

RATIONALE

Diploma holders are required to supervise and handle specialized machines and equipment like CNC machines. For this purpose, knowledge and skills about NC machines, part programming in NC machines and tooling for CNC machines are required to be imparted for enabling them to perform above functions. This subject aims at development of knowledge and skills about CNC machines, tools, equipment and use of high tech machines for increased productivity and quality.

DETAILED CONTENTS**UNIT 1**

Introduction

Introduction to NC, CNC & DNC, their advantages, disadvantages and applications, Machine Control Unit, input devices, selection of components to be machined on CNC machines, Problems with conventional NC, New developments in NC, Axis identification, PLC Control and its components. Its advantages and disadvantages.

UNIT 2

Construction and Tooling

Design features, specification Chart of CNC machines, use of slideways, balls, rollers and coatings, motor and leadscrew, swarf removal, safety and guarding devices, various cutting tools for CNC machines, overview of tool holder, different pallet systems and automatic tool changer system, management of a tool room.

UNIT 3

Part Programming

Part programming and basic concepts of part programming, NC words, part programming formats, simple programming for rational components, part programming using conned cycles, subroutines and do loops, tool off sets, cutter radius compensation and wear compensation.

UNIT 4

System Devices

Actuators, Transducers and Sensors, Tachometer, LVDT, opto-interrupters, potentiometers for linear and angular position, encoder and decoder, axis drives, open loop system, close loop system.

Problems in CNC Machine

Common problems in mechanical, electrical, pneumatic, electronic and PC components of NC machines, diagnostic study of common problems and remedies, use of on-time fault finding diagnosis tools in CNC machines.

UNIT 5

Automation and NC system

Role of computer in automation, emerging trends in automation, automatic assembly, manufacture of magnetic tape, manufacture of printed circuit boards, manufacture of integrated Circuits, Overview of FMS, Group technology, CAD/CAM and CIM.

Robot Technology

Introduction to robot technology, basic robot motion, robot applications

INSTRUCTIONAL STRATEGY

This is highly practice-based course. Efforts should be made to develop programming skills amongst the students. During practice work, it should be ensured that students get opportunity to individually perform practical tasks.

RECOMMENDED BOOKS

1. CNC Machines – Programming and Applications by M Adithan and BS Pabla; New Age International (P) Ltd., Delhi.

2. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata Mc Graw Hill, New Delhi.
3. CNC Machine by Bharaj; Satya Publications, New Delhi.

LIST OF PRACTICALS

- 1.1 Study the constructional details of CNC lathe.
- 1.2 Study the constructional details of CNC milling machine.
- 1.3 Study the constructional details and working of:
 - Automatic tool changer and tool setter
 - Multiple pallets
 - Swarf removal
 - Safety devices
- 2.1 Develop a part programme for following lathe operations and make the job on CNC lathe and CNC turning center.
 - Plain turning and facing operations
 - Taper turning operations
 - Operation along contour using circular interpolation.
- 2.2 Develop a part programme for the following milling operations and make the job on CNC milling
 - Plain milling
 - Slot milling
 - Contouring
 - Pocket milling
- 3.1 Preparation of work instruction for machine operator
- 3.2 Preparation of preventive maintenance schedule for CNC machine.
- 3.3. Demonstration through industrial visit for awareness of actual working of in production.
- 4.1 Use of software for turning operations on CNC turning center.
- 4.2. Use of software for milling operations on machine centres.
- 5.1 Operation of robot.
- 5.2. Use of PLC for various mechanical outputs viz. piston motion in a single cylinder, multiple cylinder etc

RATIONALE

The diploma holder of Mechanical Engineering are responsible for supervising and maintenance of RAC system. For this purpose, the knowledge and skill covering basic principles of refrigeration and air conditioning is required to be imparted to the students. Moreover, RAC industry is expanding and employment opportunities in this field are good.

DETAILED CONTENTS**UNIT 1**

Fundamentals of Refrigeration

Introduction to refrigeration, and air conditioning, meaning of refrigerating effect, units of refrigeration, COP, difference between COP and efficiency, methods of refrigeration, Natural system and artificial system. Rating of refrigeration

UNIT 2

Vapour Compression System

Introduction, principle, function, parts and necessity of vapour compression system, T- ϕ and p- H charts, dry, wet and superheated compression. Effect of sub cooling, super heating, mass flow rate, entropy, enthalpy, work done, Refrigerating effect and COP. actual vapour compression system

UNIT 3

Refrigerants

Functions, classification of refrigerants, properties of R -717, R -22, R-134 (a), CO₂, R-11, R-12, R-502, ammonia. Properties of ideal refrigerant, selection of refrigerant

UNIT 4

Air Refrigeration System

Introduction, advantages and disadvantages of air-refrigeration system over vapour compression system, bell – Collemann cycle, calculation of mass flow rate, work done and COP

Vapour Absorption System

Introduction, principle and working of simple absorption system and domestic electrolux refrigeration systems. Solar power refrigeration system, advantages and disadvantages of solar power refrigeration system over vapour compression system.

Refrigeration Equipment

Compressors- Function, various types of compressors

Condensers - Function, various types of condensers

Evaporators- Function, types of evaporators

Expansion Valves - Function, various types such as capillary tube, thermostatic expansion valve, low side and high side float valves, application of various expansion valves

Safety Devices- Thermostat, overload protector LP, HP cut out switch.

