BT MRE-V(R/S)-11-24-3450 Reg. No. | | | | | | | | |

C

B.Tech. Degree V Semester Regular/Supplementary Examination in Marine Engineering November 2024

19-208-0501 DYNAMICS OF MACHINERY

(2019 Scheme)

Time: 3 Hours Maximum Marks: 60

Course Outcome
On successful completion of the course, the students will be able to:

CO1: Recall the concepts of free body diagrams, principles of statics and dynamics.
CO2: Use graphical and analytical methods to do force analysis of planar mechanisms.
CO3: Apply these concepts in different machine elements for the evaluation of forces and moments.
CO4: Analyze the dynamics of different mechanisms and machine elements and determine the various forces and torques.
CO5: Analyze different modes of vibrations and their practical applications.

Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 –Analyze, L5 – Evaluate, L6 – Create
PI – Programme Indicators

(Answer *ALL* questions) (5 × 15 = 75)

			Marks	BL	CO	PI
I.	(a)	Define and explain superposition theorem as applicable to a system of forces acting on a mechanism.	5	L1	1	1
	(b)	Determine the magnitude and direction of the torque "T" to be applied on the link AB of a four link mechanism shown in Figure 1 to maintain static equilibrium at the given position.	10	L2	1	2

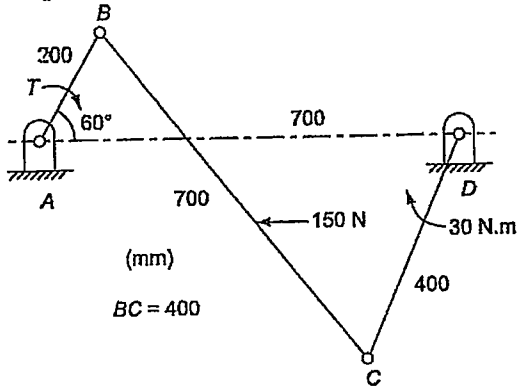

Figure 1

OR

II.	(a)	What do you mean by dynamically equivalent system? Explain.	5	L1	1	1
	(b)	The connecting rod of a vertical high-speed engine is 600 mm long between centers and has a mass of 3 kg. Its center of mass lies at 200 mm from the big end bearing. When suspended as a pendulum from the gudgeon pin axis, it makes 45 complete oscillations in 30 seconds. The piston stroke is 250 mm. The mass of the reciprocating parts is 1.2 kg. Determine the inertia torque on the crankshaft when the crank makes an angle of 140° with top-dead center. The engine speed is 1,500 rpm.	10	L2	1	2

(P.T.O.)

			Marks	BL	CO	PI
III.	(a)	Derive a relationship that can be used to find the dimensions of the flywheel rim.	5	L1	2	1
	(b)	A three-cylinder single-acting engine has its cranks at 120°. The turning-moment diagram for each cycle is a triangle for the power stroke with a maximum torque of 60 Nm at 60° after the dead center of the corresponding crank. There is no torque on the return stroke. The engine runs at 400 rpm. Determine the (i) power developed. (ii) coefficient of fluctuation of speed if the mass of the flywheel is 10 kg and radius of gyration is 88 mm. (iii) coefficient of fluctuation of energy. (iv) maximum angular acceleration of flywheel.	10	L2	2	2
		OR				
IV.	(a)	Explain the gyroscopic effects in four-wheeled vehicle.	5	L1	2	1
	(b)	A rear-engine automobile is travelling along a curved track of 120 m radius. Each of the four wheels has a moment of inertia of 2.2 kgm^2 and an effective diameter of 600 mm. The rotating parts of the engine have a moment of inertia of 1.25 kgm^2. The gear ratio of the engine to the back wheel is 3.2. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The mass of the vehicle is 2050 kg and the centre of mass is 520 mm above the road level. The width of the track is 1.6 m. What will be the limiting speed of the vehicle if all the four wheels maintain contact with the road surface?	10	L2	2	2
V.	(a)	What is meant by static and dynamic unbalance in machinery? How can the balancing be done?	5	L1	3	1
	(b)	A rotor has the following properties in Table 1. If the shaft is balanced by two counter masses located at 100 mm radii and revolving in planes midway of planes 1 and 2 and midway of 3 and 4, determine the magnitude of the masses and their respective angular positions.	10	L2	3	2

