No. of Printed Pages : 4

BIMEE-007

B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

June, 2014

BIMEE-007 : ADVANCED DYNAMICS OF MACHINE

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **any five** questions. **All** questions carry **equal** marks. Assume any missing data if required anywhere. Use of scientific calculator is **permitted**.*

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1. Block A of mass 20 kg is placed on block B of mass 30 kg. Coefficient of friction between blocks A and B is 0.35 and between block B and floor is 0.10 as shown in Fig - 1. Force P is applied on block A as shown in Fig - 1. Determine the maximum value of P that will not cause the block A to slide on B or to tip on block B. **14**

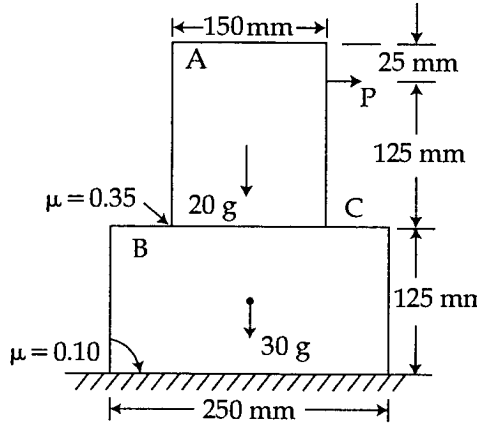

Figure - 1

2. The following data relate to a horizontal reciprocating engine : 14

Mass of reciprocating parts = 120 kg

Crank length = 90 mm

Engine speed = 600 rpm

Connecting rod :

Mass = 90 kg

Length between centres = 450 mm

Distance of Centre of mass from big end Centre = 180 mm

Radius of gyration about an axis through Centre of mass = 150 mm

Find the magnitude and the direction of inertia torque on the crank shaft when the crank has turned 30° from inner-dead centre.

3. A horizontal gas engine running at 210 rpm has a bore of 220 mm and a stroke of 440 mm. The connecting rod is 924 mm long and the reciprocating parts weigh 20 kg. When the crank has turned through an angle of 30° from the inner dead Centre the gas pressures on the cover and the crank sides are 500 kN/m^2 respectively. Diameter of piston rod is 40 mm. Determine : 14

(a) Turning moment on the crank shaft.

(b) Thrust on the bearings.

(c) Acceleration of the flywheel which has a mass of 8 kg and radius of gyration of 600 mm while the power of engine is 22 kW.

4. A machine is coupled to a two stroke engine which produces a torque of $(800 + 180\sin 3\theta)$ Nm where θ is the crank angle. The mean engine speed is 400 rpm. The flywheel and other rotating parts attached to the engine have a mass of 350 kg at a radius of gyration of 220 mm. Calculate : **14**

(a) Power of the Engine.

(b) Total fluctuation of Speed of the flywheel when the :

(i) Resisting torque is constant.

(ii) Resisting Torque is $(800 + 80\sin\theta)$ Nm

5. Three masses of 8 kg, 12 kg and 15 kg attached at radial distances of 80 mm, 100 mm and 60 mm respectively to a disc on a shaft are in complete balance. Determine the angular positions of the masses of 12 kg and 15 kg relative to the 8 kg mass. **14**

6. The rotor of the turbine of a ship has a mass of 2500 kg and rotates at a speed of 3200 rpm counter-clockwise when viewed from stern. The rotor has radius of gyration of 0.4 m determine the gyroscopic couple and its effect when : **14**

(a) The ship steers to left in a curve of 80 m radius at a speed of 15 knots (1 knot = 1860 m/h)

(b) The ship pitches 5 degrees above and 5 degrees below the normal position and the bow is descending with its maximum velocity. The pitching motion is simple harmonic with a periodic time of 40 seconds.

(c) The ship rolls and at the instant, its angular velocity is 0.4 rad/s clockwise when viewed from stern.

Also find the maximum angular acceleration during pitching.

7. A simply supported shaft having a disc of mass 5 kg is mounted midway between bearings following are the given parameters for this set up. **14**

Diameter of the shaft = 10 mm.

Bearing span = 500 mm.

Eccentricity = 2 mm.

Viscous damping at the Centre of the disc shaft = 50 N-sec/m.

Speed of the shaft = 750 rpm.

$E = 2 \times 1011$ N/m^2.

Find the maximum stress in the shaft and Power required to drive the shaft.