UNIT 5

AIR CONDITIONING

5.1 Psychrometry

Definition, importance, specific humidity, relative humidity, degree of saturation, DBT, WBT, DPT, sensible heat, latent heat, Total enthalpy of air.

5.2 Applied Psychrometry and Heat Load Estimation.

Psychrometric chart, various lines, psychrometric process, by pass factor, room sensible heat factor, effective room sensible heat factor, grand sensible heat factor, ADP, room DPT.

Heating and humidification, cooling and dehumidification, window air-conditioning, split type air-conditioning, central air-conditioning.

INSTRUCTIONAL STRATEGY

1. Teaches should take the students to industry and explain the details of refrigeration and air-conditioning systems and their components.
2. While imparting instructions, focus should be on conceptual understanding.

3. Training slides of “Carrier Fundamentals of Refrigeration Air Conditioning” to be shown to students.

RECOMMENDED BOOKS

1. Refrigeration and Air Conditioning by Domkundwar; Dhanpat Rai and Sons, Delhi.
2. Refrigeration and Air Conditioning by CP Arora; Tata McGraw Hill, New Delhi.
3. Refrigeration and Air Conditioning by R.S Khurmi and J.K. Gupta; S Chand and Company Limited, New Delhi.

LIST OF PRACTICALS

1. Identify various tools of refrigeration kit and practice in cutting, bending, flaring, swaging and brazing of tubes.
2. Study of thermostatic switch, LP/HP cut out overload protector filters, strainers and filter driers.
3. Identify various parts of a refrigerator and window air conditioner.
4. To find COP of Refrigeration system
5. To detect trouble/faults in a refrigerator/window type air conditioner
6. Charging of a refrigerator/ window type air conditioner.
7. Disassembly and assembly of single cylinder open type compressor
8. Visit to an ice plant or cold storage plant. or central air conditioning plant

RATIONALE

A diploma holder in this course is required to assist in the Design and Development of Prototype and other components. For this, it is essential that he is made conversant with the principles related to design of components and machine and application of these principles for designing. The aim of the subject is to develop knowledge and skills about various aspects related to design of machine components.

DETAILED CONTENTS**UNIT 1**

Introduction

- 1.1 Design – Definition, Type of design, necessity of design
 - 1.1.1 Comparison of designed and undesigned work
 - 1.1.2 Design procedure
 - 1.1.3 Characteristics of a good designer

- 1.2 Design terminology: stress, strain, factor of safety, factors affecting factor of safety, stress concentration, methods to reduce stress concentration, fatigue, endurance limit.
 - 1.2.1 General design consideration
 - 1.2.2. Codes and Standards (BIS standards)

- 1.3 Engineering materials and their mechanical properties :
 - 1.3.1 Properties of engineering materials: elasticity, plasticity, malleability, ductility, toughness, hardness and resilience. Fatigue, creep, tenacity, strength
 - 1.3.2 Selection of materials, criterion of material selection

UNIT 2

Design Failure

- 2.1 Various design failures-maximum stress theory, maximum strain theory, maximum strain energy theory
- 2.2 Classification of loads
- 2.3 Design under tensile, compressive and torsional loads.

- 2.1.1 Design of Shaft
- 2.1.2 Type of shaft, shaft materials, Type of loading on shaft, standard sizes of shaft available
- 2.1.3 Shaft subjected to torsion only, determination of shaft diameter (hollow and solid shaft) on the basis of :
 - Strength criterion
 - Rigidity criterion
- 2.1.4 Determination of shaft dia (hollow and solid shaft) subjected to bending
- 2.1.5 Determination of shaft dia (hollow and solid shaft) subjected to combined torsion and bending .

UNIT 3

- 3.1 Design of Key
 - 3.1.1 Types of key, materials of key, functions of key
 - 3.1.2 Failure of key (by Shearing and Crushing).
 - 3.1.3 Design of key (Determination of key dimension)
 - 3.1.4 Effect of keyway on shaft strength. (Figures and problems).

- 3.2. Design of Joints

Types of joints - Temporary and permanent joints, utility of various joints

 - 3.2.1 Temporary Joint:
 - 3.2.1.1 Knuckle Joints – Different parts of the joint, material used for the joint, type of knuckle Joint, design of the knuckle joint. (Figures and problems).
 - 3.2.1.2 Cotter Joint – Different parts of the spigot and socket joints, Design of spigot and socket joint.

 - 3.2.2 Permanent Joint:
 - 3.2.2.1 Welded Joint - Welding symbols. Type of welded joint, strength of parallel and transverse fillet welds.
 - 3.2.2.3 Strength of combined parallel and transverse weld.
 - 3.2.2.4 Riveted Joints. : Rivet materials, Rivet heads, leak proofing of riveted joint – caulking and fullering.
 - 3.2.2.5 Different modes of rivet joint failure.
 - 3.2.2.6 Design of riveted joint – Lap and butt, single and multi riveted joint.

UNIT 4

Design of Flange Coupling, Necessity of a coupling, advantages of a coupling, types of couplings, design of muff coupling, design of flange coupling. (Both protected type and unprotected type).

UNIT 5

Design of Screwed Joints

- 5.1 Introduction, Advantages and Disadvantages of screw joints, location of screw joints
- 5.2 Important terms used in screw threads, designation of screw threads, Initial stresses due to screw up forces, stresses due to combined
- 5.3 Design of power screws (Press, screw jack, screw clamp)

Note : The paper setter should provide all the relevant data for the machine design numericals in the question paper.

