

Time Allowed: 3 Hours

Full Marks: 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answer may be written either in English or in Bengali but all answers must be in one and the same language.

Answer any five questions

1. Choose the correct answer from the options given: 4x10
- (i) Proof stress corresponds to the following property of a material
- stiffness
 - plasticity
 - brittleness
 - resilience
- (ii) Common example of a non-destructive testing is
- creep testing
 - fatigue testing
 - ultrasonic testing
 - Brinell hardness testing
- (iii) Annealing of steel forgings are done for the purpose of
- increasing the internal strength of the steel
 - comparative softening of the steel
 - increasing the hardness of the steel
 - increasing the tensile strength of the steel
- (iv) Kinematics of machine is based on the assumption that links of a mechanism are made of
- incompressible material
 - inextensible material
 - rigid material
 - ductile material
- (v) Transmission of motion between two skew shafts can be done by meshing a pair of
- bevel gears
 - spur gears
 - helical gears
 - worm wheels

P.T.O.

(vi) Gear tooth can be cut by

- a) turning
- b) milling
- c) grinding
- d) broaching

(vii) The best option for tooth profile of a gear is

- a) cycloid
- b) involute
- c) helicoid
- d) ellipsoid

(viii) The train value is always

- a) greater than
- b) less than
- c) inverse of
- d) equal to

the speed ratio.

(ix) If a helical spring that is closely- coiled with a stiffness of 'S' is cut into 't' number of equal parts, the stiffness in each part of the spring will be

- a) $St^{1/2}$
- b) $tS^{1/2}$
- c) tS
- d) tS^2

(x) For a V-belt drive the wedge coefficient of friction is

- a) $\frac{\mu}{\sin \frac{\alpha}{2}}$
- b) $\frac{2\mu}{\sin \frac{\alpha}{2}}$
- c) $\frac{\mu}{2\sin \frac{\alpha}{2}}$
- d) $\frac{\mu}{2\sin \alpha}$

where μ is the coefficient of friction between the belt and pulley, and α is the included angle of V-groove.

2. (a) Two spur gears that are in contact for the purpose of transmission of motion have: (i) module of 3 mm, (ii) centre distance of 180 mm, (iii) a pressure angle of 20° and (iv) velocity ratio of 0.25. Determine the number of teeth of the driver gear and the base circle radius of the driven gear.

(b) For the above pair of gears of 20° and 3 mm module if the pinion has 28 teeth and gear has 56 teeth determine the centre to centre distance. What will be the actual pressure angle if the centre distance is increased by 5 mm.

Contd...P/3

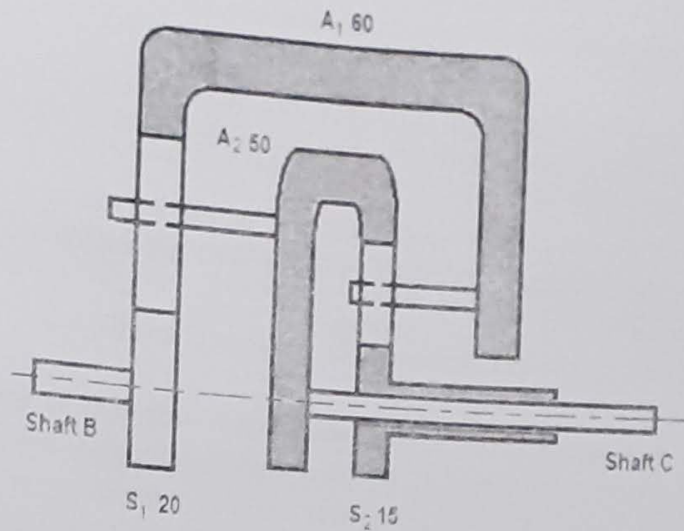


Fig. 1

(c) Fig. 1 shows a compound gear train used in a workshop between two shafts B and C. The gear train is composed of two annular gears A_1 and A_2 , and a sun wheel S_2 . Number of teeth of each gear is mentioned in the figure. Find the velocity ratio of shaft B to shaft C. Also determine the torque required to fix the gear S_2 when a clockwise torque of 160 N.m is applied to gear S_1 . (10+15+15)

