | 3            | 2         | 3+1=4                  | 40                         | 40         | 80         | 60                  | 60         | 120        | 200                                |
| 6.2                                 | Metrology and Quality Control                | 3            | 2         | 3+1=4                  | 40                         | 40         | 80         | 60                  | 60         | 120        | 200                                |
| 6.3                                 | *Entrepreneurship Development and Management | 3            | -         | 3+0=3                  | 40                         | -          | 40         | 60                  | -          | 60         | 100                                |
| 6.4                                 | Programme Elective II                        | 3            | -         | 3+0=3                  | 40                         | -          | 40         | 60                  | -          | 60         | 100                                |
| 6.5                                 | Major Project / Industrial Training          | -            | 14        | 0+7=7                  | -                          | 80         | 80         | -                   | 120        | 120        | 200                                |
| # Student Centered Activities (SCA) |  | -            | 5         | -                      | -                          | -          | -          | -                   | -          | -          | -                                  |
| <b>Total</b>                        |  | <b>12</b>    | <b>23</b> | <b>21</b>              | <b>160</b>                 | <b>160</b> | <b>320</b> | <b>240</b>          | <b>240</b> | <b>480</b> | <b>800</b>                         |

\* Common with other Diploma Courses

**Programme Elective II:** **6.4.1.** Renewable Sources of Energy **6.4.2.** Estimating and Costing in Mechanical Engineering  
**6.4.3.** Power Plant Engineering

# Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

## 6.1 AUTOMOBILE ENGINEERING

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### RATIONALE

These days, automobile has become a necessity instead of luxury. The diploma holders in this course are required to supervise production, repair and maintenance of vehicles. For this purpose, knowledge and skills are required to be imparted, so that they are able to work efficiently in the automobile industry. This subject aims at developing required knowledge and skills in this area.

### COURSE OUTCOMES

After undergoing the training, the students will be able to:

- CO1 Identify and explain the function of different chassis components and drive types.
- CO2 Maintain transmission system.
- CO3 Carry out balancing of wheels to maintain steering geometry.
- CO4 Carry out routine servicing of brake system and bleeding of hydraulic brakes
- CO5 Carry out testing and charging of Lead-acid battery.
- CO6 Interpret Bharat norms of exhaust emissions.
- CO7 Resolve Electric, Hybrid vehicles, running, charging and maintenance issues.

### DETAILED CONTENTS

#### UNIT-I

##### Introduction

Automobile and its development

Various types of automobiles manufactured, their manufacturer and location of their manufacturing unit.

Classification of automobiles

Layout of chassis

Types of drives-front wheel, rear wheel, four wheels.

## **Electric and Other Modern Vehicles**

Introduction; History of Hybrid and Electric Vehicles; Social and Environmental importance of Hybrid and Electric Vehicles; Components, Vehicle mechanics: Roadway fundamentals, Vehicle kinetics, Dynamics of vehicle motion; Propulsion System Design, Motor sizing, Introduction of CNG/PNG in Automobiles, Introduction to self-driven cars.

### **UNIT-II**

#### **Transmission System**

Clutch - Functions, Constructional details of single plate and multi plate friction clutches, Cone clutch, Hydraulic clutch

Gear Box - Functions, Working of sliding mesh, constant mesh and synchromesh gear box, Torque converter and overdrive, Introduction to Automated Manual Transmission, Automatic transmission and Continuously Variable Transmission (CVT).

Propeller shaft and rear axle - Functions, Universal joint, Differential, Different types of rear axles and rear axle drives.

Wheels and Tyres-Types of wheels, Types and specifications of tyres used in Indian vehicles, Toe in, Toe out, camber, caster, kingpin inclination, Wheel balancing and alignment, Factors affecting tyre life.

### **UNIT III**

#### **Steering System**

Function and principle of steering system, steering geometry, Types of steering mechanism-Ackerman and Davis Steering Mechanism. Types of steering gears - worm and wheel, rack and pinion, Power steering-Hydraulic and Electrical.