INSTRUCTIONAL STRATEGY

1. While imparting instructions, focus should be on concepts.
2. Presentation should be arranged for various topics.

RECOMMENDED BOOKS

1. Machine Design by R.S. Khurmi and JK Gupta, Eurasia Publishing House (Pvt.) Limited, New Delhi.
2. Machine Design by V.B.Bhandari, Tata McGraw Hill, New Delhi.
3. Engineering Design by George Dieter; Tata McGraw Hill Publishers, New Delhi.
4. Mechanical Engineering Design by Joseph Edward Shigley; McGraw Hill, Delhi.
5. Machine Design by Sharma and Agrawal; Katson Publishing House, Ludhiana.
6. Design Data Handbook by D.P. Mandali, SK Kataria and Sons, Delhi.
7. Machine Design by A.P.Verma; SK Kataria and Sons, Delhi
8. Machine Design by AR Gupta and BK Gupta ; Satya Parkashan, New Delhi.

A batch of maximum 5 students will select a problem and then plan, organize & execute the project work of solving the problem in a specified duration. Student is expected to apply the knowledge & skills acquired.

Batch may select any one problem/project work from following categories.

- Fabrication of small machine / devices/ test rigs/ material handling devices/ jig & fixtures/ demonstration models, etc. Report involving aspects of drawing, process sheets, costing, Installation, commissioning & testing should be prepared and submitted.
- Design & fabrication of mechanisms, machines, Devices, etc. Report involving aspects of designing & fabricating should be prepared & submitted.
- Development of computer program for designing and /or drawing of machine components, Simulation of movement & operation, 3D modeling, pick & place robots etc.
- Industry sponsored projects- project related with solving the problems identified by industry should be selected. One person / engineer from industry is expected to work as co- guide along with guide from institution.
- Literature survey based projects: Project related with collection tabulation, classification, analysis & presentation of the information. Topic selected must be related with latest technological developments in mechanical or mechatronics field, and should not be a part of diploma curriculum. Report should be of min 60 pages.
- Investigative projects- Project related with investigations of causes for change in performance or structure of machine or component under different constraints through experimentation and data analysis.
- Maintenance based projects: The institute may have some machine/ equipment/ system which are lying idle due to lack of maintenance. Students may select the specific machines/equipment/system. Overhaul it, repair it and bring it to working condition. The systematic procedure for maintenance to be followed and the report of the activity are submitted.
- Industrial engineering based project: Project based on work study, method study, methods improvement, leading to productivity improvement, data collection, data analysis and data interpretation be undertaken.
- Low cost automation projects: Project based on hydraulic/pneumatic circuits resulting into low cost automated equipment useful in the identified areas.
- Innovative/ Creative projects – Projects related with design, develop & implementation of new concept for some identified useful activity using PLC, robotics, non-conventional energy sources, CIM , mechatronics, etc.

- Environmental management systems projects: Projects related with pollution control, Solid waste management, liquid waste management, Industrial hygiene, etc., Working model or case study should be undertaken.
- Market research/ survey based projects: Projected related with identification of extent of demand, sales forecasting, Comparative study of marketing strategies, Comparative study of channels of distribution,
- Impact of variables on sales volume, etc. The project involves extensive survey & market research activities
- Information to be collected through various mechanisms/tools & report is prepared.
- Project based on use of appropriate technology particularly benefiting rural society or economically weaker section.
- Project can be selected other than the area specified above. Project should provide viable and feasible solution to the problem identified. Report should be of min 50 pages.

ELECTIVE-III

RATIONALE

To develop, operate and maintain alternative energy sources systems. It is therefore essential to know basics of energy conversion, conservation, energy audit and waste heat recovery techniques.

DETAILED CONTENTS

UNIT 1

Introduction to Energy Sources

- 1.1 Introduction.
- 1.2 Major sources of energy: Renewable and Non-renewable.
- 1.3 Primary and secondary energy sources.
- 1.4 Energy Scenario:
 - Prospects of alternate energy sources.
 - Need of Alternate energy sources

UNIT 2

Solar Energy

- 2.1 Principle of conversion of solar energy into heat and electricity
- 2.2 Solar Radiation: Solar Radiations at earth's surface Solar Radiation Geometry: Declination, hour angle, altitude angle, incident angle, zenith angle, solar azimuth angle
- 2.3 Applications of Solar energy: -
 - Construction and working of typical flat plate collector and solar concentrating collectors and their applications, advantages and limitations
 - Space heating and cooling.
 - Photovoltaic electric conversion.
 - Solar distillation, Solar cooking and furnace.
 - Solar pumping and Green House.
 - Agriculture and Industrial process heat

UNIT 3

Wind Energy

- 3.1 Basic Principle of wind energy conversion.

