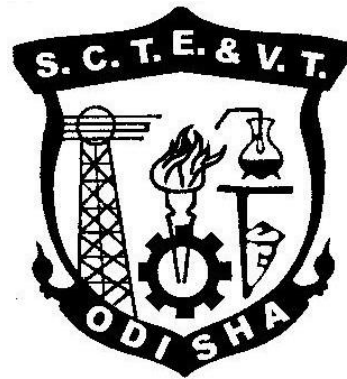


# **CURRICULLUM OF 6<sup>TH</sup> SEMESTER**

**For**

## **DIPLOMA IN MECHANICAL ENGINEERING**

**(Effective FROM 2020-21 Sessions)**



**STATE COUNCIL FOR TECHNICAL EDUCATION & VOCATIONAL TRAINING,  
ODISHA, BHUBANESWAR**

## STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA

**TEACHING AND EVALUATION SCHEME FOR 6th Semester (Mechanical Engg.) (wef 2020-21)**

| Subject Number     | Subject Code | Subject                                    | Periods/week |          |           | Evaluation Scheme                 |               |               |            |
|--------------------|--------------|--------------------------------------------|--------------|----------|-----------|-----------------------------------|---------------|---------------|------------|
|                    |              |                                            | L            | T        | P         | Internal Assessment/<br>Sessional | End Sem Exams | Exams (Hours) | Total      |
| <b>Theory</b>      |              |                                            |              |          |           |                                   |               |               |            |
| Th.1               |              | INDUSTRIAL ENGINEERING & MANAGEMENT        | 4            |          | -         | 20                                | 80            | 3             | 100        |
| Th.2               |              | AUTOMOBILE ENGINEERING AND HYBRID VEHICLES | 4            |          | -         | 20                                | 80            | 3             | 100        |
| Th.3               |              | POWER STATION ENGINEERING                  | 4            |          | -         | 20                                | 80            | 3             | 100        |
| Th.4               |              | ELECTIVE (any One)                         | 4            |          |           | 20                                | 80            | 3             | 100        |
| Th.4(a)            |              | COMPOSITE MATERIALS                        |              |          |           |                                   |               |               |            |
| Th.4(b)            |              | ADVANCE MANUFACTURING PROCESSES            |              |          |           |                                   |               |               |            |
| Th.4(c)            |              | INDUSTRIAL ROBOTICS & AUTOMATION           |              |          |           |                                   |               |               |            |
| <i>Total</i>       |              |                                            | <b>16</b>    |          |           | <b>80</b>                         | <b>320</b>    | <b>-</b>      | <b>400</b> |
| <b>Practical</b>   |              |                                            |              |          |           |                                   |               |               |            |
| Pr.1               |              | AUTOMOBILE ENGINEERING LAB                 | -            | -        | 4         | 50                                | 50            | 3             | 100        |
| Pr.2               |              | POWER STATION ENGINEERING LAB              | -            | -        | 4         | 25                                | 50            | 3             | 75         |
| Pr.3               |              | PROJECT WORK PHASE -II                     |              | -        | 10        | 50                                | 100           | 3             | 150        |
| Pr.4               |              | LIFE SKILL                                 | -            | -        | 2         | 25                                | -             | -             | 25         |
|                    |              | STUDENT CENTERED ACTIVITIES (SCA)          |              |          | 3         |                                   |               |               |            |
| <i>Total</i>       |              |                                            | <b>-</b>     | <b>-</b> | <b>23</b> | <b>150</b>                        | <b>200</b>    | <b>-</b>      | <b>350</b> |
| <b>Grand Total</b> |              |                                            | <b>16</b>    | <b>-</b> | <b>23</b> | <b>230</b>                        | <b>520</b>    | <b>-</b>      | <b>750</b> |

Abbreviations: L-Lecturer, T-Tutorial, P-Practical. Each class is of minimum 55 minutes duration

Minimum Pass Mark in each Theory subject is 35% and in each Practical subject is 50% and in Aggregate is 40%

**SCA shall comprise of Extension Lectures/ Personality Development/ Environmental issues /Quiz /Hobbies/ Field visits/ cultural activities/Library studies/Classes on MOOCS/SWAYAM /Idea Tinkering and Innovation Lab Practice etc. ,Seminar and SCA shall be conducted in a section.**

**There shall be 1 Internal Assessment done for each of the Theory Subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester**



## TH1. INDUSTRIAL ENGINEERING & MANAGEMENT

|                                                       |       |                           |       |
|-------------------------------------------------------|-------|---------------------------|-------|
| Name of the Course: Diploma in MECHANICAL ENGINEERING |       |                           |       |
| Course code:                                          |       | Semester                  | 6th   |
| Total Period:                                         | 60    | Examination               | 3 hrs |
| Theory periods:                                       | 4 P/W | Internal assessment       | 20    |
| Maximum marks:                                        | 100   | End Semester Examination: | 80    |

### A. RATIONALE:

Main objective of Mechanical Engineering is to produce goods and services for benefit to mankind. Such productions are done utilizing various resources like Men, Materials, machines and Money. Industrial engineering and quality control is the subject which allows optimized use of such resources and hence very important for a mechanical engineer.

### B. COURSE OBJECTIVES:

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

1. Identify the place for a new plant set up and systematic arrangement of machinery and shop for smooth production.
2. Take right decisions to optimize resources utilizations by improving productivity of the lands ,buildings,people,material,machines,money,methods and management effectively.
3. Understanding of stock management and maintenance to reduce plant ideal time.
- 4 To use the charts to record the quality of products.
- 5.To eliminate unproductive activities under the control of the management, supervisor, worker and the design of products and processes.

