

Code No: 55017

R09

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2016

DYNAMICS OF MACHINERY

(Common to AME, ME, MCT)

Time: 3 hours

Max. Marks: 75

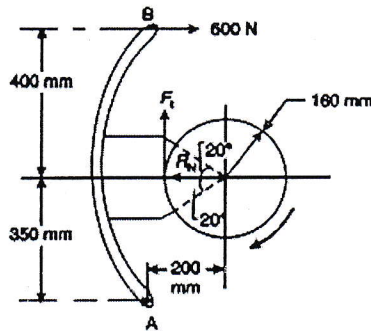
Answer any five questions

All questions carry equal marks

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1. A rear engine automobile is travelling along a track of 100 metres mean radius. Each of the four road wheels has a moment of inertia of  $2.5 \text{ kg-m}^2$  and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of  $1.2 \text{ kg-m}^2$ . The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle speed is 3:1. The automobile has a mass of 1600 kg and has its centre of gravity 0.5 m above road level. The width of the track of the vehicle is 1.5 m. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface. Assume that the road surface is not cambered and centre of gravity of the automobile lies centrally with respect to the four wheels. [15]
2. The crank length and connecting rod length of a petrol engine, running at 1800 r.p.m. are 50 mm and 200 mm respectively. The diameter of the piston is 80 mm and the mass of the reciprocating parts is 1 kg. At a point during the power stroke, the pressure on the piston is  $0.7 \text{ N/mm}^2$ , when it has moved 10 mm from the inner dead centre. Determine:  
a) Net load on the gudgeon pin  
b) Thrust in the connecting rod  
c) Reaction between the piston and cylinder  
d) The engine speed at which the above values become zero. [15]
3. A four bar mechanism is to be designed, by using three precision points, to generate the function  $y = x^{1.5}$ , for the range  $1 \leq x \leq 4$ . Assuming  $30^\circ$  starting position and  $120^\circ$  finishing position for the input link and  $90^\circ$  starting position and  $180^\circ$  finishing position for the output link, find the values of  $x$ ,  $y$ ,  $\theta$  and  $\phi$  corresponding to the three precision points. [15]
- 4.a) A conical friction clutch is used to transmit 90 kW at 1500 r.p.m. The semicone angle is  $20^\circ$  and the coefficient of friction is 0.2. If the mean diameter of the bearing surface is 375 mm and the intensity of normal pressure is not to exceed  $0.25 \text{ N/mm}^2$ , find the dimensions of the conical bearing surface and the axial load required.

b). The below figure shows a brake shoe applied to a drum by a lever AB which is pivoted at a fixed point A and rigidly fixed to the shoe. The radius of the drum is 160 mm. The coefficient of friction at the brake lining is 0.3. If the drum rotates clockwise, find the braking torque due to the horizontal force of 600 N at B. [5+10]



5. A single cylinder double acting steam engine delivers 185 kW at 100 r.p.m. The maximum fluctuation of energy per revolution is 15 percent of the energy developed per revolution. The speed variation is limited to 1 percent either way from the mean. The mean diameter of the rim is 2.4 m. Find the mass and cross-sectional dimensions of the flywheel rim when width of rim is twice the thickness. The density of flywheel material is  $7200 \text{ kg/m}^3$ . [15]

6. In an engine governor of the Porter type, the upper and lower arms are 200 mm and 250 mm respectively and pivoted on the axis of rotation. The mass of the central load is 15 kg, the mass of each ball is 2 kg and friction of the sleeve together with the resistance of the operating gear is equal to a load of 25 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are  $30^\circ$  and  $40^\circ$ , find, taking friction into account, range of speed of the governor. [15]

7. A four cylinder inline marine oil engine has cranks at angular displacement of  $90^\circ$ . The outer cranks are 3 m apart and inner cranks are 1.2 m apart. The inner cranks are placed symmetrically between the outer cranks. The length of each crank is 450 mm. If the engine runs at 90 r.p.m. and the mass of reciprocating parts for each cylinder is 900 kg, find the firing order of the cylinders for the best primary balancing force of reciprocating masses. Determine the maximum unbalanced primary couple for the best arrangement. [15]

8. An electric motor is to drive a centrifuge, running at four times the motor speed through a spur gear and pinion. The steel shaft from the motor to the gear wheel is 54 mm diameter and L metre long, the shaft from the pinion to the centrifuge is 45 mm diameter and 400 mm long. The masses and radii of gyration of motor and centrifuge are respectively 37.5 kg, 100 mm, 30 kg and 140 mm. Neglecting the inertia effect of the gears, find the value of L if the gears are to be at the node for torsional oscillation of the system and hence determine the frequency of torsional oscillation. Assume modulus of rigidity for material of shaft as  $84 \text{ GN/m}^2$ . [15]