- 3.2 Power in wind, Available wind power formulation, Power coefficient, Maximum power
- 3.3 Main considerations in selecting a site for wind mills.
- 3.4 Advantages and limitations of wind energy conversion.
- 3.5 Classification of wind mills
- 3.6 Construction and working of horizontal and vertical axis wind mills, their comparison
- 3.7 Main applications of wind energy for power generation and pumping

UNIT 4

Energy from Biomass

- 4.1 Common species recommended for biomass.
- 4.2 Methods for obtaining energy from biomass
- 4.3 Thermal classification of biomass
 - a) Gasified, b) Fixed bed and fluidized
- 4.4 Application of gasifier
- 4.5 Biodiesel production and application
- 4.6 Agriculture waste as a biomass
- 4.7 Biomass digester
- 4.8 Comparison of Biomass with conventional fuels

UNIT 5

Energy Conservation & Management:-

Global and Indian energy market, Energy scenario in various sectors and Indian economy, Need and importance of energy conservation and management, Concept of Payback period, Return on investment (ROI), Life cyclecost, Sankey diagrams, specific energy consumption. Principles of energy conservation. Energy audit, Types of audit Methods of energy conservation, Cogeneration and its application, Combined cycle system, Concept of energy management, Study of different energy management techniques like-

- Analysis of input
- Reuse and recycling of waste
- Energy education
- Conservative technique and energy audit

RECOMMENDED BOOKS

1. Non-conventional energy Resources BY Dr B.H.Khan
2. Non-conventional energy sources BY G. D. Rai

3. Solar energy BY S. P. Sukhatme
4. Power plant engineering BY Arrora Domkundwar
5. Energy resource management BY Krupal Singh Jogi
6. Non-conventional energy source BY K. M. Mittal

RATIONALE

The mechatronics, the integration of electronic, of electrical engineering, computer technology and control engineering with mechanical engineering is increasingly forming a crucial part in design, manufacture and maintenance of wide range of engineering products and processes. The diploma holders need skills and knowledge that are not confined to a single subject area. They need to be capable of operating and communicating across a range of engineering disciplines and linking those having more specialized skills. So it is important to introduce this subject.

DETAILED CONTENTS**UNIT 1****Introduction**

- 1.1 Introduction to Mechatronics
- 1.2 Mechatronic system
- 1.3 Measurement systems
- 1.4 Control system-open Loop, Close loop and sequential
- 1.5 Microprocessor based controllers
- 1.6 The Mechatronics approach

UNIT 2**Sensors and Transducers**

- 1.7 Sensors and transducers
- 1.8 Performance terminology
- 1.9 Displacement, position and motion sensors
- 1.10 Electromechanical sensors and transducers
- 1.11 Force sensors
- 1.12 Liquid flow sensors
- 1.13 Liquid level sensors
- 1.14 Temperature sensors
- 1.15 Light sensors
- 1.16 Selection of sensors
- 1.17 Simple problems

UNIT 3**Data Presentation Systems**

- 1.18 Displays
- 1.19 Data presentation elements
- 1.20 Magnetic recording
- 1.21 Data acquisition systems
- 1.22 Measurement systems
- 1.23 Testing and calibration
- 1.24 Simple problems

UNIT 4

Pneumatic and Hydraulic Systems

- 1.25 Actuation systems
- 1.26 Pneumatic and hydraulic systems
- 1.27 Directional control valves
- 1.28 Pressure control valves
- 1.29 Cylinders
- 1.30 Process control valves
- 1.31 Rotary actuators
- 1.32 Simple problems

UNIT 5

Mechanical Actuation Systems

- 1.33 Mechanical systems
- 1.34 Types of motion
- 1.35 Kinematic chains
- 1.36 Cams
- 1.37 Gear trains
- 1.38 Ratchet and pawl
- 1.39 Belt and chain drives
- 1.40 Bearing
- 1.41 Mechanical aspects of motor selection
- 1.42 Simple problems

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching learning.
2. Students should be taken to various industrial units for clear conception of various topics.
3. Efforts should be made to relate the process of teaching with direct experiences in the industry.

RECOMMENDED BOOKS

1. Mechatronics by HMT, Tata McGraw Hill, New Delhi
2. Mechatronics: Electronic Control System in Mechanical Engineering by W. Bolton; Pearson Education, Singapore.
3. Fundamentals of Electrical Engineering and Electronics by BL Thareja; S. Chand and Company, New Delhi.
4. Basic Electronics by Gupta, NN Bhargava, Kulshreshtha, TTTI, Chandigarh.

RATIONALE

These days, automobile has become a necessity instead of luxury. The diploma holders in this course are required to supervise production and repair and maintenance of vehicles. For this purpose, knowledge and skills are required to be imparted to them regarding automobile industry as a whole. This subject aims at developing required knowledge and skills in this area.

DETAILED CONTENTS**UNIT 1****COMPONENTS OF AN AUTOMOBILE**

Introduction to the following units of an automobile:-

The basic structure

The power plant

The transmission System

The auxiliaries

The controls

The superstructure

UNIT 2**FRAMES, WHEELS AND TYRES**

Functions of the frame

loads on the frame

Conventional frame construction

Frame types

Frameless construction

Constructional details of wheels

Wheel dimensions and tread design considerations.

UNIT 3**POWER SYSTEM**

Nomenclature of cylinder bore, piston area, stroke, swept volume clearance volume, compression ratio

Introduction of various components of an automobile engine.

Concept of two stroke and four stroke engines.

Working of petrol engine and diesel engine.

Fuel supply systems for both petrol and diesel engines.

Elementary idea about various systems like:-

Cooling, lubrication, Starting, charging and ignition.

UNIT 4

TRANSMISSION SYSTEM

Function of clutch

Constructional details of single plate and multi-plate clutches

Synchromesh gear box-construction, working of final drive and differential

UNIT 5

5.1 BRAKING SYSTEM

Principle of braking/back plate construction mechanical and hydraulic brakes.

Constructional detail of components of braking system.

5.2 STEERING AND SUSPENSION SYSTEM

Introduction to suspension system, basic requirements for suspension, components of suspension like leaf springs, coil springs, shock absorbers

Introduction to steering system, steering mechanism, steering linkages and steering gears.

