

5.1 THEORY OF MACHINES

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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 THEORY

1. Simple Mechanisms (08 hrs)
 - 1.1 Introduction to link, kinematic pair, lower and higher pair, Kinematic chain, mechanism, Inversions.
 - 1.2 Different types of mechanisms (with examples)
2. Power Transmission (16 hrs)
 - 2.1 Introduction to Belt and Rope drives
 - 2.2 Types of belt drives and types of pulleys
 - 2.3 Concept of velocity ratio, slip and creep; crowning of pulleys (simple numericals)
 - 2.4 Flat and V belt drive: Ratio of driving tensions, power transmitted, centrifugal tension, and condition for maximum horse power (simple numericals)
 - 2.5 Different types of chains and their terminology
 - 2.6 Gear terminology, types of gears and their applications; simple and compound gear trains; power transmitted by simple spur gear
3. Flywheel (10 hrs)
 - 3.1 Principle and applications of flywheel
 - 3.2 Turning - moment diagram of flywheel for different engines
 - 3.3 Fluctuation of speed and fluctuation of energy - Concept only
 - 3.4 Coefficient of fluctuation of speed and coefficient of fluctuation of energy
 - 3.5 Simple numerical problems on fluctuation of speed and fluctuation of energy
4. Governor (12 hrs)
 - 4.1 Principal of governor
 - 4.2 Simple description and working of Watt, Porter and Hartnel governor (simple numericals based on watt governor)
 - 4.3 Hunting, isochronism, stability, sensitiveness of a governor

5. Balancing (08 hrs)

- 5.1 Concept of balancing
- 5.2 Introduction to balancing of rotating masses (simple numericals)
- 5.3 Simple problems related to several masses rotating in different planes

6. Vibrations (10 hrs)

- 6.1 Concept of vibrations and its types - longitudinal, transverse and torsional vibrations (simple numericals)
- 6.2 Damping of vibrations
- 6.3 Causes of vibrations in machines, their harmful effects and remedies

INSTRUCTIONAL STRATEGY

- 1. Use teaching aids for classroom teaching
- 2. Give assignments for solving numerical problems
- 3. Arrange industry visits to augment explaining use of various machine components like belt, rope, chain, gear drives, action due to unbalanced masses, brake clutch, governors, fly wheels, cams and gear drives
- 4. Video films may be used to explain the working of mechanisms and machine components like clutch, governors, brake etc.

RECOMMENDED BOOKS

- 1. Theory of Machines by D.R. Malhotra; Satya Prakashan, New Delhi.
- 2. Theory of Machines by V.P Singh; Dhanpat Rai and Sons, New Delhi.
- 3. Theory of Machines by Jagdish Lal; Metropolitan Publishers, New Delhi.
- 4. Theory of Machines by R.C. Jindal; North Publications.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	8	12
2	16	26
3	10	15
4	12	20
5	8	12
6	10	15
Total	64	100

5.2 CAD/CAM

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RATIONALE

CAD/CAM subject is very important these days and is extensively required in industry. This subject enables the students to learn about the applications of computer in design and manufacturing.

DETAILED CONTENTS

Section – I CAD

1. Fundamentals of CAD (04 hrs)

Introduction, Design Process, Application of Computers in Design. Creating Manufacturing, Database, Automation, Difference between CAD/CAM and Automation. Coordinate systems, User coordinates, Working Coordinate System (WCS), User Coordinate System (UCS). Benefits of CAD

2. CAD Hardware (10 hrs)

Input Devices: Keyboard, Touch Panel, Light pens, Graphic tables, Joysticks, Trackball, Mouse, Voice System. **Output Devices :** Storage Tube, Graphics displays, Raster Refresh Graphic Displays, Plasma Panel Displays, Liquid Crystal Displays (LCD), Light Emitting Diodes (LED), Central Processing Unit (CPU)

3. CAD/CAM (10 hrs)

Geometrical Modelling, Data Structures, Database Management System (DBMS), Database coordinate System, Solid frame modelling and Wire frame modelling

4. Geometrical Transformation (10 hrs)
Introduction to transformation, scaling, rotation and translation in 2D. Concatenation

Section – II CAM

5. Fundamentals of CAM (10 hrs)

Introduction, Manufacturing line, Application of computers in manufacturing

6. NC Machine Tools (10 hrs)

Nomenclature NC Machine axis, Types of NC machine tools, Features of NC machine tools, NC Motion control System. Machine control Unit: Manual Control Panel, NC Actuation Systems, Part program to command signal, MCU organization, Transducer for NC machine tools

