Register Number:……..

KUMARAGURU
college of technology
character is life

B.E DEGREE EXAMINATIONS: NOV/DEC 2022

(Regulation 2018)

Fifth Semester

MECHANICAL ENGINEERING

U18MEI5205: Dynamics of Machinery

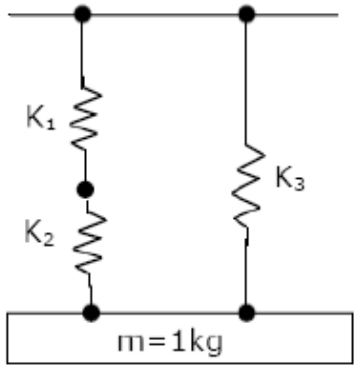
COURSE OUTCOMES

CO1: Analyze the static and dynamic force in mechanical systems. Evaluate the fluctuation of energy stored in flywheel.
CO2: Determine the unbalanced force in reciprocating and rotating mass
CO3: Apply the fundamental concepts of vibrating system to predict the natural frequency
CO4: Estimate the frequency of damped and forced vibrating systems
CO5: Calculate the speed range of governors.
CO6: Determine the gyroscopic couple.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

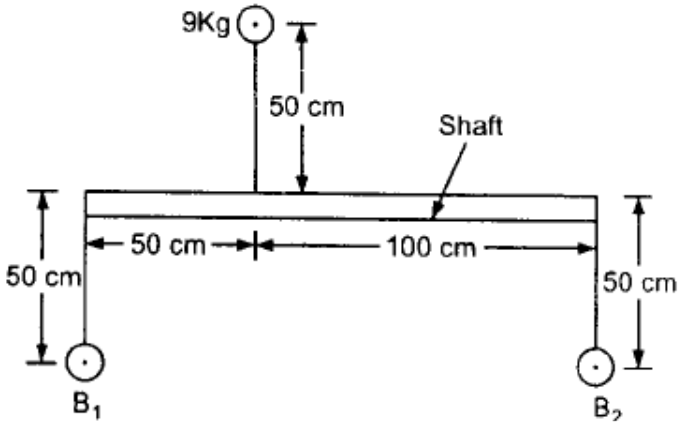
1.	Differentiate between static force analysis and dynamic force analysis.	CO1	[K_2]
2.	If the rotating mass of a rim type fly wheel is distributed on another rim type flywheel whose mean radius is half mean radius of the former, then find the energy stored in the latter at the same speed.	CO1	[K_2]
3.	Whether grinding wheels are balanced or not? If so, why?	CO2	[K_2]
4.	Why complete balancing is not possible in reciprocating engine?	CO2	[K_2]
5.	A mass of 1 kg is suspended by means of 3 springs as shown in figure. The spring constants K_1, K_2 and K_3 are respectively 1 kN/m, 3 kN/m and 2 kN/m. Find the natural frequency of the system in Hz	CO3	[K_2]



6.	What are the inferences at node point in torsional vibration?		CO3	[K_2]
7.	Define transmissibility ratio or isolation factor.		CO4	[K_2]
8.	What is the relationship between frequencies of undamped and damped vibration?		CO4	[K_2]
9.	Identify the effect of friction on the governor?		CO5	[K_2]
10.	Specify the application of gyroscopic principle.		CO6	[K_2]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11.	a)	The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm to 500 N-m torque and 1 mm to 6° of crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end, in sq. mm are – 30, + 410, – 280, + 320, – 330, + 250, – 360, + 280, – 260 sq. mm, when the engine is running at 800 r.p.m. The engine has a stroke of 300 mm and the fluctuation of speed is not to exceed ± 2% of the mean speed. Determine a suitable diameter and cross-section of the flywheel rim for a limiting value of the safe centrifugal stress of 7 MPa. The material density may be assumed as 7200 kg/m^3. The width of the rim is to be 5 times the thickness.	12	CO1	[K_3]
	b)	Discuss the dynamically equivalent system with neat sketch.	4	CO1	[K_2]
12.	a)	A shaft supported in bearings that are 1.6 m apart projects 400 mm beyond bearings at each end. It carries three pulleys one at each end and one at the centre of its length. The masses of the end pulleys are 40 kg and 22 kg and their centers of mass are 12 mm and 18 mm respectively from the shaft axes. The mass of the centre pulley is 38 kg and its centre of mass is 15 mm from the shaft axis. The pulleys are arranged in a manner that they give static balance, determine (i) the relative angular positions of the pulleys (ii) dynamic forces developed on the bearings when the shaft rotates at 210 rpm.	12	CO2	[K_3]
	b)	Masses B_1, B_2 and 9 kg are attached to a shaft in parallel planes as shown in the figure. If the shaft is rotating at 100 rpm, find the mass B_2.	4	CO2	[K_2]



13.	a)	A shaft 50 mm diameter and 3 metres long is simply supported at the ends and carries three loads of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. The Young's modulus for shaft material is 200 GN/m^2. Find the frequency of transverse vibration.	12	CO3	[K_3]
	b)	Explain the whirling speed of shafts?	4	CO3	[K_2]
14.	a)	A machine part of mass 2 kg vibrates in a viscous medium. Determine the damping coefficient when a harmonic exciting force of 25 N results in a resonant amplitude of 12.5 mm with a period of 0.2 second. If the system is excited by a harmonic force of frequency 4 Hz what will be the percentage increase in the amplitude of vibration when damper is removed as compared with that with damping.	12	CO4	[K_3]
	b)	Discuss the steady -state response of the system in case of forced vibrations.	4	CO4	[K_2]
15.	a)	The arms of a Porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified.	12	CO5	[K_3]

	b)	Discuss the following characteristics of governors (i)Stability (ii) Sensitivity of governors.	4	CO5	[K_2]
16.	a)	A ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 rpm. The rotor has a radius of gyration of 0.5m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions: 1) The ship sails at a speed of 30km/h and steers to the left in a curve having 60m radius. 2) The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds. 3) The ship rolls and at a certain instant it has an angular velocity of 0.03rad/s clockwise when viewed from stern. Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case.	12	CO6	[K_3]
	b)	What is the effect of reactive gyroscopic couple on ship steering? And state the difference between steering ,rolling and pitching.	4	CO6	[K_2]

****