INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

May/ June 2017 End Semester Examinations

B.Tech. (Marine Engineering) Second Semester

(AY 2009-2014 batches)

Mechanics of Machines - II (UG11T1403/ UG11T2403)

Date : 15.06.2017 Maximum Marks: 100

Time: 3 Hrs Pass Marks : 50

Part – A (10 x 3=30 marks)

(All questions are compulsory)

1. a) Explain the term static balancing and dynamic balancing. State necessary condition to achieve them

   b) why balancing of rotating parts is necessary for high speed machine.

   c) Draw the sketch and find the differential equation of motion of free vibration. Draw displacement vs. time curve and find time period.

   d) All torsional vibration is angular vibration but all angular vibration is not torsional vibration – Explain

   e) Draw a sketch of torsional pendulum and write down differential equation of motion.

   f) Explain with sketch two node and single node torsional vibration of 3 – rotor system.

   g) Explain critical speed of rotor.

   h) Derive by energy method natural frequency of transverse vibration of a beam when several concentrated loads act on the beam.

   i) Draw a sketch of forced damped vibration and write down differential equation of motion from free body diagram.

   j) Explain the term "critical damping co-efficient". How it is related to "damping factor"

Part – B (5 x 14 = 70 marks)

Answer Any Five of the following

2. A shaft carries four masses in parallel plane A, B, C, D in this order along with it's length. The mass at B and C are 25 kg and 20 kg respectively and each has an eccentricity of 120 mm. the masses at A and D have an eccentricity of 150 mm. the angle between masses at B and C is 120^o and that between the masses at B and A is 200^o, both being measured in the same direction. The axial distance between plane A and B is 500 mm and that between B and C is 1000 mm. If the shaft is in complete dynamic balance, determine
   (a) magnitude of masses A and D
   (b) Distance between plane A and D,
   (c) the angular position of the mass at D. (14 Marks)

3. a) Find primary and secondary force of a single cylinder engine by direct and reverse crank method. Show primary and secondary crankangle position, location of mass and direction of angular velocity. (7 Marks)

   b) Three cylinder of radial vertical engine have their axis at 120° to one another and connecting rods are coupled to a single crank. The stroke is 15cm and length of each connecting rod is 35 cm.The mass of reciprocating parts of each cylinder is 2kg. Determine primary and secondary forces of the engine running at 2000 rpm . The crank is in vertical position in line with axis of cylinder 1. (7 Marks)

4. a) A mass of 10 kg hangs from spring having stiffness 1500 N/m. Vibration has been created by hammering the mass and creates initial velocity 10 cm/sec. Find the equation of displacement, velocity, acceleration and draw their curves with time. Also find time period from curves. (7 Marks)

   b) Find differential equation and natural frequency of a body mass "M" hanging from a spring of stiffness "k" and mass of spring is " m". (7 Marks)

5. a) Find the natural frequency of transverse vibration of beam of several concentrated load by Dunkerley's empirical equation of a simply supported beam. (7 Marks)

b) A simply supported beam of span 2.5 m, the cross section of beam is 250mm wide and 300 mm deep. The mass of beam is 200 kg/m. Two equal mass of 2 tonnes each are placed at 0.8 m and 0.9m from left and right support respectively. Find natural frequency of transverse vibration of beam. Assume E= 200 GN/m^2. (7 Marks)

6. A shaft, 20 mm diameter, rotates in a spherical bearing with a span of 1.2 m and carries of rotor of mass 15 kg at mid point of two bearings. Neglect the mass of shaft. Determine dynamic deflection of shaft in terms of angular velocity, if the mass centre of the rotor is 0.25 mm out of alignment. a) find whirling speed of shaft. b) if the bending stress is not to exceed 120 MN/m^2, determine range of speed within which it is unsafe to run the shaft and their corresponding frequencies. Take E=200GN/m^2. (14 Marks)

7. a) A steel shaft is fitted with rotor A and B at two ends having mass moment of inertia of A is 650 Kgm^2 and B is 200 Kgm^2. The stepped shaft has 90 mm dia. and 600 mm long; 70 mm dia. and 500 mm long and 60 mm dia. and 400 mm long. Rotor A is fitted with 90 mm dia. shaft end and rotor B is fitted with 60 mm dia. shaft end. Find the actual location of node point and natural frequencies of torsional vibration.
Take G=80 GN/m^2. (7 Marks)

b) A motor drives a centrifugal pump through gearing. The pump speed is one-third of motor. Mass moment of inertia of motor is 500 kgm^2 and impeller is 1200 kgm^2. The shaft diameter and length from motor to pinion is 60 mm dia. and 350 mm long; and from gear to pump is 90 mm dia. and 550 mm long. Find natural frequency of torsional vibration, neglecting inertia of gears and shaft. Take G = 80 GN/m^2. (7 Marks)

8. a) A mass of 10 Kg hangs from the spring and makes damped oscillation. The time of 50 complete oscillation requires 30 sec., the ratio of first amplitude to tenth consecutive amplitude is 3. Find spring stiffness and critical damping co-efficient of the system. (7 Marks)

b) A vertical reciprocating engine mounted on steel base plate fitted with dash-pot. Total mass of engine is 350kg and reciprocating mass is 25 kg, vertical stroke is 200 mm, the damping resistance of dashpot is 500 N at 0.3 m/sec and static deflection of base plate is 2 mm. Find the speed of driving shaft at which resonance will occur and find corresponding steady state amplitude. (7 Marks)

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