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.**

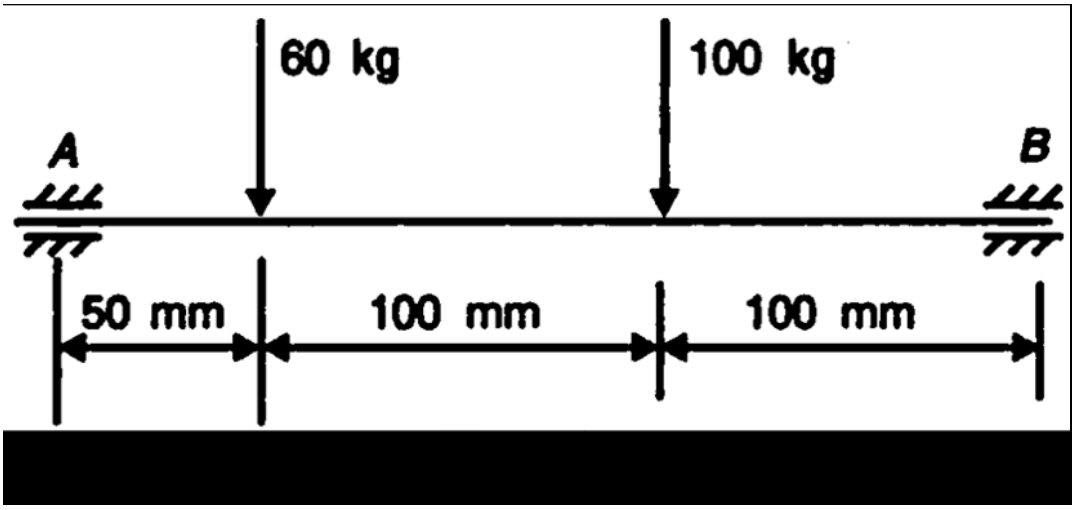
Q.1	**(a)**	State D'Alembert's principle and explain its significance in dynamic analysis.	**03**
	(b)	Calculate the inertia force in a slider-crank mechanism given crank speed and dimensions.	**04**
	(c)	Analyze a three-rotor torsional vibration system and determine its natural frequencies.	**07**
Q.2	**(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: **07**
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

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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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V EXAMINATION – SUMMER 2025

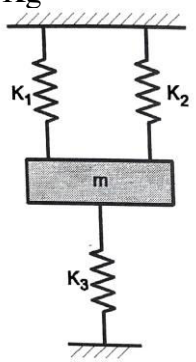
Subject Code:3151911 Date:28-05-2025

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.**

			MARKS
Q.1	**(a)**	Explain static balancing of rotating masses. Why is it necessary?	**03**
	(b)	Explain the role of flywheel in two wheelers. How its function is differing from governor?	**04**
	(c)	Explain inline engines and procedure of balancing of inline engines.	**07**
Q.2	**(a)**	Define the terms: i) Natural frequency, ii) damping, iii) forced vibrations	**03**
	(b)	Derive necessary formula for critical speed of rotating shaft carrying a single rotor for un-damped vibrations.	**04**
	(c)	The mass of the turbine rotor of a ship is 3000 Kg and radius of gyration is 0.4 m, rotating at speed of 2500 rpm clockwise, when looking from stern. Determine gyroscopic couple and its effect when a) the ship steers to the left on curve of 100 m radius at a speed of 36 kmph. b) when the ship is pitching in SHM, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12^0.	**07**
		OR	
	(c)	Determine the natural frequency of the system shown in the figure**.** Given K_1 = 1000 N/m, K_2 = 1000 N/m and K_3 = 20000 N/m, m = 10 Kg 	**07**
Q.3	**(a)**	Explain the method of dry friction damping.	**03**
	(b)	State and explain D'Alembert's principle.	**04**
	(c)	The following data relate to horizontal reciprocating engine: Mass of reciprocating parts = 100 Kg, mass of connecting rod = 80 Kg, Stroke length = 200 mm, length of connecting rod between centers = 400 mm, Radius of gyration of connecting rod about an axis through C. G. = 120 mm, Distance of C. G. from big end center = 160 mm, Engine speed = 900 rpm clockwise, Determine the inertia torque on crankshaft when crank has turned 40^0 from I. D. C.	**07**
		OR	
Q.3	**(a)**	Draw the force transmissibility curve and explain the three regions of control of vibration.	**03**

