BT–MRE–V-12.19-1464 Reg. No. | | | | | | | | | |

B

B.Tech. Degree V Semester Examination in Marine Engineering December 2019

MRE 1501 DYNAMICS OF MACHINERY

(2013 scheme)

Time : 3 Hours Maximum Marks : 100

(5 × 20 = 100)

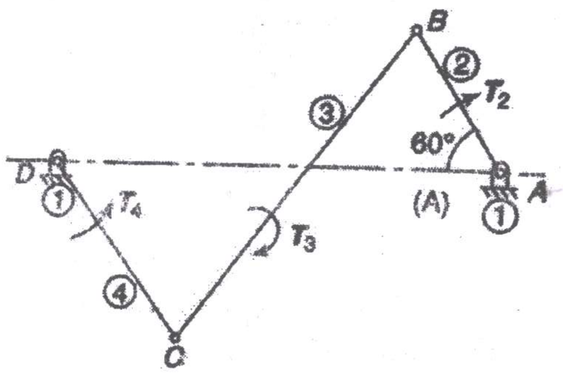
I. (a) Explain D' Alembert's principle.

(b) The crank pin circle radius of a horizontal engine is 300 mm. The mass of piston is 250 kg. When the crank makes 60^0 with IDC, the difference between driving and back pressure is 0.35 N/mm^2. The connecting rod length is 1.2 m and cylinder bore is 0.5 m. If the engine runs at 250 rpm, calculate Thrust on cylinder walls, thrust on connecting rod, thrust on bearings, crank effort and turning moment on crankshaft.

OR

II. (a) What are the conditions for a body to be in equilibrium under the action of two forces, three forces and two force and a torque?

(b) In a four-link mechanism shown in figure, torque T_3 and T_4 have magnitudes of 30 Nm and 20 Nm respectively. The link lengths are AD = 800 mm, AB = 300 mm, BC = 700 mm and CD = 400 mm. For the static equilibrium of the mechanism, determine the required input torque T_2.



III. The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship

(i) When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h.

(ii) When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.

OR

IV. (a) Define coefficient of fluctuation of speed in an IC engine and derive an expression for it.

(b) The flywheel of a steam engine has a radius of gyration of 1 m and mass 2500 kg. The starting torque of the steam engine is 1500 Nm and may be assumed constant.
Determine:

(i) The angular acceleration of flywheel

(ii) The kinetic energy of flywheel after 10 seconds from the start

(P.T.O.)

V. (a) Explain the effect of Swaying couple and hammer blow.

(b) The three cranks of a three-cylinder locomotive are all on the same axle and are set at 120°. The pitch of the cylinder is 1m and the stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40 % of the reciprocating parts are to be balanced, find:

(i) The magnitude and position of the balancing masses required at a radius of 0.6 m

(ii) The hammer blow per wheel when the axle makes 6 rps.

OR

VI. (a) A single cylinder reciprocating engine has speed 240 rpm, stroke 300 mm, mass of reciprocating parts 50 kg, 37 kg mass revolving at 150 mm radius. If two third of the reciprocating parts and all the revolving parts are to be balanced, find

(i) The mass required at a radius of 400 mm

(ii) The residual unbalanced force when the crank has rotated 60^0 from inner dead center.

(b) A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100^0 and that between masses at B and A is 190^0, both being measured in the same direction. The axial distance between the planes A and B is 100 mm, and between B and C is 200 mm. If the shaft is in complete dynamic balance, determine

(i) Magnitude of masses in Plane A and D

(ii) Axial distance between planes A and D

(iii) Angular position of mass at plane D

VII. (a) A mass of 1200 kg is placed at the free end of a cantilever beam with width 0.2 m, 0.4 m and length 2 m. If the modulus of elasticity of cantilever beam is 200 GPa and mass of cantilever is negligible, determine the natural frequency of the cantilever.

(b) A machine part having a mass of 2.5 kg vibrates in a viscous medium. A harmonic exciting force of 30 N acts on the part and causes resonance amplitude of 14 mm with time period 0.22 second.

