B.Tech. Degree V Semester Regular/Supplementary Examination in Marine Engineering November 2022

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 analytic 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: Analyse 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

PO – Programme Outcome

			(5 × 15 = 75)	Marks	BL	CO	PO
I.	(a)	What are free-body diagrams of a mechanism? How are they helpful in finding various forces acting on the various members of a mechanism? Explain with the help of a typical four-link mechanism acted upon by an external force its output link.		5	L2	1	1
	(b)	A four-link mechanism with the following dimensions is acted upon by a force 80∠150°N on the link DC. AD = 500 mm, AB = 400 mm, BC = 1000 mm, DC = 750 mm, DE = 350 mm. Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration.		10	L3	1	2

OR

				Marks	BL	CO	PO
II.	(a)	Derive an expression for the displacement of the piston from the inner-dead centre of a slider-crank mechanism and show that the piston executes a simple harmonic motion when the connecting rod is very large.		5	L2	1	1
	(b)	In a vertical double-acting steam engine, the connecting rod is 4.5 times the crank. The weight of the reciprocating parts is 120 kg and the stroke of the piston is 440 mm. The engine runs at 250 RPM. If the net load on the piston due to steam pressure is 25 kN when the crank has turned through an angle of 120° from the TDC. Determine:		10	L3	1	2
		(i)	The thrust in the connecting rod.				
		(ii)	The pressure on the slide bars.				
		(iii)	The tangential force on the crankpin.				
		(iv)	The thrust on the bearings.				
		(v)	The turning moment on the crankshaft.				
III.	(a)	Derive an expression for the limiting tangential velocity at the mean radius of the flywheel.		5	L2	2	1
	(b)	In a single-acting four-stroke engine, the work done by the gases during the expansion stroke is three times the work done during the compression stroke. The work done during the suction and exhaust strokes is negligible. The engine develops 14 kW at 280 RPM. The fluctuation of speed is limited to 1.5% of the mean speed on either side. The turning-moment diagram during the compression and expansion strokes may be assumed to be triangular in shape. Determine the inertia of the flywheel.		10	L3	2	2

OR

BT MRE-V(R/S)-11-22-2031

IV. (a) The turbine of a ship has a mass of 2.2 tonnes and rotates at 1,800 RPM clockwise when viewed from the aft. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when   10   L3   2   2
      (i) Ship turns at a radius of 250 m with a speed of 25 kmph
      (ii) Ship pithes with the bow raising at an angular velocity of 0.8 rad/s
      (iii) Ship rolls at an angular velocity of 0.1 rad/s

    (b) Explain gyroscopic effects on naval ships.   5   L2   2   1

V. (a) A rotating shaft carries three unbalanced masses of 4 kg, 3 kg and 2.5 kg at radial distances of 75 mm, 85 mm and 50 mm and at the angular positions of 45°, 135° and 240° respectively. The second and the third masses are in the planes at 200 mm and 375 mm from the plane of the first mass. The angular positions are measured counter-clockwise from the reference line along x-axis and viewing from the first mass end. The shaft length is 800 mm between bearings and the distance between the plane of the first mass and the bearing at the plane of the first mass and the bearing at that end is 225 mm. Determine the amount of counter mass in planes at 75 mm from the bearings for the complete balance of the shaft. The first counter mass is to be in a plane between the first mass and the bearing and the second mass in a plane between the third mass and the bearing at that end. Solve graphically.   5   L3   3   2

    (b) Verify the above answers using analytical solution.   10   L3   3   2

OR

VI. (a) The six cylinder four stroke engine is inherently balanced. Justify the above statement.   5   L2   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 crank pin 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 the 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   L3   3   2

VII. Explain the types of damping used in mechanical systems.   15   L2   4   1

OR

VIII. Explain the classification of damped systems based on the value of damping ratio.   15   L2   4   1

IX. Three rail bogies are connected by two springs of stiffness 40×10^5 N/m each. The mass of each bogey is 20×10^3 kg. Determine the frequencies of vibration. Neglect friction between the wheels and rails.   15   L4   5   2

OR

X. A shaft of negligible weight 6 cm diameter and 5 metres long is simply supported at the ends and carries four weights 50 kg each at equal distances over the length of the shaft. Find the natural frequency of vibration by Dunkerley's method. Take $E = 2 \times 10^6$ kg/cm^2.   15   L4   5   2

Bloom's Taxonomy Levels
L2 = 36.66%, L3 = 43.33%, L4 = 20%.

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