## C. CHAPTER WISE DISTRIBUTION OF PERIODS

| SI No. | Topic                           | Periods |
|--------|---------------------------------|---------|
| 1      | PLANT ENGINEERING               | 10      |
| 2      | OPERATIONS RESEARCH             | 10      |
| 3      | INVENTORY CONTROL               | 10      |
| 4      | INSPECTION AND QUALITY CONTROL  | 15      |
| 5      | PRODUCTION PLANNING AND CONTROL | 15      |

## D. COURSE CONTENT

### 1. PLANT ENGINEERING:

- 1.1 Selection of Site of Industry.
- 1.2 Define plant layout.
- 1.3 Describe the objective and principles of plant layout.
- 1.4 Explain Process Layout, Product Layout and Combination Layout.
- 1.5 Techniques to improve layout.
- 1.6 Principles of material handling equipment.
- 1.7 Plant maintenance.

1.7.1 Importance of plant maintenance.

1.7.2 Break down maintenance.

1.7.3 Preventive maintenance.

1.7.4 Scheduled maintenance.

## **2. OPERATIONS RESEARCH:**

2.1 Introduction to Operations Research and its applications.

2.2 Define Linear Programming Problem,

2.3 Solution of L.P.P. by graphical method.

2.4 Evaluation of Project completion time by Critical Path Method and PERT (Simple problems)-

2.5 Explain distinct features of PERT with respect to CPM.

## **3. INVENTORY CONTROL:**

3.1 Classification of inventory.

3.2 Objective of inventory control.

3.3 Describe the functions of inventories.

3.4 Benefits of inventory control.

3.5 Costs associated with inventory.

3.6 Terminology in inventory control

3.7 Explain and Derive economic order quantity for Basic model. (Solve numerical)

3.8 Define and Explain ABC analysis.

## **4. INSPECTION AND QUALITY CONTROL:**

4.1 Define Inspection and Quality control.

4.2 Describe planning of inspection.

4.3 Describe types of inspection.

4.4 Advantages and disadvantages of quality control.

4.5 Study of factors influencing the quality of manufacture.

4.6 Explain the Concept of statistical quality control, Control charts (X, R, P and C - charts).

4.7 Methods of attributes.

4.8 Concept of ISO 9001-2008.

4.9.1 Quality management system, Registration /certification procedure.

4.9.2 Benefits of ISO to the organization.

4.9.3 JIT, Six sigma, 7S, Lean manufacturing

4.9.4 Solve related problems.

## **5.0 PRODUCTION PLANNING AND CONTROL**

5.1 Introduction

5.2 Major functions of production planning and control

5.3 Methods of forecasting

5.3.1 Routing

5.3.2 Scheduling

5.3.3 Dispatching

5.3.4 Controlling

5.4 Types of production

5.4.1 Mass production

5.4.2 Batch production

5.4.3 Job order production

5.5 Principles of product and process planning.

**Syllabus to be covered before IA: Chapter 1,2,3**

| <b>Learning Resources:</b> |                        |                                         |                              |
|----------------------------|------------------------|-----------------------------------------|------------------------------|
| <i>Sl. No.</i>             | <i>Name of Authors</i> | <i>Title of the Book</i>                | <i>Name of the Publisher</i> |
| 1                          | O.P.KHANNA             | INDUSTRIAL ENGINEERING & MANAGEMENT     | DHANPAT RAI & SONS           |
| 2                          | MARTAND<br>TELSANG     | INDUSTRIAL ENGG & PRODUCTION MANAGEMENT | S.CHAND                      |
| 3                          | M.MAHAJAN              | STATISTICAL QUALITY CONTROL             | DHANPAT RAI & SONS           |
| 4                          |                        |                                         |                              |

## TH.2 AUTOMOBILE ENGINEERING AND HYBRID VEHICLES

|                                                       |       |                           |       |
|-------------------------------------------------------|-------|---------------------------|-------|
| Name of the Course: Diploma in MECHANICAL ENGINEERING |       |                           |       |
| Course code:                                          |       | Semester                  | 6th   |
| Total Period:                                         | 60    | Examination               | 3 hrs |
| Theory periods:                                       | 4 P/W | Internal assessment       | 20    |
| Maximum marks:                                        | 100   | End Semester Examination: | 80    |

### A. RATIONALE:

Automobiles are the principal mode of transport system. Their manufacture and maintenance gives a major scope for employment. Many entrepreneur pass outs go for servicing of automobiles or trading/manufacturing of auto components. Thus automobile engineering is an important subject to be in the regular curriculum of the mechanical engineering.

### B. COURSE OBJECTIVES:

At the end of the course the students will be able to:

- Understand automobile chassis, transmission, breaking and fuel system etc.
- Understand the basics of electric vehicle kinematics.
- Understand the concepts of hybrid electric vehicles.

### C.TOPIC WISE DISTRIBUTION OF PERIODS

| Sl No. | Topic                              | Periods |
|--------|------------------------------------|---------|
| 1      | Introduction & Transmission System | 12      |
| 2      | Braking system                     | 5       |
| 3      | Ignition & Suspension System       | 10      |
| 4      | Cooling and Lubrication            | 8       |
| 5      | Fuel system                        | 10      |
| 6      | Hybrid and Electric Vehicles       | 15      |

### C.COURSE CONTENTS

#### 1.0 INTRODUCTION & TRANSMISSION SYSTEM:

- 1.1 Automobiles: Definition, need and classification: Layout of automobile chassis with major components (Line diagram)
- 1.2 Clutch System: Need, Types (Single & Multiple) and Working principle with sketch
- 1.3 Gear Box: Purpose of gear box, Construction and working of a 4 speed gear box
- 1.4 Concept of automatic gear changing mechanisms
- 1.5 Propeller shaft: Constructional features
- 1.6 Differential: Need, Types and Working principle

