

National Institute of Technology  
Kurukshetra  
Theory Examination  
Question Paper

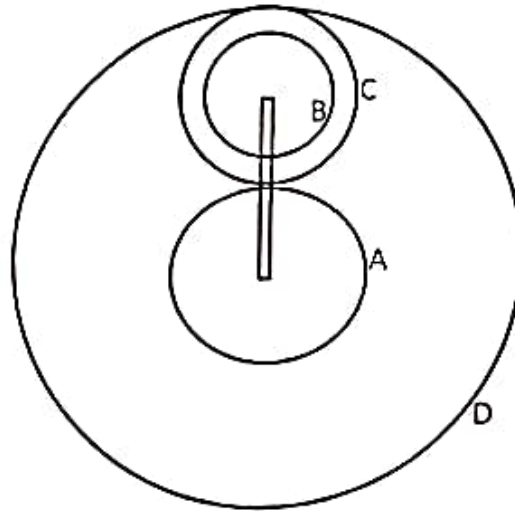
B.Tech  
Dynamics of Machines  
MEPC-208/MEPC-21

4<sup>th</sup> Semester  
Max marks 50  
Time 3 hours

Note: All questions are compulsory

- Q-1(a) The following data relate to a horizontal reciprocating engine: 15  
Mass of reciprocating parts = 120 kg  
Crank length = 90mm  
Engine speed = 600 rpm  
Connecting rod mass = 90 kg  
Connecting rod length = 450 mm  
Distance of center of mass from big end center = 180 mm  
Radius of gyration about an axis through center of mass of connecting rod = 150 mm  
Find the magnitude and the direction of the torque required on the crank shaft to overcome inertia of moving parts when the crank has turned  $30^\circ$  from the inner dead center.
- Q-2(a) A punching press is required to punch 40 mm diameter holes in a plate of 15 mm thickness at the rate of 30 holes per minute. It requires 6 Nm of energy per  $\text{mm}^2$  of sheared area. If the actual time for punching is 1 second and flywheel speed varies from 160 rpm to 140 rpm determine the mass of the flywheel having radius of gyration of 1 meter. 5
- Q-2(b) The outer cranks of four cylinder inline engine are set at  $120^\circ$  to each other and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. The lengths of crank and connecting rod is 300 mm and 1200 mm respectively. the engine speed is 240 rpm. If the engine is to be under complete primary balance find the reciprocating mass and relative angular position for each of the inner cranks. 5
- Q-3(a) Derive a formula to calculate the minimum number of teeth on the wheel in order to avoid interference. 5

- Q-3(b) In the epicyclic gear train shown in figure the number of teeth on gears A, B and C are 80, 60 and 100 respectively. Determine the speed of A if arm rotates at 100 rpm clockwise and D is stationary. B and C form a compound gear. 5



- Q-4(a) Derive a formula for calculating braking torque in the leading shoe of internal expanding shoe brake. 5
- Q-4(b) The arms of a porter governor are 250 mm long. The upper arms are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 50 mm from the axis of rotation. The weight of the sleeve is 60 kg and weight of each ball is 10 kg. Determine the equilibrium speed when the radius of rotation of the balls is 150 mm. 5
- Q-5 The moment of inertia of an airplane air screw is  $20 \text{ kgm}^2$  and the speed of rotation is 1000 rpm clockwise when viewed from the front. The speed of flight is 200 km per hour. Find the gyroscopic reaction of the air screw on the airplane when it makes a left handed turn on a path of 150 m radius. 5