7. Computer Control in NC

(10 hrs)

Problems with Conventional NC, Computer Numerical Control, Direct Numerical Control (DNC), Combined DNC/CNC Systems. ADAPTIVE CONTROL SYSTEM - their types, Advantages; Adaptive control for proper cutting speed, feed in turning operation

PRACTICAL EXERCISES

1. Practice on creating new drawing file, setting drawing limits and saving a file, drawing lines in different ways using absolute coordinate system, user co-ordinates, WCS, UCS, drawing circles, drawing arcs, drawing ellipses. Drawing polygons, drawings splines. Drawing polylines, using window, zoom commands.
2. Practice on edit commands such as erase, copy, mirror array, offset, rotate, oops, undo, redo, scale, stretch, trim, break, extend chamfer, fillet.
3. Practice on text commands: editing text, text size, text styles, change properties commands.
4. Practice on layer Commands: creating layer, freeze, layer on/off colour assigning, current layer, load line type, lock and unlock layer, move from one layer to other.
5. Practice on hatching, hatch pattern selection, practice on dimensioning linear dimensioning, angular dimensioning radius/diameter dimensioning O-snap command, aligned dimensioning, editing of dimensioning, tolerance in dimensioning.
6. Practice on print /plot commands. Export/Import commands.
7. Practice on making complete drawings of components by doing following exercises:
 - a) Detail and assembly drawing of the following using AUTOCAD 2D (4 Sheets)
 - Plummer Block
 - Wall Bracket
 - Stepped pulley, V-belt pulley
 - Flanged coupling
 - Machine tool Holder (Three views)
 - Screw jack or knuckle joint
 - b) Isometric Drawing by CAD using Auto CAD (1 sheet)
 - Drawings of following on computer

- Cone
 - Cylinder
8. Modelling and Simulation of CAM Software
 9. Demonstration on the CNC trainer.
 10. Practice on CNC trainer for various types of jobs.

INSTRUCTIONAL STRATEGY

Before teaching this subject, it would be very helpful if teacher knows and give the knowledge to the students about basics of computer and mathematics and their application in engineering and technology

RECOMMENDED BOOKS

1. CAD/CAM- Theory and Practice by Zeiod libraham; Tata McGraw Hill
2. CAD/CAM by Groover and Zimmers; PHI
3. CNC Machine by Kundra Rao and Tiwari
4. CNC Machine by Pabla and Adithan; NITTTR, Chandigarh
5. Computer Graphics by Steven Harrington; Mc Graw Hill
6. Numerical Control of Machine Tools by Koren and Ben-Uri; Khanna Publisher

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	06
2	10	16
3	10	16
4	10	14
5	10	16
6	10	16
7	10	16
Total	64	100

5.3 EMPLOYABILITY SKILLS – I

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RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. Our diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market and survive in cut throat competition among professionals.

DETAILED CONTENTS\

1. Writing skills (08 hrs)
 - i) Official and business correspondence
 - ii) Job application - covering letter and resume
 - iii) Report writing - key features and kinds
2. Oral Communication Skills (20 hrs)
 - i) Giving advice
 - ii) Making comparisons
 - iii) Agreeing and disagreeing
 - iv) Taking turns in conversation
 - v) Fixing and cancelling appointments
3. Generic Skills (04 hrs)
 - i) Stress management
 - ii) Time management
 - iii) Negotiations and conflict resolution
 - iv) Team work and leadership qualities

5.4 ENVIRONMENTAL EDUCATION

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RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the eco system and controlling pollution by pollution control measures. He should also be aware of environmental laws related to the control of pollution.

DETAILED CONTENTS

1. Definition, Scope and Importance of Environmental Education (02 hrs)
2. Basics of ecology, biodiversity, eco system and sustainable development (03 hrs)
3. Sources of pollution - natural and manmade, causes, effects and control measures of pollution (air, water, noise, soil, radioactive and nuclear) and their units of measurement (12 hrs)
4. Solid waste management – Causes, effects and control measures of urban and industrial waste (06 hrs)
5. Mining and deforestation – Causes, effects and control measures (04 hrs)
6. Environmental Legislation - Water (prevention and control of pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board, Environmental Impact Assessment (EIA) (10 hrs)
7. Role of Non-conventional Energy Resources (Solar Energy, Wind Energy, Bio Energy, Hydro Energy) (04 hrs)
8. Current Issues in Environmental Pollution – Global Warming, Green House Effect, Depletion of Ozone Layer, Recycling of Material, Environmental Ethics, Rain Water Harvesting, Maintenance of Groundwater, Acid Rain, Carbon Credits. (07 hrs)

INSTRUCTIONAL STRATEGY

In addition, different activities pertaining to Environmental Education like expert lectures, seminar and awareness camps etc. may also be organized.

RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Engineering and Management by Suresh K Dhamija; SK Kataria and Sons, New Delhi.
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by Erach Bharucha; UGC University Press
7. Basic Environmental Engineering by R.C. Gaur; New Age International Publishers, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted for Lectures (Periods)	Marks Allotted (%)
1	02	04
2	03	06
3	12	24
4	06	12
5	04	10
6	10	20
7	04	10
8	07	14
Total	48	100

5.5 CNC MACHINES AND AUTOMATION

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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

1. Introduction (06 hrs)
Introduction to NC, CNC & DNC, their advantages, disadvantages and applications. Basic components of CNC machines, Machine Control Unit, input devices, selection of components to be machined on CNC machines, Axis identification
2. Construction and Tooling (06 Hrs)
Design features, specification 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, Concept of CNC tool holder, different pallet systems and automatic tool changer system, management of a tool room.
3. System Devices (12 Hrs)
Control System; Open Loop and Closed Loop System, Concept of Actuators, Transducers and Sensors, Tachometer, LVDT, opto-interrupters, potentiometers for linear and angular position, encoder and decoder and axis drives
4. Part Programming (08 Hrs)
Introduction to Part programming, Basic concepts of part programming, NC words, part programming formats, simple programming for rational components, part programming using coned cycles, subroutines and do loops, tool off sets, cutter radius compensation and tool wear compensation.
5. Problems in CNC Machines (04 Hrs)
Common problems in CNC machines related to mechanical, electrical and pneumatic, electronic components. Study of common problems and remedies, use of on-time fault finding diagnosis tools in CNC machines.

6. Automation and NC system (06 Hrs)
Concept of automation, emerging trends in automation, automatic assembly. Overview of FMS, Group technology, CAD/CAM and CIM.
7. Robot Technology (06 hrs)
Introduction to robot technology, basic robot motion and its applications

LIST OF PRACTICALS

1. Study of constructional detail of CNC lathe.
2. Study of constructional detail of CNC milling machine.
3. Study the constructional details and working of Automatic tool changer and Multiple pallets
4. Develop a part programme for following lathe operations and make the job on CNC lathe.
 - Plain turning and facing operation
 - Taper turning operation
 - Circular interpolation.
5. Develop a part programme for the following milling operation and make the job on CNC milling
 - Plain milling
 - Slot milling
 - Contouring
 - Pocket milling
6. Preparation of work instructions for machine operator
7. Preparation of preventive maintenance schedule for CNC machine.
8. Demonstration through industrial visit for awareness of actual working of FMS in production.

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. CNC Machines by M.S. Sehrawat and J.S. Narang; Dhanpat Rai and Co., New Delhi.
3. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata Mc Graw Hill, New Delhi.
4. CNC Machine by Bharaj; Satya Publications, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	12
2	06	12
3	12	26
4	08	18
5	04	08
6	06	12
7	06	12
Total	48	100

5.6 WORKSHOP TECHNOLOGY - III

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RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various machining processes and modern machining methods is required to be imparted. Hence the subject of workshop technology.

DETAILED CONTENTS

1. Milling (12 hrs)
 - 1.1 Specification and working principle of milling machine
 - 1.2 Classification, brief description and applications of milling machine
 - 1.3 Main parts of column and knee type milling machine
 - 1.4 Milling machine accessories and attachment – Arbors, adaptors, collets, vices, circular table, indexing head and tail stock, vertical milling attachment
 - 1.5 Milling methods - up milling and down milling
 - 1.6 Identification of different milling cutters and work mandrels
 - 1.7 Work holding devices
 - 1.8 Milling operations – face milling, angular milling, form milling, straddle milling and gang milling.
 - 1.9 Cutting parameters
 - 1.10 Indexing on dividing heads, plain and universal dividing heads.
 - 1.11 Indexing methods: direct, Plain or simple, compound, differential and angular indexing, numerical problems on indexing.

