BT-MRE-V-12.18-1932 Reg. No. | | | | | | | | |

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B.Tech. Degree V Semester Examination in Marine Engineering December 2018

MRE 1501 DYNAMICS OF MACHINERY

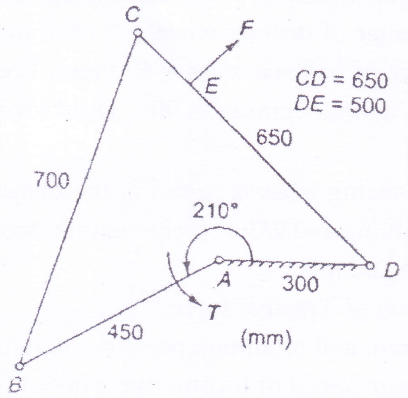
(2013 Scheme)

Time: 3 Hours Maximum Marks: 100

(5 × 20 = 100)

I. (a) Explain the conditions for a body to be in equilibrium under the action of two forces, three forces, and two forces and a torque. (8)

(b) Find the torque required to be applied to link AB of the linkage shown in figure to maintain static equilibrium. (12)



OR

II. (a) Derive an expression for angular acceleration of the connecting rod of a reciprocating engine. (8)

(b) In a vertical double acting steam engine, the connecting rod is 4.5 times the crank. The weight of 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 TDC, determine: (12)

(i) the thrust in the connecting rod
(ii) pressure on slide bars
(iii) tangential force on crank pin
(iv) thrust on bearings
(v) turning moment on crank shaft

III. (a) Define the terms coefficient of fluctuation of energy and coefficient of fluctuation of speed. (6)

(b) A shearing machine is used to cut flat strips and each operation requires 37.5 kN.m of energy. The machine has a flywheel with radius of gyration of 900 mm. The speed at the start of each operation is 1300 rpm. Determine the mass of the flywheel assuming that the energy required for cutting is fully supplied by the flywheel and the speed reduction is not more than 15% of maximum. Also find the torque supplied to flywheel so that it regains its full speed in 3.3 seconds. (14)

OR

IV. (a) Explain in what way the gyroscopic couple affects the motion of an aircraft while taking a turn? (5)

(b) A ship is propelled by turbine rotor having a mass of 6 tonnes and a speed of 2400 rpm. The direction of rotation of the rotor is clockwise when viewed from the stern. The radius of gyration of the rotor is 450 mm. Determine gyroscopic effect when (15)

(i) The ship steers to left in a curve of 60 m radius at a speed of 18 knot.

(ii) The ship pitches 7.5 degrees above and 7.5 degrees below the normal position and the bow is descending with its maximum velocity; the pitching motion is simple harmonic with periodic time of 18 sec.

(iii) Ship rolls at the instant its angular velocity is 0.035 rad/s counter clockwise when viewed from stern. Also find out the maximum acceleration during pitching.

V. The following data refers to a two cylinder uncoupled locomotive: Rotating mass per cylinder = 280 kg, Reciprocating mass per cylinder = 300 kg, Distance between wheels = 1400 mm, Distance between cylinder center = 600 mm, Diameter of driving wheels = 1800 mm, Crank radius = 300 mm, Radius of centre of balance mass = 620 mm, Locomotive speed = 60 km/hr, Angle between cylinder cranks = 90°, Dead load on each wheel = 3.5 tonne. Determine: (20)

(i) the balancing mass required in the plane of driving wheels if whole of revolving and 2/3 of reciprocating mass are to be balanced.

(ii) Swaying couple

(iii) Variation of Tractive force

(iv) Maximum and minimum pressure on rails

(v) Maximum speed of locomotive without lifting the wheel from rail

OR

VI. Each crank of a four cylinder vertical engine is 225 mm. The reciprocating masses on the first, second and fourth cranks are 100 kg, 120 kg and 100 kg respectively, and the plane of rotation is 600 mm, 300 mm and 300 mm from the plane of rotation of the third crank. Determine the mass of the reciprocating parts of the third cylinder and the relative angular positions of the crank, if the engine is in complete primary balance. (20)

VII. (a) Find the natural frequency of a vibratory system having a mass suspended from the free end of a massless spring. Explain the effect of the inertia of the spring mass. (5)

(b) In a single degree damped vibrating system, the suspended mass of 4 kg makes 24 oscillations in 20 seconds The amplitude decreases to 0.3 of the initial value after 4 oscillations. Find the (i) Logarithmic decrement (ii) Stiffness of the spring (iii) Damping factor (iv) Damping coefficient. (15)

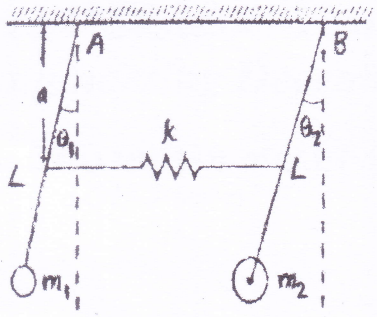
OR

VIII. (a) What is meant by whirling or critical speed of shafts? Explain. (10)

(b) A shaft of 40 mm diameter and 2.5 m length has a mass of 15 kg per meter length. It is simply supported at the ends and carries three masses 90 kg, 140 kg and 60 kg at 0.8 m, 1.5 m and 2 m respectively from the left support. Taking E = 200 GN/m^2, find the frequency of transverse vibrations. Also determine the critical speed of the shaft. ($\Delta = (mga^2b^2)/3EIl$). (10)

(Contd...3)

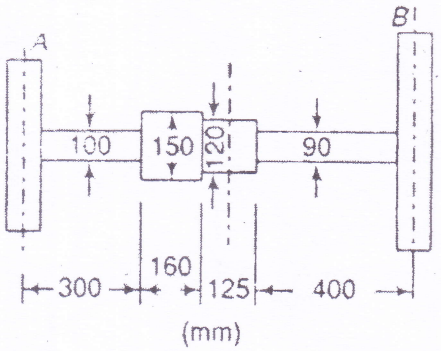
IX. Consider a pendulum of length L as shown in figure. Determine the natural frequency of each pendulum if k = 100 N/m, m_1 = 2 kg, m_2 = 5 kg, L = 20 m. (20)



OR

X. (a) What do you mean by torsionally equivalent shaft? Derive an expression to determine its length. (5)

(b) The shaft shown in figure carries two masses. The mass A is 300 kg with a radius of gyration of 0.75 m and the mass B is 500 kg with a radius of gyration of 0.9 m. Determine the frequency of torsional vibrations. (15)



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