

**FACULTY OF ENGINEERING**  
**B.E. 3/4 (M / P / AE) I – Semester (Main) Examination, November 2013**

**Subject: Dynamics of Machines**

**Time: 3 Hours**

**Max. Marks: 75**

**Note: Answer all questions from Part A. Answer any five questions from Part B.**

**PART – A (25 Marks)**

1. Explain how the gyroscopic couple affects the motion of an aircraft while taking a turn.
2. Distinguish between dead weight and spring loaded governors.
3. With a simple sketch differentiate a Proell governor from Porter Governor.
4. What is the role of gyroscopic effect on Naval ships?
5. What are turning moment diagrams? Why are they drawn?
6. What is meant by static and dynamic unbalance in machinery?
7. Define the terms 'Hammer-blow' and 'Swaying couple'.
8. What are the three basic elements of a vibrating system? Discuss briefly.
9. Discuss the reasons for occurrence of whirling in shafts. What is meant by critical speed?
10. Write a short note on any one appropriate method to determine natural frequencies in a multi rotor system.

**PART – B (50 Marks)**

11. The turbine rotor of a ship has a mass of 2.2 tonnes and rotates at 1800 rpm clockwise when viewed from the aft. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when
  - i) The ship turns right at a radius of 250 m with a speed of 25 kmph.
  - ii) Ship pitches with the bow rising at an angular velocity of 0.8 rad/sec.
12. Each arm of a Porter Governor is 180 mm long and its pivoted on the axis of rotation. The mass of each ball is 4 kg and the sleeve is 18 kg. The radius of rotation of the ball is 100 mm when the sleeve begins to raise, and 140 mm when at top. Determine the range of speed, also find the coefficient of insensitiveness if the friction at the sleeve is 15N.
13. A double acting steam engine develops 56 KW of power at 210 rpm. The maximum and minimum speeds do not vary more than 1% of the mean speed and the excess energy is 30% of the indicated work per stroke. Determine the mass of the fly wheel if the radius of gyration of the fly wheel is 500 mm.
14. The information related to a single-cylinder reciprocating engine are given as followed:  
 Mass of reciprocating parts = 40 kg  
 Mass of revolving parts = 30 kg at crank  
 Speed = 150 rpm; stroke = 350 mm  
 If 60% of the reciprocating parts and all the revolving parts are to be balanced, determine,
  - i) Balance mass required at a radius 320 mm
  - ii) Unbalanced force when the crank has turned 45° from the top dead centre.
15. The length and diameter of a shaft held in long bearings are 1.2 m and 14 mm respectively, mass of the rotor at the mid point = 16 kg. Eccentricity of centre of mass of rotor from the centre of rotor is equal to 0.4 mm. Modulus of elasticity of the shaft is equal to 200 GN/m<sup>2</sup>.  
 If the permissible stress in shaft material is 70 x 10<sup>6</sup> N/m<sup>2</sup>, determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. (Assume the shaft to be massless).
16. A machine part having a mass of 2.5 kg vibrates in a viscous medium. A harmonic exciting force of 30 N acts on the part and causes a resonant amplitude of 14 mm with a period of 0.22 second then,
  - i) Find the damping coefficient
  - ii) If the frequency of the exciting force is changed to 4 Hz, determine the increase in the amplitude of the forced vibrations upon the removal of the damper.
17. Write a short note on the following:
  - a) Hartnell and Hartung governors
  - b) Balancing of radial engines
  - c) Types of damping.