No. of Printed Pages : **4**

BIMEE-007

00860

B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

June, 2013

BIMEE-007 : ADVANCED DYNAMICS OF MACHINE

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **any five** questions, including **Question No. 1**, which is **compulsory**. Assume missing data; if any.*

1. Solve ***any four*** of the following : **3.5x4=14**

(a) Explain a dynamically equivalent system. How is a connecting rod replaced by an equivalent dynamical system of two masses ? Explain by graphical method.

(b) Define the following :

(i) D'Alembert principle.

(ii) Coefficient of fluctuation of Energy.

(iii) Coefficient of fluctuation of speed.

(c) What are the conditions of static and dynamic balancing ? How are the reciprocating parts of the I.C. engines balanced ?

(d) Discuss the gyroscopic effects on the naval ship during pitching and steering.

(e) What do you mean by whirling of shaft ? What is critical speed ? How is critical speed of a shaft estimated ?

2. The following data refer to a connecting rod of a reciprocating engine : **14**

Mass = 55 kg ; Distance between bearing centres = 850 mm ; diameter of small and big end bearings = 75 mm and 100 mm respectively. Time of oscillation when the connecting rod is suspended from small end = 1.83 s ; ,

Time of oscillation when the connecting rod is suspended from big end = 1.68 s. Determine :

(a) the radius of gyration of the rod about an axis passing through the centre of gravity and perpendicular to the plane of oscillation.

(b) moment of Inertia of the rod about the same axis ; and

(c) the dynamically equivalent system for the connecting rod, constituted of two masses, one of which situated at the small end centre.

3. A vertical petrol engine 100 mm diameter and 120 mm stroke has a connecting rod 250 mm long. The mass of the piston is 1.1 Kg. The speed is 2000 r.p.m. During the expansion stroke with a crank 20° from top - dead - centre, the gas pressure is 0.7 MPa. Determine : **14**

(a) Net force on the piston

(b) Resultant load on the gudgeon pin,

(c) Thrust on the cylinder wall and

(d) Speed above which the gudgeon pin load would be reversed in direction while other parameters remain unchanged.

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 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 fly wheel. Also sketch the turning - moment diagram for the engine. **14**

5. The crank and connecting rods of a 4-cylinder in-line engine running at 1800 rpm are 60 mm and 240 mm respectively. The cylinders are placed 150 mm from each other. If the cylinders are numbered 1 to 4 in sequence from one end, the crank appear at intervals of 90° in an end view in the clockwise order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine : **14**

   (a) Unbalanced primary and secondary forces ; if any and

   (b) Unbalanced primary and secondary couples with reference to the central plane of the engine.

6. (a) Write the equations of motions for the general plane motion of a rigid body. 4

(b) The turbine rotor of a ship has a mass of 2200 kg and rotates at 1800 rpm clockwise when viewed from the stern. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when : 10

(i) the ship turns right at a radius of 250 m with a speed of 20 km/hr.

(ii) the ship pitches with the bow rising at an angular velocity of 0.8 rad/s and

(iii) the ship rolls at an angular velocity of 0.2 rad/s.

7. The following data refers to a shaft held in a long bearings. 14

(a) Length of the shaft = 1.2 m

(b) Diameter of the shaft = 14 mm

(c) Mass of the rotor at mid span = 16 kg

(d) Eccentricity of the centre of mass = 0.4 mm

(e) Modulus of elasticity for the material of the shaft = 200 GPa

(f) Permissible stress for the material of the shaft = 70 MPa.

Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. Assume the shaft is massless.