Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2023

Subject Code:3151911 Date:20-12-2023

Subject Name:Dynamics of Machinery

Time:10:30 AM TO 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.**
   Simple and non-programmable scientific calculators are allowed.

			MARKS
Q.1	**(a)**	Explain the need of balancing of rotating and reciprocating masses. Explain the effects of unbalancing in rotating and reciprocating masses.	**03**
	(b)	Define the terms: (i) Natural frequency, (ii) damping, (iii) free vibrations, (iv) amplitude of vibration	**04**
	(c)	The four masses P_1, P_2, P_3 and P_4 having their radii of rotation as 100 mm, 120mm, 250 mm and 300 mm respectively. The angles between the masses P_1 & P_2, P_2 & P_3 and P_3 & P_4 are 45^0, 70^0 and 140^0 respectively. Find the position and magnitude of the balancing masses required located at the radius of 350 mm. Use mass value of P1 = 200 KG, P2=250 KG, P3=150 KG,P4=100 KG	**07**
Q.2	**(a)**	Define terms: (i) Turning moment diagram, (ii) Coefficient of fluctuation of energy in case of flywheel, (iii) Critical or whirling speed of shaft	**03**
	(b)	Explain the term vibration isolation. List the different materials used as isolation materials with their applications.	**04**
	(c)	Find the natural frequency of the system shown in figure 2.1. Mass supported by spring is 100 tones. $K_1 = K_2 = K_3 = K_4 = K_5 = K_6 = K = 1000$ N/m.	**07**

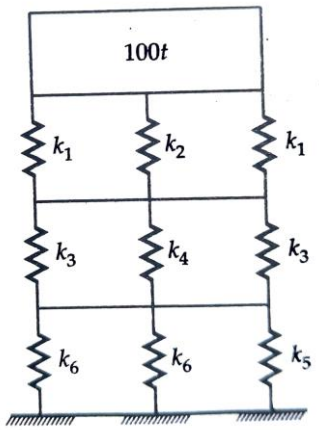


Figure 2.1

OR

	(c)	A flywheel rotating at a maximum speed of 250 rpm and is having radius of gyration of 0.5 m is attached to a punching press. The press is driven by a constant torque electric motor and punches 750 holes per hour. Each punching operation requires 14000 Nm of energy and takes 1.8 seconds. If the speed of the flywheel is not to fall below 225 rpm, find (i) power required by the motor and (ii) mass of the flywheel.	**07**
Q.3	**(a)**	Draw and explain the turning moment diagram of multi-cylinder in line four stroke engine.	**03**
	(b)	State and explain D'Alembert's principle.	**04**

(c) In IC engine mechanism, the crank radius is 400 mm and connecting rod is 950 mm long. The diameter of piston is 100 mm and net gas pressure acting on the piston is 15 MPa. Find (i) thrust on connecting rod, (ii) piston side thrust, (iii) torque acing on the crank shaft. (iv) load on main bearings when crank has made of 45^0 from TDC. **07**

OR

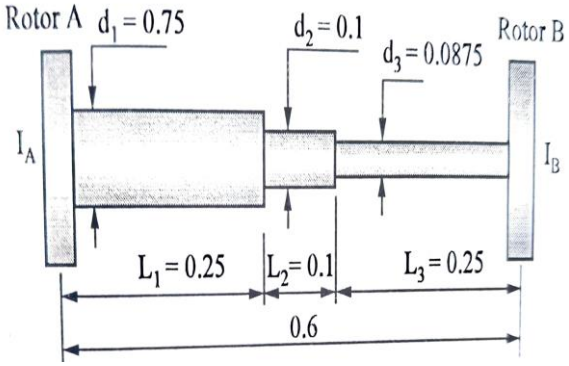
Q.3 **(a)** List the types of damping and explain any one of it. **03**

(b) Explain the effect of active and reactive gyroscopic couple on the aeroplane taking right turn looking from tail end and propeller rotating in clockwise direction. **04**

(c) A turbine rotor weighing 9800 N rotates at 2000 rpm clockwise when viewed from stern. The vessel pitches with an angular velocity of 0.5 rad/sec. Calculate the gyroscopic couple during the rise of the bow if rotor has radius if gyration of 254 mm. Explain the effect of reactive gyroscopic couple on the ship. **07**

Q.4 **(a)** Derive an expression for natural frequency of torsional vibration of a disc connected at the end of the shaft. **03**

(b) Find the equivalent length of the system given below considering the diameter of equivalent shaft as 0.0875 m. **04**



(c) The successive amplitudes of vibrations of vibratory system as obtained under free vibrations are 0.69, 0.32, 0.19, 0.099 units respectively. Determine the damping ratio of the system. Also determine the natural frequency of un-damped vibrations if time period of damped vibration is 0.5 seconds. **07**

OR

Q.4 **(a)** Explain the methods of measurement of displacement and velocity of vibrating bodies. **03**

(b) Draw and explain the two regions of vibration control on transmissibility curve. **04**

(c) A vertical single stage air compressor having a mass of 500 Kg is mounted on springs having stiffness of $1.96 * 10^5$ N/m and damping factor of 0.20. The rotating parts are completely balanced and the equivalent reciprocating parts weigh 20 Kg. The stroke is 0.2 m. Determine the amplitude of steady state vibration of vertical motion and the phase difference between the motion and excitation force if the compressor is operated at 200 rpm. **07**

Q.5 **(a)** **03**

Why the shape of the crank is made like this  ?

(b) Explain the procedure of balancing of V-engines. **04**

(c) In an in-line six-cylinder engine working on two stroke cycle, the cylinder center lines are spaced at 600 mm. In the end view, the cranks are 60° apart and in the order 1-4-5-2-3-6. The stroke of each piston is 400 mm and the connecting rod length is 1 meter. The mass of the reciprocating parts is 200 kg per cylinder and that of rotating parts 100 kg per crank. The engine rotates at 300 r.p.m. Examine the engine for the balance of primary and secondary forces and couples. Find the maximum unbalanced forces and couples. **07**

OR

Q.5 **(a)** What is Hammer blow? Derive an expression for limiting speed required for hammer blow. **03**

(b) Derive an expression for critical speed of shaft carrying a single rotor and having no damping. **04**

(c) A rotor having a mass of 5 kg is mounted midway on a simply supported shaft of diameter 10 mm and length 400 mm. Because of manufacturing tolerances, the CG of the rotor is 0.02 mm away from the geometric center of the rotor. If the rotor rotates at 3000 rpm, find the amplitude of steady state vibrations and the dynamic force transmitted to the bearings. Neglect the effect of damping. Take $E = 2 * 10^{11}$ N/m^2. **07**

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