# INDIAN MARITIME UNIVERSITY

(A Central University)

## DEPARTMENT OF MARINE ENGINEERING

## B.TECH-MARINE ENGINEERING

## SEMESTER EXAMINATION-June 2011

Course code:UG/ME/BS/T/223 Sub.name: MECHANICS OF MACHINES-II

TIME : 3 hours Max.marks:100

*Part A (3 × 10 = 30 Marks)*

*Answer all the Questions*

1. a) Why is balancing of rotating parts necessary for high speed engines?

b) Explain the terms "static balancing" and "dynamic balancing?

c) Derive equivalent spring stiffness of a spring mass system where one spring in tension and other in compression.

d) Define in short about free vibration, forced vibration and damped vibration?

e) Using free body diagram show the differential equation of motion of Forced vibration?

f) How many nodes will be there for shaft carrying two rotors at ends, and shaft carrying three rotors?

g) Write the expression for natural frequency of free transverse vibration for simply supported beam carrying a number of point loads by Energy method and Dunkerley's method?

h) Write the equation of deflection for simply supported beam with an eccentric point load and simply supported beam with a uniform distributed load of W per unit length?

i) Write differential equation of motion of forced damped vibration and state type of force of each component.

j) Explain the term "Damping Factor"?

*Part B (14 × 5 = 70 Marks)*

*Answer any five of the following*

2. Four masses $m_1$, $m_2$, $m_3$ and $m_4$ are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2m, 0.15m, 0.25m and 0.3m respectively and the

angles between successive are 45°, 75°, and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2m. (14 MARKS)

3. A shaft 50mm diameter and 3 meters long is simply supported at the ends and carries three loads of 1000N, 1500N and 750N at 1m, 2m and 2.5m from the left support. The young's modulus for shaft material is 200 GN/m$^2$. Find the frequency of transverse vibration. (14MARKS)

4. a) Derive the torsional vibration of two rotor system having uniform shaft diameter 'd'. Find the natural frequency of vibration of each rotor in term of 'd' and other relevant parameters. (7 MARKS)

b) A shaft of 1.5m long has diameter of 50Φ and 100 cm length and remaining length of 50cm has diameter 75mm. The end of bigger diameter of shaft is fixed and end of small diameter is fitted with rotor of mass 250kg having radius of gyration 50cm. Calculate the natural frequency of trosional vibration. Take G = 85 GN/m$^2$. Neglect the inertia of shaft. (7 MARKS)

5. a) Find the natural frequency of vibration of several concentrated load by maximum energy method. (7 MARKS)

b) A simply supported beam of span 5.5m having mass of beam per meter run in 150kg., area moment of inertia is 16 x 10$^{-6}$ m$^2$. Two equal mass of 2.0 t placed at point 1.5m and 2m from left and right support respectively. Find the natural frequency of transverse vibration system. Assume E = 200 GN/m$^2$ and maximum static deflection of beam due to its own weight may be taken as 5Wl$^4$/384 EI, where l is length of beam and W is weight per meter run. (7 MARKS)

6. A shaft 1.5m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375mm from the centre towards left. The shaft is hollow of external diameter 75mm and internal diameter 40mm. the density of the shaft material is 7700 kg/m$^3$ and its modulus of elasticity is GN/m$^2$. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. (14 MARKS)

7. The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can be combined to give an equivalent spring of stiffness 5.4 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40N when the mass has a velocity of 1m/s. Find 1.Critical damping coefficient 2. Damping factor 3. Logarithmic decrement and 4.Two consecutive amplitudes. (14 MARKS)

8. Establish an expression for the amplitude of forced vibrations. (14 MARKS)