#### **Braking System**

Function of braking system, Constructional details and working of mechanical, hydraulic, air and vacuum brake, Power brake. Relative merits and demerits. Details of master cylinder, wheel cylinder, Concept of brake drum, brake lining/pad and Brake adjustment, Introduction to Anti-lock Brake System (ABS) Electronic Brake-force Distribution (EBD) and its working, Regenerative braking.

### **UNIT IV**

#### **Suspension System**

Function of suspension system and types of Coil spring, leaf spring, Air suspension, Shock Absorber (Telescopic type) –Function, construction and working.

**Battery**

Functions and types, Constructional details of Lithium ion batteries, Specification of battery-capacity, rating , number of plates, selection of battery for particular use, Battery charging, chemical reactions during charge and discharge, Maintenance of batteries, Checking of batteries for voltage and specific gravity. Batteries for electric and hybrid vehicles. Battery pack Design, Properties of Batteries

**UNIT V****Dynamo and Alternator**

Dynamo- Function and details, Regulators - voltage current and compensated type, Cutout- construction, working and their adjustment,

Alternator- Construction and working, charging of battery by alternator. Introduction to Integrated starter-alternator, wiring Diagram of an Automobile.

**Safety Measures**

Road safety symbols & rules. Various safety star rating systems tests of vehicles. Air bags and other safety equipments such as bull guard, cameras, sensors.

Advance Driver Assistance Systems (ADAS).

**PRACTICAL EXERCISES**

1. Fault and their remedies in Battery Ignition system
2. Adjustment of Head Light Beam (ii) Wiper and Indicators.
3. Dismantling and inspection of (i) AC Pump (ii) SU Pump
4. Dismantle (i) rear axle (ii) differential and find out the gear ratio of crown wheel & driven sun gear and planet pinion.
5. Fault finding practices on an automobile - four wheelers (petrol/ diesel vehicles).
6. Servicing/Tuning of a 2 wheeler/4 wheeler.
7. Servicing of hydraulic brakes :
  - a) adjustment of brakes
  - b) bleeding of brakes
  - c) fitting of leather pads
8. Learning Driving Practice
9. Testing and Charging of an automobile battery and measuring cell voltage and
  - a) Specific gravity of electrolyte.

10. Rotation of tyres inflation of tyres and balancing of wheels.

### **RECOMMENDED BOOKS**

1. Automobile Engineering by GBS Narang; Khanna Publishers, Delhi.
2. Automobile Engineering by Dr. Kirpal Singh; Standard Publishers and Distributors, Delhi.
3. Automotive Mechanics, by W.Crouse and Anglin; Tata McGraw Hill, Delhi.
4. Automobile Engineering by G. S. Aulakh; Eagle Prakashan, Jalandhar.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

### **RECOMMENDED WEBSITES**

1. <https://www.shiksha.com/engineering/automobile-engineering-chp>
2. [https://onlinecourses.nptel.ac.in/noc20\\_de06/preview](https://onlinecourses.nptel.ac.in/noc20_de06/preview)
3. <https://swayam.gov.in/explorer>

### **INSTRUCTIONAL STRATEGY**

This is hands on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills among the students. This subject contains five units of equal weightage. Teachers should take the students to industry and explain the details of refrigeration and air-conditioning systems and their components. While imparting instructions, focus should be on conceptual understanding.

## 6.2 METROLOGY AND QUALITY CONTROL

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### RATIONALE

Diploma holders are required to measure and inspect for ensuring quality of product in the industries. For this purpose, knowledge and skills about standards of measurement, limits, fits and tolerances, types of inspection and various measuring instruments, SQC & quality standards are necessary.

