

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

METAL CUTTING AND MACHINE TOOLS

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)2. Answer **ALL** the question in **Part-A**3. Answer any **FOUR** Questions from **Part-B****PART –A****(14 Marks)**

1. a) What assumptions are made in Merchant's theory? [2M]
- b) What do you mean by 'Lathe Accessories'? [2M]
- c) Discuss the working principle and operation of a shaper. [2M]
- d) Define the terms 'Indexing' and 'Dividing head'. [3M]
- e) Write any two advantages and limitations of broaching. [3M]
- f) Describe briefly "Principle of Location". [2M]

PART –B**(56 Marks)**

2. a) What are the factors influencing in selection of cutting speeds and feeds for machining operation? [7M]
- b) In an orthogonal turning of a mild steel bar on a lathe the following data were available: Diameter of work piece = 60 mm; cutting speed = 100 m/min, back rake angle = 14° ; Feed rate=0.25 mm/rev.; Cutting force = 150 kg; Feed force =50 kg; chip thickness =0.4 mm. Calculate shear angle, coefficient of friction, cutting power chip flow velocity and shear force. [7M]
3. a) Explain any two tool holding devices in lathe machine. [7M]
- b) What is the effect of cutting speed, depth of cut and feed rate on the force on cutting tool? [7M]
4. a) Explain with neat sketch the construction and working principle of radial drilling machine. [7M]
- b) Describe the construction and working of jig boring machine. [7M]
5. a) Classify various milling operations that can be performed on a milling machine. [7M]
- b) Explain briefly with neat sketches: [7M]
 - (i) Planetary milling machines, (ii) knee-column milling machines.
6. a) Compare honing, lapping and buffing operations. [7M]
- b) What are the various factors to be considered in selection of a grinding wheel? Discuss each in detail. [7M]
7. a) What are the main differences between the jigs and fixture? [7M]
- b) Explain the various types of CNC machines in detail. [7M]

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1. a) What is the cause of built up edge? [2M]
- b) How do you specify a lathe? Explain. [2M]
- c) Find the time required for drilling an 18 mm hole in work piece having thickness of 50 mm. Assume cutting speed 12 m/min and feed 0.2 mm/revolution. Neglect the length of approach. [2M]
- d) List out the merits of indexing method on milling machine. [3M]
- e) Differentiate between Honing and Buffing. [3M]
- f) What do you mean by 3-2-1 location principle? [2M]

PART –B**(56 Marks)**

2. a) During an orthogonal cutting a chip length of 160 mm was obtained from an uncut chip length of 350 mm. The cutting tool has 22° rake angles and a depth of cut of 0.8 mm. Determine the shear plane angle and chip thickness. [7M]
- b) Define various tool angles used in single point cutting tool with neat sketch. [7M]
3. a) Explain any three methods of taper turning on a lathe. [7M]
- b) Explain briefly the following lathe accessories: [7M]
 - i) Driving Plate
 - ii) Lathe Centers.
4. a) State the advantages, limitations and applications of a slotter machine. [7M]
- b) Differentiate between counter boring, counter sinking and spot facing. [7M]
5. a) What machining operations can be done on a milling machine? Explain them. [7M]
- b) Draw the block diagram of a horizontal milling machine and explain briefly its various parts. [7M]
6. a) Discuss the effect of abrasive, grain size, grade, structure and bonding on the performance of a grinding wheel. [7M]
- b) Explain the operations performed by a broaching machine. [7M]
7. a) Explain the constructional features of a CNC machine. [7M]
- b) Discuss the following jigs with a neat sketch: [7M]
 - i) Template Jig and
 - ii) Leaf Jig.

