

5.1 HEAT TREATMENT

L T P
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 & 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 constitutes, 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** (3 hrs)
Concept of quenching, various quenching media used in heat treatment, applications and suitability of various quenching media.
5. **Hardening of steel** (4 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.

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 & 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 & bushes of die-set.
6. Hardening of pillars & bushes of die-set and checking their hardness.
7. Prepare list of various types of steels used for tools & dies with BIS and BS designation and codes.
8. Prepare list of composition of various type of steels used for tools & dies.
9. Perform hardening & 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 & Metallurgy, Dhanpat Rai Publishers Pvt. Ltd. New Delhi.

5.2 PLASTIC MOULD - DESIGN & DRAWING

L T P
3 - 4

RATIONALE

A diploma holder should be able to conceive, design & 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.** (6 hrs)
Injection moulding, compression/transfer moulding, blow/rotational moulding, thermoforming, examples for the above machines used.
2. **Moulding Machines** (6 hrs)
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** (12 hrs)
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** (6 hrs)
Materials used for various mould parts, their treatment like hardening, tempering electroplating.

6. Mould Maintenance

(6 hrs)

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

Section B

Making drawings of the relevant topics learned, design & drawing of multicavity, mould for simple components, injection & 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 40%. Section B will contain Design and Drawing to the extent of 60%.

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 & II. by A.S. Athalye, Multitech Publishers Co. Mumbai.
3. Injection Moulding by A.S. Athalye, Multitech Publishers Co. Mumbai.
4. Rubber & Plastic technology by Chandra & Mishra, CBS Publishers & Distributor, N.D.
5. Plastics Mould Engineering Handbook by J. Harry Du Bois and Waynel Pribble; Van Nostrand Reinhold Company.

5.3 ESTIMATING AND COSTING

L	T	P
3	-	-

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.

5.4 WORKSHOP TECHNOLOGY - III

L T P
3 - -

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, modern machining methods, processing of plastic, CNC machining, tool, jigs and fixtures is required to be imparted. Hence the subject of workshop technology.

DETAILED CONTENTS

1. Modern Machining Processes (20 hrs)
 - Mechanical Process: Ultrasonic machining (USM): Introduction, principle, process, advantages and limitations, applications.
 - Electro Chemical Processes: Electro chemical machining (ECM) – Fundamental principle, process, applications.
 - Electrical Discharge Machining (EDM): Introduction, principle parts of EDM machine, EDM terminology. Principal, metal removing rate, dielectric fluid and properties of electric fluid, applications. Wire cut EDM.

2. Plastic Moulding Techniques (8 hrs)
 - Injection moulding – working principle, advantages and limitations
 - Blow moulding – working principle, advantages and limitations
 - Compression moulding – Working principle, advantages and limitations

3. Metallic Coating Process (4 hrs)
 - Metal spraying – Wire process, powder process, applications
 - Electro plating, anodizing and galvanizing
 - Organic Coatings- oil base paint, rubber base coating

4. Gear Manufacturing and Finishing Processes (4 hrs)
 - Gear hobbing
 - Gear shaping
 - Gear shaving
 - Gear burnishing

5. Finishing Processes (5 hrs)
- Purpose of finishing surfaces
 - Surface roughness – definition & units.
 - Honing process and its applications.
 - Description of hones.
 - Brief idea of honing machines.
 - Lapping process, its applications.
 - Description of lapping compounds & tools.
 - Brief idea of lapping machines.
 - Super finishing process and its applications.
 - Use of super finishing attachment on center lathe.
 - Polishing.
 - Buffing.
6. Jigs & Fixtures (7 hrs)
- Importance and use of jigs & fixtures.
 - Principle of location.
 - Locating devices.
 - Clamping devices.
 - Types of jigs – Drilling jigs, bushes, template jigs, plate jigs, channel jig, leaf jig.
 - Fixture for milling.
 - Advantages of jigs & fixtures.