#### 2.0 BRAKING SYSTEM:

- 2.1 Braking systems in automobiles: Need and types
- 2.2 Mechanical Brake
- 2.3 Hydraulic Brake
- 2.4 Air Brake
- 2.5 Air assisted Hydraulic Brake
- 2.6 Vacuum Brake

### 3.0 IGNITION & SUSPENSION SYSTEM:

- 3.1 Describe the Battery ignition and Magnet ignition system
- 3.2 Spark plugs: Purpose, construction and specifications
- 3.3 State the common ignition troubles and its remedies
- 3.4 Description of the conventional suspension system for Rear and Front axle
- 3.5 Description of independent suspension system used in cars (coil spring and tension bars)
- 3.6 Constructional features and working of a telescopic shock absorber

### 4.0 COOLING AND LUBRICATION:

- 4.1 Engine cooling: Need and classification
- 4.2 Describe defects of cooling and their remedial measures
- 4.3 Describe the Function of lubrication
- 4.4 Describe the lubrication System of I.C. engine

### 5.0 FUEL SYSTEM:

- 5.1 Describe Air fuel ratio
- 5.2 Describe Carburetion process for Petrol Engine
- 5.3 Describe Multipoint fuel injection system for Petrol Engine
- 5.4 Describe the working principle of fuel injection system for multi cylinder Engine
- 5.5 Filter for Diesel engine
- 5.6 Describe the working principle of Fuel feed pump and Fuel Injector for Diesel engine

### 6.0 ELECTRIC AND HYBRID VEHICLES:

- 6.1 Introduction, Social and Environmental importance of Hybrid and Electric Vehicles
- 6.2 Description of Electric Vehicles, operational advantages, present performance and applications of Electric Vehicles
- 6.3 Battery for Electric Vehicles, Battery types and fuel cells
- 6.4 Hybrid vehicles, Types of Hybrid and Electric Vehicles: Parallel, Series, Parallel and Series configurations;
- 6.5 Drive train
- 6.6 Solar powered vehicles

## D.SYLLABUS COVERED UP TO I.A-CHAPTERS 1,2 &3

| <b>E.LEARNING RESOURCES:</b> |                        |                                                  |                                          |
|------------------------------|------------------------|--------------------------------------------------|------------------------------------------|
| <i>Sl. No.</i>               | <i>Name of Authors</i> | <i>Title of the Book</i>                         | <i>Name of the Publisher</i>             |
| 1                            | R.B.Gupta              | Automobile Engineering                           | Satya Prakashan                          |
| 2                            | Dr Kirpal Singh        | Automobile Engineering Vol- I & II               | Standard Publishers                      |
| 3                            | C.P.Nakra              | Automobile Engineering                           | Dhanpat Rai Publication                  |
| 4                            | W.H.Course             | Automotive Engine                                | McGraw Hill                              |
| 5                            | Iqbal Hussain          | Electric & Hybrid Vehicles – Design Fundamentals | CRC Press, 2                             |
| 6                            | A.K. Babu              | Statistical Electric & Hybrid Vehicles           | Khanna Publishing House, New Delhi, 2018 |



### TH.3 POWER STATION ENGINEERING

|                                                       |       |                           |       |
|-------------------------------------------------------|-------|---------------------------|-------|
| Name of the Course: Diploma in MECHANICAL ENGINEERING |       |                           |       |
| Course code:                                          |       | Semester                  | 6th   |
| Total Period:                                         | 60    | Examination               | 3 hrs |
| Theory periods:                                       | 4 P/W | Internal assessment       | 20    |
| Maximum marks:                                        | 100   | End Semester Examination: | 80    |

#### A. RATIONALE:

Bulk powers used in industries and for domestic purposes are generated in power stations. A large number of diverse and specialized equipment and system are used in a power plant should have this important subject in mechanical engineering.

#### B. COURSE OBJECTIVES:

At the end of the course the students will be able to:

- Understand the generation of power by utilizing various energy sources.
- Understand the use of steam, its operation in thermal power stations.
- Understand the nuclear energy sources and power developed in nuclear power station.
- Understand the basics of diesel electric power station and hydroelectric power station.
- Understand the basics of gas turbine power station
- 

#### C. TOPIC WISE DISTRIBUTION OF PERIODS

| Sl No. | Topic                          | Periods |
|--------|--------------------------------|---------|
| 1      | INTRODUCTION                   | 05      |
| 2      | THERMAL POWER STATIONS         | 20      |
| 3      | NUCLEAR POWER STATIONS         | 10      |
| 4      | DIESEL ELECTRIC POWER STATIONS | 10      |
| 5      | HYDEL POWER STATIONS           | 10      |
| 6      | GAS TURBINE POWER STATIONS     | 05      |

#### D. COURSE CONTENTS:

##### 1.0 INTRODUCTION:

- 1.1 Describe sources of energy.
- 1.2 Explain concept of Central and Captive power station.
- 1.3 Classify power plants.
- 1.4 Importance of electrical power in day today life.
- 1.5 Overview of method of electrical power generation.

##### 2.0 THERMAL POWER STATIONS:

- 2.1 Layout of steam power stations.
- 2.2 Steam power cycle. Explain Carnot vapour power cycle with P-V, T-s diagram and determine thermal efficiency.
- 2.3 Explain Rankine cycle with P-V, T-S & H-s diagram and determine thermal efficiency, Work done, work ratio, and specific steam Consumption.
- 2.4 Solve Simple Problems.
- 2.5. List of thermal power stations in the state with their capacities.
- 2.6 Boiler Accessories: Operation of Air pre heater, Operation of Economiser, Operation Electrostatic precipitator and Operation of super heater. Need of boiler mountings and operation of boiler

- 2.7 Draught systems (Natural draught, Forced draught & balanced draught) with their advantages & disadvantages.
- 2.8 Steam prime movers: Advantages & disadvantages of steam turbine, Elements of steam turbine, governing of steam turbine. Performance of steam turbine: Explain Thermal efficiency, Stage efficiency and Gross efficiency.
- 2.9 Steam condenser: Function of condenser, Classification of condenser. function of condenser auxiliaries such as hot well, condenser extraction pump, air extraction pump, and circulating pump.
- 2.10 Cooling Tower: Function and types of cooling tower, and spray ponds
- 2.11 Selection of site for thermal power stations.

