

PROD

SE/IV/CBES/Prod/Theory of Machines / May 14



QP Code : NP-19716

DURATION: 3Hours

MAX MARKS: 80

Note:

1. Question no.1 is compulsory.
2. Attempt any three questions from the remaining questions.
3. Assume suitable data wherever required.

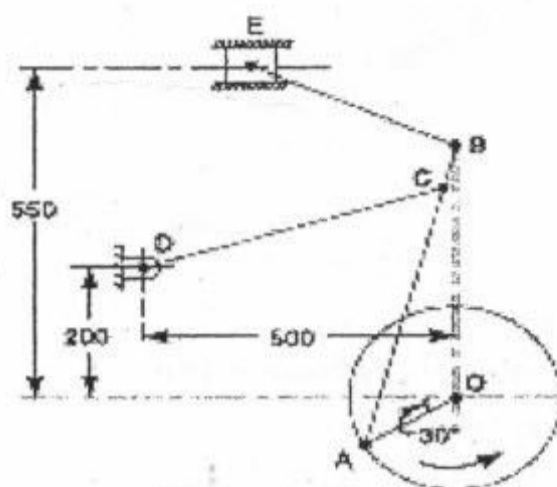
1 Answer any four questions. 20

- (a) What is Coriolis acceleration. Derive an expression to find it.
- (b) Explain Lower pair, higher pair, kinematic link, kinematic chain and inversion.
- (c) Derive an expression for the natural frequency of free transverse vibrations for a simply supported beam carrying a number of point loads by Dunkerly's method.
- (d) What is degree of freedom of mechanism? How is it determined?
- (e) For gears define module, addendum, pressure angle, circular pitch and length of path of contact.
- (f) Explain rope brake dynamometer.
- (g) Write a note on Gyroscope.

- 2 (a) The following fig. shows the mechanism of a radial valve gear. The crank OA 14 turns uniformly at 150 rpm and is pinned at A to rod AB. The point C in the rod is guided in the circular path with D as centre and DC as radius. The dimensions of various links are:
OA = 150 mm ; AB = 550 mm ; AC = 450 mm ; DC = 500 mm ; BE = 350 mm.
Determine velocity and acceleration of the ram E and link CD for the given position of the mechanism.

[TURN OVER

Con. 12014-14.

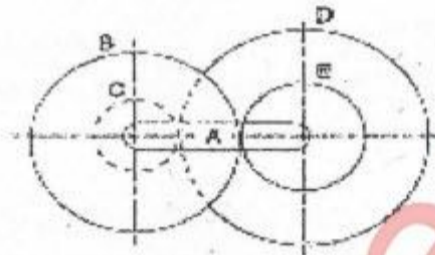


All dimensions in mm.

- (b) State and explain inversions of slider crank mechanism. 6
- 3 (a) Construct the profile of a cam to suit the following specifications : 15
 Cam shaft diameter = 40 mm, Least radius of cam = 25 mm, Diameter of roller = 25 mm, Angle of lift = 120° , Angle of fall = 150° , Lift of the follower = 40 mm
 Number of pauses are two of equal interval between motions. During the lift, the motion is S.H.M. During the fall the motion is uniform acceleration and deceleration. The speed of the cam shaft is uniform. The line of stroke of the follower is off-set 12.5 mm from the centre of the cam.
- (b) A shaft of 100 mm diameter and 1m long is fixed at one end and other end carries a flywheel of mass 1 tonne. Taking Young's modulus for the shaft material as 200 GN/m², find the natural frequency of longitudinal vibrations. 5
- 4 (a) A pair of involute spur gears with 16° pressure angle and pitch of module 6 mm is in mesh. The number of teeth on pinion is 16 and its rotational speed is 240 rpm. When the gear ratio is 1.75, find in order that the interference is just avoided 10
 1. the addenda on pinion and gear wheel
 2. the length of path of contact and
 3. the maximum velocity of sliding of teeth on either side of the pitch point.
- (b) A multi-disc clutch has three discs on the driving shaft and two on the driven shaft. The outside diameter of the contact surfaces is 240 mm and inside diameter 120 mm. Assuming uniform wear and coefficient of friction as 0.3, find the maximum axial intensity of pressure between the discs for transmitting 25 kW at 1575 rpm. 10

[TURN OVER

- 5 (a) The following data refer to two cylinder locomotive with cranks at 90° : 10
 Reciprocating mass per cylinder = 300 kg, Crank radius = 0.3 m, Driving wheel diameter = 1.8 m, Distance between cylinder centre lines = 0.65 m
 Distance between the driving wheel central planes = 1.55 m. Determine :
 1. the fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 kmph
 2. the variation in tractive effort and
 3. the maximum swaying couple
- (b) In a reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear D - E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 rpm clockwise. 10



- 6 (a) A simple band brake is operated by a lever of length 500 mm. The brake drum has a diameter of 500mm and the brake band embraces $5/8$ of the circumference. One end of the band is attached to the fulcrum of the lever while the other end is attached to a pin on the lever 100 mm from the fulcrum. If the effort applied to the end of the lever is 2 kN and the coefficient of friction is 0.25, find the maximum braking torque on the drum. 10
- (b) A shaft of diameter 10 mm carries at its centre a mass of 12 kg. It is supported by two short bearings, the centre distance of which is 400 mm. Find the whirling speed : 10
 1. neglecting the mass of the shaft, and
 2. taking the mass of the shaft also into consideration.
 The density of shaft material is 7500 kg/m^3 .