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1. a) Name the factors that contribute to the formation of segmental chips. [2M]
- b) What are the functions of the saddle on a lathe? [2M]
- c) Mention the operation performed by planer. [2M]
- d) Why is milling a versatile machining process? [3M]
- e) Differentiate between grit and grade of a grinding wheel. [3M]
- f) Give the classification of jigs. [2M]

PART –B**(56 Marks)**

2. a) Draw a neat sketch of a single point cutting tool indicating its complete geometry on it. [7M]
- b) The lives of two cutting tools governed by equation $VT^{0.125} = 2.5$ and $VT^{0.25} = 7$ [7M]
respectively in certain machining operation, where V is cutting speed in m/s and T is the tool life in seconds. Find out the speed at which both tools have the same tool life. Also calculate the corresponding tool life.
3. a) Explain the various types of chucks in detail. [7M]
- b) Explain the principle of operation of a Multi-spindle progressive action type horizontal automatic machine. [7M]
4. a) How will you adjust the length of stroke and ram position in shaper? [7M]
- b) Explain with neat sketch the construction and working principle of radial drilling machine. [7M]
5. a) Draw a neat sketch of universal dividing head and explain its working. [7M]
- b) What are the various types of indexing methods? Explain with examples. [7M]
6. a) What are the various factors to be considered in selection of a grinding wheel? Discuss each in detail. [7M]
- b) What is the difference between lapping and honing? Explain. [7M]
7. a) Explain the principle of six point location. [7M]
- b) Describe the main features of CNC machines, which distinguish them from conventional machine tools. [7M]

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1. a) What are the factors responsible for built-up edge in cutting tools? [2M]
- b) What are the advantages of using a taper turning attachment? [2M]
- c) What are the differences between a planer and a shaper? [2M]
- d) Differentiate between up milling and down milling. [3M]
- e) Write the advantages of broaching. [3M]
- f) What is the purpose of clamping? [2M]

PART -B**(56 Marks)**

2. a) Explain why studying the types of chips produced are important in understanding metal cutting operation. [7M]
- b) A carbide-cutting tool lasted for 150 min while machining M.S at 35 m/min. If a similar tool is used at 30% higher speed to machine M.S. Calculate the tool life. Also calculate the value of cutting speed if the tool is to machine for 2 hours. Assume $n=0.3$ in Taylors tool life equation $VT^n = C$. [7M]
3. a) Name the different methods of taper turning done on a centre lathe and explain any two methods with neat sketch. [7M]
- b) Draw a tool layout for production of hexagonal button using capstan lathe. [7M]
4. a) Explain with the help of neat sketch open belt and cross belt drive mechanism used in planer machine. [7M]
- b) How do you carry deep hole drilling? Discuss in detail. [7M]
5. a) With the help of a simple diagram explain the role of each element of milling cutter. [7M]
- b) Explain briefly the following with neat sketches: [7M]
 - i) Straddle milling
 - ii) Dove-tail milling.
6. a) Explain the working principle of surface grinding. [7M]
- b) Describe the continuous broaching machines. [7M]
7. a) Explain any one milling fixture with a neat sketch. [7M]
- b) Describe the following tool positioning systems: [7M]
 - i) Point to point system
 - ii) Straight line system.

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 3. Answer any **FOUR** Questions from **Part-B**

PART – A

(14 Marks)

- | | | | |
|---|----|--|------|
| 1 | a) | How does the rake angle affect the life of the cutting tool? | [2M] |
| | b) | Differentiate between Turret and Capstan lathes. | [2M] |
| | c) | How is drill sizes designated? | [2M] |
| | d) | Differentiate between up milling and down milling. | [2M] |
| | e) | What are the applications of super finishing operations? | [3M] |
| | f) | Give the complete classification of jigs? | [3M] |

PART – B

(56 Marks)

