

Q.P. Code: 39368

Duration: 3 hours

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) State and explain Kennedy's theorem.
 - (b) Explain the terms link, kinematic chain, kinematic pair, mechanism and machine.
 - (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) Explain Kutzbach criterion for determining degree of freedom for mechanisms.
 - (e) Explain Law of Gearing.
 - (f) Explain Prony brake dynamometer.
 - (g) Derive an equation of gyroscopic couple.
- 2 (a) In the toggle mechanism, as shown in Fig. 1, D is constrained to move on a horizontal path. The dimensions of various links are: AB = 200 mm; BC = 300 mm ; OC = 150 mm; and BD = 450 mm. The crank OC is rotating in a counter clockwise direction at a speed of 180 r.p.m., increasing at the rate of 50 rad/s². Determine, for the given configuration 1. velocity and acceleration of D, and 2. Angular velocity and angular acceleration of BD. 15

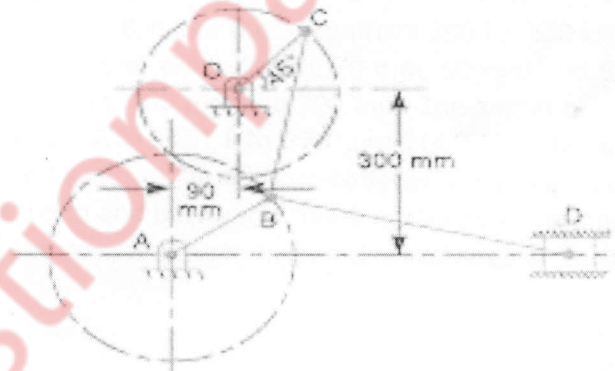


FIG 1

- (b) Explain Hart's mechanism. 5
- 3 (a) 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. Determine the whirling speed: 5
1. neglecting the mass of the shaft, and
 2. considering the mass of the shaft also into consideration.
- The density of shaft material is 7500 kg/m³.

- (b) A flat faced reciprocating follower has the following motion : 15
 (i) The follower moves out for 80° of cam rotation with uniform acceleration and retardation, the acceleration being twice the retardation.
 (ii) The follower dwells for the next 80° of cam rotation.
 (iii) It moves in for the next 120° of cam rotation with uniform acceleration and retardation, the retardation being twice the acceleration.
 (iv) The follower dwells for the remaining period.
 The base circle diameter of the cam is 60 mm and the stroke of the follower is 20 mm. The line of movement of the follower passes through the cam centre. Construct the displacement diagram and the profile of the cam very neatly showing all constructional details
- 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 r.p.m. When the gear ratio is 1.75, find in order that the interference is just avoided; 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. 10
- (b) A plate clutch has three discs on the driving shaft and two discs on the driven shaft, providing four pairs of contact surfaces. The outside diameter of the contact surfaces is 240 mm and inside diameter 120 mm. Assuming uniform pressure and $\mu = 0.3$; find the total spring load pressing the plates together to transmit 25 kW at 1575 r.p.m. If there are 6 springs each of stiffness 13 kN/m and each of the contact surfaces has worn away by 1.25 mm, find the maximum power that can be transmitted, assuming uniform wear. 10
- 5 (a) A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45° , B to C 70° and C to D 120° . The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. 10

(b)

10

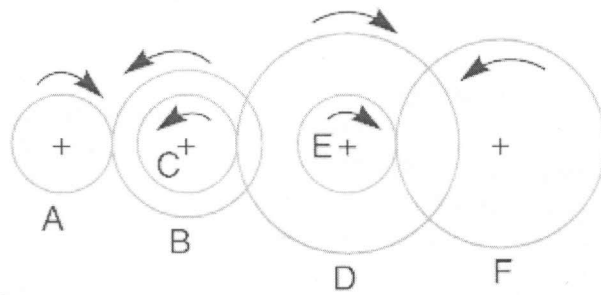


FIG 2

The gearing of a machine tool is shown in Fig. 2. The motor shaft is connected to gear A and rotates at 975 r.p.m. The gear wheels B, C, D and E are fixed to parallel shafts rotating together. The final gear F is fixed on the output shaft. What is the speed of gear F? The number of teeth on each gear are as given below :

Gear	A	B	C	D	E	F
No. of teeth	20	50	25	75	26	65

- 6 (a) State the effects of unbalanced reciprocating mass in a locomotive and derive an expression for the same. 10
- (b) A band and block brake, having 14 blocks each of which subtends an angle of 15° at the centre, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find: 1. maximum braking torque, 2. angular retardation of the drum, and 3. time taken by the system to come to rest from the rated speed of 360 r.p.m. The coefficient of friction between blocks and drum may be taken as 0.25. 10