### COURSE OUTCOMES

After undergoing the training, the students will be able to:

- CO1 Apply different inspection techniques to improve quality of products and processes.
- CO2 Select and use suitable measurement tools / gauges to measure product dimensions.
- CO3 Measure geometrical parameters such as Straightness, Flatness and Parallelism.
- CO4 Use different quality charts to control products quality and interpret different quality control charts.
- CO5 Explain the use of different business tools (TQM / ISO-Standards) and QC tools in manufacturing environment.
- CO6 Explain different types of Transducers and measure displacement, vibration, pressure and temperature.

### DETAILED CONTENTS

#### UNIT-I

##### Inspection

Introduction to inspection, Planning of inspection: W<sup>5</sup>H principle

Types of inspection: remedial, preventive and operative inspection, incoming, in-process and final inspection

Standards of Measurement - International, national and company standard, line and wavelength standards.

Factors influencing the quality of manufacture.

### **Metrology: Measurement and Gauging-I**

Introduction, Definition, Basic principles used in measurement and gauging, mechanical, optical, electrical and electronic, Slip gauges, Sine bar, clinometer, comparators – mechanical, electrical and pneumatic.

### **UNIT-II**

#### **Metrology: Measurement and Gauging-II**

Types of gauges, Limit gauges: plug, ring, snap, taper, thread, height, depth, form, feeler, wire and their applications for linear, angular, surface, thread and gear measurements, gauge tolerances.

Tool room microscope, profile projector.

#### **Errors in Measurement**

Geometrical parameters and errors: Errors & their effect on quality, concept of errors, measurement of geometrical parameter such as straightness, flatness and parallelism.

### **UNIT III**

#### **Statistical Quality Control -I**

Sampling Plans, Basic statistical concepts, empirical distribution and histograms, Central tendency measures-frequency, mean, mode, standard deviation, normal distribution, binomial and Poisson, Simple- examples.

#### **Statistical Quality Control-II**

Introduction to control charts, variable and attribute charts - namely, X and R, X bar and nP, P, C charts and their applications.

### **UNIT IV**

#### **Sampling Plans**

Sampling plans, selection of sample size, method of taking samples, frequency of samples. Acceptance Sampling, Inspection plan format and test reports

#### **Modern Quality Concepts**

Concept of total quality management (TQM)

National and International Codes.

ISO-9000, concept and its evolution

## UNIT V

### Quality Control Tools

QC tools- Fish Bone diagram, Cause and Effect Diagram, scatter Diagram, Histogram Introduction to Kaizen, 5S and Quality Circle

### Instrumentation

Transducers – Its different types.

Measurement of mechanical quantities such as displacement, vibration, frequency, pressure temperature by electro mechanical transducers of resistance, capacitance & inductance type.

### PRACTICAL EXERCISES

1. Use of dial indicator for measuring taper.
2. Use of combination set, bevel protector and sine bar for measuring taper.
3. Measurement of thread characteristic using vernier and gauges.
4. Use of slip gauge in measurement of center distance between two pins.
5. Use of tool maker's microscope and comparator.
6. Plot frequency distribution for 50 turned components.
7. With the help of given data, plot X and R, P and C charts

### RECOMMENDED BOOKS

1. Inspection and Quality Control by J.S. Narang & A. Gupta, Dhanpat Rai & Sons, Delhi.
2. Statistical Quality Control by M. Mahajan: Dhanpat Rai and Sons, Delhi
3. Engineering Metrology by RK Jain
4. Engineering Metrology by RK Rajput; SK Kataria and Sons
5. Production Planning Control and Management by KC Jain & Aggarwal

### RECOMMENDED WEBSITES

1. <https://swayam.gov.in/explorer>
2. <https://www.engineering.com/story/an-introduction-to-metrology-and-quality-in-manufacturing>



## **INSTRUCTIONAL STRATEGY**

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## 6.3 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

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### RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

### COURSE OUTCOMES

After undergoing the subject, the students will be able to:

- CO1: Explain the importance of entrepreneurship and its role in nation's development.
- CO2: Classify the various types of business and business organizations.
- CO3: Identify the various resources / sources and / or schemes for starting a new venture.
- CO4: Explain the principles of management including its functions in an organisation.
- CO5: Conduct market survey and prepare project report.

