2012

TECHNOLOGY OF MACHINING & METAL CUTTING

Time Allotted : 3 Hours   *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words

as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

$$10 \times 1 = 10$$

i) A condition tending to promote built-up edge formation

includes

a) high cutting speed

b) large rake angle

c) large uncut thickness

d) more flow of cutting fluid.

ii) A universal chuck has the feature of

a) four jaws

b) independently moving jaws

c) more gripping

d) self centering.

iii) A negative rake angle on tool imposes cutting speed

condition as

a) high   b) moderate

c) low   d) none of these.

iv) the sum of back rake angle, the end clearance and the

tool wedge angle in turning operation is

a)π b)$3\pi/4$

c) $\pi/2$ d) $\pi/4$.

v) In a twist drill, the chisel is primarily provided for

a) cutting action b) axial thrust

c) drilling torque d) none of these.

vi) Very hard work material can be turned at

a) low cutting speed and small feed

b) high cutting speed and small feed

c) low cutting speed and large feed

d) high cutting speed and large feed.

vii) A filleted shoulder may be turned by

a) knife-edged facing tool

b) boring tool having large clearance

c) straight tool with side cutting edge angle

d) straight tool with nose radius.

viii) A fixture is used for

a) guiding the cutting tool in correct position

b) holding and locating a workpiece

c) holding the work rigidly for subsequent operations

d) quick handling and clamping the work.

ix) An operation not included in micro-finishing is

a) buffing

b) polishing

c) power brushing

d) lapping.

x) A hard grinding wheel refers to the

a) hardness of the abrasive

b) type of bonding material

c) strength of bonding

d) dense packing of the grains.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3x5 = 15

2. Describe the methods of taper turning with neat sketches.

3. Discuss the features of ceramic tools and state as to why negative rake is provided and no coolant is used in such tools.

4. What is the role of reaming operation ? Show schematically the difference between a reamer and a drill.

5. Bring out the salient features of diffusion wear mechanism of metal cutting tools.

6. Describe superfinishing operation for the job which has already been ground.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3x15 = 45

7. a) Considering various forces acting on the chip, draw Merchant's circle diagram of forces. Establish interrelationship of the forces in terms of shear angle, rake angle, and the friction angle. 8

b) The cutting and thrust components of forces, during orthogonal machining of Aluminium work with tool rake angle of 10°, are 312N and 185N, respectively.

i) Estimate the coefficient of friction between the tool and the chip.

ii) If the rake angle is reduced to zero degrees keeping all other parameters including the coefficient of friction to remain the same, estimate the changed values of the cutting and thrust forces. Use Merchant's first solution for the required estimates. 7

8. a) Describe the modes of cutting tool failure. 7

b) Estimate the three main components of machining force during shaping of a mild-steel block using the following

data :

Depth of cut = 2·5 mm

Side cutting edge angle = 20°

Feed = 0·125 mm/stroke

Normal rake angle of the tool = 7°

Coefficient of friction between the chip and the tool = 0·8

Ultimate shear strength of the work material = 450 N/mm ^{2}.

8

9. a) Characterise the scale of production in different boundaries and explain the kind of production which is based on the principle of the steady flow of fluid. 7

b) A steel block is drilled with a 10 mm diameter tool. Given : helix angle = 30°, point angle = 120°, feed = 0·2 mm/revolution, ultimate shear strengtho f the work material = 450 N/mm ^{2}. Estimate the drilling torque and the thrust using Lee and Shaffer's shear angle relationship. Also, assume the coefficient of friction between the chip and the drill to be 0·75.

8

10. a) How is a grinding wheel coded ? 7

b) Taking the thrust force as twice the cutting force, estimate the total grinding force during surface grinding a thick plate with 0·05 mm depth of cut. Diameter of the grinding wheel is 200 mm and the wheel rotates at 3000 r.p.m. The number of grits/mm ^{2} is measured as 3. The feed velocity of the work table is 100 mm/minute. The energy constant for the work material is taken as U_0 = 1·4 J/mm ^{2} and the ratio of the grain width of cut to the uncut thickness per grit is taken as 15. 8

11. a) Optimise the metal cutting parameter for mass

production of a cylindrical work by turning at the

minimum cost. 8

b) Why is cutting fluid used and what are its desirable

properties ? 7

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