Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – SUMMER • 2014

Subject Code: 161901 **Date: 19-05-2014**

Subject Name: Dynamics of Machinery

Time: 10:30 am - 01:00 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)** Attempt the following questions.

(i) Explain the term half frequency whirl, Derive the expression for it. **04**

(ii) Explain Rayleigh's method for finding the natural frequency of vibratory system. **03**

(b) A two cylinder locomotive engine has the following specifications: **07**

Reciprocating masses/cylinder = 300 kg, Crank radius = 90 mm, Angle between crank = 90°, Driving wheel diameter = 1780 mm, Distance between cylinder centers = 640 mm, Distance between driving wheel plans = 1500 mm.

Determine:

(i) The fraction of reciprocating masses to be balanced if the hammer blow is not to exceed 45 kN at 95 Km/hr speed.

(ii) The variation in the tractive effort.

(iii) The magnitude of swaying couple.

Q.2 **(a)** A connecting rod of mass 3 kg and 200 mm long between points of suspension is suspended vertically. The time for 50 oscillations is found to be 40 seconds, when the axis of oscillation coincides with the small end centre, and 35 seconds when it coincides with the big end centre. Locate the centre of gravity of the connecting rod from the small end and calculate the mass moment of inertia of the rod about an axis through its centre of gravity. **07**

(b) A shaft is supported in bearings 1.8 m apart and projects 0.45 m beyond bearings at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The mass of end pulleys is 48 kg and 20 kg and their centre of gravity are 15 mm and 12.5 mm respectively from the shaft axis. The centre pulley has a mass of 56 kg and its centre of gravity is 15 mm from the shaft axis. If the pulleys are arranged so as to give static balance. Determine : **07**

(i) Relative angular positions of the pulleys.

(ii) Dynamic forces produced on the bearings when the shaft rotates at 300 r.p.m.

OR

(b) A machine of mass 1000 kg is acted upon by an external force of 2450 N at 1500 r.p.m. To reduce the effect of vibration, isolators of rubber having a static deflection of 2 mm under machine weight and an estimated damping factor of 0.2 are used. **07**

Determine:

(i) Amplitude of vibration of machine.

(ii) Force transmitted to the foundation.

(iii) Phase lag and Phase angle between transmitted force and exciting force.

(iv) Speed at which the maximum amplitude of vibration would occur.

Q.3 **(a)** Define logarithmic decrement and derive an expression for it. **07**

(b) In a single degree viscously damped vibrating system, the suspended mass of 16 kg makes 45 oscillations in 27 seconds. The amplitude of natural vibration decreases to one fourth of initial value after 5 oscillations. Determine: **07**

(i) The logarithmic decrement.

(ii) The damping factor and damping coefficient.

(iii) The stiffness of the spring.

OR

Q.3 **(a)** Explain an analytical method of balancing of several masses rotating in different planes. **07**

(b) A motor car moving with a speed of 100 km/hr has a gross mass of 1500 kg. It passes over rough road which has a sinusoidal surface with amplitude of 75 mm and a wavelength of 5 m. The suspension system has a spring constant of 500 N/mm and damping ratio of 0.5. Determine the displacement amplitude of the car and time lag. **07**

Q.4 **(a)** Explain the method to determine the critical speed of shaft carrying single rotor, considering damping. **07**

(b) Derive an expression for force transmissibility. **07**

OR

Q.4 **(a)** Explain Hozer's method to determine natural frequencies of multi-rotor system. **07**

(b) A shaft of 50 mm diameter and 3 m length has a mass of 10 kg per meter length. It is simply supported at the ends and carries three masses of 70 kg, 90 kg and 50 kg at 1 m, 2 m and 2.5 m respectively from the left support. Find the natural frequency of transverse vibrations by using Dunkerley's method. Consider value of E=200 GPa. **07**

Q.5 **(a)** Find the natural frequency of a system shown in fig.1,Take K=1000 N/m, M =10 kg, m = 2 kg, R = 50 mm and r = 30 mm **07**