5.3 LIGHTING AND ACCESSORIES

Wiring circuits, components of wiring circuits. Function of windscreen wiper, horn, speedometer, central locking and power windows.

INSTRUCTIONAL STRATEGY

1. Teaches should demonstrate various systems and sub systems of automobile while dealing with the subject.
2. While imparting instructions, focus should be on conceptual understanding.

RECOMMENDED BOOKS

1. Automobile Engineering by R.B. Gupta, Satya Prakashan, New Delhi
2. Automobile Engineering by Kirpal Singh, Standard Publisher Distributor
3. Automobile Engineering by GBS Narang, Khanna Publishers, Delhi

RATIONALE

To impart, concepts, principles & procedures of tool engineering to achieve highest productivity and perform duties as a technician in tool room, shop floor, quality control & assist tool Engineer in design of tools and production processes.

DETAILED CONTENTS**UNIT 1****Metal Cutting**

Mechanics of Metal cutting: requirements of tools, cutting forces –Types of chips, chip thickness ratio, shear angle – simple numerical only, Types of metal cutting process – orthogonal, oblique and form cutting. Cutting fluids – types, characteristics and applications. Tool wear, Types of wear, Tool life - Tool life equations. Machinability – definition, factors affecting machinability, machinability Index.

UNIT 2

Tool materials: Types, characteristics, applications. Heat treatment of tool steels, Specification of carbide tips, Types of ceramic coatings. Cutting Tool Geometry: Single point cutting tool, drills, reamers, milling cutters.

UNIT 3

Presses: Types, Specification

Types of dies and construction: Simple Die, Compound Die, Progressive Die, Combination Die. Punch & die mountings, pilots, strippers, misfeed detectors, Pressure Pads, Knock outs, stock guide, Feed-Stop, guide bush, guide pins.

Die Design Fundamentals: Die Operations- blanking, piercing, shearing, cropping, notching, lancing, coining, embossing, stamping, curling, drawing, bending, forming. Die set, Die shoe, Die area, Calculation of clearances on die and punch for blanking and piercing dies, Strip layout, Calculation of material utilization factor

UNIT 4

Forming Dies: Bending: methods, Bending Dies, bend allowance, spring back, spanning, bending pressure, pressure pads, development of blank length. Drawing: operations, Metal flow during drawing. Calculation of Drawing blank size, variables affecting metal flow during drawing, single action and double action dies, combination dies.

UNIT 5

Fundamentals of Other Tools

Constructional features of - Pressure Die casting dies, metal extrusion dies, injection moulding dies, forging dies, plastic extrusion dies.

RECOMMENDED BOOKS

1. A Text Book OF Production Engineering BY P. C. Sharma
2. Production Technology BY H. M. T.
3. Introduction to Jig and Tool Design BY M.H.A. Kempster
4. Jigs and Fixtures BY P. H. Joshi
5. Tool engineers handbook publication McGraw-Hill

RATIONALE

Industries are expected to generate their own power and supply the excess power to national grid. Alternate energy sources are also harnessed to meet the increasing demand. To study the layout, components of different power plants and economic aspects of power plants.

DETAILED CONTENTS**UNIT 1****Introduction to power plant**

- 1.1 Power scenario in India
- 1.2 Types of power plants – Hydro, Nuclear, Thermal, Future trends in power sector.
- 1.3 Analysis of steam cycles- Carnot, Rankine, Reheat cycle, Regenerative cycle, Methods of reheating, Advantages and disadvantages of reheat cycle,
- 1.4 Gas turbine cycle

UNIT 2**Steam power plant**

- 2.1 Layout of steam power plant, general features of selection of site
- 2.2 High pressure boilers – Construction and working of Sub-critical and Super-critical boilers.
- 2.3 Coal and ash handling system- equipments for in plant handling of coal such as belt conveyor, screw conveyor, bucket elevator, Coal crushing, Pulverized fuel handling system, Ball mill, Pulverized fuel and their advantages, Multi retort stoker, Pulverized fuel burner, Hydraulic and pneumatic ash handling, Electrostatic precipitator.
- 2.4 Boiler Feed water treatment
- 2.5 Environmental aspects of steam power plant - water pollution, air pollution, emission standard and its control

UNIT 3**Nuclear power plant**

- 3.1 Fusion and fission reaction, general criteria for selection of site.
- 3.2 Elements of nuclear power station, layout, types of nuclear reactors.
- 3.3 Nuclear fuels, coolant & moderators.
- 3.4 Working of PWR, BWR, CANDU, BREEDER type reactor.
- 3.5 Safety precautions and waste disposals.

Gas turbine power plant

- 3.6 General Layout, selection of site, Gas turbine power plants in India.
- 3.7 components of gas turbine plants, gas turbine Fuels.
- 3.8 Comparison of Gas turbine plant with diesel and Steam power plant.
- 3.9 Environmental impact of gas turbine power plant. Waste Heat recovery
- 3.10 Sources of waste heat
- 3.11 Heat recovery forms & methods – Sensible and latent Heat recovery.
- 3.12 Use of waste heat- Agricultural, green house, Animal shelter, Aqua cultural uses, process heating.
- 3.13 waste Heat recovery boilers

UNIT 4

Non-conventional power generation plants

- 6.1 Geothermal power plant- types, economical justification
- 6.2 Tidal power plant- factors affecting suitability of site, working of different tidal power plants, advantages and disadvantages
- 6.3 Wind power plant- different types, advantages and Disadvantages.
- 6.4 Solar power plant
- 6.5 Magneto Hydro dynamics power plant
- 6.6 Small hydro power plant
- 6.7 Introduction to Plasma technology

UNIT 5

Economics and operational aspects

- 7.1 Prediction of load, selection of types of generation, number of generating units.
- 7.2 Load duration curves, cost analysis, elements, controlling the cost of Power plant (simple numerical)
- 7.3 Major electrical equipments in power station- generator, step-up Transformer, switch gear, electrical motors.

