Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VI (Old) EXAMINATION – WINTER 2019

Subject Code: 161901 **Date: 13/12/2019**

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)** Derive an expression for natural frequency of free under-damped system. **07**

(b) Derive an expression for critical speed of shaft carrying a single rotor and having no damping. **07**

Q.2 **(a)** What are inline engines? Explain the procedure of balancing of inline engines. **07**

(b) In a spring mass system, a mass of 100 kg is attached with the spring of stiffness 30 KN/m. The damping provided in only the 25 % of the critical value. Determine (i) the damping ratio, (ii) the critical damping coefficient, (iii) the natural frequency of damped vibrations, (iv) the logarithmic decrement, (v) the ratio of two successive amplitudes. **07**

OR

(b) The following data refer to an outside cylinder uncoupled locomotive: **07**

Weight of rotating parts /cylinder = 300 kg,
Weight of reciprocating parts /cylinder = 270 kg,
Angle between cranks = 90^0,
Crank radius = 0.3 m,
Cylinder centers = 1.75 m,
Wheel centers = 1.55 m,
Radius of balancing weights = 0.7 m,

If whole of the rotating unbalance and two third of reciprocating parts are to be balanced in the planes of the driving wheels. Determine

(i) The magnitude and angular position of the balancing masses.

(ii) Speed in kmph at which the wheel is start lifting, when the load on each driving wheel is 2500 kg and the diameter of tread of driving wheel is 1.8 m.

Q.3 **(a)** A machine weighing 20 Kg is supported on two slabs of isolators, natural rubber and felt as shown in figure 2.1. K & C represents stiffness and damping coefficients of the respective materials. Find the undamped and damped natural frequencies of the system in vertical direction. Neglect the mass of the isolators. **07**

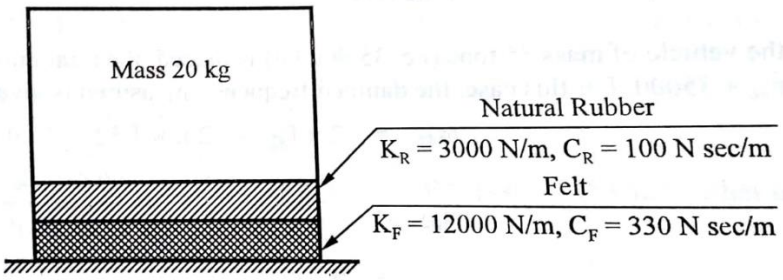

Figure: 3.1

(b) Three cylinders of an air compressor have their axes at 120^0 to one another and their connecting rods are coupled to a single crank. The stroke is 100 mm and length of each connecting rod is 150 mm. the weight of the reciprocating parts per cylinder is 15 N. Find the maximum primary and secondary forces acting on the frame of the compressor when running at 3000 rpm. Describe clearly a method by which such forces may be balanced. **07**

OR

Q.3 **(a)** Four masses P, Q, R & S are completely balanced. Masses R & S makes an angle of 90^0 and 195^0 respectively with that of mass Q in the counterclockwise direction. The rotating masses have the following properties: masses at Q, R & S are 25 Kg, 40 Kg and 35 Kg respectively with their radii of rotations are 200 mm, 100 mm & 180 mm respectively. The radius of rotation of mass P is 150 mm. Planes Q & R are 250 mm apart. Determine the (i) mass P and its angular position with that of mass Q, (ii) position of all the planes relative to plane of mass P. **07**

(b) A body of mass 1 kg lies on a dry horizontal plane and is connected by spring to a rigid support. The body is displaced from the unstressed position by an amount equal to 0.255 m with the tension in the spring at this displacement equal to 5 kg, and then released with zero velocity. How long will the body vibrate and at what distance from the unstressed position will it stop if the coefficient of friction is 0.25? **07**

Q.4 **(a)** Explain the principle on which vibration measuring instruments are working. Derive an expression for relative amplitude. **07**

(b) A machine 100 kg mass has a 20 kg rotor with 0.5 mm eccentricity. The mounting springs have stiffness of 85 KN/m and damping factor of 0.02. the operating speed of machine is 600 rpm and the unit is constrained to move vertically. Find (i) the dynamic amplitude of machine, (ii) the force transmitted to the supports. **07**

OR

Q.4 **(a)** Derive an expression for length of torsionally equivalent shaft system. **07**

(b) An instrument of 50 kg mass is located in an airplane cabin which vibrates at 2000 cpm with an amplitude of 0.1 mm. determine the stiffness of the four springs required as supports for the instrument to reduce its amplitude to 0.005 mm. Also calculate the maximum total load for which each spring must be designed. **07**

Q.5 **(a)** Explain jump phenomenon in cam. **07**

(b) Two identical rotors are attached to the two ends of a stepped shaft as shown in figure 5.1. Each rotor weighs 450 kg and has radius of gyration of 0.38 m. The total length of the shaft is 0.6 m. find the frequency of free torsional vibration of the system and the position of the node from either mass. Assume modulus of rigidity as $80 * 10^9$ N/mm^2. **07**

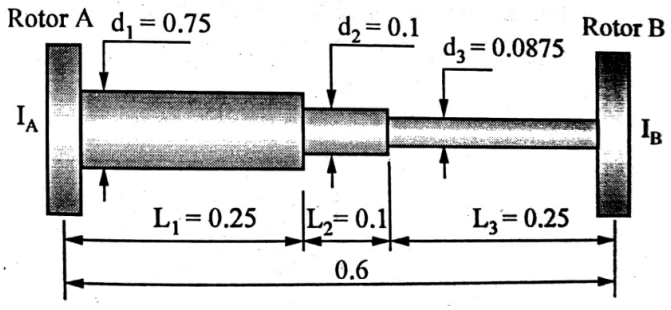

Figure 5.1

OR

Q.5 **(a)** Write a shore note on (i) viscous damping, (ii) eddy current damping. **07**

(b) Neglecting the effect of damping, find the amplitude of steady state vibrations of a rotor having a mass of 5 kg mounted midway on a simply supported shaft of diameter 10 mm and length 400 mm. The CG of the rotor is 0.02 mm away from the geometric center of the rotor due to manufacturing tolerances. Speed of rotor 3000 rpm, Youngs modulus of elasticity of shaft material is $2* 10^{11}$ N/mm^2. Also, determine the dynamic force transmitted to the bearings. **07**

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