- | | | | |
|---|----|--|------|
| 2 | a) | In an orthogonal cutting experiment with a tool of rake angle $\alpha=7^\circ$, the chip thickness was found to be 2.5 mm when the uncut chip thickness was set to 1 mm. Find: i) the shear angle, β , ii) the friction angle γ , assuming that Merchant's formula holds good. | [7M] |
| | b) | Discuss briefly the following tool materials:
i) High speed steels and ii) Cemented Carbides. | [7M] |
| 3 | a) | Explain in detail the single-spindle automatic lathe and compare it with multispindle automatic lathe. | [6M] |
| | b) | Explain briefly the following lathe operations:
i) Facing ii) Threading iii) Knurling iv) Forming. | [8M] |
| 4 | a) | Sketch and describe any one quick return mechanism of shaper. | [7M] |
| | b) | Draw the block diagram of a slotting machine and explain briefly its principal parts. | [7M] |
| 5 | a) | Explain different types of indexing methods with example. | [7M] |
| | b) | Describe the different types of cutters used in milling operations and give an application of each type. | [7M] |
| 6 | a) | What is an abrasive? Explain briefly the following abrasives:
i) Silicon Carbide ii) Aluminum Oxide. | [7M] |
| | b) | Explain the external centre less grinding process with sketch. | [7M] |
| 7 | a) | List out the essential characteristics required in the proper design of jigs and fixtures. Explain them. | [7M] |
| | b) | Explain the coordinate system used for vertical CNC milling machines. | [7M] |



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PART -A

(14 Marks)

1. a) List out the various types of cutting fluids. [2M]
- b) Sketch a block diagram of a turret lathe. Name its major parts. [3M]
- c) How the jobs are held on the table of a horizontal shaper? [2M]
- d) What type of surfaces can be produced by a milling process? [2M]
- e) What is meant by dressing and truing? [3M]
- f) Differentiate between NC and CNC. [2M]

PART -B

(56 Marks)

2. a) How is metal removed in metal cutting? Explain the process by giving any simple model for metal removal. [7M]
- b) During a metal cutting test under orthogonal conditions in a lathe with a tool of rake angle 20° , with a depth of cut 3 mm and feed rate of 0.38 mm/rev, the following data is recorded:
 Average chip thickness=0.89 mm,
 Horizontal component of the cutting force =1600 N,
 Vertical component of the cutting force =2340 N,
 Calculate the following:
 - i) Coefficient of friction at the chip tool interface
 - ii) Shear plane angle
 - iii) Shear stress at the shear plane.
3. a) What are the various methods available for taper turning in a lathe? Explain their specific advantages and limitations. [7M]
- b) Is the productivity of multi-spindle machines higher compared to a single –spindle automatic lathe? Explain your answer. [7M]
4. a) Give a schematic sketch of a shaper labeling the important parts and their functions. [7M]
- b) Explain the differences between drilling, the reaming and tapping. [7M]
5. a) Describe the application and relative merits of various types of milling cutters used in milling. [8M]
- b) Explain any one indexing method on Universal Dividing Head. [6M]
6. a) Explain the principle of operation of cylindrical grinding with a neat diagram. [8M]
- b) How is grinding different from other machining operations? Explain its applications in view of its capabilities. [6M]
7. a) Explain the basic principles involved in designing a clamping device for a jig or fixture. [7M]
- b) What are the advantages and disadvantages of CNC machines? Explain. [7M]

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PART -A**(14 Marks)**

1. a) What are the standard angles of cutting tools? Describe them. [2M]
- b) How is the size of the engine lathe given? [2M]
- c) Write the uses of a slotter. [2M]
- d) What is feed on a milling machine? [3M]
- e) Why is grinding so important in modern production? [3M]
- f) Define CNC. [2M]

