MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

AUE-505

MACHINE TOOLS AND MACHINING TECHNOLOGY

Time Allotted: 3 Hours   Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1.   Answer *all* questions.   10×1 = 10

(i) In which kind of the following operation on lathe, the spindle speed will be minimum

(A) knurling   (B) taper turning
(C) thread cutting   (D) parting off

(ii) Tungsten content in High Speed Steel cutting tool material is

(A) 18%   (B) 4%
(C) 1%   (D) 16%

(iii) Electro discharge machining uses the following dielectric fluid,

(A) water   (B) aqueous salt solution
(C) sodium hydroxide   (D) kerosene

(iv) Ceramic tools are made from

(A) Tungsten oxide   (B) Silicon carbide
(C) Cobalt   (D) Aluminum oxide

(v) In electro-chemical machining, best surface finish is obtained

(A) with low current density   (B) with high current density
(C) with slow rate of metal removal   (D) with high rate of metal removal

(vi) Laser beam machining process is used for machining

(A) very thick materials   (B) thin materials
(C) heavy sections   (D) is not used for machining

(vii) Knurling operation in a lathe is used for producing

(A) a plane surface   (B) a cylindrical surface
(C) a serrated surface   (D) a tapered surface

(viii) The following process provides best surface finish

(A) hand grinding   (B) cylindrical grinding
(C) cylindrical turning   (D) milling

(ix) Water soluble cutting fluids are mainly used to

(A) cool the cutting tool and work piece
(B) clean the work piece
(C) clean the machine tool
(D) lubricate the cutting tool and work piece interface

(x) Shear angle in orthogonal cutting is the angle between the

(A) flank face and the shear plane
(B) rake face and the shear plane
(C) flank face and machined surface
(D) rake face and the machined surface

GROUP B
(Short Answer Type Questions)

Answer any *three* questions.   3×5 = 15

2. Discuss the process parameters of abrasive jet machining with a neat sketch.   5

3. Sketch a HSS twist drill to show principle geometrical specifications.   5

4. In a shaper work the length of the stroke is 300 mm, number of double   5
    stroke per minute is 40 and the ratio of return time to cutting is 1:2. Find the
    cutting speed.

5. Describe twist drill nomenclature using sketches.   5

6. Explain the working principle of laser beam machining.   5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions.   3×15 = 45

7. (a) Derive an expression for shear strain developed in an orthogonal cutting tool   5
        and also determine the shear angle at which shear strain is minimum.
    (b) Explain causes of failure of a cutting tool. Discuss on crater wear and flank   5
        wear of cutting tool.
    (c) Mild steel is being machined at a cutting speed of 200 m/min with a tool of   5
        rake angle of 10°; width of cut and the uncut thickness are 2 mm 0.2 mm
        respectively. If the average value of the coefficient of friction between the
        tool and the chip is 0.5 and the shear stress τ_s of the work material is 400
        N/mm^2 determine (i) shear angle (ii) cutting and thrust component of the
        machining force.

8. (a) Describe with neat sketch tool angles and cutting tool nomenclatures.   5
    (b) Show schematically Merchant's force circle in orthogonal cutting and derive   5
        the equations for shear and friction. Also establish the relationship between
        shear angle, rake angle and friction angle for minimum cutting energy
        consumption.

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(c) Show that, in orthogonal cutting with 0° rake angle the rate of shear stress τ_s 5
    to the specific cutting energy (U_s) is given by, $\dfrac{\tau_s}{U_s} = \dfrac{(1-\mu r)r}{(1+r^2)}$.

9. (a) How speed variations can be obtained in an all geared headstock of a centre   5
        lathe? Explain with figure.
    (b) Explain with schematic diagram the principle of thread cutting on a lathe.   5
    (c) 1 mm pitch screw thread is to be cut on a centre lathe having 6 TPI lead   2
        screw. Calculate the gearing arrangement for the driver and driven,
        assuming the usual change gear availability.
    (d) Determine the actual machining time required to reduce diameter of a rod   3
        from 200 mm to 195 mm over a length of 200 mm to 195 mm over a length
        of 200 mm at cutting velocity of 220 m/min and feed 0.2 mm/rev. Assume
        approach 5 mm and overrun 5 mm respectively.

10. (a) Show schematically merchant's force circle in orthogonal cutting and derive   7
        the equations for shear and friction forces. Also establish the relationship
        between shear angle, rake angle and friction angle for minimum cutting
        energy consumption.
    (b) In an orthogonal cutting test with a tool of rake angle 10°, the following   8
        observations were made:
        Chip thickness ratio - 0.3
        Horizontal component of cutting force - 1290 N
        Vertical component of cutting force - 1650 N
        From the merchant's theory, calculate the various components of the cutting
        forces and the co efficient of the friction at the chip tool interface.

11. Distinguish between– (answer any *three* of the following):   3×5
    (a) Shaper and Planer
    (b) Centre lathe and Turret lathe
    (c) Turret lathe and Capston lathe
    (d) Boring and Reaming
    (e) Plain milling and Universal milling.

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