### DETAILED CONTENTS

#### UNIT I

Entrepreneurship: Concept and definitions, classification and types of entrepreneurs, entrepreneurial competencies, Traits / Qualities of entrepreneurs, manager v/s entrepreneur, role of Entrepreneur, barriers in entrepreneurship, Sole proprietorship and partnership forms of business organisations, small business vs startup, critical components for establishing a start-up, Leadership: Definition and Need, Manager Vs leader, Types of leadership

#### UNIT II

Definition of MSME (micro, small and medium enterprises), significant provisions of MSME Act, importance of feasibility studies, technical, marketing and finance related problems faced by new enterprises, major labor issues in MSMEs and its related laws, Obtaining financial assistance through various government schemes like Prime Minister Employment Generation Program (PMEGP) Pradhan Mantri Mudra Yagna (PMMY) , Make in India, Start up India, Stand up India , National Urban Livelihood Mission (NULM); Schemes of assistance by entrepreneurial support agencies at National,

State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).

### **UNIT III**

**NATURE AND FUNCTIONS OF MANAGEMENT:** Definition, Nature of Management, Management as a Process, Management as Science and Art, Management Functions, Management and Administration, Managerial Skills, Levels of Management; Leadership.

**PLANNING AND DECISION MAKING:** Planning and Forecasting - Meaning and definition, Features, Steps in Planning Process, Approaches, Principles, Importance, Advantages and Disadvantages of Planning, Types of Plans, Types of Planning, Management by Objective. Decision Making-Meaning, Characteristics.

### **UNIT IV**

**ORGANISING AND ORGANISATION STRUCTURE:** Organising Process - Meaning and Definition, Characteristics Process, Need and Importance, Principles, Span of Management, Organisational Chart - Types, Contents, Uses, Limitations, Factors Affecting Organisational Chart.

**STAFFING:** Meaning, Nature, Importance, Staffing process. Manpower Planning, Recruitment, Selection, Orientation and Placement, Training, Remuneration.

**CONTROLLING AND CO-ORDINATION** Controlling - Meaning, Features, Importance, Control Process, Characteristics of an effective control system, Types of Control. Co-ordination - characteristics, essentials.

### **UNIT V**

Market Survey and Opportunity Identification, Scanning of business environment, Assessment of demand and supply in potential areas of growth, Project report Preparation, Detailed project report including technical, economic and market feasibility, Common errors in project report preparations, Exercises on preparation of project report.

### **RECOMMENDED BOOKS**

1. Entrepreneurship Development and Management by Dr. Ranjana Verma, Dr. Sangeeta, Dr. Pooja Sharma; Anant Publications, Ambala City.
2. BS Rathore and Dr JS Saini, "A Handbook of Entrepreneurship", Aapga Publications, Panchkula (Haryana).

3. Entrepreneurship Development, Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. CB Gupta and P Srinivasan, “Entrepreneurship Development in India”, Sultan Chand and Sons, New Delhi.
5. Poornima M Charantimath, “Entrepreneurship Development - Small Business Enterprises”, Pearson Education, New Delhi.
6. David H Holt, “Entrepreneurship: New Venture Creation”, Prentice Hall of India Pvt. Ltd., New Delhi.
7. PM Bhandari, “Handbook of Small Scale Industry”.
8. L M Prasad, “Principles and Practice of Management”, Sultan Chand & Sons, New Delhi.

### RECOMMENDED WEBSITES

1. <https://ipindia.gov.in/>

### INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided. In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organised. This subject contains five units of equal weightage.

## 6.4 PROGRAMME ELECTIVE-II

### 6.4.1 RENEWABLE SOURCES OF ENERGY

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#### RATIONALE

Since the conventional energy resources are fast depleting, it is high time to tap the renewable and non-conventional energy sources. The Diploma holder must be aware about the renewable energy resources like solar energy, wind energy, geothermal energy, ocean energy, hydro energy which is used for number of applications such as power generation, heating, cooling etc. This subject aim is to develop the skill required for renewable energy resource, so that they help the society for fulfilling the energy demand which is increasing day by day.

#### COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Describe various renewable and non-renewable sources of energy

CO2: Explain working principle of various solar energy systems

CO3: Describe concepts of power generation with the wind energy, ocean energy, hydro, geothermal energy, tidal energy, fuel cell.

CO4: Work on a bio gas plant.

CO5: Describe different energy storage devices used in renewable energy resources.

#### DETAILED CONTENTS

##### UNIT I

##### Introduction to Energy and Solar Energy

1.1 **Classification of Energy Resources:** Conventional Energy Resources, Non-conventional Energy Resources, Roles and responsibility of Ministry of New and Renewable Energy Sources. Needs of renewable energy. Targets and Present Status of Renewable Energy Sources in India.

- 1.2 **Solar Energy:** Introduction, potential of solar energy in India, Solar Radiation, Principle of conversion of solar radiation into heat, construction and working principle of photo-voltaic cell. Solar cell materials, Difference between solar cell, panel, array, module, Characteristics, important terms related to solar energy, Efficiency of Solar Cells. Applications of solar energy like solar PV system (standalone and grid connected), solar water heating system, solar furnaces, solar cookers, solar lighting, solar water pumping system, solar still. Government schemes and policies.

## UNIT II

### Bio-Energy and Hydro Energy

- 2.1 **Bio-Energy:** Introduction, Biomass energy, Photosynthesis process, Biomass fuels, Biomass energy conversion technologies and applications, Biomass Gasification, Types and application of gasifier, Types of biogas plants, Factors affecting biogas generation, Environmental impacts and benefits, Future role of biomass, Biomass potential and programs in India.
- 2.2 **Hydro Energy:** Introduction, Capacity and Potential, Hydro Power Plant (mini and micro), Environmental and social impacts.

## UNIT III

### Wind Energy and Geothermal Energy

- 3.1 **Wind Energy:** Introduction, Wind energy conversion system, windmills, types of wind mills, selection of site, electricity generation from wind energy, Wind Energy potential and Scenario in India.
- 3.2 **Geothermal Energy:** Introduction, Geothermal Resource Utilization like hydrothermal, Geopressured hot dry rock, magma, Geothermal based Electric Power Generation, Associated Problems, environmental Effects, prospects of geothermal energy in India.

## UNIT IV

### Tidal Energy and Mhd

- 4.1 **Tidal Energy:** Introduction, Capacity and Potential, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants.
- 4.2 **Ocean Energy:** Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation, prospects of OTEC in India.
- 4.3 **MHD power generation:** Principle of working of Magneto Hydro Dynamic (MHD) Power Generation, materials for MHD generators and future prospects, performance and limitations.

## UNIT V

### Fuel Cell and Energy Storage Devices

- 5.1 **Fuel Cells:** Fuel cell definition, difference between batteries and fuel cells, Principle of working of fuel cells ,types of fuel cell, power generation by fuel cell ,conversion efficiency, applications, advantages and disadvantages of fuel cell .
- 5.2 **Energy Storage:** Need of energy storage, Different modes of energy storage, Flywheel storage, Superconducting Magnet Energy Storage (SMES) systems, Capacitor, battery, Super capacitor. Comparison and application.