### 3.0 NUCLEAR POWER STATIONS:

- 3.1 Classify nuclear fuel (Fissile & fertile material)
- 3.2 Explain fusion and fission reaction.
- 3.3 Explain working of nuclear power plants with block diagram .
- 3.4 Explain the working and construction of nuclear reactor .
- 3.5 Compare the nuclear and thermal plants.
- 3.6 Explain the disposal of nuclear waste.
- 3.7 Selection of site for nuclear power stations.
- 3.8 List of nuclear power stations.

### 4.0 DIESEL ELECTRIC POWER STATIONS:

- 4.1 State the advantages and disadvantages of diesel electric power stations.
- 4.2 Explain briefly different systems of diesel electric power stations: Fuel storage and fuel supply system, Fuel injection system, Air supply system, Exhaust system, cooling system, Lubrication system, starting system, governing system.
- 4.3 Selection of site for diesel electric power stations.
- 4.4 Performance and thermal efficiency of diesel electric power stations.

### 5.0 HYDEL POWER STATIONS:

- 5.1 State advantages and disadvantages of hydroelectric power plant.
- 5.2 Classify and explain the general arrangement of storage type hydroelectric project and explain its operation.
- 5.3 Selection of site of hydel power plant.
- 5.4 List of hydro power stations with their capacities and number of units in the state.
- 5.5 Types of turbines and generation used.
- 5.6 Simple problems.

### 6.0 GAS TURBINE POWER STATIONS

- 6.1 Selection of site for gas turbine stations.
- 6.2 Fuels for gas turbine
- 6.3 Elements of simple gas turbine power plants
- 6.4 Merits, demerits and application of gas turbine power plants.

### Syllabus covered up to I.A-Chapters 1,2 &3

| <b>E.LEARNING RESOURCES:</b> |                        |                          |                              |
|------------------------------|------------------------|--------------------------|------------------------------|
| <i>Sl. No.</i>               | <i>Name of Authors</i> | <i>Title of the Book</i> | <i>Name of the Publisher</i> |
| 1                            | R.K Rajput             | Power Plant Engineering  | Laxmi Publication            |
| 2                            | P.K.NAG                | Power Plant Engineering  | TMH                          |
| 3                            | Nag pal G,R            | Power plant Engineering  | Khanna Publisher             |
| 4                            | P.C.SHARMA             | Power Plant Engineering  | S.K KATARIA &SONS            |

## Th-4a-COMPOSITE MATERIALS (ELECTIVE)

|                                                       |       |                           |       |
|-------------------------------------------------------|-------|---------------------------|-------|
| Name of the Course: Diploma in MECHANICAL ENGINEERING |       |                           |       |
| Course code:                                          |       | Semester                  | 6th   |
| Total Period:                                         | 60    | Examination               | 3 hrs |
| Theory periods:                                       | 4 P/W | Internal assessment       | 20    |
| Maximum marks:                                        | 100   | End Semester Examination: | 80    |

**RATIONALE: Composite material is the advanced engineering material and plays an important Role in design of engineering products.it is s.a valuable subject for mechanical engineer**

### **COURSE OBJECTIVES:**

At the end of the course the students will be able to:

- Understand the basic concept of composite materials
- Understand the Classification of Composites
- Understand the Mechanical Properties of Composites
- Understand the Laminates
- Understand the Joining Methods and Failure Theories.

### **Topic Wise Distribution of Periods**

| Sl No. | Topic                                | Periods |
|--------|--------------------------------------|---------|
| 1      | Introduction                         | 15      |
| 2      | Classification of Composites         | 8       |
| 3      | Mechanical Properties of Composites  | 12      |
| 4      | Laminates                            | 15      |
| 5      | Joining Methods and Failure Theories | 10      |

## **CHAPTERS**

### **1.0 Introduction:**

- 1.1 Classifications of Engineering Materials, Concept of composite materials.
- 1.2 Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.
- 1.3 Types of Reinforcements/Fibers: Role and Selection or reinforcement materials.
- 1.4 Types of fibers, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc.,
- 1.5 Mechanical properties of fibers.

### **2.0 Classification of Composites:**

- 2.1 Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC).
- 2.2 Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites.
- 2.3 Comparison with Metals, Advantages & limitations of Composites.

### **3.0 Mechanical Properties of Composites:**

- 3.1 Geometrical aspects – volume and weight fraction.
- 3.2 Unidirectional continuous fiber, discontinuous fibers, Short fiber systems, woven

reinforcements – Mechanical Testing.

3.3 Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

#### 4.0 Laminates:

4.1 Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Computation of Stresses.

4.2 Types of Laminates - Symmetric Laminates, Antisymmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angle ply Laminate. Orthotropic Laminate.