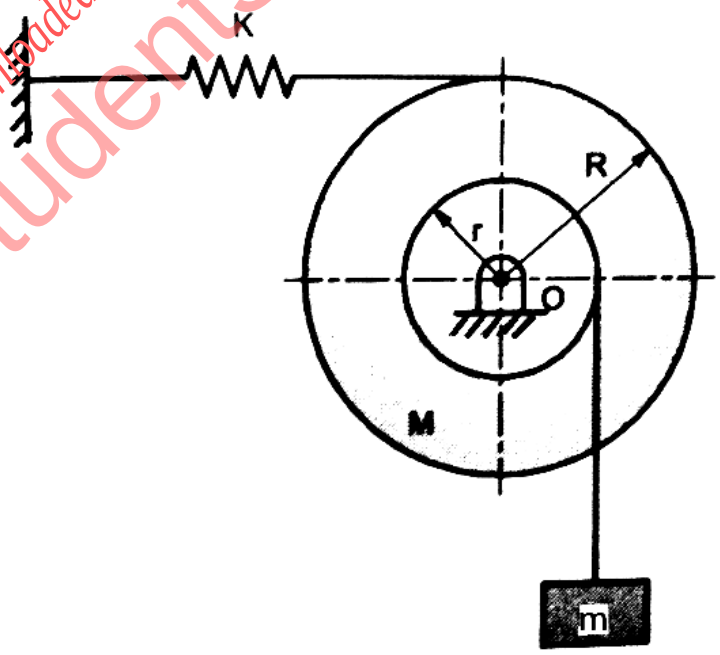

Fig.1

(b) In a geared system shown in Fig.2 the mass of moment of inertia of rotor A and B are 2 kg-m^2 and 0.3 kg-m^2 respectively. The gear ratio between rotor B and A is 3. Calculate the node position and natural frequency of torsional oscillations. Ignore the inertia of the gears and shafts. Take modulus of rigidity of shaft material as 80×10^9 N/ m^2. **07**

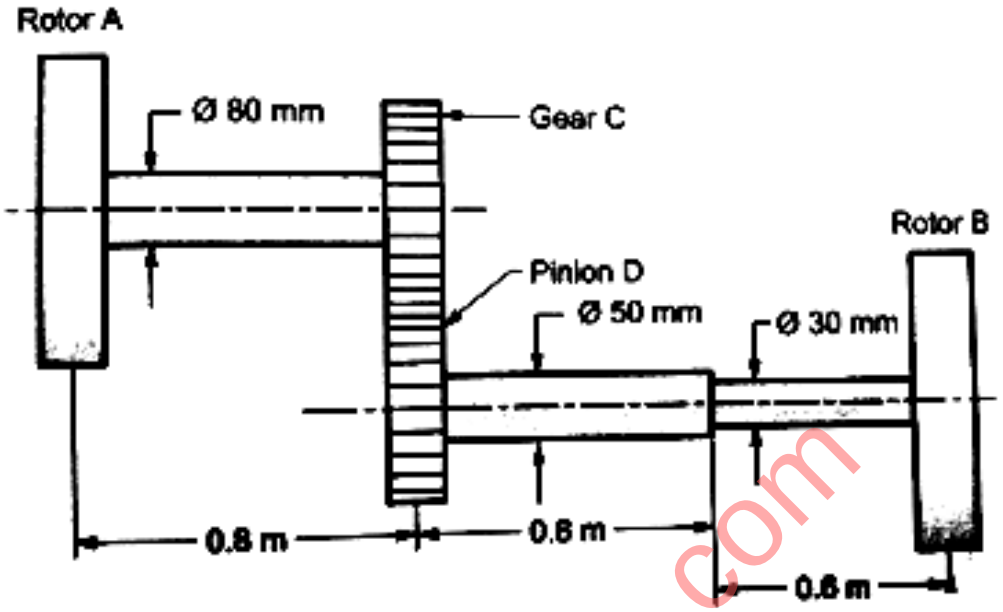

Fig.2

OR

Q.5 **(a)** What do you mean by vibration monitoring of machine? Explain various types of vibration monitoring techniques. **07**

(b) The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 r.p.m. are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. **07**

Determine :

(i)Unbalanced primary and secondary forces, if any, and

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

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