

5.1 HEAT TREATMENT

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2 - 2

RATIONALE

The subject is intended to make the students understand the concepts, principles and procedures in performing heat treatment of components/parts of tools and dies. It also aims at developing knowledge and skills in preparing for various operations of heat treatment. It also assists in understanding workshop technology and workshop practices subjects.

DETAILED CONTENT

1. **Introduction** (2 hrs)
Heat treatment and its applications. Principles of heat treatment such as heating, soaking and quenching.
2. **Iron Carbon Diagram** (6 hrs)
Heating and cooling, allotropic forms of iron; various phases and their constitues, phase transformation, eutectic and eutectoid points of curves, classification of iron, steel and cast iron group.
3. **Heat Treatment Processes** (4 hrs)
Common heat treatment processes for steel such as annealing, normalizing, hardening, and tempering, tempering colours and temperatures, temperature range of heat treatment processes and rate of cooling.
4. **Quenching and Quenching Media** (2 hrs)
Concept of quenching, various quenching media used in heat treatment, applications and suitability of various quenching media.
5. **Hardening of Steel** (5 hrs)
 - Concept of chemical hardening such as solid carburising (pack), liquid carburising and gas carburising, advantages and disadvantages of each process.
 - Flame and induction hardening. Concept and procedure for performing the operation.
 - Nitriding

6. **TTT Curve (Isothermal transformation)** (6 hrs)

Concept of TTT Curve in heat treatment, transformation of various phases at constant temperature, procedure to describe transformation into various phases of steel with the help of TTT Curve.

7. **Furnaces and Equipment** (3 hrs)

Common furnaces used in heat treatment shop. Working principles and selection of furnaces for heat treatment operations.

8. **Defects during heat treatment, their causes and prevention** (4 hrs)

Concept of defects such as decarburising, quenching cracks, excessive hardness, less hardness, soft spots.

LIST OF PRACTICALS

1. Hardening and tempering of a chisel or similar item. Checking its hardness
2. (Full) Annealing of hardened chisel or similar item. Checking its hardness.
3. Study of sketch of a salt bath furnace.
4. Study of sketch of an induction furnace.
5. Case carburizing of pillars and bushes of die-set.
6. Hardening of pillars and bushes of die-set and checking their hardness.
7. Prepare list of various types of steels used for tools and dies with BIS and BS designation and codes.
8. Prepare list of composition of various type of steels used for tools and dies.
9. Perform hardening and tempering operation for punch or die, made out of tool steel or equivalent steel and check their hardness.
10. Annealing of a stainless steel job for machining.

RECOMMENDED BOOKS

1. GBS Narang "Material Science" Khanna Publishers Delhi-6.
2. B.K. Agarwal "Introduction To Engg. Material" Tata Mc Graw Hill, Publishers Co. Ltd. New Delhi.
3. G.K. Narula., K.S. Narula., V.K. Gupta., "Material Science" Tata Mc Graw Hill Publishers Ltd. Co. New Delhi.
4. O.P. Khanna "A text book of Materials and Metallurgy, Dhanpat Rai Publishers Pvt. Ltd. New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Allotted Time (in hrs.)	Allotted Marks (in %)
1	2	6
2	6	18
3	4	12
4	2	6
5	5	15
6	6	22
7	3	9
8	4	12
Total	32	100

5.2 PLASTIC MOULD - DESIGN AND DRAWING

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2 - 4

RATIONALE

A diploma holder should be able to conceive, design and draw assembly drawing and detailed part drawings of injection/compression/transfer moulds with proper dimensioning and calculations. Hence this subject.

DETAILED CONTENT

Section – A

1. **Introduction to Moulding Process** (3 hrs)

Injection moulding, blow/rotational moulding, compression/transfer moulding, Extrusion, thermoforming, examples for the above machines used.

2. **Moulding Machines** (3hrs)

Injection and compression moulding machines- classification, specifications, parts and their functions. Hand machines.

3. **Injection Moulds** (12 hrs)

Main parts and their function, feeding systems, runners, gates, parting line, ejection systems, ejector return mechanism, under cuts, sliders, split moulds, multicavity moulds, moulds for threaded components, draft angle placement of cavities, three plate moulds, mould cooling, location and guide system, shrinkage allowances, clamping force, mould ventilation, moulding defects, moulding cycle.