- 2 Grinding (12 hrs)
 - 2.1 Purpose of grinding
 - 2.2 Various elements of grinding wheel – Abrasive, Grade, structure, Bond
 - 2.3 Common wheel shapes and types of wheel – built up wheels, mounted wheels and diamond wheels. Specification of grinding wheels as per BIS.
 - 2.4 Truing, dressing, balancing and mounting of wheel.
 - 2.5 Grinding methods – Surface grinding, cylindrical grinding and centreless grinding.
 - 2.6 Grinding machine – Cylindrical grinder, surface grinder, internal grinder, centreless grinder, tool and cutter grinder.
 - 2.7 Selection of grinding wheel

3. Gear Manufacturing and Finishing Processes (02 hrs)
 - 3.1 Gear hobbing
 - 3.2 Gear shaping

4. Modern Machining Processes (08 hrs)
 - 4.1 Mechanical Process - Ultrasonic machining (USM): Introduction, principle, process, advantages and limitations, applications
 - 4.2 Electro Chemical Processes - Electro chemical machining (ECM) – Fundamental principle, process, applications, Electro chemical Grinding (ECG) – Fundamental principle, process, application
 - 4.3 Electrical Discharge Machining (EDM) - Introduction, basic EDM circuit, Principle, metal removing rate, dielectric fluid, applications
 - 4.4 Laser beam machining (LBM) – Introduction, machining process and applications
 - 4.5 Electro beam machining (EBM)- Introduction, principle, process and applications

5. Metallic Coating Processes (02 hrs)
 - 5.1 Metal spraying – Wire process, powder process, applications
 - 5.2 Powder coating

6. Metal Finishing Processes (12 hrs)
 - 6.1 Purpose of finishing surfaces.
 - 6.2 Surface roughness-Definition and units
 - 6.3 Honing Process, its applications
 - 6.4 Description of hones.
 - 6.5 Brief idea of honing machines.
 - 6.6 Lapping process, its applications.
 - 6.7 Description of lapping compounds and tools.
 - 6.8 Brief idea of lapping machines.
 - 6.9 Super finishing process, its applications.
 - 6.10 Polishing
 - 6.11 Buffing

INSTRUCTIONAL STRATEGY

1. Teachers should lay special emphasis in making the students conversant with concepts, principles, procedures and practices related to various manufacturing processes.
2. Focus should be laid in preparing jobs using various machines/equipment in the workshop.
3. Use of audio-visual aids/video films should be made to show specialized operations.

RECOMMENDED BOOKS

1. Manufacturing Technology by Rao; Tata McGraw Hill Publishers, New Delhi.
2. Workshop Technology Vol. I, II, III by Chapman; Standard Publishers Distributors, New Delhi.
3. Production Technology by HMT; Tata McGraw Publishers, New Delhi.
4. Production Engineering and Science by Pandey and Singh; Standard Publishers Distributors, New Delhi.
5. Modern Machining Processes by Pandey; Tata McGraw Publishers, New Delhi.
6. A Text Book of Production Engineering by P.C. Sharma; S. Chand and Company Ltd., New Delhi.
7. Workshop Technology Vol-III, by R.P. Dhiman, Ishan Publications Jalandhar

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	25
2	12	25
3	02	05
4	08	15
5	02	05
6	12	25
Total	48	100

5.7 WORKSHOP PRACTICE - III

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RATIONALE

Workshop Practice is included in the curriculum to provide practice on use of different tools and various manufacturing practices. The other objectives of this subject are to develop awareness about safety at work place and ability to work in a team.

DETAILED CONTENTS

Advance Turning Shop

1. Exercise of boring with the help of boring bar
2. Exercises on internal turning on lathe machine
3. Exercises on internal threading on lathe machine
4. Exercises on external turning on lathe machine
5. Resharpener of single point cutting tool with given geometry

Machine Shop

1. Produce a rectangular slot on one face with a sharper
2. Produce a rectangular block using a milling machine with a side and face cutter
3. Prepare a slot on one face using milling machine
4. Job on grinding machine using a surface grinder
5. Prepare a job on cylindrical grinding machine.
6. Exercise on milling machine with the help of a form cutter
7. Exercise on milling machine to produce a spur gear
8. Grinding a drill-bit on tool and cutter grinder
9. Exercise on dressing a grinding wheel.