3. A plate cam with offset roller follower has the following data: (i) minimum radius of cam = 25 mm, (ii) roller diameter = 7.5 mm, (iii) lift = 28 mm, (iv) offset = 12 mm towards right, (v) angle of ascent = 60° , (vi) angle of descent = 90° , (vii) angle of dwell between ascent and descent = 45° and the speed of the cam = 200 rpm. Draw the profile of the cam. Also find out the maximum velocity and the uniform acceleration of the follower during the outstroke and the return stroke. (30+2x5)

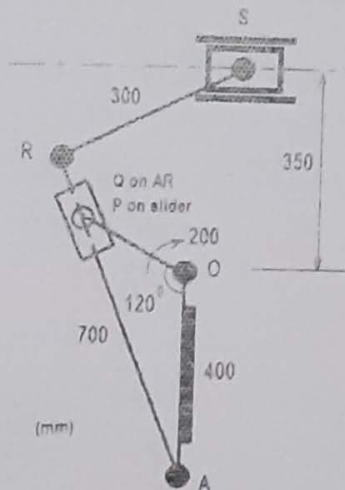


Fig. 2

4. Fig. 2 shows a slider crank quick return mechanism. If the driver crank OP rotates at a speed of 210 rpm find the acceleration of S and the angular acceleration of the link RS. Compute by drawing velocity and acceleration diagram.

5. (a) Make a list of operations that can be done by a drilling machine.
 (b) Describe the following operations with illustrations: (i) reaming, (ii) boring, (iii) counter-boring and (iv) tapping.
 (c) Draw a taper shank twist drill and describe its elements like (i) axis, (ii) body, (iii) body clearance, (iv) chisel edge, (v) face, (vi) flank, (vii) heel, (viii) lands, (ix) lip and (x) neck. (5+4x5+10x1.5)

6. (a) With respect to iron-carbon equilibrium diagram explain the following: (i) eutectic point, (ii) austenite phase, (iii) primary cementite + pearlite (iv) hypo-eutectoid steel zone and (v) hyper-eutectoid steel zone.
 (b) What do you understand by (i) malleable CI, (ii) white CI and (iii) S.G. CI? (5x5+3x5)

7. (a) Fig. 3 shows a stepped solid circular shaft that is built-in at its ends A and B. If the shaft is subjected to an external torque of T_e at the shoulder, determine the angle of rotation ϕ of the section where T_e is applied. Assume G the shear modulus, d the diameter and J the polar moment of inertia.

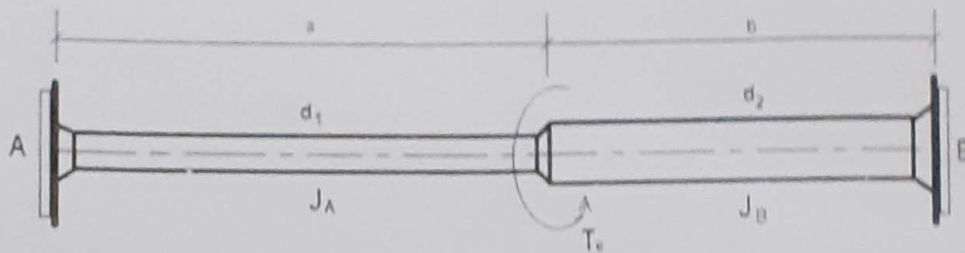


Fig. 3

- (b) Fig. 4 shows a steel wire rope of cross-section 'a' moving downward with a constant velocity 'v' while carrying a weight 'W'. What stresses are induced in the rope when its upper end is stopped suddenly? The free length of the rope at the point of impact on the ground is 'l'. Given that $W = 5000 \text{ kg}$, $v = 1 \text{ m/sec}$, $l = 20 \text{ m}$, $a = 10 \text{ cm}^2$, $E = 10^6 \text{ kg/cm}^2$. (2x20)

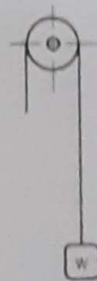


Fig. 4