4. **Compression/Transfer Moulds** (8hrs)

Main parts of compression moulds and their function, ejection system, ejector return, mould heating, moulding pressure, tool location. Hand mould, multicavity mould, semi positive mould, flash mould, encapsulation, work cycle, draft angle, transfer moulds. Main parts and their functions, runners and gates, location of gate ventilation, moulding materials, powder, tablet, pre heating.

5. **Material for Mould Parts** (4 hrs)

Materials used for various mould parts, their treatment like hardening, tempering electroplating.

6. **Mould Maintenance**

(2 hrs)

Maintenance, storage and safety of moulds, transportation/handling.

Section B

Making drawings of the relevant topics learned, design and drawing of multicavity, mould for simple components, injection and compression.

Note: -

The question paper on the subject will consist of two parts i.e. Section-A and Section-B. Section A will contain Theory contents to the extent of 50%. Section B will contain Design and Drawing to the extent of 50%.

At last 2 industrial visits should be arranged in the concerned industry dealing with plastic moulds and moulding machine.

RECOMMENDED BOOKS

1. Injection Mould design fundamentals by A.B. Glanvill, E.N. Denton, Industrial Press Inc.
2. Plastic Material handbook Vol. I and II. by A.S. Athalye, Multitech Publishers Co. Mumbai.
3. Injection Moulding by A.S. Athalye, Multitech Publishers Co. Mumbai.
4. Rubber and Plastic technology by Chandra and Mishra, CBS Publishers and Distributor, New Delhi
5. Plastics Mould Engineering Handbook by J. Harry Du Bois and Waynel Pribble; Van Nostrand Rehnhold Company.
6. Injection moulds by R.G.W. Pye

Suggested Distribution of Marks

Topic No.	Allotted Time	Allotted Hours
1	3	9
2	3	9
3	12	40
4	8	24
5	4	12
6	2	6
Total	32	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 (3 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 canned 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

5.8 ESTIMATING AND COSTING

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RATIONALE

A diploma holder is supposed to have knowledge of cost accounting and elements of cost as he/she will be required to prepare cost estimates related to machining and manufacturing a job.

DETAILED CONTENTS

1. **Introduction** (2 hrs)
Meaning and definition of estimation, cost accounting, purpose of estimating, difference between estimating and costing. Qualities of estimator.
2. **Cost Accounting** (4 hrs)
Objects, difference between financial accounting and cost accounting. Advantages of cost accounting. Methods of costing, unit costing, batch costing, Multiples of composite costing
3. **Elements of Cost** (6 hrs)
Material, labour, expenses or overheads (factory, administrative, selling), direct-indirect labour, material, expenses, prime cost, factory cost, production cost, total cost, selling price, factors effecting selling price in determining profit, break even analysis, simple problems
4. **Overheads** (6 hrs)
Different types of overheads, depreciation, obsolescence, interest on capital, idleness costs, repairs and maintenance cost. Method of calculating depreciation/ methods of distributing overhead charges.
5. **Estimates of Material Costs** (4 hrs)
Estimation of volumes, weights and cost of material for item like pulley, spindle, lathe center, flywheel casting, wall bracket, crank shaft and similar items
6. **Estimation in Machine Shop** (6 hrs)
Set up time, operation time, handling time, aligning time, tear down time. Allowance, personal fatigues, tool sharpening or changing, checking and other miscellaneous allowances. Unit operation of different tool materials and product

materials. Estimation of time for various machining operations: turning, milling, drilling, boring, tapping, shaping, grinding and planning

7. Estimation in Forging Shop (4 hrs)

Losses in forging shop. Estimation of materials. Procedure for estimation in forging shop, simple problems

8. Estimation in Welding Shop (4 hrs)

Welding cost, gas welding, arc welding, cutting cost. Factors affecting welding costs. Simple problems

9. Estimation in Foundry Shop (4 hrs)

Estimation of pattern cost, foundry losses, processes for finding foundry cost. Simple problems

10. Estimation in Sheet Metal Shop (6 hrs)

Calculation of blank size, Estimation of time for sheet metal operations: blanking, piercing, drawing, punching, and shearing. Estimation of products like funnel, bucket, mug tray. Simple problems

11. Costing of a Product (2 hrs)

LIST OF BOOKS

1. Production Estimating and Costing by M. Adithan and B.S. Pabla; Konark Publishers, Delhi.

SUGGESTED MARKS DISTRIBUTION

Topic No.	Allotted Time	Allotted Hours
1	2	4
2	4	8
3	6	12
4	6	12
5	4	8
6	6	16
7	4	8
8	4	8
9	4	8
10	6	12
11	2	4
Total	48	100