RECOMMENDED BOOKS

1. Power plant engineering by P. K. Nag; Tata McGraw Hill
2. A text book of Power System Engineering by A. Chkrabarti and M. L. Soni; Dhanpat Rai and Co
3. Power plant engineering by Fredrick T. Mosse; East-West press
4. A course in power plant engineering by Arora and Domkundwar; Dhanpat Rai and Co.

RATIONALE

To know about the advancements in the area of manufacturing and production processes. To impart knowledge & skills necessary for working in modern manufacturing environment. To get familiarized with working principles and operations performed on non-traditional machines, machining centre, SPM, automated machines and maintenance of machine tools.

DETAILED CONTENTS**UNIT 1****Non-traditional machining processes**

1.1 Electrical discharge Machining. Principle of working, Setup of EDM, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, Applications e.g. micro hole drilling, curve hole drilling.

1.2 Wire cut EDM - Principle of working, Setup of WEDM, controlling Parameters, Applications.

1.3 Laser Beam Machining. Physical principle of Laser, Laser action in ruby rod, Types of Lasers. Set-up for LBM. Characteristics, controlling Parameters, Applications, Application Of Laser Beam for Welding (LBW)

1.4 Other non-traditional machines such as ECM, Principle of working, Applications.

UNIT 2**CNC milling machines**

Vertical and horizontal machining center: Constructional features, Axis identification, Electronic control system. Automatic tool changer and tool magazine. CNC programming: Preparatory functions (G code), miscellaneous functions (M code), Part programming including subroutines and canned cycles. Principles of computer aided part programming.

UNIT 3**Machine Tool Automation: Introduction and Need.**

(A) Single spindle automates, transfer lines.

(B) Elements of control system, Limit switches, Proximity switches, Block diagram for feedback and servo control system, Introduction to PLC, Block diagram of PLC.

UNIT 4

Special Purpose Machines (SPM)

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

UNIT 5

Maintenance of Machine Tools

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

RECOMMENDED BOOKS

1. Manufacturing Science by Amitabh Ghosh , Mallik; East-West Press Pvt. Ltd.
2. Production Technology by HMT, Bangalore; Tata Mc-Graw Hill
3. CNC machines by Pabla B. S., M. Adithan; New Age international limited.
4. Industrial maintenance by H.P.Garg; S. Chand & Co. Ltd.
5. Non-conventional Machining by P. K. Mistra; Narvasa Publishining House
6. Manufacturing Processes by Begman, Amsted; John Willey and Sons.
7. Manufacturing Technology Metal Cutting & Machine tools by P. N. Rao; Tata McGrow-Hill

DETAILED CONTENTS**UNIT-1**

Introduction: Definition and scope of industrial engineering, role of an industrial engineer in industry, functions of industrial engineering department and its organization, qualities of an industrial engineer, principles of industrial engineering, system and review of growth and development of industrial engineering and scientific management.

UNIT-2

Plant Layout and Material Handling: Different types of layouts viz. product, process and combination layouts, introduction to layouts based on GT, JIT and cellular manufacturing systems, development of plant layout, types of material handling Equipments, relationship of material handling with plant layouts.

UNIT-3

Work Study: Use and Applications, techniques, human factors in the application of work study, method study objectives, basic procedure, various charting techniques, use of photographic techniques, SIMO charts, principles of motion economy, work measurement techniques, time study, work sampling, predetermined motion time standards (PMTS), analytical estimation.

UNIT-4

Production Planning and Control: Functions, forecasting techniques, product design, process planning, machine loading and scheduling, dispatching, progress reporting, corrective action, inventory control - different costs, determining economic order quantity, quantity discounts, re-order level, re-order cycle systems, ABC, VED, FSN models.

UNIT-5

Quality Control: Meaning of quality and quality control, quality of design, quality of conformance and quality of performance, functions of quality control, introduction to statistical quality control-control charts and sampling plans.

Text Books/Reference Books:

1. Khanna O. P., Industrial Engineering and Management, *Khanna Publishers*.

2. Dalela S., Mansuor Ali, Industrial Engineering and Management systems, *Standard Distributors and Publishers, New Delhi.*
3. Ralph M. B., Motions and Time Standards, *John Wiley & Sons.*
4. ILO - Introduction to Work Study, *International Labor Office, Geneva.*
5. Jain K. C., Agarwal L. N., Production Planning Control & Industrial Management, *Khanna Publishers.*

ELECTIVES OFFERED TO SISTER BRANCHES

RATIONALE

The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines which are required by the students for further understanding of other allied subjects. The subject enhances the analytical ability of the students.