4.3 Laminate Moduli, Hydrothermal Stresses.

#### 5.0 Joining Methods and Failure Theories:

5.1 Joining –Advantages and disadvantages of adhesive and mechanically fastened joints.

5.2 Typical bond strengths and test procedures.

**Syllabus covered up to I.A-Chapters 1, 2 & 3**

| <b>E.LEARNING RESOURCES:</b> |                        |                                                          |                              |
|------------------------------|------------------------|----------------------------------------------------------|------------------------------|
| <i>Sl. No.</i>               | <i>Name of Authors</i> | <i>Title of the Book</i>                                 | <i>Name of the Publisher</i> |
| 1                            | A.K Bhargava           | Engineering Materials: Polymers, Ceramics and Composites | Prentice Hall India          |
| 2                            | G. Dieter              | Mechanical Metallurgy                                    | Mc-Graw Hill                 |
| 3                            | R.F. Speyer            | Thermal Analysis of Materials                            | Marcel Decker                |

## TH 4b ADVANCE MANUFACTURING PROCESSES

|                      |                           |                            |                 |
|----------------------|---------------------------|----------------------------|-----------------|
| <b>Theory</b>        | <b>4 Periods per week</b> | <b>Internal Assessment</b> | <b>20 Marks</b> |
| <b>Total Periods</b> | <b>60 Periods</b>         | <b>End Sem Exam</b>        | <b>80 Marks</b> |
| <b>Examination</b>   | <b>3hours</b>             | <b>Total Marks</b>         | <b>100Marks</b> |

### RATIONALE:

Advance manufacturing processes is the field of production by advance nontraditional methods which give the conversion of raw materials into finished product..

### COURSE OBJECTIVES:

At the end of the course the students will be able to:

- Understand the working principle of modern machining processes.
- Understand the Plastic Processing
- Understand the additive manufacturing process
- Understand the Special Purpose Machines
- Understand the Maintenance of Machine Tools

### Topic Wise Distribution of Periods

| <b>Sl No.</b> | <b>Topic</b>                   | <b>Periods</b> |
|---------------|--------------------------------|----------------|
| 1             | Modern Machining Processes     | 20             |
| 2             | Plastic Processing             | 10             |
| 3             | Additive Manufacturing Process | 15             |
| 4             | Special Purpose Machines       | 7              |
| 5             | Maintenance of Machine Tools   | 8              |

### DETAILED CONTENTS

#### 1.0 Modern Machining Processes:

- 1.1 Introduction – comparison with traditional machining.
- 1.2 Ultrasonic Machining: principle, Description of equipment, applications.
- 1.3 Electric Discharge Machining: Principle, Description of equipment, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, applications.
- 1.4 Wire cut EDM: Principle, Description of equipment, controlling parameters; applications.
- 1.5 Abrasive Jet Machining: principle, description of equipment, Material removal rate, application.
- 1.5 Laser Beam Machining: principle, description of equipment, Material removal rate, application.
- 1.6 Electro Chemical Machining: principle, description of equipment, Material removal rate, application.
- 1.7 Plasma Arc Machining – principle, description of equipment, Material removal rate, Process parameters, performance characterization, Applications.
- 1.8 Electron Beam Machining - principle, description of equipment, Material removal rate, Process parameters, performance characterization, Applications.

#### 2.0 Plastic Processing:

- 2.1 Processing of plastics.
- 2.2 Moulding processes: Injection moulding, Compression moulding, Transfer moulding.
- 2.3 Extruding; Casting; Calendering.
- 2.4 Fabrication methods-Sheet forming, Blow moulding, Laminating plastics (sheets, rods & tubes), Reinforcing.
- 2.5 Applications of Plastics.

### 3.0 Additive Manufacturing Process:

- 3.1 Introduction, Need for Additive Manufacturing
- 3.2 Fundamentals of Additive Manufacturing, AM Process Chain
- 3.3 Advantages and Limitations of AM, Commonly used Terms
- 3.4 Classification of AM process, Fundamental Automated Processes, Distinction between AM and CNC, other related technologies.
- 3.5 Application –Application in Design, Aerospace Industry, Automotive Industry, Jewelry Industry, Arts and Architecture. RP Medical and Bioengineering Applications.
- 3.6 Web Based Rapid Prototyping Systems.
- 3.7 Concept of Flexible manufacturing process, concurrent engineering, production tools like capstan and turret lathes, rapid prototyping processes.

### 4.0 Special Purpose Machines (SPM):

- 4.1 Concept, General elements of SPM, Productivity improvement by SPM, Principles of SPM design.

### 5.0 Maintenance of Machine Tools:

- 5.1 Types of maintenance, Repair cycle analysis, Repair complexity, Maintenance manual, Maintenance records, Housekeeping. Introduction to Total Productive Maintenance (TPM).

### Syllabus covered up to I.A-Chapters 1,2 &3

| <b>E.LEARNING RESOURCES:</b> |                                                |                                                |                                                 |
|------------------------------|------------------------------------------------|------------------------------------------------|-------------------------------------------------|
| <i>Sl. No.</i>               | <i>Name of Authors</i>                         | <i>Title of the Book</i>                       | <i>Name of the Publisher</i>                    |
| 1                            | O.P.KHANNA                                     | Production technology –Vol-II                  | Dhanpat Rai Publication                         |
| 2                            | B.S. Raghuwanshi                               | Workshop Technology, Vol – II                  | Dhanpat Rai Publication                         |
| 3                            | HMT, Bangalore                                 | Production Technology                          | Tata Mc-Graw Hill                               |
| 4                            | 1. Chua C.K.,<br>Leong K.F.<br>and LIM<br>C.S, | Rapid prototyping: Principles and Applications | WORLD SCIENTIFIC PUBLICATION,THIRD EDITION,2010 |
| 5                            | Stephen F. Krar &<br>Arthur Gil                | Exploring Advanced Manufacturing Technologies  | 1. Industrial Press                             |

## TH.4(c) INDUSTRIAL ROBOTICS & AUTOMATION (Elective)

|                                                       |       |                           |       |
|-------------------------------------------------------|-------|---------------------------|-------|
| Name of the Course: Diploma in MECHANICAL ENGINEERING |       |                           |       |
| Course code:                                          |       | Semester                  | 6th   |
| Total Period:                                         | 60    | Examination               | 3 hrs |
| Theory periods:                                       | 4 P/W | Internal assessment       | 20    |
| Maximum marks:                                        | 100   | End Semester Examination: | 80    |

### A. RATIONALE:

Today's manufacturing units are using robots as substitute for workers working in hazardous atmosphere. Any automation found are using robots which are known as industrial robots and helps in mass production and assembling parts to make a finished product. So to meet the need of the day this Subject should be included in the syllabus of mechanical engineering of diploma stream.