(b) Write the equation of gyroscopic couple on the aeroplane and explain the terms in it. Explain the effect of gyroscopic effect on it when propeller is rotating in anticlockwise direction when looking from nose end and aeroplane taking right turn. **04**

(c) Determine the power required and mass of the flywheel to operate the punching press with following data: maximum and minimum speed of rotation of flywheel 250 rpm and 225 rpm respectively, and radius of gyration is 500 mm. The press is driven by a constant torque electric motor and punches 750 holes per hour. Each punching operation requires 14000 N-m of energy and takes 1.8 seconds. **07**

Q.4 **(a)** Explain why the leading and trailing wheels of a high speed locomotives are connected with connecting rods. **03**

(b) Three masses are rotating in the different planes. How many balancing masses are required for balancing of these masses? Explain in brief procedure of balancing of these masses. **04**

(c) The following data refers to an inside cylinder locomotive; **07**
Mass of a rotating parts/ cylinder = 14 Kg,
Mass of reciprocating parts/ cylinder = 39 Kg,
Pitch of the cylinder = 700 mm,
Angle between the cranks = 90^0,
Length of each crank = 320 mm,
Wheel tread diameter = 1900 mm,
Distance between planes of wheel = 1800 mm,
If total rotating masses and 2/3 of the reciprocating masses are to be balanced, then determine the magnitude and angular position of balanced masses to be placed at a radius of 700 mm in the plane of wheels.

OR

Q.4 **(a)** Explain why the army soldiers are not allowed to marched on the bridges. **03**

(b) Derive an expression for critically damped system. **04**

(c) A mass suspended from a helical spring vibrates in a viscous fluid medium whose resistance varies directly with the speed. It is observed that the frequency of damped vibration is 2 Hz and the amplitude decreases to 20 % of its initial value in one complete cycle. Find the frequency of the free un-damped vibrations. **07**

Q.5 **(a)** Explain vibration isolation in detail. **03**

(b) Explain with neat sketch vibration measuring instrument. **04**

(c) A shaft of 50 mm diameter and 3 m long is simply supported at the ends carries three rotors of mass 100 Kg, 150 Kg and 75 Kg at 2 m, 1 m and 0.5 m from the right hand support. The modulus of elasticity of the shaft material is $2x10^5$ N/mm^2. Find the critical speed of the shaft by using Dunkerley's method. **07**

OR

Q.5 **(a)** Explain the magnification factor. Write an expression of it. What is the role of magnification factor in vibrations. **03**

(b) Determine the displacement and velocity of a machine running at 120 rpm. A vibration measuring instrument is used for the measurements. The natural frequency of the instrument is 5 Hz and it shows 0.004 cm reading on it. Assume no damping. **04**

(c) A vibrating body of mass 250 Kg supported on springs of total stiffness 1050 KN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. Determine the amplitude of forced vibration and the transmissibility. Assume damping factor as 0.3. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2024

Subject Code: 3151911 Date:31-05-2024

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)**	Explain the Whirling Speed of a Shaft	**03**
	(b)	Explain the Dynamical Equivalent System of two masses.	**04**
	(c)	Analyze the forces like Piston effort and force acting along the connecting rod.	**07**
Q.2	**(a)**	Illustrate the various types of vibrations.	**03**
	(b)	List the characteristics of Static balancing and Dynamic balancing.	**04**
	(c)	The mass of a single degree damped vibrating system is 7.5 kg and makes 24 free oscillations in 14 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.25 of its initial value after five oscillations. Determine : 1. stiffness of the spring, 2. logarithmic decrement, and 3. damping factor, i.e. the ratio of the system damping to critical damping.	**07**
		OR	
	(c)	A shaft 1.5 m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft.	**07**
Q.3	**(a)**	List the criteria for selection of reference plane for balancing masses rotating in multiple plane.	**03**
	(b)	Apply Rayleigh's method to derive natural frequency of free transverse vibrations for a shaft subjected to a number of point loads.	**04**
	(c)	Analyze the effect of unbalanced forces on V-engine and derive the relation for secondary unbalanced force.	**07**
		OR	
Q.3	**(a)**	Explain the concept of imaginary crank in secondary unbalanced forces.	**03**
	(b)	Examine the effect of Magnification Factor on vibrating system.	**04**
	(c)	Justify the statement "Balancing of primary unbalanced force is partial".	**07**
Q.4	**(a)**	Apply Rayleigh's method to determine natural frequency of free longitudinal vibration.	**03**
	(b)	A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass 100 kg at its free end. The Young's modulus for the shaft material is 200 GN/m^2. Determine the frequency of longitudinal and transverse vibrations of the shaft.	**04**
	(c)	The rotor of the turbine of a ship has a mass of 2500 kg and rotates at a speed of 3200 rpm counter-clockwise when viewed from stem. The rotor has radius of gyration of 0.4 m. Determine the gyroscopic couple and its effect when (i) the ship steers to the left in a curve of 80 m radius at a speed of 15 knots (1 knot = 1860 m/h) (ii) the ship pitches 5 degrees above and 5 degrees below the normal position and the bow is descending with its maximum velocity-the pitching	**07**