### RECOMMENDED BOOKS

1. S. P. Sukhatme, “Solar Energy”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. B. H. Khan, “Non-Conventional Energy Resources”, The McGraw Hill.
3. J. W. Twidell & A. Weir, “Renewable Energy Sources”, EFN Spon Ltd., UK, 2006.
4. S. P. Sukhatme and J.K. Nayak, “Solar Energy – Principles of Thermal Collection and Storage”, Tata McGraw-Hill, New Delhi.
5. Garg, Prakash, “Solar Energy, Fundamentals and Applications”, Tata McGraw Hill.
6. G.D. Rai, “Non-Conventional Energy Sources”, Khanna Publications, New Delhi, 2011.
7. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 1996.
8. K. C. Khandelwal & S. S. Mahdi, “Biogas Technology – A Practical Handbook”, Tata Mc Graw Hill.
9. G. N. Tiwari, “Solar Energy – Fundamentals Design, Modeling & Applications”, Narosa Publishing House, New Delhi, 2002.
10. Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.
11. Frank Krieth & John F Kreider, “Principles of Solar Energy”, John Wiley, New York.
12. N. K. Bansal, “Renewable Energy Sources and Conversion Technology”, Manfred Kleemann, Michael Meliss, Tata McGraw Hill Publishing Co. Ltd New Delhi.

### RECOMMENDED WEBSITES

1. <http://swayam.gov.in>

## **INSTRUCTIONAL STRATEGY**

Topics taught in the class should be demonstrated in the field/industries. This subject contains five units of equal weightage. The teacher should make the students aware about the depletion of energy sources and the availability of alternate sources of energy their feasibility and limitations. The need for adopting renewable and non-conventional energy sources should be made clear to students. Teacher must discuss application of these energy sources in nearby surrounding areas. Visit nearby renewable energy source plants to enhance the real time practical skill in the students.



## 6.4.2 ESTIMATING AND COSTING IN MECHANICAL ENGINEERING

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### RATIONALE

Diploma holders are also engaged in purchasing of raw materials and production. For this purpose, they must know the basics of estimating and costing to work out the cost and budget of the job for the customers. They are also involved in tendering and preparing the quotes.

### COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Explain the fundamentals of estimation.

CO2: Explain elements of costing.

CO3: Describe the fundamentals of cost accounting.

CO4: Estimate the material cost.

CO5: Estimate machining time.

CO6: Estimate foundry cost, forging cost and welding cost.

CO7: Apply the concept of process costing, and types of budget, and familiarize with accounting terminology.

### DETAILED CONTENTS

#### UNIT-1

##### Introduction

Cost estimation-definition, Importance, purpose, elements for estimation, cost estimation procedure.

Case study of any utility item, cost accounting, purposes of cost accounting, Comparison of estimating and costing.

##### Fundamentals of Estimating

Organization of estimating department, cost estimator- his essential qualifications, types of estimates, constituents of job estimates, cost of production, selling price, capital investment, rate of return (ROR) on investment, principal factors in estimating, miscellaneous allowances,

## **UNIT-II**

### **Elements of Costing**

Definitions, objectives, elements of costs, components of costs, ladder of cost, overhead expenses: factory expenses, depreciation cost-causes; methods of calculation of depreciation, obsolescence, interest on capital, idleness costs, repairs and maintenance cost, selling and distribution overheads and methods of allocation of overhead charges, procedure for costing

Methods of costing with example; unit costing, batch costing, departmental costing, process costing, multiple and composite costing

## **UNIT-III**

### **Estimation of Material Cost**

Estimation of volumes, weights and cost of material for items like pulley, spindle, lathe centre, fly wheel, crank shaft and similar items. Simple numerical on the above, Provision of budgets based on estimates.

## **UNIT-IV**

### **Estimation of Machine Shop**

Set-up time, operation time, handling time, machining time, tear down time, allowances; personal, fatigue, tool checking/sharpening/changing, unit operation time, cycle time and total time, full depth of cut, cutting speeds for various operations for different tool materials and product materials, estimation of time for various machining operations - turning, drilling, boring, tapping, shaping, planning, milling and grinding.

### **Estimation of Welding and Plastic Moulding**

Estimation of cost of different products produced in welding- gas and electric welding, Estimating in injection and plastic moulding

## **UNIT-V**

### **Estimation of Forging and Foundry Shops**

Estimating in forging and foundry shops, various losses.

