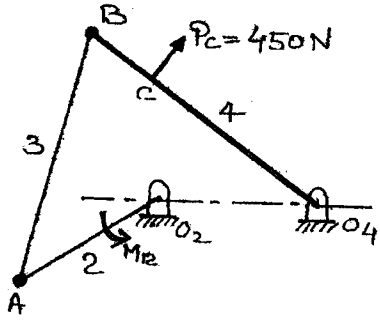
B.Tech. Degree V Semester Examination in Marine Engineering December 2012

MRE 501 DYNAMICS OF MACHINERY

Time : 3 Hours Maximum Marks : 100

I. (a) Discuss the inertia forces due to piston and connecting rod in a reciprocating engine. (8)

(b) What torque must be applied to link 2 of the illustrated mechanism to maintain static equilibrium? Draw complete free body diagrams of links 2 and 4. (12)



$O_2A = 9$ cm
$AB = O_4B = 15$ cm
$O_4C = 10$ cm
$O_4D = 17.75$ cm
$O_2O_4 = 5$ cm.

OR

II. (a) (i) Discuss the effect of sliding friction in the solution of static equilibrium problems. (4)

(ii) Explain the concept of equivalent masses as applied with a single cylinder engine mechanism. (6)

(b) The ratio of connecting rod length to crank length of a vertical gasoline engine is 4. The engine bore and stroke is 8cm and 10cm respectively. The mass of reciprocating parts is 1 kg. The gas pressure on the piston is 6 bar when it has moved 40° from the inner dead center on its power stroke. Determine. (10)

(i) net load on the piston
(ii) net load on the gudgeon pin and the crank pin.
(iii) thrust on cylinder walls
(iv) thrust on crank bearing.

III. (a) Obtain a relation between the maximum fluctuations of energy and percentage fluctuations of speed of a flywheel. (8)

(b) The effective turning moment exerted by two stroke engine at crank shaft is represented by (cycle repeats every 180° of crank rotation) (12)
$T(N.m) = 8000 + 1000 \sin(2\theta) - 2000 \cos(2\theta)$,
where θ = inclination of the crank to the inner dead center. The mass of flywheel is 500Kg. and its radius of gyration is 75cm. The engine speed is 300 rpm. Assuming external resistance as constant, determine

(i) the power developed
(ii) the total percentage fluctuations in speed.

OR

IV. (a) Define the terms. (3)

(i) Spin
(ii) Precession
(iii) Gyroscopic acceleration

(b) Explain briefly gyroscopic stabilization of the sea vessels. (5)

(P.T.O)

(c) The mass of turbine rotor of a ship is 3500kg. It has a radius of gyration of 45cm and a speed of 3000 rpm, clockwise, when looking from the stern. Estimate the gyroscopic couple and its effects upon the ship under the following two conditions. (12)

(i) when the ship is steering to the left in a curve of 100m radius at a speed of 36km/hr.

(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.

V. (a) Distinguish between static unbalance and dynamic unbalance. (6)

(b) The revolving masses of a single crank engine are equivalent to a mass of 100 kg. at a radius of 225cm. Determine the position and magnitude of the balance mass at a radius of 60cm in two planes 1 and 2 at a distance of 30cm and 90cm from the plane of the crank, when (i) these planes are on the opposite sides of the crank (ii) these are both on the same sides of the crank. (14)

OR

VI. (a) Briefly explain the principle of working of a balancing machine. (6)

(b) The following data refers to a two cylinder locomotive with cranks at 90°. (14)
reciprocating mass per cylinder = 300 kg.
crank radius = 0.25cm
pricing wheel diameter = 1.75m
distance between the cylinder center lines = 0.6m.
distance between the drilling wheel central planes = 1.5m

Determine:

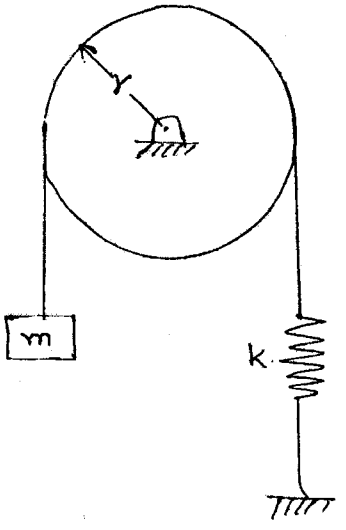
(i) the fraction of the reciprotating masses to be balanced, if the hammer blow is not to exceed 45kN at 100 km/hr,

(ii) the variation in tractive effort.

