

sem-IV / Prod-CBGS / Theory of Machines / 19-05-16

Q. P. Code : 559502

TIME- 3 Hrs

Total Marks-80

- N.B. :**
1. Question No 1 is compulsory
  2. Attempt any **Three** questions from the remaining five questions.
  3. Assume any **suitable data** if necessary with justification.
  4. Figures to the right indicates full marks

Q.1 Attempt any **four** of the following questions.

20

- a) Explain the following terms:  
1. Lower pair, 2.Higher pair, 3.Kinematic chain, 4.Mechanism, 5.Inversion
- b) Describe the construction and operation of a proney brake dynamometer.
- c) Prove that the velocity of sliding is proportional to the distance of the point of contact from the pitch point in meshed gear wheels.
- d) What do you mean by Corolli's component? Prove that this component of acceleration is equal to  $2v\omega$ .
- e) Explain epicyclic gear train with its applications.

Q. 2 a) The kinematic diagram of one of the cylinders of a rotary engine is shown in figure 1. The crank OA which is vertical and fixed, is 50 mm long. The length of the connecting rod AB is 125 mm. The line of the stroke OB is inclined at  $50^\circ$  to the vertical.

The cylinders are rotating at a uniform speed of 300 rpm in a clockwise direction, about the fixed center O. Determine: - 1. Acceleration of the piston inside the cylinder, and 2. Angular acceleration of the connecting rod.

15

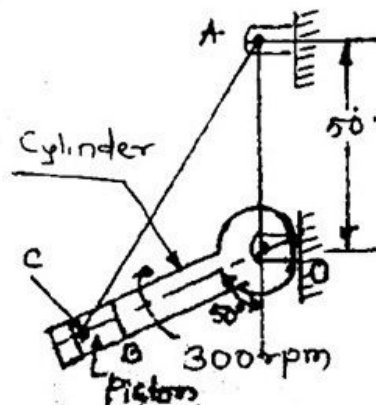


Figure 1

[Turnover

b) Sketch Hart's straight line mechanism and prove that the tracing point describes a straight line path. 05

Q. 3 a) A band and block brake, having 10 blocks each of which subtends an angle of  $15^\circ$  at the centre of the wheel. The two ends of the band are fixed to pins on the opposite sides of the brake fulcrum at distances of 40 mm and 200 mm from it. Determine the maximum force required to be applied on the lever at a distance of 300 mm from the the fulcrum to absorb 250 KW of power at 280 r.p.m. The effective diameter of drum is 840 mm. The coefficient of friction between blocks and drum may be taken as 0.35. muADDA.com 10

b) A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass 100 kg at its free end. The young's modulus for the shaft material is 200 GN/m<sup>2</sup>. Determine the frequency of longitudinal and transverse vibrations of the shaft. 10

Q.4 a) A single plate clutch is required to transmit 30 KW at 1000 rpm. The maximum pressure intensity between the plates is 90 KN/m<sup>2</sup>. The outer diameter of the plate is 380 mm. Both the sides of the plate are effective and the coefficient of friction is 0.25. Determine the

i) Inner diameter of the plate and ii) the axial force to engage the clutch. 10

b) Two 20<sup>o</sup> involute spur gears mesh externally and give a velocity ratio of 2.5. The module is 4 mm and the addendum is equal to 1.23 module. If the pinion rotates at 150 rpm, determine the (i) minimum number of teeth on each wheel to avoid interference. (ii) number of pairs of teeth in contact. 10

Q.5 a) Draw the profile of the cam when the roller follower moves with cycloidal motion during out stroke and return stroke, as given below: 15

1. Out stroke with maximum displacement of 31.4 mm during 180<sup>o</sup> of cam rotation.
2. Return stroke for the next 150<sup>o</sup> of cam rotation. muADDA.com
3. Dwell for the remaining 30<sup>o</sup> of cam rotation.

The minimum radius of the cam is 15 mm and the roller diameter of the follower is 10 mm. The axis of the roller follower is offset by 10 mm towards right from the axis of cam shaft.

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3

b) Derive an expression for minimum number of teeth on the wheel in order to avoid interference. 05

**Q.6** a) A, B, C and D are four masses carried by a rotating shaft at radii 80 mm, 100 mm, 160 mm, and 120 mm respectively are completely balanced. Masses B, C & D are 8 kg, 4 kg and 3 kg respectively. Determine the required mass A and the relative angular positions of the four masses if the planes are spaced 500 mm apart. 12

b) Sketch and describe the working of two different types of quick return mechanisms. Give examples of their applications. 08

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