B.Tech. Degree V Semester Regular/Supplementary Examination in Marine Engineering November 2023

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 conceptsin 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)	In a slider crank mechanism, the crank is 480 mm long and rotates at 20 rads/s in the counter clockwise direction. The length of the connecting rod is 1.6 m. When the crank turns 60° from the inner dead centre, determine the:	15	L4	1	1.3.1

     (i) velocity of the slider.

     (ii) velocity of a point E located at a distance 450 mm on the connecting rod extended.

     (iii) position and velocity of a point F on the connecting rod having least absolute velocity.

     (iv) angular velocity of the connecting rod.

     (v) velocity of rubbing at the pins of the crankshaft, crank and the cross-head having diameters 80 mm, 60 mm and 100 mm respectively.

OR
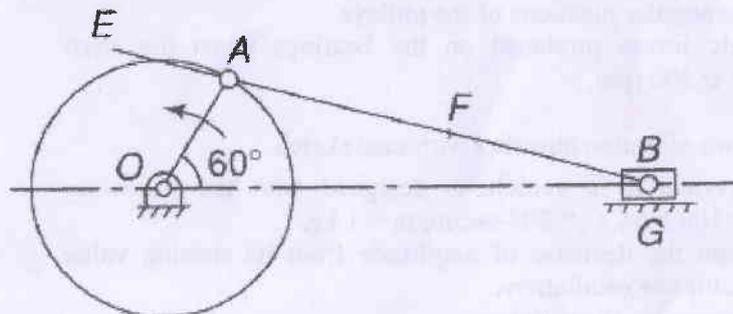
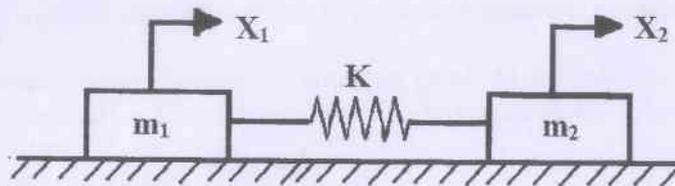|			Marks	BL	CO	PI
II.	(a)	What is instantaneous centre of rotation? How do you know the number of instantaneous centre in a mechanism?	6	L2	1	1.3.1
	(b)	In a slider crank mechanism the stroke of the slider is one half of the length of the connecting rod. Draw a diagram to give the velocity of the slider at any instant assuming the crankshaft to turn uniformly.	9	L3	1	1.3.1

				Marks	BL	CO	PI

III. (a) A flywheel with a mass of 3 kN has a radius of gyration of 1.6 m. Find the energy stored in the flywheel when its speed increases from 315 rpm to 340 rpm.

      Marks: 5   BL: L3   CO: 2   PI: 1.3.1

(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 15 kW at 300 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 the expansion strokes may be assumed to be triangular in shape. Determine the inertia of the flywheel.

      Marks: 10   BL: L3   CO: 2   PI: 1.3.1

OR

IV. The torque delivered by a two stroke engine is represented by $T = (1000 + 300 \sin 2\theta - 500 \cos 2\theta)$ N.m, where θ is the angle turned by the crank from inner dead centre. The engine speed is 250 rpm. The mass of the flywheel is 400 kg and radius of gyration is 400 mm. Determine the:
  (i) power developed
  (ii) total percentage fluctuation of speed
  (iii) angular acceleration of the flywheel when the crank has rotated through an angle of 60° from the inner dead centre
  (iv) maximum angular acceleration and retardation of the flywheel.

      Marks: 15   BL: L4   CO: 2   PI: 1.3.1

V. A, B, C and D are four masses carried by a rotating shaft at radii 100 mm, 125 mm, 200 mm and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance.

      Marks: 15   BL: L4   CO: 3   PI: 1.3.1

OR

VI. A shaft is supported in bearings 1.8 m apart and projects 0.45 m beyond bearings at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The mass of end pulleys is 48 kg and 20 kg and their centre of gravity are 15 mm and 12.5 mm respectively from the shaft axis. If the pulleys are arranged so as to give static balance, determine:
  (i) relative angular positions of the pulleys
  (ii) dynamic forces produced on the bearings when the shaft rotates at 300 rpm.

      Marks: 15   BL: L3   CO: 3   PI: 1.3.1

VII. (a) Describe any two vibration absorber with neat sketch.

      Marks: 8   BL: L2   CO: 4   PI: 1.3.1

(b) A vibratory system in a vehicle is designed with the following parameters K= 100 N/m, C = 2 N-sec/m, m = 1 kg.
  (i) Calculate the decrease of amplitude from its starting value after complete oscillations.
  (ii) The frequency of oscillation.

      Marks: 7   BL: L3   CO: 4   PI: 1.3.1

OR

		Marks	BL	CO	PI
VIII.	The torsional pendulum with a disc of moment of inertia $J = 0.05$ kg-m^2 immersed in a viscous fluid. During vibrations of pendulum the observed amplitudes on the same side of the neutral axis for successive cycles are found to decay 50% of the initial value. Determine: (i) logarithmic decrement (ii) damping torque per unit velocity (iii) the periodic time of vibrations (iv) frequency when the disc is removed from the fluid.	15	L3	4	1.3.1
IX.	Solve the system shown in the figure, $m_1 = 10$ kg, $m_2 = 15$ kg and $K = 320$ N/m.	15	L3	5	1.3.1

OR

X.	Two rotors A and B are attached to the ends of shaft 600 mm long. The mass of the rotor A is 400 kg and its radius of gyration is 400 mm. The corresponding values of rotor B are 500 kg and 500 mm respectively. The shaft is 80 mm diameter for the first 250 mm, 120 mm for next 150 mm length and 100 mm for the remaining length. Modulus of rigidity of the shaft material is 0.8×10^5 MN/m^2 Find the: (i) position of the node (ii) frequency of torsional vibrations.	15	L4	5	1.3.1

Bloom's Taxonomy Levels
L2- 9.33%, L3- 50.66%, L4- 40%.

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