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. Manufacturing Technology by M. Adithan and A.B. Gupta; New Age International (P) Ltd., New Delhi.
4. Production Engineering and Science by Pandey and Singh; Standard Publishers Distributors, New Delhi
5. Modern Machining Process 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

5.5 CNC MACHINES AND AUTOMATION

L T P
3 - -

RATIONALE

Diploma holders in Mechanical Engineering 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 | (6 hrs) |
| | <ul style="list-style-type: none"> • Basic concepts of NC, CNC & DNC, adoption controls. • Advantages & Disadvantage of CNC Machines. • Application of CNC Machines. • Difference between conventional & CNC Machines. • Profitable applications of CNC Machines. | |
| 2. | Construction of CNC Machines | (16 hrs) |
| | <ul style="list-style-type: none"> • Machine control unit. • NC control. • PLC control, its advantages & disadvantages. • Application and limitations of PLC machines. • Axis designation of CNC machines. • Special constructional requirement of CNC machines. • Slide ways, bolt screw & nut assembly. • Lubrication & cooling of CNC machines. • Spindle & spindle motors, axis drives motor. • Swarf removal & safety provision of CNC machines. • Feedback mechanism in CNC machines. | |
| 3. | Tooling of CNC Machines | (6 hrs) |
| | <ul style="list-style-type: none"> • Introduction. • Various cutting tools for CNC machines. • Work holding devices. • Automatic tool changer. | |
| 4. | Control System | (8 hrs) |
| | <ul style="list-style-type: none"> • Open & close loop control system | |

- Fundamental problem in control: Accuracy, resolution, repeatability, instability, response & damping,
- Type of position control:
 - i) Point to point
 - ii) Straight line
 - iii) Continuous

5. **Part Programming** (8 hrs)

Part programming and 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 wear compensation

6. **Common Problems in CNC Machines** (4 hrs)

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

7. **Industrial Automation** (6 hrs)

- What is automation?
- Need of automation.
- Different types of automation.
- Advantages/disadvantages of automation.

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. Numerical Control of Machines Tools by Yoram Korem and IB Uri, Khanna Publishers, New Delhi.
4. CNC Machine by Bharaj Satya Publication, New Delhi.
5. Mechatronics by HMT Bangalore.

5.6 WORKSHOP PRACTICE – III

L T P
- - 9

RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, skills in various machining processes, modern machining methods, processing of plastic, CNC machining, tool, jigs and fixtures is required to be imparted. Hence the subject of workshop practice.

LIST OF PRACTICALS

CNC Machine

1. Plain turning, facing, step turning, taper turning.
2. Taper turning.
3. Concave and convex curves.
4. Threading.
5. Two surface at 90° on a square block.
6. Machine students' first name on an acrylic sheet on a CNC milling machine.
7. Demonstration of FMS & Wire cut EDM machine
8. Exercise for preparation of one female & one male electrode on EDM machine.
9. Exercise on profile cutting on EDM wire cut.
10. Various types of programming like polar programming, blue print programming and profile programming.

Milling & Shaper

11. Machine of a square block of 100mm*100mm. *100mm on a shaper.
12. Cutting of a slot & V-groove on opposite faces of the block on the shaper.
13. Cutting of a slot and V-groove by a milling machine on a suitable block.
14. Cutting of a T slot by milling.
15. Milling of a spur gear.
16. Flute cutting of a tap or reamer.

Surface Finishing

17. Exercise on hand lapping.
18. Honing of a hole.
19. Buffing practice
20. Electroplating of copper and nickel.
21. Barrel polishing and barrel plating for small pieces.

Grinding

22. Grinding of surface at 45°, 60°, 75° on tool and cutter grinder.
23. Grinding and sharpening of lathe tool, drills.
24. Grinding of job on cylindrical grinder.
25. Grinding of job on centreless grinder.
26. Grinding of die plate on a surface grinder.
27. Grinding of a wedge shape job on a surface grinder.

Project Work

The students will make preparations for the project to be undertaken by them in the final semester like detailed drawing, materials, cost analysis and all other prerequisites. (A Foreman Instructor in consultation with HOD/Workshop Superintendent will handle this group.

Note: The Workshop Superintendent. will finalize the specific drawings of all the jobs in the beginning of semester in consultation with the staff.

5.7 CAD-IIL T P
- - 6**RATIONALE**

Diploma holder should be able to make 3D modeling, draw isometric views, carry out surface modeling, import and export data. Hence this subject.

DETAILED CONTENTS**1. Introduction to Parametric Sketches**

Practice on making sketches using constraints, degree of freedom, practice on view port commands, practice on path sketch, practice on split line

2. Practice on creating isometric views**3. 3D Modelling**

Creating sketches using sketch planes. Practice on extrusion, cut, joint, hole, commands.

4. Creating chamfer and fillet.

Practice on surface modeling, create part file, practice on assembly of parts, creating assembly view, orthographic views, section view. (Practice on different views), practice on data transfer.

RECOMMENDED BOOKS

1. AutoCAD by R.W. Leigh, Galgotia Publication, New Delhi.
2. Engineering Drawing with Autocad-2000 by T. Jaypooran, Vikas Publisher House, Delhi.