motion is simple harmonic with a periodic time of 40 seconds (iii) the ship rolls and at the instant, its angular velocity is 0.4 rad/s clockwise when viewed from stem. Also find the maximum angular acceleration during pitching.

OR

Q.4 **(a)** Anlyse the effect of Natural Frequency of Free Transverse Vibrations. **03**

(b) An instrument vibrates with a frequency of 1 Hz when there is no damping. When the damping is provided, the frequency of damped vibrations was observed to be 0.9 Hz. Find 1. the damping factor, and 2. logarithmic decrement. **04**

(c) A rear engine automobile is travelling along a track of 100 metres mean radius. Each of the four road wheels has a moment of inertia of 2.5 kg-m^2 and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of 1.2 kg-m^2. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle speed is 3:1. The automobile has a mass of 1600 kg and has its centre of gravity 0.5 m above road level. The width of the track of the vehicle is 1.5 m. Calculate the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface. Assume that the road surface is not cambered and centre of gravity of the automobile lies centrally with respect to the four wheels. **07**

Q.5 **(a)** Solve the equation of motion for a forced damped vibration by graphical method. **03**

(b) Compare the Frequency of Free Damped Vibrations under following situations using a graph amplitude vs time period. **04**

- Under damping
- Over damping
- Critical damping

(c) Each crank and the connecting rod of a four-crank in-line engine are 200 mm and 800 mm respectively. The outer cranks are set at 120° to each other and each has a reciprocating mass of 200 kg. The spacing between adjacent planes of cranks are 400 mm, 600 mm and 500 mm. If the engine is in complete primary balance, determine the reciprocating masses of the inner cranks and their relative angular positions. Also find the secondary unbalanced force if the engine speed is 210 rpm. **07**

OR

Q.5 **(a)** Identify the significance of Damping Factor and Logarithmic Decrement for damped vibration **03**

(b) Demonstrate the Dunkerley's method to determine the Natural Frequency of Free Transverse Vibrations For a Shaft Subjected to a Number of Point Loads **04**

(c) A rotor is completely balanced when masses of 2 kg and 1.2 kg are added temporarily in planes A and D each at 200 mm radius as shown in Fig. 1. The balanced mass in the plane A is along the x-axis whereas in the plane D, it is at 120° counter-clockwise. It is desired that the actual balancing is to be done by adding permanent masses in planes B and C, each at 120 mm radius. Determine the magnitudes and the directions of the masses B. **07**

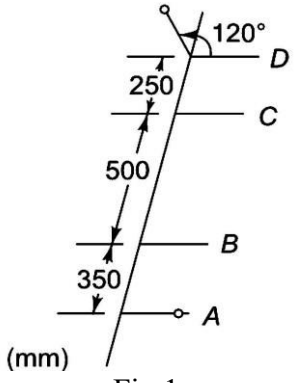


Fig.1

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- V EXAMINATION-SUMMER 2023

Subject Code: 3151911 Date: 03/07/2023

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**

			MARKS
Q.1	**(a)**	Explain the effect of gyroscopic couple on naval ship.	**03**
	(b)	Explain the difference between piston effort, crank effort and crank-pin effort.	**04**
	(c)	The three cranks of a three-cylinder locomotive are all on the same axle and are set at 120°. The pitch of the cylinders is 1 metre and the stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40% of the reciprocating parts are to be balanced, find the magnitude and the position of the balancing masses required at a radius of 0.6 m.	**07**
Q.2	**(a)**	Define the terms: i) magnification factor, ii) force transmissibility, iii) relative amplitude.	**03**
	(b)	Explain the terms 'fluctuation of energy' and 'fluctuation of speed' as applied to flywheels.	**04**
	(c)	Find the natural frequency of the given system given in the figure 2.1.	**07**

