

***B.Tech. Degree V Semester Special Supplementary Examination in
Marine Engineering June 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:

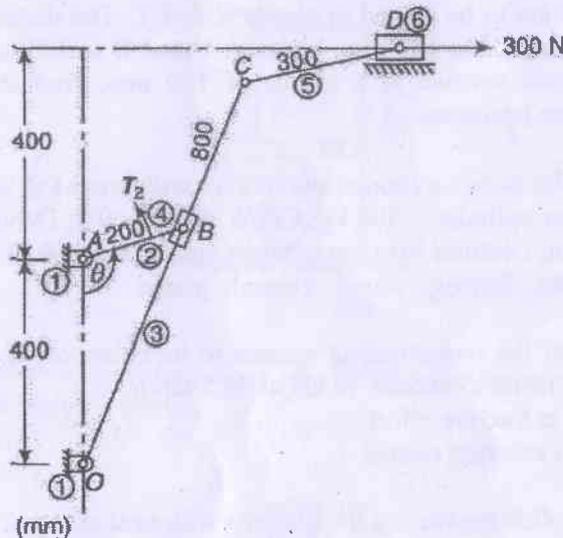
- CO1: Recall the concepts of free body diagrams, principles of statics and dynamics.
 CO2: Use graphical and analytic methods to do force analysis of planar mechanisms.
 CO3: Apply these concepts in different machine elements for the evaluation of forces and moments.
 CO4: Analyze the dynamics of different 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. For the static equilibrium of the quick-return mechanism shown in figure, determine the input torque T_2 to be applied on the link AB for a force of 300 N on the slider D. The dimensions of the various links are OA = 400 mm, AB = 200 mm, OC = 800 mm, CD = 300 mm.



OR

- II. (a) What do you mean by applied and constraint forces? Explain 3 L2 1 1
 (b) The crank and connecting rod of a vertical petrol engine, running at 1800 rpm are 60 mm and 270 mm respectively. The diameter of the piston is 100 mm and the mass of the reciprocating parts is 1.2 kg. During the expansion stroke when the crank has turned 20° from the top dead centre, the gas pressure is 650 kN/m^2 . Determine the
- (i) net force on the piston
 - (ii) net load on the gudgeon pin
 - (iii) thrust on the cylinder walls
 - (iv) speed at which the the gudgeon pin load is reversed in direction. 12 L3 1 1

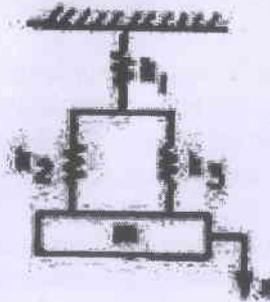
		Marks	BL	CO	PI
III.	(a) A flywheel with a mass of 3 kN has a radius of gyration of 1.6 m. Find the energy stored in the flywheel when its speed increases from 315 rpm to 340 rpm.	5	L3	2	1
	(b) In a single – acting four – stroke engine, the work done by the gases during the expansion stroke is three times 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 the expansion strokes may be assumed to be triangular in shape. Determine the inertia of the flywheel.	10	L3	2	1
OR					
IV.	The turning – moment diagram of a four – stroke engine is assumed to be represented by four triangles, the areas of which from the line of zero pressure are Suction stroke = 440 mm ² Compression stroke = 1600 mm ² Expansion stroke = 7200 mm ² Exhaust stroke = 660 mm ² Each mm ² of area represents 3 Nm of energy. If the resisting torque is uniform, determine the mass of the rim of a flywheel to keep the speed between 218 and 222 rpm when the mean radius of the rim is to be 1.25 m.	15	L4	2	2
V.	A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions.	15	L4	3	2
OR					
VI.	The following data refer to two cylinder locomotive with cranks at 90°: Reciprocating mass per cylinder = 300 kg; Crank radius = 0.3; Driving wheel diameter = 1.8 m; Distance between cylinder centre lines = 0.65 m, Distance between the driving wheel central planes = 1.55 m. Determine: (i) The fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 km/h (ii) The variation in tractive effort (iii) The maximum swaying couple.	15	L3	3	2
VII.	(a) Describe any two vibration measuring instruments with neat sketches.	8	L2	4	1
	(b) A single cylinder vertical petrol engine of total mass 320 kg is mounted upon a steel chassis and causes a vertical static deflection of 2 mm. The reciprocating part of the engine has a mass of 24 kg and move through a vertical stroke of 150 mm with simple harmonic motion. A dash pot attached to the system offers a resistance of 490 N at a velocity of 0.3 m/sec. Determine: (i) The speed of the driving shaft at resonance and (ii) The amplitude of steady state vibration when the driving shaft of the engine rotate at 480 rpm.	7	L3	4	2

OR

(Continued)

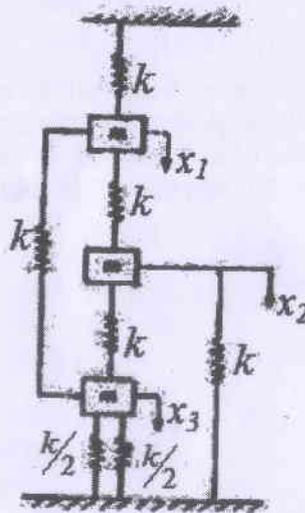
- VIII. (a) A machine of mass of one ton is acted upon by an external force of 2450 N at a frequency of 1500 rpm. To reduce the effects of vibration, isolator of rubber having a static deflection of 2 mm under the machine load and an estimated damping $e = 0.2$ are used. Determine:
- (i) The force transmitted to the foundation
 - (ii) The amplitude of vibration of machine
 - (iii) The phase lag.
- (b) A mass is suspended from a spring system as shown in figure. Determine the natural frequency of the system
 $k_1 = 5000 \text{ N/m}$, $k_2 = k_3 = 8000 \text{ N/m}$, $m = 25 \text{ kg}$.

Marks	BL	CO	PI
9	L2	4	1
6	L2	4	1



- IX. Determine the natural frequencies of multi degree of freedom spring-mass system shown in figure.

15	L3	5	2
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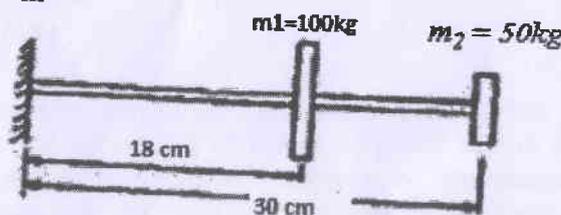
OR

- X. Find the lower natural frequency of vibration for the system shown in figure by Rayleigh's method.

15	L4	5	2
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$$E = 1.96 \times 10^{11} \text{ N/m}^2$$

$$I = 4 \times 10^{-7} \text{ m}^4$$



Bloom's Taxonomy Levels
 L2 - 17.33%, L3 - 42.66%, L4 - 40%.