

BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
B.E. 5TH SEMESTER (ME) FINAL EXAMINATIONS, 2012

Machine Tools & Metal Cutting (ME – 504)

Full Marks: 70

Time: 3 hrs

Use separate answer script for each half.
Answer SIX questions, taking THREE from each half.
All questions carry equal marks.

FIRST HALF

1. (a) Classify different types of lathe according to various designs, constructions and applications.
(b) Name the principal parts of a lathe. What is the function of Apron mechanism?
(c) Name at least ten different operations that can be performed in lathe?
Explain at least four of them with suitable sketches.

2. (a) Detail out different methods of taper turning performed on lathe.
(b) State the differences between a shaper and a planing machine.
(c) It is required to cut a screw of 4 threads per inch on a lathe having leadscrew of 6 mm pitch.
Calculate the gears.

3. (a) What is the significance of machining time and purpose of its evaluation?
(b) What are the factors those are to be considered for selecting cutting velocity and feed for any machining operation?
(c) A circular steel bar of 200 mm length having a diameter of 100 mm to be turned down to 92 mm diameter for a length of 120 mm in three passes on a lathe. Considering 280 r.p.m and longitudinal feed as 0.1 mm/rev find the cutting time. Consider appropriate values if required.

4. (a) How the radial drilling machines are specified?
(b) Draw a neat sketch of a two fluted twist drill with proper labeling.
(c) Deduce the expression of cutting velocity in shaping operation with respect to rpm of the bull gear, length of cutting stroke and the ratio of return stroke time to cutting stroke time.

5. (a) What do you understand by the term 'tool life'? State Taylor's tool life equation.
(b) Plot the flank wear versus machining time diagram for a single point turning tool and explain the salient features of the diagram.
(c) While turning mild steel rod with HSS tool, the tool life was 44 min at cutting speed 24m/min. The tool life was reduced to 11 min when the cutting speed was increased at 40m/min, keeping all other parameters same. Calculate the values of index and constant of the Taylor's tool life equation.

SECOND HALF

6. (a) A single point turning tool is specified as “ $8^\circ - 8^\circ - 6^\circ - 6^\circ - 30^\circ - 45^\circ - \frac{1}{4}$ inch”, draw the different views of the tool and label the tool angles.
- (b) Determine the orthogonal rake angle (γ_o) and inclination angle (λ) of the above tool. Deduce the formula you use.
- (c) Describe the role of cutting edge angle (ϕ) in turning operation performed on lathe.
7. (a) What is meant by ‘Built-Up-Edge (BUE)’ ? With necessary sketch explain the mechanism of formation of BUE. State the conditions which promote the formation of BUE and discuss its consequences.
- (b) What are the desirable properties of an ideal cutting fluid ?
- (c) During cylindrical turning operation of a 20 mm diameter shaft with a single point tool, having signature “ $0^\circ - 5^\circ - 6^\circ - 6^\circ - 20^\circ - 60^\circ - 1$ mm”, the tool was by mistake fixed 0.7 mm below the desired position. With necessary sketch show how the tool angles have changed. Calculate the effective tool angles.
8. (a) Explain the terms: (i) chip reduction coefficient (ξ) and (ii) shear angle (θ).
- (b) Derive from fundamentals the expression for shear strain (ϵ) in metal cutting operation.
- (c) Cylindrical turning operation of a mild steel shaft was done with a HSS tool having rake angle (γ_o) = 5° and cutting edge angle (ϕ) = 45° . The feed rate was 0.25 mm/rev and the actual chip thickness was measured as $a_c = 0.33$ mm. Calculate (i) Chip reduction coefficient (ξ), (ii) Shear angle (θ) and (iii) Shear strain (ϵ).
9. (a) What do you understand by ‘machinability’ of a material ? What does it signify when it is stated that machinability of material ‘M’ is more than that of material ‘N’ ?
- (b) Define ‘machinability index’. Arrange the following materials by ascending order of machinability index: (i) Copper (ii) Stainless steel (iii) Brass (iv) SAE1112 steel.
- (c) Define the following terms and deduce an appropriate expression for each of them:
(i) shearing velocity, (ii) specific power, (iii) specific shear energy, (iv) specific frictional energy.
10. (a) Draw the Merchant’s diagram and show the different force components in orthogonal machining operation.
- (b) Deduce the expressions for shear force (F_S) & normal force (F_N) in terms of cutting force (F_C) & thrust force (F_T).
- (c) During orthogonal turning of C40 steel, following data were obtained:
Cutting force $F_C = 23$ Kgf, thrust force $F_T = 10$ Kgf, cutting speed $v = 150$ m/ min, feed $s = 0.125$ mm/ rev, chip thickness $a_c = 0.25$ mm, rake angle $\gamma_o = -5^\circ$. Calculate the shear strain and work done in shear.