BIMEE-007

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

00521

June, 2019

BIMEE-007 : ADVANCED DYNAMICS OF MACHINES

Time : 3 hours *Maximum Marks : 70*

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

1. The length of the crank and connecting rod of a horizontal reciprocating engine are 200 mm and 1000 mm respectively. The crank is rotating at 400 rpm. When the crank has turned 30° from the inner dead centre, the difference in pressure between the cover end and piston end is 0·4 N/mm^2. If the mass of the reciprocating parts is 100 kg and cylinder bore is 0·4 m, calculate :

   (a) Inertia force

   (b) Force on piston

   (c) Piston effort

   (d) Thrust on sizes of cylinder walls

   Neglect the effect of piston rod diameter and frictional resistance. *14*

2. The following data refers to a shaft held on a long bearing :

Length of the shaft = 1·2 m

Diameter of the shaft = 14 mm

Mass of the rotor at mid span = 16 kg

Eccentricity of the centre of mass = 0·4 mm

Modulus of elasticity for
the material of the shaft = 200 GPa

Permissible stress for
the material of the shaft = 70 GPa

Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. Neglect the mass of the shaft. *14*

3. The mass of the motor-cycle along with the rider is 180 kg. The height of the centre of gravity of total mass is 60 cm above the ground when it moves straight. Each wheel has a diameter equal to 70 cm and the polar mass moment of inertia of each wheel is 2 kg m^2. The engine rotates at a speed 5 times the road wheel and the engine rotating parts have polar moment of inertia equal to 0·2 kg m^2. Determine the angle of heel required if the motor-cycle makes a curve of radius 100 m at a speed of 108 km/hr. *14*

4. A single cylinder, single acting, 4-stroke gas engine develops 20 kW at 300 rpm. The work done by the gas during expansion stroke is three times the work done on the gas during the compression stroke; the work done during suction and exhaust stroke being negligible. If the total fluctuation in speed is not to exceed $\pm 2\%$ of the mean speed and the turning moment diagram during compression and expansion is assumed to be triangular, find the moment of inertia of the flywheel. Also sketch the turning moment diagram for the engine. *14*

5. A four wheeled trolley car of total mass 3000 kg running on rails of 1·6 m gauge, rounds a curve of 30 m radius at 54 km/hr. The track is banked at 8°. The wheels have an external diameter of 0·7 m and each pair with axle has mass of 200 kg. The radius of gyration for each pair is 0·3 m. The height of centre of gravity of the car above the wheel base is 1 m. Determine the pressure on each rail, allowing gyroscopic couple actions. *14*

6. Write short notes on *any* ***four*** of the following : $4 \times 3\frac{1}{2} = 14$

(a) Gyroscopic Stabilization

(b) Euler's Equation of Motion

(c) Dynamic Force Analysis of the Link

(d) Balancing of Inertia Forces in Machines

(e) Dynamics of Rotating Shafts