Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – WINTER 2013

Subject Code: 161901 **Date: 27-11-2013**

Subject Name: Dynamics of Machinery

Time: 02:30 pm to 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define the following terms: **07**
(i) Periodic motion (ii) Simple Harmonic Motion (iii) Degree of Freedom
(iv) Natural Frequency (v) Damping Factor (vi) Logarithmic Decrement
(vii) Resonance

(b) 1) Why is balancing of rotating parts necessary for high speed engines? **07**
2) Explain clearly the terms static balancing and dynamic balancing. State the necessary conditions to achieve them.

Q.2 **(a)** Derive the governing equation characterizing the motion of free-damped system. Also explain the terms 'under-damping', 'over-damping' and 'critical damping'. **07**

(b) A rotating shaft carries four masses A, B, C and D which are radially attached to it. The mass centers are 30 mm, 40 mm, 35 mm and 38 mm respectively from the axis of rotation. The masses A, C and D are 7.5 kg, 5 kg and 4 kg respectively. The axial distances between the planes of rotation of A and B is 400 mm and between B and C is 500 mm. The masses A and C are at right angles to each other. Find for a complete balance, (i) the angles between the masses B and D from mass A, (ii) the axial distance between the planes of rotation of C and D, and (iii) the magnitude of mass B. **07**

OR

(b) Four masses P, Q, R and S are carried by a rotating shaft at radii 100 mm, 125 mm, 200 mm and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses Q, R and S are 10 kg, 5 kg and 4 kg respectively. Determine the required mass P and the relative angular positions of four masses so that the shaft shall be in complete balance. **07**

Q.3 **(a)** A mass of 85 kg is supported on a spring which deflects 18 mm under the weight of the mass. The vibrations of the mass are constrained to be linear and vertical. A dashpot is provided which reduces the amplitude to one-quarter of its initial value in two complete oscillations. Calculate magnitude of the damping force at unit velocity and periodic time of damped vibrations. **07**

(b) Explain about 'primary' and 'secondary' balancing of reciprocating masses. **07**
A single cylinder reciprocating engine has speed 240 rpm, stroke 300 mm, mass of reciprocating parts 50 kg, mass of revolving parts at 150 mm radius 30 kg. If all the mass of revolving parts and two-third of the mass of reciprocating parts are to be balanced, find the balance mass required at radius of 400 mm and the residual unbalanced force when the crank has rotated 60^o from IDC.

OR

Q.3 **(a)** A machine of mass 100 kg is supported on an elastic support of total stiffness 800 kN/m and has rotating unbalanced element which results in disturbing force of 400 N at a speed of 3000 rpm. Assuming the damping ratio as 0.25, determine the amplitude of vibrations due to unbalance and the force transmitted to the support. **07**

(b) For an uncoupled two cylinder locomotive engine, derive the expressions of 'variation in tractive force', 'swaying couple' and 'hammer blow'. **07**

Q.4 (a) A shaft 50 mm diameter and 3 m long is simply supported at the ends carries three loads of 100 kg, 150 kg and 75 kg at 1 m, 2 m and 2.5 m from the left support. The modulus of elasticity of the shaft material is 2×10^5 MPa. Find the critical speed of the shaft by using Dunkerley's method. **07**

(b) The following data is in context with an outside cylinder uncoupled locomotive: **07**

Mass of rotating parts per cylinder = 360 kg
Mass of reciprocating parts per cylinder = 300 kg
Angle between cranks = 90^o
Crank radius = 0.3 m
Distance between cylinder center lines = 1.75 m
Radius of balancing masses = 0.75 m
Distance between planes of wheel = 1.45 m

If whole of the rotating and two-thirds of reciprocating parts are to be balanced in planes of the driving wheels, find the magnitude and angular positions of balance masses.

OR

Q.4 (a) Derive the expression to determine the natural frequency of free torsional vibrations of a 'geared system' in standard notations. **07**

(b) The cranks and connecting rods of a four-cylinder in-line engine running at 1800 rpm are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. The reciprocating mass corresponding to each cylinder is 10 kg. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90^o in an end view in order 1-4-2-3. Determine unbalanced primary and secondary forces, if any and unbalanced primary and secondary couples with reference to central plane of the engine. **07**

Q.5 (a) What are various frequency measuring instruments? Explain any one in detail. **07**

(b) A twin V-engine has the cylinder center lines at 90^o and the connecting rods operate a common crank. The mass of reciprocating parts per cylinder is 10 kg and the crank radius is 75 mm. The length of connecting rod is 300 mm. Show that the engine may be balanced for primary forces by means of a revolving balance mass. If the engine speed is 500 rpm, what is the value of maximum resultant secondary force? **07**

OR

Q.5 (a) Two rotors, A and B are attached to the ends of the shaft 600 mm long. The mass and radius of gyration of rotor A is 40 kg and 400 mm respectively and that of rotor B are 50 kg and 500 mm respectively. The shaft is 80 mm diameter for first 250 mm, 120 mm for next 150 mm and 100 mm for the remaining length from the rotor A. Assume the modulus of rigidity of the shaft material 0.8×10^5 N/mm^2. Find the position of node on equivalent shaft of diameter 80 mm and on the actual shaft. Also find the natural frequency of the torsional vibrations. **07**

(b) Explain about vibrometer, accelerometer and balancing machine in brief. **07**

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