

ANSWER ALL QUESTIONS

Question No. One

[20 Marks]

- a) Show by neat sketches only the feed and cutting motions for the following processes: [5 Marks]
- 1- Cutting-off in turning.
 - 2- Cylindrical grinding.
 - 3- Planing operation.
 - 4- Reaming process.
 - 5- Face milling operation
- b) In a particular mechanical shaper mechanism, the length of the rocker arm is 1400mm, the rocker arm pivot is 1400mm below the connection between the link and the arm, the radius of the crank is 150mm, and the crank pivot is 700mm above the rocker arm-arm pivot. If the crank is rotated at $0.3s^{-1}$, calculate:
- 1- The time for a forward stroke of the ram, [5 Marks]
 - 2- The time for a return stroke of the ram, and [5 Marks]
 - 3- The maximum cutting speed during the forward stroke in (m/s). [5 Marks]

Question No. Two

[20 Marks]

- a) Derive (with help of sketches) an expression for determining the average metal removal rate for external cylindrical turning. [5 Marks]
- b) Derive (with help of sketches) an expression for determining machining time in slab milling operation. [5 Marks]
- c) In a drilling operation using a twist drill, the rotational frequency of a drill is $5s^{-1}$, the feed 0.25mm, the major cutting-edge angle 60° , and the drill diameter 12mm. Assuming that the specific cutting energy for the work material is $2GJ/m^3$, calculate:
- 1- The maximum removal rate, [3 Marks]
 - 2- The undeformed chip thickness, and [3Marks]
 - 3- The drill torque. [4 Marks]

Question No. Three

[20 Marks]

- a) During turning operation, three main forces act on the point of the cutting tool, with help of neat sketches: [5Marks]
- Show the positions of these forces relative to the tool point.
 - In what type of turning operations would only two of these forces act on the tool point?
 - Show by means of diagram these two forces acting on the tool.

b) How do the following parameters affect the cutting forces in orthogonal cutting: [5Marks]

- Rake angle.
- Depth of cut, and
- Cutting speed.

c) In an orthogonal cutting test on a lathe, the following information was gathered. The feed rate was 0.1 mm and the chip thickness after cut was 0.2 mm. The depth of chip being cut was 5 mm. The surface cutting speed of the tool was 2 m/s. The tool has a rake angle of 10° . The tangential force was measured as 200 N and the cutting force was 500 N.

Calculate:

[10Marks]

- The shear force and velocity,
- The total energy produced in the cut,
- The energy used to shear, and
- Explain the difference between the total and shear energy.

Question No. Four

[20 Marks]

a) What are the effects of high cutting temperature on both the machined workpiece and on the cutting tool used? [5Marks]

b) Describe briefly the effects of tool geometry and cutting conditions on tool life. [5Marks]

c) A tool life of 110 min is obtained at 25 m/min and 10 min at 65 m/min. What is the tool life equation? Determine the cutting speed for a tool life of 1 min and 60 min. Also, determine the tool life for speed of 50 m/min. [10Marks]

Question No. Five

[10 Marks]

a) State (with help of sketches) the ideal surface roughness for a cutting tool with a sharp corner and for another with a rounded corner. [5Marks]

b) What are the reasons for using chip breakers in metal cutting? Illustrate with suitable equations and sketches two different types of chip breakers. [5Marks]

-----GOOD LUCK-----