### COURSE OBJECTIVES:

At the end of the course the students will be able to:

- Understand the basic concepts, parts of robots and types of robots.
- Understand the various drive systems for robot, sensors and their applications in robots and programming of robots.
- Understand the robots according to its usage.
- Understand the various applications of robots, justification and implementation of robot.
- Conceptualize automation and understand applications of robots in various industries.

### Topic Wise Distribution of Periods

| Sl No. | Topic                                  | Periods |
|--------|----------------------------------------|---------|
| 1      | Fundamentals of Robotics               | 10      |
| 2      | Robotic Drive System and Controller    | 12      |
| 3      | Sensors                                | 8       |
| 4      | Introduction to Machine Vision         | 10      |
| 5      | Robot kinematics and Robot Programming | 15      |
| 6      | Automation & Industrial Applications   | 5       |

### CHAPTERS

#### 1.0 Fundamentals of Robotics:

- 1.1 Definition; Robot anatomy (parts) and its working.
- 1.2 Robot Components: Manipulator, End effectors; Construction of links, Types of joints.
- 1.3 Classification of robots; Cartesian, Cylindrical, Spherical, Scara, Vertical articulated.
- 1.4 Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume.
- 1.5 Robot work Volumes, comparison.
- 1.6 Advantages and disadvantages of robots.

#### 2.0 Robotic Drive System and Controller:

- 2.1 Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives.
- 2.2 AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion.
- 2.3 Feedback devices; Potentiometers; Optical encoders; DC tachometers.

- 2.4 Robot controller; Level of Controller; Open loop and Closed loop controller.  
 2.5 Microprocessor based control system; Robot path control: Point to point, Continuous path control and Sensor based path control; Controller programming.

### 3.0 Sensors:

- 3.1 Requirements of a sensor.  
 3.2 Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo Electric); Range sensors (Triangulation Principle, Structured lighting approach).  
 3.3 Proximity sensing; Force and torque sensing.

### 4.0 Introduction to Machine Vision:

- 4.1 Robot vision system (scanning and digitizing image data); Image processing and analysis.  
 4.2 Cameras (Acquisition of images); Videocon camera (Working principle & construction).  
 4.3 Applications of Robot vision system: Inspection, Identification, Navigation & serving.

### 5.0 Robot kinematics and Robot Programming:

- 5.1 Forward Kinematics; Inverse Kinematics and Differences.  
 5.2 Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems.  
 5.3 Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming.  
 5.4 Motion Commands; Sensor Commands; End effector commands; and Simple programs.

### 6.0 Automation & Industrial Applications:

- 6.1 Basic elements of automated system, advanced automation functions, levels of automation.  
 6.2 Application of robots in machining; welding; assembly and material handling.

### Syllabus covered up to I.A-Chapters 1, 2 & 3

| <b>E.LEARNING RESOURCES:</b> |                                 |                                                               |                                              |
|------------------------------|---------------------------------|---------------------------------------------------------------|----------------------------------------------|
| <i>Sl. No.</i>               | <i>Name of Authors</i>          | <i>Title of the Book</i>                                      | <i>Name of the Publisher</i>                 |
| 1                            | Saeed B. Niku                   | Introduction to Robotics: Analysis, Systems, Applications     | Pearson Education Inc.New DELHI 2006         |
| 2                            | M.P. Groover                    | Industrial Robotics: Technology, Programming and Applications | Tata Mc Graw Hill Co,2001                    |
| 3                            | Fu K S Gonzalz R Cand Lee C S G | Robotics control,sensing,visionand intelligence               | 1. Mc-Graw Hill Book Co, 1987.               |
| 4                            | Ganesh S. Hedge                 | A Text book on Industrial Robotics                            | 1. , Laxmi Publications Pvt. Ltd., New Delhi |
| 5                            | S.R. Deb & Sankha Deb           | Robotics Technology and Flexible Automation Robot             | 1. Tata McGraw-Hill, 2010.                   |



## Pr.1 AUTOMOBILE ENGINEERING LAB

|                                                       |       |                           |       |
|-------------------------------------------------------|-------|---------------------------|-------|
| Name of the Course: Diploma in MECHANICAL ENGINEERING |       |                           |       |
| Course code:                                          |       | Semester                  | 6th   |
| Total Period:                                         | 60    | Examination               | 3 hrs |
| Practical periods:                                    | 4 P/W | Sessional                 | 50    |
| Maximum marks:                                        | 100   | End Semester Examination: | 50    |

### COURSE OBJECTIVES

At the end of the course the students will be able to

#### List of Practical .

1. Study of Automobile chassis.
2. Study the differential mechanism of the Tractor.
3. Study the hydraulic braking system of automobile.
4. Study Study the cut section model of carburetor solex type and maruti car type.
5. Study the fuel pump cut section model.
6. Study the actual cut section of gear box.
7. Study of actual car engine.

## Pr 2. POWER STATION ENGINEERING LAB

|                                                       |       |                           |       |
|-------------------------------------------------------|-------|---------------------------|-------|
| Name of the Course: Diploma in MECHANICAL ENGINEERING |       |                           |       |
| Course code:                                          |       | Semester                  | 6th   |
| Total Period:                                         | 60    | Examination               | 3 hrs |
| Practical periods:                                    | 4 P/W | Sessional                 | 25    |
| Maximum marks:                                        | 75    | End Semester Examination: | 50    |

### COURSE OBJECTIVES

At the end of the course the students will be able to

#### List of Practical

Experiment 01-To study the modern steam power plant with model.