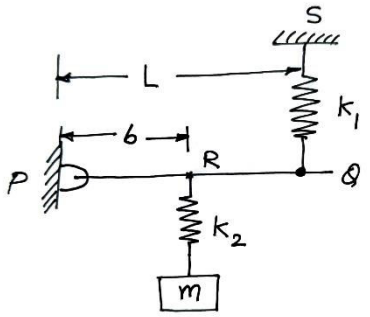


Figure 2.1

OR

	(c)	In a slider crank mechanism, the length of the crank and connecting rod are 150 mm and 600 mm respectively. The crank position is 60° from inner dead center. The crank shaft speed is 450 r.p.m. (clockwise). Using analytical method, determine: 1. Velocity and acceleration of the slider, and 2. Angular velocity and angular acceleration of the connecting rod.	**07**
Q.3	**(a)**	Derive an expression of swaying couple for an uncoupled two-cylinder locomotive engine.	**03**
	(b)	Explain the method of balancing of inline engines.	**04**

(c) Four masses P, Q, R and S as shown below are to be completely balanced. **07**

	P	Q	R	S
Mass (Kg)	---	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses Q and R are 300 mm apart. The angle between planes containing Q and R is 90°. Q and R make angles of 210° and 120° respectively with S in the same sense. Find:

1. The magnitude and the angular position of mass P; and
2. The position of planes P and S.

OR

Q.3 **(a)** Derive an expression for time period of damped vibration. **03**

(b) Explain with neat sketch working of any one frequency measuring instrument. **04**

(c) A vibratory body of mass 150 Kg supported on springs of total stiffness 1050 KN/m and has a rotating unbalance of 525 N at a speed of 6000 rpm. If the damping factor is 0.3, determine; **07**

i) the amplitude caused by the unbalance,
ii) the transmissibility
iii) the actual force transmitted and its phase angle.

Q.4 **(a)** State the D'Alembert's principle and explain any one application of it. **03**

(b) Explain the turning moment diagram of a four stroke cycle internal combustion engine. **04**

(c) A single cylinder double acting steam engine develops 150 kW at a mean speed of 80 r.p.m. The coefficient of fluctuation of energy is 0.1 and the fluctuation of speed is ± 2% of mean speed. If the mean diameter of the flywheel rim is 2 meter and the hub and spokes provide 5% of the rotational inertia of the flywheel, find the mass and cross-sectional area of the flywheel rim. Assume the density of the flywheel material made of cast iron as 7200 kg/m^3. **07**

OR

Q.4 **(a)** Define the terms: i) Natural frequency, ii) damping, iii) mechanical vibrations **03**

(b) Derive an expression for equation of motion of critically-damped system. **04**

(c) Determine the damping constant of the particular viscous system for the following data; **07**

Amplitude of second cycle = 12 mm
Amplitude of third cycle = 10.5 mm
Spring constant = 800 N/m
Weight on spring = 2 Kg.

Q.5 **(a)** Differentiate between static balancing and dynamic balancing. **03**

(b) What do you understand by gyroscopic couple? Derive a formula for its magnitude. **04**

(c) A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width 1.5 m and height of centre of gravity 500 mm above the ground level and lies at 1 metre from the front axle. Each wheel has an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m2. The drive shaft, engine flywheel and transmission are rotating at 4 times the speed of road wheel, in a clockwise direction when viewed from the front, and is equivalent to a mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60 km/h, find the load on each wheel. **07**

OR

Q.5 **(a)** State different ways of providing the damping and explain any one in detail. **03**

(b) Derive an expression for torsionally equivalent shaft system. **04**

(c) A vertical shaft is held between the long bearings and a disc is attached to the shaft at its mid-point. The center of gravity of the disc does not coincide with the axis of the shaft. The diameter of the shaft is 15 mm and the span of the shaft between two **07**

bearings is 1 meter. The mass of the disc is 10 Kg and the center of the gravity of the disc is 0.3 mm from the axis of the shaft. Take E = 200 GN/m2 and permissible stress in the shaft material as 70 * 106 /m^2.
Determine the critical speed of the shaft and the range of the speed over which it is unsafe to run the shaft.