DETAILED CONTENTS**UNIT 1**

Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields, Definition of Applied Mechanics

Definition, basic quantities and derived quantities of basic units and derived units

Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another for density, force, pressure, work, power, velocity, acceleration

Concept of rigid body, scalar and vector quantities

UNIT 2

Definition of force, measurement of force in SI units, its representation, types of force

Point force/concentrated force & uniformly distributed force, effects of force, characteristics of a force

Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position

Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components

Free body diagram, Equilibrant force and its determination, Lami's theorem (concept only)

UNIT 3

MOMENTS

Concept of moment, Moment of a force and units of moment, Varignon's theorem (definition only), Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)

Parallel forces (like and unlike parallel force), calculating their resultant, Concept of couple, its properties and effects

General conditions of equilibrium of bodies under coplanar forces, Position of resultant force by moment

UNIT 4

Definition and concept of friction, types of friction, force of friction

Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction

Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane

Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies

Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion

Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed

UNIT 5

Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines Simple and compound machine (Examples)

Definition of ideal machine, reversible and self-locking machine

Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency

Working principle and application of wheel and axle, Weston's Differential Pulley Block, simple screw jack, worm and worm wheel, single and double winch crab, Expression for their velocity ratio and field of their application

RECOMMENDED BOOKS

1. A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co. Ltd.
2. Applied Mechanics By, Col. Harbhajan Singh, TL Singha and Parmod Kumar Singla, Published By Abhishek Publication, 57-59, Sector-17, Chandigarh
3. A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi.
4. A Text Book of Applied Mechanics by RK Rajput; Laxmi Publications, New Delhi..
5. Text Book of Applied Mechanics by Birinder Singh, Kaption Publishing House, New Delhi.

RATIOANLE

A diploma holder in this course is supposed to maintain steam generators, turbines, compressors and other power plant equipment. Therefore, it is essential to impart him basic concepts of thermodynamics, steam generators, steam turbines, and compressors and about IC engines.

DETAILED CONTENTS**UNIT 1**

Thermodynamic state and system, boundary, surrounding, universe, thermodynamic systems – closed, open, isolated, adiabatic, homogeneous and heterogeneous, properties of system – intensive and extensive, thermodynamic equilibrium, quasi – static process, reversible and irreversible processes, Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy, internal energy.

Definition of gases, explanation of perfect gas laws – Boyle's law, Charle's law, Avagadro's law, Regnault's law, Universal gas constant, Characteristic gas constants, derivation

Specific heat at constant pressure and constant volume of gas, derivation of an expression for specific heats with characteristics, simple problems on gas equation

Types of thermodynamic processes – isochoric, isobaric, isothermal, hyperbolic, isentropic, polytropic and throttling processes, equations representing the processes

Derivation of work done, change in internal energy, change in entropy, rate of heat transfer for the above processes

UNIT 2

Laws of conservation of energy, first law of thermodynamics (Joule's experiment), Application of first law of thermodynamics to non-flow systems – Constant volume, constant pressure, Adiabatic and polytropic processes, steady flow energy equation, Application of steady flow energy to equation, turbines, pump, boilers, compressors, nozzles, evaporators, limitations.

Heat source and heat sinks, statement of second laws of thermodynamics: Kelvin Planck's statement, Clausius statement, equivalence of statements, Perpetual motion Machine of first kind, second kind, Carnot engine, Introduction of third law of thermodynamics, concept of irreversibility, entropy.

Concept of ideal gas, enthalpy and specific heat capacities of an ideal gas,
P – V – T surface of an ideal gas, triple point, real gases, Vander-Wall's equation

UNIT 3

Formation of steam and related terms, thermodynamics properties of steam, steam tables, internal latent heat, internal energy of steam, entropy of water, entropy of steam, T- S diagrams, Mollier diagram (H – S Chart), Expansion of steam, Hyperbolic, reversible adiabatic and throttling processes

Quality of steam (dryness fraction), finding dryness fraction using separating and throttling calorimeter, Rankine cycle

Uses of steam, classification of boilers, comparison of fire tube and water tube boilers. Construction features of Lancashire boiler, nestler boiler, Babcock & Wilcox Boiler. Introduction to modern boilers.

UNIT 4

Meaning of air standard cycle – its use, condition of reversibility of a cycle

Description of Carnot cycle, Otto cycle, Diesel cycle, simple problems on efficiency, calculation for different cycles

Comparison of Otto, Diesel cycles for same compression ratio or same peak pressure developed

Reasons for highest efficiency of Carnot cycle and all other cycles working between same temperature limits

UNIT 5

Functions of air compressor – uses of compressed air, type of air compressors

Single stage reciprocating air compressor, its construction and working, representation of processes involved on P – V diagram, calculation of work done.

Multistage compressors – advantages over single stage compressors, use of air cooler – condition of minimum work in two stage compressor (without proof), simple problems

Rotary compressors – types, descriptive treatment of centrifugal compressor, axial flow compressor, vane type compressor

INSTRUCTIONAL STRATEGY

1. Expose the students to real life problems.
2. Plan assignment so as to promote problem solving abilities.

RECOMMENDED BOOKS

1. Engineering Thermodynamics by PK Nag; Tata McGraw Hill, Delhi.
2. Basic Engineering Thermodynamics by Roy Chaudhary; Tata McGraw Hill, Delhi.
3. Engineering Thermodynamics by CP Arora; Tata McGraw Hill, Delhi.
4. A Treatise on Heat Engineering by VP Vasandani and DS Kumar; Metropolitan Book Company.

RATIONALE

To develop, operate and maintain alternative energy sources systems. It is therefore essential to know basics of energy conversion, conservation, energy audit and waste heat recovery techniques.