Mass	Magnitude	Radius	Angle	Axial distance from first mass
1	9 kg	100 mm	0°	
2	7 kg	120 mm	60°	160 mm
3	8 kg	140 mm	135°	320 mm
4	6 kg	120 mm	270°	560 mm

Table 1

OR

VI.	(a)	What do you mean by balancing machines? Describe any one type of a static balancing machine.	5	L1	3	1
	(b)	The cylinders of a V-engine are set at an angle of 40° with both cylinders connected to a common crank. The connecting rod is 300 mm long and the crank radius is 60 mm. The reciprocating mass is 1 kg per cylinder whereas the rotating mass at the crankpin is 1.5 kg. A balance mass equivalent to 1.8 kg is also fitted opposite to the crank at a radius of 80 mm. Determine the maximum and minimum values of the primary and secondary forces due to inertia of the reciprocating and rotating masses if the engine rotates at 900 rpm.	10	L2	3	2

(Continued)

			Marks	BL	CO	PI
VII.	(a)	Explain the principle behind Eddy current damping.	5	L1	4	1
	(b)	A disc of a torsional pendulum is immersed in a viscous fluid. During the vibrations of pendulum, the observed amplitudes on the same side of the neutral axis for successive cycles are found to decay by 50% of the initial value. Determine the (i) logarithmic decrement. (ii) damping torque per unit velocity. (iii) the periodic time of vibration. (iv) the frequency when the disc is removed from the fluid. Assume $G = 4.5 \times 10^{10}$ N/m^2 for the material of the shaft, diameter of shaft = 0.10 m, length of shaft = 0.50 m, Polar MI of disc = 0.05 kg-m^2.	10	L2	4	2
		OR				
VIII.	(a)	Explain the effects of partial balancing in locomotives.	5	L1	4	1
	(b)	A vibrating system is defined by the following parameters: m = 3 kg, k = 100 N/m, C = 3 N-sec/m. Determine: (i) the damping factor. (ii) the natural frequency of damped vibration. (iii) logarithmic decrement. (iv) the ratio of two consecutive amplitudes. (v) the number of cycles after which the original amplitude is reduced to 20%.	10	L2	4	2
IX.	(a)	Explain the concept of critical speed in shafts.	5	L1	5	1
	(b)	Figure 2 shows a vibrating system having two degrees of freedom. Determine the two natural frequencies of vibrations and the ratio of amplitudes of motion of m_1 and m_2 for the two modes of vibration. Given $m_1 = 1.5$ kg, $m_2 = 0.80$ kg, $k_1 = k_2 = 40$ N/m.	10	L2	5	2

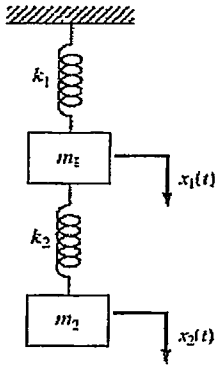

Figure 2

OR

X.	(a)	Explain the principle behind vibration absorers.	5	L1	5	1
	(b)	Find the lower natural frequency of vibration for the system shown in Figure 3 by Rayleigh's method: Assume E = 1.96×10^{11} N/m$_2$, I = 4×10^{-7} m^4.	10	L2	5	2

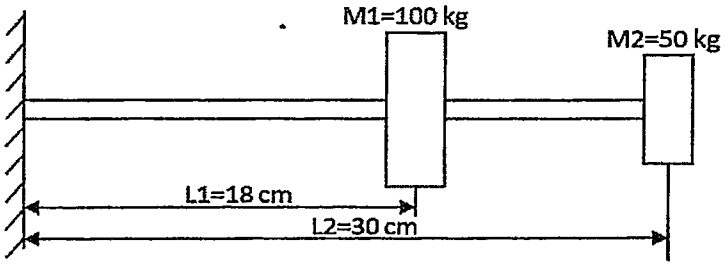

Figure 3

Blooms's Taxonomy Level
L1 – 33.33%, L2 – 66.67%.