Seat No./Enrollment No.: ________

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 5 – EXAMINATION – SUMMER 2026

Subject Code: 3151911 **Date: 06/06/2026**

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.

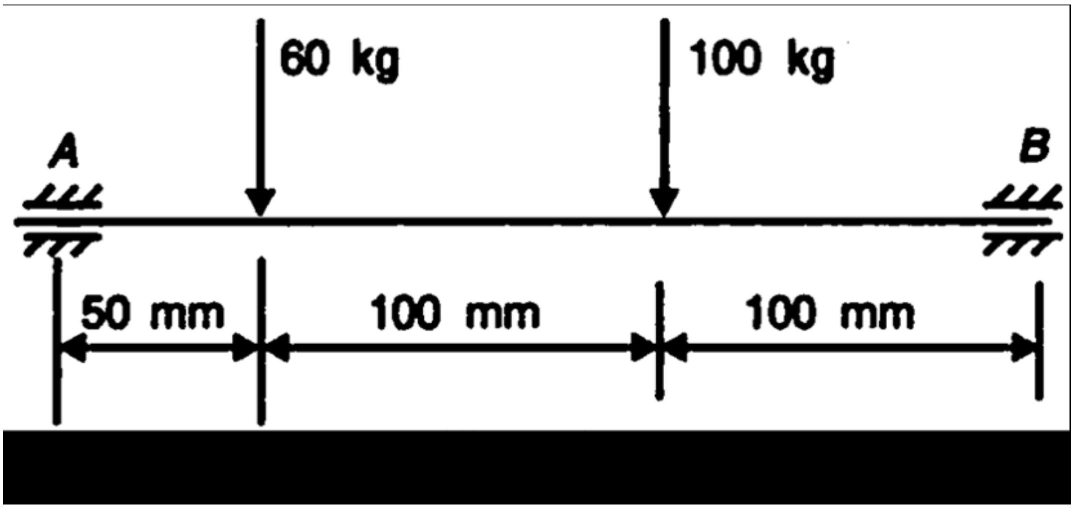
3. Figures to the right indicate full marks.

4. Simple and non-programmable scientific calculators are allowed.

Q.1	**(a)**	State D'Alembert's principle and explain its significance in dynamic analysis.	**03**
	(b)	Calculate the inertia force in a slider-crank mechanism given crank speed and dimensions.	**04**
	(c)	Analyze a three-rotor torsional vibration system and determine its natural frequencies.	**07**
Q.2	**(a)**	Analyze the effect of gyroscopic couple on the stability of a two-wheeler during a turn.	**03**
	(b)	An aeroplane makes a complete half circle of 60 m radius towards left when flying at 250 km/h. The rotary engine and the propeller of the plane have a mass of 450 kg with a radius of gyration of 300 mm. The engine runs at 2400 rpm clockwise when viewed from the rear. Find the gyroscopic effect on the aircraft.	**04**
	(c)	A spring-mass system consists of a spring of stiffness 350 N/m. The mass is 0.35 kg. The mass is displaced 20 mm beyond the equilibrium position and released. The damping coefficient is 14 N.s/m. Determine (a) critical damping coefficient, (b) damped natural frequency, and (c) logarithmic decrement.	**07**
		OR	
Q.2	**(c)**	A vibrating system consists of a mass of 30 kg, a spring of stiffness 20 kN/m and a damper of damping factor 0.25. Calculate: (a) the critical damping coefficient (b) the natural frequency of damped vibrations (c) the logarithmic decrement, and (d) the ratio of two successive amplitudes.	**07**
Q.3	**(a)**	Propose design modifications to prevent resonance in high-speed rotors.	**03**

(b) Compare the characteristics of turning moment diagram for a single cylinder engine and multi-cylinder engine. **04**

(c) A solid shaft of uniform diameter is supported by two short-bearings as shown in Figure 1. The above shaft carries two discs having concentrated masses of 60 kg and 100 kg respectively. Determine the fundamental frequency of vibration if the moment of inertia of the shaft is 40 x 10^4 mm^4 and damping at the bearing is neglected. **07**



OR

Q.3 **(a)** Propose safety considerations for operating near critical speed. **03**

(b) Analyze the role of a flywheel in punching presses. **04**

(c) A motor drives a centrifugal pump through gearing. The speed of the pump is one-third of the speed of the motor. The diameter of pinion shaft is 40 mm and it is 300 mm long. The mass moment of inertia of motor is 400 kgm^2. The gear shaft, on which impeller of centrifugal pump is mounted, has 60 mm diameter and is 600 mm long. The mass moment of inertia of the impeller is 1500 m^2. Neglecting the inertia of gear and pinion, determine the natural frequency of torsional vibration. **07**

Q.4 **(a)** Explain logarithmic decrement and its use. **03**

(b) Analyze the effect of damping on the critical speed of a horizontal shaft. **04**

(c) A single cylinder vertical petrol engine of total mass 300 kg is mounted upon a steel chassis frame and causes a vertical static deflection of 2 mm. The reciprocating parts of the engine has a mass of 20 kg and move through a vertical stroke of 150 mm with simple harmonic motion. A dashpot is provided whose damping resistance is directly proportional to the velocity and amounts to 1.5 kN per meter per second. Examine the effect of forced vibration considering that the steady state of vibration is reached and determine the amplitude of forced vibrations, when the driving shaft of the engine rotates at 480 r.p.m., and the speed of the driving shaft at which resonance will occur. **07**

OR

Q.4 **(a)** Explain vibration isolation and Transmissibility. **03**

	(b)	Examine the effect of resonance in rotating shafts.	**04**
	(c)	Analyze the effect of damping on frequency Forced Vibrations under Under damped condition using graphical method.	**07**
Q.5	**(a)**	Define static and dynamic balancing with examples.	**03**
	(b)	Explain the concept of primary and secondary balancing in reciprocating engines.	**04**
	(c)	The following data refer to an outside cylinder uncoupled locomotive: Mass of rotating parts per cylinder = 350 kg Mass of reciprocating parts per cylinder = 300 kg Angle between cranks = 90o Crank radius = 0.3 m Cylinder centers = 1.8 m Radius of balance masses = 0.8 m Wheel centers = 1.5 m If whole of the rotating and 2/3rd of the reciprocating parts is to be balanced in planes of the driving wheels, find (a) magnitude and angular positions of balance masses, (b) speed in km/h at which the wheel will lift off the rails when the load on each driving wheel is 30 kN, and the diameter of tread of driving wheels is 1.8 m	**07**

OR

Q.5	**(a)**	Define imaginary crank using neat sketch with regard to the balancing of reciprocating secondary unbalanced forces.	**03**
	(b)	Explain the partial balancing of primary unbalanced forces in single cylinder reciprocating engine.	**04**
	(c)	A twin cylinder V-engine has the cylinders set at an angle of 45°. The connecting rods are 30 cm long and the crank radius is 70 mm. The total rotating mass is equivalent to 3 kg at the crank radius and the reciprocating parts mass is 2 kg per line. A balance mass is fitted opposite to the crank equivalent to 2.5 kg at a radius 10 cm. The engine speed is 2000 rpm. What the value of maximum resultant secondary force.	**07**

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