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(NEW) EXAMINATION – SUMMER 2022

Subject Code:3151911 Date:07/06/2022

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.**

			MARKS
Q.1	**(a)**	Define inertia force and inertia couple. State D′ Alembert principle.	**03**
	(b)	Draw the turning moment diagram for I). Four stroke Cycle Internal Combustion engine. II). Multi-cylinder Engine.	**04**
	(c)	Explain the effect of gyroscopic couple and centrifugal couple on the reaction of the four wheels of a vehicle negotiating a curve.	**07**
Q.2	**(a)**	Define following terms. I). Over damped system II). Logarithmic decrement III). Under damped system	**03**
	(b)	Differentiate between static balancing and dynamic balancing system.	**04**
	(c)	Explain briefly the balancing of several mass in same plane.	**07**
		OR	
	(c)	In a slider crank mechanism, the length of the crank and connecting rod are 150 mm and 600 mm respectively. The crank position is 60^o from the dead center. The crank shaft speed is 450 r.p.m. (clock wise). Using analytical method, determine: I). Velocity and acceleration of the slider. And II). Angular velocity and angular acceleration of the connecting rod.	**07**
Q.3	**(a)**	What do you understand by gyroscopic couple? Derive a formula for its magnitude.	**03**
	(b)	Classify types of vibration.	**04**
	(c)	The turning moment diagram for a multi-cylinder engine has been drawn to a scale 1mm = 600 N-m vertically and 1 mm = 3^o horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as +52,-124,+92,-140,+85,-72 and +107 mm^2 , when the engine is running at a speed of 600 r.p.m. If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the necessary mass of the flywheel of the radius 0.5 m.	**07**
		OR	
Q.3	**(a)**	Write the short note on primary and secondary balancing.	**03**
	(b)	Explain in what way the gyroscopic couple affects the motion of an aircraft while taking a turn.	**04**
	(c)	Discuss the method of Balancing of v- engines and determine the expression for magnitude and direction of resultant primary force.	**07**
Q.4	**(a)**	Define: I). Natural frequency, II). Damping, III). Forced Vibration.	**03**
	(b)	Explain partial balancing of reciprocating engine.	**04**
	(c)	For the system in Fig 1. If K_1= 2800 N/m, K_2= 1400 N/m, K_3= 3800 N/m, $K_4 = K_5$ = 700 N/m; find the mass m such that the system will have a natural frequency of 15 Hz.	**07**

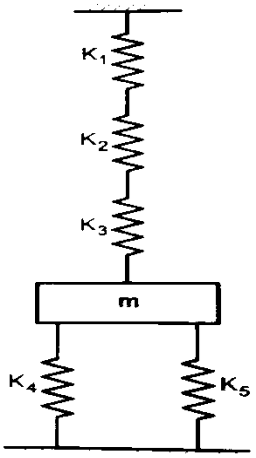


Fig 1.

OR

Q.4	**(a)**	Explain the term magnification factor and obtain expression for it.	**03**
	(b)	Define logarithmic decrement and derive an expression for it.	**04**
	(c)	Explain briefly forced vibrations due to rotating unbalance.	**07**
Q.5	**(a)**	Classify the vibration measuring instruments.	**03**
	(b)	Clearly explain the working principle of vibrometer and accelerometer.	**04**
	(c)	A damped vibration system consisting of 40 kg mass executes 20 oscillations in 5 sec. amplitude of vibration decreases to one-eighth of the initial value after 8 complete oscillations. Determine: Logarithmic decrement, Damping factor, Damping co-efficient and spring stiffness.	**07**

OR

Q.5	**(a)**	Why balancing of rotating and reciprocating masses is necessary? What are effects of unbalancing?	**03**
	(b)	Write 250 words on Torsionally Equivalent Shaft.	**04**
	(c)	Two rotors A and B are attached to the ends of a shaft 1.6 m long. The mass of rotor A is 2500 kg and it radius of gyration is 0.8m. The corresponding values for rotor B are 500 kg and 0.5 m respectively. The diameter of shaft is 180 mm for first 0.5 m, 220 mm for next 0.4 m and 100 mm for the remaining length, measuring length, measuring from rotor A. Assuming G = 0.8×10^5 MPa. For the shaft material, find position of node and natural frequency of torsional vibration.	**07**

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