Experiment 02-To determine the various efficiencies of steam turbine.

Experiment 03-To study the cooling tower.

Experiment 04-Study of jet condenser.

Experiment 05-Study of De-level turbine.

Experiment 06-To study the spring loaded safety valve.

Experiment 07-To study the following steam generators (boilers)models.

- a) Lancashire boiler.
- b) Cornish boiler.
- c) Babcock & Wilcox Boiler.
- d) Vertical water tube boiler.

## Pr3. PROJECT Phase - II

|                                                       |             |                     |                 |
|-------------------------------------------------------|-------------|---------------------|-----------------|
| Name of the Course: Diploma in Mechanical Engineering |             |                     |                 |
| Course code:                                          |             | Semester            | 6 <sup>th</sup> |
| Total Period:                                         | 150         | Examination         | 3 hrs           |
| Lab. periods:                                         | 10 P / week | Sessional           | 50              |
| Maximum marks:                                        | 150         | End Sem Examination | 100             |

### RATIONALE

Students' Project Work aims at developing innovative skills in the students whereby they apply the knowledge and skills gained through the course covered in many subjects and Labs, by undertaking a project. The prime emphasis of the project work is to understand and apply the basic knowledge of the principles of Mechanical engineering and practices in real life situations, so as to participate and manage a large Mechanical engineering projects, in future. Entire Project spreads over 5<sup>th</sup> and 6<sup>th</sup> Semester. Part of the Project covered in 5<sup>th</sup> Semester was named as *Project Phase-I* and balance portion to be covered in 6<sup>th</sup> Semester shall be named as *Project Phase-II*.

### OBJECTIVES

After undergoing the Project Work, the student will be able to:

- Implement the theoretical and practical knowledge and skills gained through various subjects/courses into an application suitable for a real practical working environment, preferably in an industrial environment.
- Develop software packages or applications and implement these for the actual needs of the community/industry.
- Identify and contrast gap between the technological knowledge acquired through curriculum and the actual industrial need and to compensate it by acquiring additional knowledge as required.
- Carry out cooperative learning through synchronous guided discussions within the class in key areas, asynchronous document sharing and discussions, as well as prepare collaborative edition of the final project report.
- To achieve real life experience in Project design.
- To develop the skill of writing Project Report

### Project Phase-I and Phase-II

The Project work duration covers 2 semesters(5<sup>th</sup> and 6<sup>th</sup> sem). The Grouping of students, selection of Project, assignment of Project Guide to the Group was done in the beginning of 5<sup>th</sup> semester under Project Phase-I. The students were allowed to study literature, any existing system and then define the Problem/objective of the Project. Preliminary work and Design of the system also have to be complete in Phase-I. Development may also begin in this phase. Project Milestones are to be set so that progress can be tracked .

In Phase-II Development, Testing, Documentation and Implementation have to be complete. Project Report have to be prepared and complete in Phase-II. All Project reports should be organized uniformly in proper order, irrespective of group. Teacher Guides can make suitable alteration in the components of Task and schedule.

At the end of Project Phase-II in 6<sup>th</sup> semester there shall be one presentation by each group on whole Project work undertaken by them.

A suggestive criterion for assessing student performance by the external (preferably person from industry) and internal (teacher) examiner is given in table below:

| Sl. No. | Performance Criteria                                              |
|---------|-------------------------------------------------------------------|
| 1.      | Selection of project assignment                                   |
| 2.      | Planning and execution of considerations                          |
| 3.      | Quality of performance                                            |
| 4.      | Providing solution of the problems or production of final product |
| 5.      | Sense of responsibility                                           |
| 6.      | Self expression/ communication/ Presentation skills               |
| 7.      | Interpersonal skills/human relations                              |
| 8.      | Report writing skills                                             |
| 9       | Viva voce                                                         |

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations to such an exhibition.

The Project Report need to be prepared as per standard format and following is the indicative format. The Teacher Guide may make minor alteration keeping the sense in tact.

#### Organization of Project Report

1. Cover page:

It should contain the following ( in order)

- (i) Title of the Project
- (ii) "Submitted in partial fulfillment of the requirements for the Diploma in <Branch Name>"
- (iii) By Name of the Student(s)
- (iv) Logo of the Institution
- (v) Branch Name/Depart Name and Institution Name with Address
- (vi) Academic Year

2. 1<sup>st</sup> Inner page

Certificate:

It should contain he following

"This is to certify that the work in this Project Report entitled <Project Title> by <Name of student(s)> has been carried out under my supervision in partial fulfillment of the requirements for the Diploma in <Branch Name>" during session <session > in <Branch /Department Name> of <Institute name> and this work is the original work of the above student(s).

Seal and signature of the Supervisor/Guide with date

3. 2<sup>nd</sup> Inner Page

Acknowledgement by the Student(s)

4. Contents.

5. Chapter wise arrangement of Reports

6. Last Chapter: Conclusion

It should contain

- (i) Conclusion
- (ii) Limitations
- (iii) Scope for further Improvement

7. References

## Pr-4 LIFE SKILL (Common to All Branches)

|               |                    |             |          |
|---------------|--------------------|-------------|----------|
| Practical     | 2 Periods per week | Sessional   | 25 Marks |
| Total Periods | 30 Periods         | Total Marks | 25 Marks |

**Objective:** After completion of this course the student will be able to:

- Develop team spirit i.e. concept of working in team
- Apply problem solving skills for a given situation
- Use effective presentation techniques
- Apply task management techniques for given projects
- Enhance leadership traits
- Resolve conflict by appropriate method
- Survive self in today's competitive world
- Face interview without fear