DETAILED CONTENTS**UNIT 1****Introduction to Energy Sources**

- 1.1 Introduction.
- 1.2 Major sources of energy: Renewable and Non-renewable.
- 1.3 Primary and secondary energy sources.
- 1.4 Energy Scenario:
 - Prospects of alternate energy sources.
 - Need of Alternate energy sources

UNIT 2**Solar Energy**

- 2.1 Principle of conversion of solar energy into heat and electricity
- 2.2 Solar Radiation: Solar Radiations at earth's surface Solar Radiation Geometry: Declination, hour angle, altitude angle, incident angle, zenith angle, solar azimuth angle
- 2.3 Applications of Solar energy: -
 - Construction and working of typical flat plate collector and solar concentrating collectors and their applications, advantages and limitations
 - Space heating and cooling.
 - Photovoltaic electric conversion.
 - Solar distillation, Solar cooking and furnace.
 - Solar pumping and Green House.
 - Agriculture and Industrial process heat

UNIT 3**Wind Energy**

- 3.1 Basic Principle of wind energy conversion.
- 3.2 Power in wind, Available wind power formulation, Power coefficient, Maximum power
- 3.3 Main considerations in selecting a site for wind mills.
- 3.4 Advantages and limitations of wind energy conversion.

3.5 Classification of wind mills

3.6 Construction and working of horizontal and vertical axis wind mills, their comparison

3.7 Main applications of wind energy for power generation and pumping

UNIT 4

Energy from Biomass

4.1 Common species recommended for biomass.

4.2 Methods for obtaining energy from biomass

4.3 Thermal classification of biomass

a) Gasified, b) Fixed bed and fluidized

4.4 Application of gasifier

4.5 Biodiesel production and application

4.6 Agriculture waste as a biomass

4.7 Biomass digester

4.8 Comparison of Biomass with conventional fuels

UNIT 5

Energy Conservation & Management:-

Global and Indian energy market, Energy scenario in various sectors and Indian economy, Need and importance of energy conservation and management, Concept of Payback period, Return on investment (ROI), Life cyclecost, Sankey diagrams, specific energy consumption. Principles of energy conservation. Energy audit, Types of audit Methods of energy conservation, Cogeneration and its application, Combined cycle system, Concept of energy management, Study of different energy management techniques like-

- Analysis of input
- Reuse and recycling of waste
- Energy education
- Conservative technique and energy audit

RECOMMENDED BOOKS

7. Non-conventional energy Resources BY Dr B.H.Khan
8. Non-conventional energy sources BY G. D. Rai
9. Solar energy BY S. P. Sukhatme
10. Power plant engineering BY Arrora Domkundwar
11. Energy resource management BY Krupal Singh Jogi
12. Non-conventional energy source BY K. M. Mittal

RATIONALE

The mechatronics, the integration of electronic, of electrical engineering, computer technology and control engineering with mechanical engineering is increasingly forming a crucial part in design, manufacture and maintenance of wide range of engineering products and processes. The diploma holders need skills and knowledge that are not confined to a single subject area. They need to be capable of operating and communicating across a range of engineering disciplines and linking those having more specialized skills. So it is important to introduce this subject.

DETAILED CONTENTS**UNIT 1****Introduction**

- 1.43 Introduction to Mechatronics
- 1.44 Mechatronic system
- 1.45 Measurement systems
- 1.46 Control system-open Loop, Close loop and sequential
- 1.47 Microprocessor based controllers
- 1.48 The Mechatronics approach

UNIT 2**Sensors and Transducers**

- 1.49 Sensors and transducers
- 1.50 Performance terminology
- 1.51 Displacement, position and motion sensors
- 1.52 Electromechanical sensors and transducers
- 1.53 Force sensors
- 1.54 Liquid flow sensors
- 1.55 Liquid level sensors
- 1.56 Temperature sensors
- 1.57 Light sensors
- 1.58 Selection of sensors
- 1.59 Simple problems

UNIT 3

Data Presentation Systems

- 1.60 Displays
- 1.61 Data presentation elements
- 1.62 Magnetic recording
- 1.63 Data acquisition systems
- 1.64 Measurement systems
- 1.65 Testing and calibration
- 1.66 Simple problems

UNIT 4

Pneumatic and Hydraulic Systems

- 1.67 Actuation systems
- 1.68 Pneumatic and hydraulic systems
- 1.69 Directional control valves
- 1.70 Pressure control valves
- 1.71 Cylinders
- 1.72 Process control valves
- 1.73 Rotary actuators
- 1.74 Simple problems

UNIT 5

Mechanical Actuation Systems

- 1.75 Mechanical systems
- 1.76 Types of motion
- 1.77 Kinematic chains
- 1.78 Cams
- 1.79 Gear trains
- 1.80 Ratchet and pawl
- 1.81 Belt and chain drives
- 1.82 Bearing
- 1.83 Mechanical aspects of motor selection
- 1.84 Simple problems

INSTRUCTIONAL STRATEGY

4. Use computer based learning aids for effective teaching learning.
5. Students should be taken to various industrial units for clear conception of various topics.
6. Efforts should be made to relate the process of teaching with direct experiences in the industry.

RECOMMENDED BOOKS

1. Mechatronics by HMT, Tata McGraw Hill, New Delhi
2. Mechatronics: Electronic Control System in Mechanical Engineering by W. Bolton; Pearson Education, Singapore.
3. Fundamentals of Electrical Engineering and Electronics by BL Thareja; S. Chand and Company, New Delhi.
4. Basic Electronics by Gupta, NN Bhargava, Kulshreshtha, TTTI, Chandigarh.