BT-4/M-20   **34119**

DYNAMICS OF MACHINES

ME-210N, (Opt. II)

Time : Three Hours]   [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. A vertical single cylinder, diesel engine running at 300 r.p.m. has a cylinder diameter 250 mm and stroke 400 mm. The mass of the reciprocating parts is 200 kg. The length of the connecting rod is 0.8 m. The ratio of compression is 14 and the pressure remains constant during injection of oil for 1/10th of stroke. If the index of the law of expansion and compression is 1.35, find the torque on the crankshaft when it makes an angle of 60º with the top dead centre during the expansion stroke. The suction pressure may be taken as 0.1 N/mm^2. **15**

(3)L-34119   1

2. A single cylinder, single acting four-stroke gas engine develops 20 kW at 300 r.p.m. The work done by the gases during the expansion stroke is three times the work done on the gases during the compression stroke, the work done during the suction and exhaust strokes being negligible. If the total fluctuation of speed is not to exceed +2 percent of the mean speed and the turning moment diagram during compression and expansion is assumed to be triangular in shape, find the moment of inertia of the flywheel. **15**

Unit II

3. A pinion having 20 involute teeth of module pitch 6 mm rotates at 200 r.p.m. and transmits 1.5 kW to a gear wheel having 50 teeth. The addendum on both the wheels is 1/4 of the circular pitch. The angle of obliquity is 20º. Find (a) the length of the path of approach; (b) the length of the arc of approach, (c) the normal force between the teeth at an instant where there is only pair of teeth in contact. **15**

(3)L-34119   2

4. An epicyclic gear train, as shown in Fig. 1, is composed of a fixed annular wheel A having 150 teeth. The wheel A is meshing with wheel B which drives wheel D through an idle wheel C, D being concentric with A. The wheels B and C are carried on an arm which revolves clockwise at 100 r.p.m. about the axis of A and D. If the wheels B and D have 25 teeth and 40 teeth respectively, find the number of teeth on C and the speed and sense of rotation of C. **15**
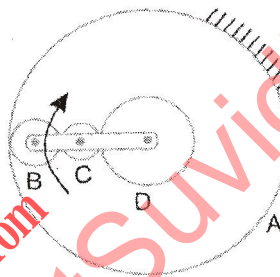

Fig. 1

Unit III

5. A differential band brake acting on the 3/4th of the circumference of a drum of 450 mm diameter, is to provide a braking torque of 225 N-m. One end of the band is attached to a pin 100 mm from the fulcrum of the lever and the other end to another pin 25 mm from the

(3)L-34119 3

fulcrum on the other side of it where the operating force is also acting. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the two values of the operating force corresponding to two directions of rotation of the drum. **15**

6. The following particulars refer to a Proell governor with open arms : Length of all arms : 200 mm, distance of pivot of arms from the axis of rotation = 40 mm, length of extension of lower arms to which the ball is attached = 100 mm, mass of each ball = 6 kg and mass of the central load = 150 kg. If the radius of rotation of the balls is 180 mm when the arms are inclined at 40º to the axis of rotation, find : (i) The equilibrium speed for the above configuration, (ii) The coefficient of insensitiveness if the friction of the governor mechanism is equivalent to a force of 20 N at the sleeve, and (iii) The range of speed between which the governor is inoperative. **15**

Unit IV

7. A racing car weighs 20 kN. It has a wheel base of 2 m, track width 1 m and height of C.G. 300 mm above the ground level and lies miday between the front and rear

axle. The engine flywheel rotates at 3000 r.p.m. clockwise when viewed from the front. The moment of inertia of the flywheel is 4 $kg\text{-}m^2$ and moment of inertia of each wheel is 3 $kg\text{-}m^2$. Find the reactions between the wheels and the ground when the car takes a curve of 15 m radius towards right at 30 km/h, taking into consideration the gyroscopic and the centrifugal effects. Each wheel radius is 400 mm. **15**

8. A four cylinder engine has cranks arranged symmetrically along the shaft as shown in Fig. 2. The distance between the outer cranks A and D is 5.4 metres and that between the inner cranks B and C is 2.4 metres. The mass of the reciprocating parts belonging to each of the outer cylinders is 2 tonnes and that belonging to each of the inner cylinders is m tonnes. If the primary and secondary forces are to be balanced and also the primary couples, determine the crank angle positions and the mass of the reciprocating parts (m) corresponding to the inner cylinders. Find also the maximum value of the unbalanced secondary couple, if the stroke is 1 metre, the connecting rod length 2 metres, and the speed of the engine is 110 r.p.m. **15**
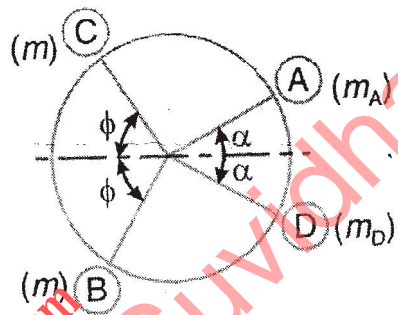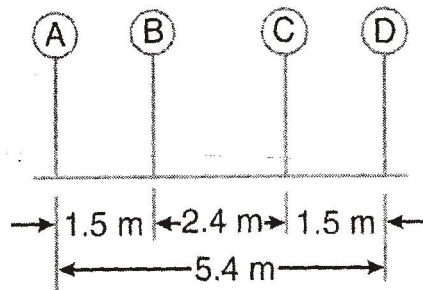
Fig. 2