### DETAIL CONTENTS:

#### 1. SOCIAL SKILL

Society, Social Structure, Develop Sympathy and Empathy

Swot Analysis – Concept, How to make use of SWOT

Inter personal Relation: Sources of conflict, Resolution of conflict ,

Ways to enhance interpersonal relation

#### 2. PROBLEM SOLVING

Steps of Problem solving:

- Identify and clarify the problem,
- Information gathering related to problem,
- Evaluate the evidence,
- Consider alternative solutions and their implications,
- Choose and implement the best alternative,
- Review
- Problem solving techniques:

1) Trial and error, 2) Brain storming, 3) Lateral (Out of Box) thinking

#### 3. PRESENTATION SKILL

Body language , Dress like the audience

Posture, Gestures, Eye contact and facial expression. STAGE FRIGHT,

Voice and language – Volume, Pitch, Inflection, Speed, Pause

Pronunciation, Articulation, Language, Practice of speech.

Use of AV aids such as Laptop with LCD projector, white board etc.

#### 4. GROUP DISCUSSION AND INTERVIEW TECHNIQUES

*Group Discussion:*

Introduction to group discussion, Ways to carry out group discussion,

Parameters— Contact, body language, analytical and logical thinking, decision making

*Interview Technique :*

Dress, Posture, Gestures, facial expression, Approach

Tips for handling common questions.

#### 5. WORKING IN TEAM

Understand and work within the dynamics of a groups.

Tips to work effectively in teams,

Establish good rapport, interest with others and work effectively with them to meet common objectives,

Tips to provide and accept feedback in a constructive and considerate way ,

Leadership in teams, Handling frustrations in group.

#### 6. TASK MANAGEMENT

Introduction, Task identification, Task planning ,

organizing and execution, Closing the task

## PRACTICAL

**List of Assignment:** (Any Five to be performed including Mock Interview)

**1. SWOT analysis:-**

Analyse yourself with respect to your strength and weaknesses, opportunities and threats. Following points will be useful for doing SWOT.

- a) Your past experiences,
- b) Achievements,
- c) Failures,
- d) Feedback from others etc.

**2. Solve the True life problem assigned by the Teacher.**

**3. Working in a Team**

Form a group of 5-10 students and do a work for social cause e.g. tree plantation, blood donation, environment protection, camps on awareness like importance of cleanliness in slum area, social activities like giving cloths to poor etc. (One activity per group where Team work shall be exhibited)

**4. Mock Interview**

**5. Discuss a topic in a group and prepare minutes of discussion.**

**6. Deliver a seminar for 5 minutes using presentation aids on the topic given by your teacher.**

**7. Task Management**

Decide any task to be completed in a stipulated time with the help of teacher. Write a report considering various steps in task management (with Break up into sub tasks and their interdependencies and Time)

**Note:** -1. Please note that these are the suggested assignments on given contents/topic. These assignments are the guide lines to the subject teachers. However the subject teachers are free to design any assignment relevant to the topic.

**Note:** -2. The following Topics may be considered for Seminar/GD in addition to other Topics at the discretion of the Teacher.

(Comparison with developed countries, Occupational Safety, Health Hazard, Accident & Safety, First-Aid, Traffic Rules, Global Warming, Pollution, Environment, Labour Welfare Legislation, Labour Welfare Acts, Child Labour Issues, Gender Sensitisation ,Harassment of Women at Workplace)

## **METHODOLOGY:**

*The Teacher is to explain the concepts prescribed in the contents of the syllabus and then assign different Exercises under Practical to the students to perform.*

## **Books Recommended:-**

| SI.No | Name of Authors     | Title of the Book                 | Name of the Publisher        |
|-------|---------------------|-----------------------------------|------------------------------|
| 01    | E.H. Mc Grath , S.J | Basic Managerial Skills for All   | PHI                          |
| 02    | Lowe and Phil       | Creativity and problem solving    | Kogan Page (I) P Ltd         |
| 03    | Adair, J            | Decision making & Problem Solving | Orient Longman               |
| 04    | Bishop , Sue        | Develop Your Assertiveness        | Kogan Page India             |
| 05    | Allen Pease         | Body Language                     | Sudha Publications Pvt. Ltd. |

## EQUIPMENT LIST

### AUTOMOBILE ENGINEERING LAB

| <b>SL.NO</b> | <b>NAME OF THE EQUIPMENTS</b>                 | <b>QUANTITY</b> |
|--------------|-----------------------------------------------|-----------------|
| 01           | Chassis of a car                              | 01 no           |
| 02           | Differential of a Tractor                     | 01 no           |
| 03           | Hydraulic brake system of a car working model | 01 no           |
| 04           | Solex carburetor                              | 01 no           |
| 05           | Maruty car type carburetor                    | 01 no           |
| 06           | Cut section of a fuel pump                    | 01no            |
| 07           | New car engine                                | 01 no           |
| 08           | Gear box                                      | 01no            |

### POWER STATION ENGINEERING LAB

| <b>SL.NO</b> | <b>NAME OF THE EQUIPMENTS</b>                       | <b>QUANTITY</b> |
|--------------|-----------------------------------------------------|-----------------|
| 01           | Stainless steel steam turbine test rig 01Kw 3000RPM | 01no            |
| 02           | Cooling Tower Apparatus or model                    | 01no            |
| 03           | Jet Condenser apparatus or model                    | 01no            |
| 04           | De Lavel turbine                                    | 01no            |
| 05           | Spring loaded safety valve                          | 02nos           |
| 06           | Lancashire boiler model                             | 01no            |
| 07           | Babcock and Wilcox boiler model                     | 01nos           |
| 08           | Cornish boiler model                                | 01no            |
| 09           | Vertical water steam boiler model                   | 01no            |
|              |                                                     |                 |