Die Cost Estimation: Basic approach to cost estimation – pricing history, work intensity history, additional costs, machinability of materials, cost of materials, evaluation. Die building estimates.

### **Process and Job Costing**

Characteristics -Principles -Procedure for Process costing, Accounting terminology like -book value- Net Present Value-Work in progress- Gross Domestic Product (GDP)-balance sheet, Introduction to

tendering process.

### **RECOMMENDED BOOKS**

1. Production and Costing by GBS Narang and V. Kumar, Khanna Publishers, New Delhi.
2. Mechanical Estimating and Costing by Sinha BP; Tata McGraw Hill, New Delhi.
3. Production Engineering, Estimating and Costing by M Adithan and BS Pabla; Konark Publishers, New Delhi.
4. Mechanical Estimating and Costing by T.T.T.I, Madras: Tata McGraw Hill, New Delhi.
5. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.
6. Process planning & cost estimation M.Adithan New age International.

### **RECOMMENDED WEBSITES**

1. <http://swayam.gov.in>

### **INSTRUCTIONAL STRATEGY**

This subject contains five units of equal weightage. Teachers should take the students to industry and explain the details of refrigeration and air-conditioning systems and their components. While imparting instructions, focus should be on conceptual understanding. Use computer based learning aids for effective teaching learning. Expose the students to real life problems. Plan assignments so as to promote problem-solving abilities and develop continued learning skills. Motivate students to bring calculators in class from the very first day.

## 6.4.3 POWER PLANT ENGINEERING

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### RATIONALE

The students of mechanical engineering should have the knowledge and skills pertaining to power generation systems, their control and economics in different type of power plants for their operation and maintenance. The students should also be able to analyze economics of power plants alongwith the factors affecting the performance of power plants.

### COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Analyse economics of power plants, list factors affecting the efficiency of power plants and interpret the performance of power plants based on load variations.

CO2: Identify elements and their functions of, hydro power plants.

CO3: Identify elements and their functions and operations of steam power plants.

CO4: Identify elements and their functions and operations of nuclear and gas turbine power plants.

CO5: Identify elements and their functions and operations of solar, wind and diesel power plants.

CO6: Explain the Social and Economic issues of power plants.

### DETAILED CONTENTS

#### UNIT-1

##### Introduction & Economics of Power Plant

Power plant- Introduction, Classification-Location of power plant-Choice of Power plant Terminology used in power plant: Peak load, Base load, Load factor, Load curve, demand factor-Variou factor affecting the operation of power plant-Load sharing- power tariff methods-factors involved in fixing of a tariff.

##### Hydro Power Plant

Hydro-electric power plant- Introduction, storage and poundage, General layout and essential elements of Hydro-electric power plant and its working-Classification of the plant-base load plant, peak load

plant, Run off river plant, storage river plant, pumped storage plant, mini and micro hydel plants, governing of hydraulic turbines-impulse turbine- reaction turbine, selection of turbines, Advantages and disadvantages-limitations of hydro-electric power plant.

## UNIT-II

### Thermal Power Plant

Thermal power plant -General layout –working-Site Selection–materials required for thermal power plants, coal handling and its methods, stages in coal storage, Fuel burning-Stoker firing-overfeed stoker –under feed stokers-chain grate stoker, Pulverized fuel handling system-unit and central system, Pulverization of coal-Ball mill, Ash handling system-Gravity system-electrostatic precipitation (ESP) system-Feed water treatment-Mechanical method, Advantages and disadvantages-limitations of Thermal power plant.

## UNIT-III

### Nuclear Power Plant & Gas Turbine Power Plants

**Nuclear power plant**-Introduction-nuclear fuels, nuclear fission and fusion, working of a nuclear power plant, types of reactors- pressurized water reactor- boiling water reactor, effects of nuclear radiation, different methods for nuclear waste disposal-low, medium and high-level waste disposal, Advantages-disadvantages-limitations.

