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 × 1 = 10

i) Segmental or discontinuous chips are formed in the case of

a) high cutting speed b) brittle work material

c) large rake angle d) low uncut thickness.

ii) For smooth turning for mass production, a suitable metal removal rate in cc/minute may be

a) more than 200 b) between 150-200

c) between 100-150 d) less than 50.

iii) Signature of a single-point cutting tool starts with the description of

a) side rake angle

b) front cutting edge angle

c) back rake angle

d) side cutting edge angle.

iv) The value of specific energy for a steel work at a fixed uncut thickness

a) increases with hardness

b) decreases with hardness

c) increases with cutting speed

d) decreases with cutting speed.

v) With the maximum allowable feed rate, the optimum

machining speed for maximum production in

comparison to that for minimum cost is

a) more b) less

c) equal d) independent.

vi) A jig is used for holding the work and

a) guiding the tool

b) locating

c) positioning

d) clamping with the table.

vii) Idle cost includes the time lost in

a) regrinding the tool

b) changing the tool

c) loading and unloading the work

d) all of these.

viii) Cemented carbide tools are considered suitable for

brittle work material like cast iron due to

a) high conductivity b) shock resistance

c) wear resistance d) high tensile strength.

ix) A negative rake angle on tool imposes cutting speed

condition as

a) high b) moderate

c) low d) none of these.

x) The product of work length and conicity provides the

tail-stock set-over for taper turning when this product

has a factor of

a) 2 b) 1

c) $\frac{1}{2}$ d) $\frac{1}{4}$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. What are the fundamental differences and similarities

between a planer and a shaper ?

3. Describe external and internal centreless grinding methods.

4. Illustrate the principle of location.

5. What are the desirable characteristics of cutting tool materials ?

6. Describe the honing tool-head for finishing round holes.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Describe the work holding devices for a shaper. 4

b) Illustrate the forces acting on a shaper tool. 3

c) In shaping operation on a cast-iron block, depth of cut given was 4 mm and feed of 0·25 mm/stroke. The shaper operated at 60 strokes per minute while other pertinent data are :

Normal rake angle = 10°

Principal cutting edge angel = 30°

Coefficient of friction between chip and tool = 0·6

Ultimate shear stress of work material = 340 N/mm^2

Using Lee & Shaffer's shear angle relationship, estimate the power consumption of the shaper, if the length of work be 200 mm. 8

8. a) While describing up-milling and down-milling with neat sketches, illustrate the components of milling forces. 7

b) Estimate the power required during up-milling a mild steel block of 20 mm width using a straight slab milling cutter, with 10 teeth in 75 mm diameter, having 10° radial rake. The feed velocity of the table is 100 mm/ minute while the cutter rotates at 60 rpm and the depth of cut given is 5 mm. Assume the co-efficient of friction at the rake face as 0·5, the ultimate shear stress of the work material as 400 N/mm^2 and Lee &

Shaffer's share angle relationship. 8

9. a) Describe the advantages and disadvantages of broaching operation and also illustrate broaching of a circular hole in a thick plate. 8

b) A circular hole of 25 mm diameter in a 20 mm thick mild steel plate has to be enlarged to 27 mm diameter by broaching operation which has cutter rake angle of 10°, a cut of 0·08 mm per tooth. Estimate the peak broaching load by assuming the coefficient of friction of 0·5, ultimate share stress of work material to be 400 N/mm^2 and Lee & Shaffer's shear angle relationship. 7

10. a) What is grinding-wheel loading ? Describe, with neat sketch, the plunge grinding operation on a crank shaft. 7

b) During plunge grinding operation on a prismatic bar of cross-section 25 mm × 10 mm, a grinding wheel of 250 diameter rotating at 2500 rpm is used. What will be the percentage change in power consumption, if the original wheel of surface density 3 grits/mm^2 is replaced by a similar wheel of surface density of 9 grits/mm^2 ? 8

11. a) When the rake angle is zero during orthogonal metal cutting, prove that $\tau_s/Uc = (1- \mu r)r /(1+r^2)$ where

τ = ultimate shear stress of work material,

μ = coefficient of friction between chip and the tool and

r = cutting ratio. 4

b) Find the time required for one complete cut on a work of metal 350 mm long and 50 mm diameter. The cutting speed is 35 m / minute and the feed rate is 0·5 mm/rev. 3

c) Cylindrical bars are to be turned economically for mass

production. The maximum allowable feed is 0·2 mm/rev and at this feed rate, Taylor's tool life equation is $vT^{0.25} = 75$, where v is the cutting speed in m/minute and T is the corresponding tool life in minutes. Labour charge is Rs. 5 per minute and the cost on regrinding the tool is Rs. 200. On an average, it takes about 2 minutes to change the tool. Estimate the optimum cutting speed. 8

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