PART -B**(56 Marks)**

2. a) What are the various forms of wear found in cutting tools? Show with a neat sketch. [8M]
- b) In an orthogonal cutting process following data were observed: Chip length of 80 mm and was obtained with an uncut chip length of 200 mm and the rake angle used was 20° and depth of cut 0.5 mm. The horizontal and vertical components of cutting force F_H and F_V were 2000 N and 200 N respectively. Determine the shear plane angle, chip thickness, friction angle and resultant force. [6M]
3. a) What are the various types of automatic lathes you are familiar the multi-spindle category? Explain their differences and applications. [7M]
- b) Write any four operations that can be performed on a lathe machine with Diagrams. [7M]
4. a) Give similarities and differences among shaping, planning and slotting machines with respect to constructed features, applications and working. [6M]
- b) Show with sketches the principal features of any three hole-making operations you are familiar with along with the tools used. [8M]
5. a) Describe the differences between a lathe and milling machine in terms of the types of surfaces generated, the types of tools used, and applicability for general and production applications. [7M]
- b) Explain the construction of a dividing head giving the applications for which it can be used. [7M]
6. a) Explain different ways in which the wear in grinding wheel can take place. What can be done to prevent them? [7M]
- b) Give a simple sketch of a broaching tool and explain various elements. [7M]
7. a) Discuss different types of clamping devices. [7M]
- b) What are the different types of motion controls in CNC machines? Explain. [7M]



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PART -A

(14 Marks)

1. a) Why Cutting fluids are used? [2M]
- b) What is the difference between the 'live' and 'dead centre'? [2M]
- c) Write the product applications of planer. [2M]
- d) List the various types of milling cutters. [3M]
- e) Why the natural abrasives are not suitable for making grinding wheels? [3M]
- f) Write any two applications of CNC machines. [2M]

PART -B

(56 Marks)

2. a) What is meant by built up edge in metal cutting? When it is formed? How to avoid it? [7M]
- b) In an orthogonal cutting of steel component with carbide tool, the following data was obtained; [7M]
 Tool rake angle = 10°
 Chip width = 6 mm
 Uncut chip thickness = 0.10
 Chip thickness ratio = 0.33
 Horizontal cutting force = 1290 N
 Vertical cutting force = 1650 N
 Sketch the force diagram and calculate the mean shear stress on the shear plane.
3. a) What types of work-holding devices are generally used in a lathe? Give the typical applications, comparative accuracies, precautions and disadvantages for each type of work-holding device. [9M]
- b) Explain the difference between Capstan and Turret lathe. [5M]
4. a) Give a neat sketch of a slotter and describe its main parts. [6M]
- b) Write a brief note on deep-hole drilling operation. [8M]
5. a) Write on the following milling operations [9M]
 (i) Straddle milling; (ii) Gang milling; (iii) string milling.
- b) Describe the construction of milling cutter. [5M]
6. a) Sketch and explain the various methods of surface grinding. [7M]
- b) Write the advantages and limitations of broaching process. [7M]
7. a) Explain the principle of 3-2-1 location. [7M]
- b) Describe four features of CNC machines which distinguish them from conventional machine tools. [7M]



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PART -A**(14 Marks)**

1. a) How do you define tool life? [2M]
- b) Name the four main parts of a lathe. [2M]
- c) Compare 'Boring' and 'reaming' operations. [3M]
- d) Define a milling cutter. [2M]
- e) Define a broaching operation. [3M]
- f) Differentiate between a jig and fixture. [2M]

PART -B**(56 Marks)**

2. a) Draw merchant circle diagram for metal cutting process and derive relations for various forces in metal cutting. [7M]
- b) What are the desirable properties of cutting fluids used in metal cutting? Explain. [7M]
3. a) What is the importance of tool layout in automats? Explain with an example for one type with a component sketch. [7M]
- b) Explain the methods used for the generation of threads in lathe. [7M]
4. a) Explain the following principal parts of a mechanical shaper. [7M]
 i) Ram ii) Tool post iii) Quick- return motion.
- b) Explain principle parts of a vertical boring machine with a sketch. [7M]
5. a) Sketch and describe differential indexing method. [7M]
- b) What is the difference between face milling and end milling? Explain. [7M]
6. a) What are the advantages and limitations of using centre less grinding? [6M]
- b) Distinguish between grinding, lapping and honing machines. [8M]
7. a) What are the essential characteristics in the proper design of jigs and fixture? [7M]
- b) What are the advantages and disadvantages of CNC machines? Explain. [7M]