**Gas turbine power plant**-Schematic diagram & working of open and closed cycle gas turbine power plant, Components of Gas turbine–compressor, combustion chamber, gas turbine, vortex blading , gas turbine fuels, Advantages -disadvantages-limitations of Gas turbine power plant.

## UNIT-IV

### SOLAR, WIND AND DIESEL POWER PLANTS

**Solar power plant**-Introduction-layout, Solar cell fundamentals & classification –maximum power point tracker (MPPT) and solar panel. Comparison with conventional Power plants.

**Wind power plant:** Introduction, -Factors affecting distribution of Wind energy, Variation of wind speed with height and time-Horizontal axis wind turbine (HAWT)-types of rotors, Vertical axis wind turbine- types of rotors, Wind energy conversion system (WECS) advantages and disadvantages, limitations of Wind power plant.

**Diesel power plant**- layout -Components and the working- Advantages -disadvantages limitations.

## UNIT-V

### PLANT SAFETY AND ENVIRONMENTAL IMPACT OF POWER PLANTS

**Social and Economic issues of power plant**-Issues related to health- Oxides of sulphur, oxides of carbon, oxides of nitrogen, Acid precipitation, Acid rain, acid snow, Dry deposition, acid fog, smog,

greenhouse effect, air and water pollution from thermal power plants and its control, Thermal pollution from thermal power plants, noise pollution and its control, natural and artificial radio activity nuclear power and environment- radiations from nuclear power plant effluents-high level wastes-methods to reduce pollution, global warming-its effects and control, standardization for environmental pollution.

### RECOMMENDED BOOKS

1. Power plant engineering Arora and Domkundwar, Dhanpat rai & CO (P) LTD
2. Power plant engineering P.K .Nag McGraw Hill
3. Power plant engineering G.R. Nagpal Khanna publishers
4. Power Plant Engineering. Dr. P.C.Sharma S. K. Kataria
5. A Text Book of Power Plant Engineering. R K Rajput Laxmi Publications,
6. Power plant technology M.M. EL-Wakil McGraw Hill
7. Power Plant Engineering. C. Elanchezhian, L. Saravanakumar, B. Vijaya Ramnath I.K. International Publishing House
8. Power Station Engineering and Economy. Bernhardt G A Sarotzki, William A Vopat Tata Mc Graw Hill

### RECOMMENDED WEBSITES

1. <http://swayam.gov.in>

### INSTRUCTIONAL STRATEGY

This subject contains five units of equal weightage. Teachers should take the students to industry and explain the details of refrigeration and air-conditioning systems and their components. While imparting instructions, focus should be on conceptual understanding. Use computer based learning aids for effective teaching learning. Expose the students to real life problems. Plan assignments so as to promote problem-solving abilities and develop continued learning skills. Motivate students to bring calculators in class from the very first day.

## 6.5 MAJOR PROJECT/INDUSTRIAL TRAINING

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### RATIONALE

Major project / Industrial training work will help in developing the relevant skills among the students as per National Skill Qualification Framework. It aims at exposing the students to the present and future needs of various relevant industries. It is expected from the students to get acquainted with desired attributes for industrial environment. For this purpose, students are required to be involved in industrial training / Major Project Work in different establishments.

### COURSE OUTCOMES

After undergoing this course, the students will be able to:

- CO1: Define the problem statement of the Industrial training / Major project according to the need of industry.
- CO2: Work as a team member for successful completion of Industrial training / Major project.
- CO3: Write the major project/industrial training report effectively.
- CO4: Present the major project/industrial training project report using PPT.

### GUIDELINES

Depending upon the interest of the students, they can go for Industrial training / Major project as per present and future demand of the industry. The supervisors may guide the students to identify their project work and chalk out their plan of action well in advance. As an Industrial training / Major project activity each student is supposed to study the operations at site and prepare a detailed project report of the observations/processes/activities. The supervisor may create a group of 4-5 students as per their interest to work as a team for successful completion of the Industrial training / Major Project.