

Time : 3 Hours

Maximum Marks : 80 Min. Passing Marks : 26

### Instructions to Candidates:

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

### Unit - I

- (a) What do you mean by inversion of a mechanism ? Explain with the help of neat sketches, all the inversions of double slider crank chain.
  (8)
  - (b) Explain with the help of neat sketches, various types of Kinematic pairs giving example for each one of them. (8)

## OR

- (a) Draw and explain klien's construction for determining the velocity and acceleration of the piston in a slider crank mechanism. (8)
  - (b) In Figure-1, the angular velocity of the crank OA is 600 r.p.m. Determine the linear velocity of the slider D and the angular velocity of the link BD, when the crank is inclined at an angle of 75° to the vertical. The dimensions of various links are: OA=28 mm, AB =44 mm, BC=49 mm and BD=46 mm. The centre distance between the centres of rotation 'O' and ' C' is 65 mm. the path of travel of the slider is 11 mm below the fixed point C. The slider moves along a horizontal path and oc is vertical. (8)



## Unit - II

3. (a) Derive an expression for the ratio of shaft velocities for Hooke's joint and draw the polar diagram depicting the salient features of driven shaft speed.

(8)

(b) Explain with neat sketch the working of overhead value mechanism of an I.C.
 Engine. (8)

## OR

- 4. (a) What is the condition for correct steering ? Derive the relation  $\tan \alpha = \frac{c}{2b}$  for Davis steering gear mechanism. (8)
  - (b) With a neat sketch, explain the working principle of Scott-Russel mechanism.

#### Unit - III

- 5. a) State the laws of dry friction.
  - b) Define the following terms.
    - (i) Coefficient of friction.
    - (ii) Limiting friction.
    - (iii) Angle of friction.
    - (iv) Angle of repose
  - c) The pitch of 50 mm mean diameter threaded screw of a screw jack is 12.5mm. The coefficient of friction between the screw and nut is 0.13. Determine the torque required on the screw to raise a load of 25kN, assuming the load to rotate with the screw. Determine the ratio of the torque required to

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(4)

(4)

(8)

raise the load to the torque required to lower the load and also the efficiency of the machine. (8)

- 6. a) A leather belt is required to transmit 7.5 kw from a pulley 1.2m in diameter, running at 250 r.p.m. The angle embraced is 165° and the coefficient of friction between the belt and the pulley is 0.3. If the safe working stress for the leather belt is 1.5 Mpa, density of leather 1Mg/m³ and the thickness of belt 10 mm.Determine the width of the belt taking centrifugal tension into account.(8)
  - (b) Derive the condition for transmitting maximum power in a flat belt drive. (8)

## Unit - IV

- 7. (a) The thrust of a propeller shaft in a marine engine is taken up by a number of collars integral with the shaft which is 300 mm in diameter. The thrust on the shaft is 200 KN and the speed is 75 r.p.m. Taking coefficient of friction equal to 0.05 and assuming intensity of pressure as uniform and equal to 0.3 Mpa, find the external diameter of the collar and the number of collars required, if the power lost in friction is not to exceed 16 kw.
  - (b) Describe with a neat sketch the working of a single place friction clutch. (8)

#### OR

8. a) Show that in a band and block brake, the ratio of the maximum and minimum

tension in the brake staps is  $\frac{T_0}{T_n} = \left[\frac{1+\mu\tan\theta}{1-\mu\tan\theta}\right]^n$ 

where  $T_0 = maximum$  tension,  $T_n = minimum$  tension,  $2\theta$  =angle subtended by each block at the centre of the drum. (8)

b) A band brake acts on the  $\frac{3''}{4}$  of cicumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225 N-m.One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the operating force when the drum rotates in the anticlockwise direction. (8)

## Unit - V

- 9. (a) Define the following terms as applied to cam with a neat sketch.
  - (i) Base circle
  - (ii) Pitch circle
  - (iii) Pressure angle

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(3)

- (iv) pitch point (4) (4)
- (b) Explain with sketches the different types of cams and followers.
- (c) Draw the displacement, velocity and acceleration diagram for a follower moving with simple harmonic motion. Dervie the expression for velocity and acceleration during outstroke and return stroke of the follower. (8)

# OR

- 10. A cam is to be designed for a knife edge follower with the following data :
  - Cam lift = 40 mm during  $90^{\circ}$  of cam rotation with simple harmonic motion. (i)
  - Dwell for the heat 30°. (ii)
  - (iii) During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.
  - (iv) Dwell during the remaining 180°. Draw the profile of the cam when the line of stroke of the follower passes through the axis of cam shaft. Radius of the base circle is 40 mm. Determine the velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m. (16)