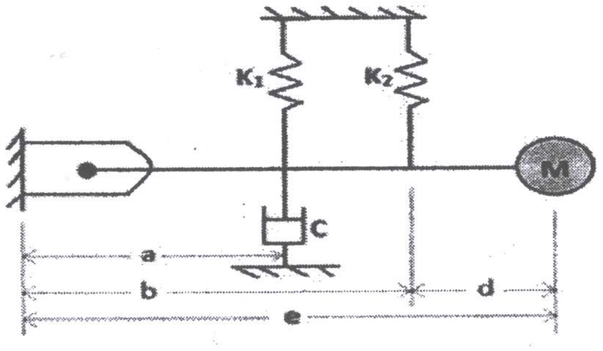
(i) Find the damping coefficient.

(ii) If the excitation frequency is changed to 4 Hz, determine the increase in the amplitude of the forced vibrations upon the removal of the damper.

OR

VIII. (a) The free vibration records of a 1 tonne machine mounted over an isolator reveals the following data. The 2^{nd} and 6^{th} amplitude are 5 mm and 0.1 mm respectively and time taken to complete 10 cycles of operation is 6.4 seconds. Identify the type of isolator and find its characteristics.

(b) The figure shows a spring-mass-damper system.



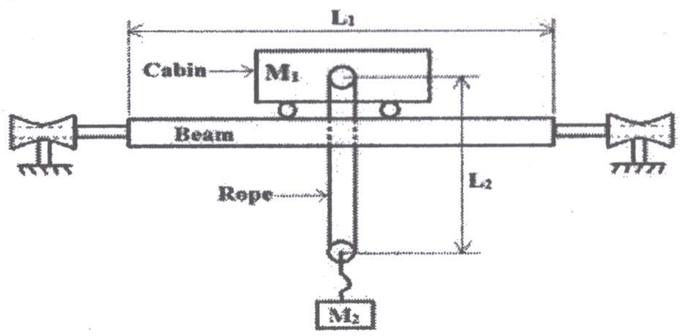
(i) Derive the EOM for the system

(ii) If M = 1.5 kg, K_1 = 4900 N/m, K_2 = 4000 N/m, a = 6 cm and b = 10 cm, d = 4 cm, determine the value of 'C' for which the system is critically damped.

(Contd....3)

IX. The figure shows an overhead crane. The cabin is at the center of beam. The following specifications are given: M_1 = 3000 Kg, M_2 = 700 Kg, L_1, = 5 m, L_2 = 6 m, Radius of rope = 7 cm. Modulus of elasticity of beam = 206 GPa, Modulus of elasticity of rope = 160 MPa, Moment of inertia of beam = 10194 cm^4. Reduce the system to a discrete system and find:

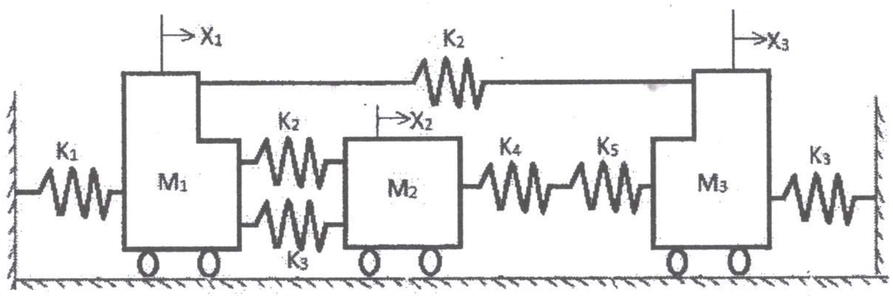
(i) The Equation of motion
(ii) Eigen values
(iii) Eigen vectors
(iv) Represent the Normal modes graphically



OR

X. A spring-mass system is undergoing free vibration as shown in figure. If M_1 = 100 kg, M_2 = 150 kg, M_3 = 200 kg, K_1 = 1000 N/m, K_2 = 2000 N/m, K_3 = 1200 N/m, K_4 = 2400 N/m, K_5 = 2400 N/m

(i) Express the Equation of motion in matrix format
(ii) Find the Eigen values
(iii) Find the Eigen vectors
(iv) Represent the Normal modes graphically



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