VII. (a) Explain the terms. (10)

(i) free vibration
(ii) damped free vibration
(iii) forced vibration
(iv) natural frequency
(v) resonance

(b) Determine the natural frequency of oscillation of the system shown in figure by the energy method. (10)



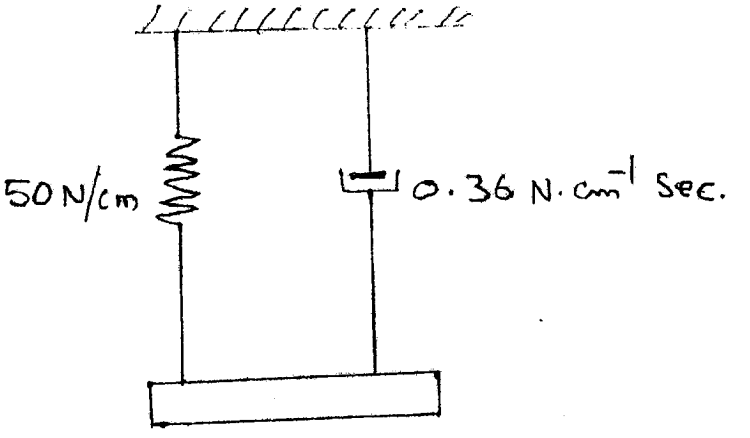
OR

(Contd.....3)

VIII. (a) Explain the working of an accelerometer. (4)

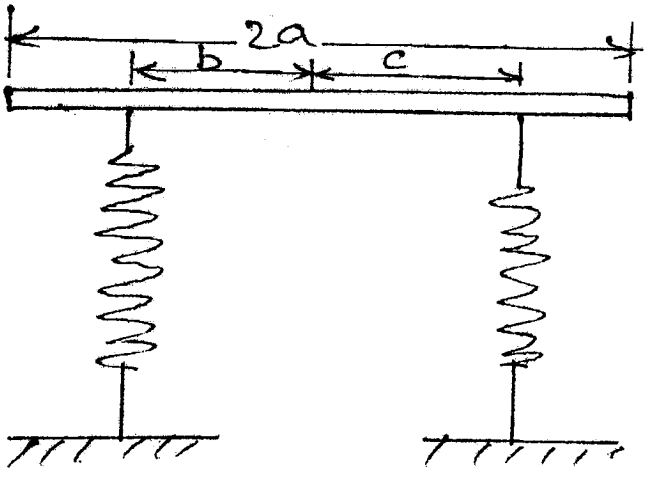
(b) Explain transmissibility and the force transmitted to foundation of a machine as referred to in the vibratory system. (4)

(c) A vibrating system consists of a mass of 7 kg, a spring of stiffness 50N/cm and damper of damping coefficient 0.36 $Ncm^{-1}sec$. Find the damping factor, the logarithmic decrement and the ratio of any two consecutive amplitudes. (12)



IX. (a) Distinguish between single degree of freedom and two degrees of freedom possessed by a system. (4)

(b) A uniform beam of length $2a$ and mass m is supported horizontally on two equal springs, each of stiffness S at points, distance b and c from the middle. Derive the equations of the two frequencies of small oscillations in the vertical plane. Show that their frequencies are equal only if $b = c = a/\sqrt{3}$. (16)

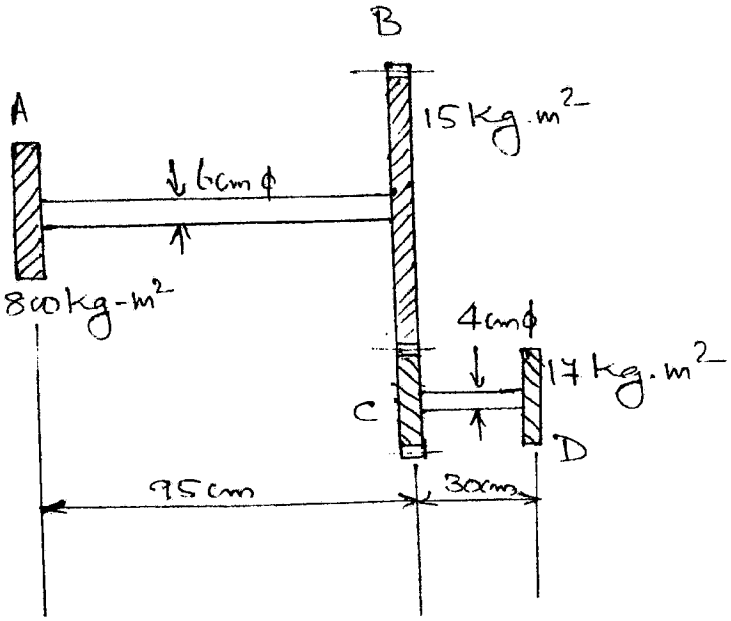


OR

X. A reciprocating internal combustion engine is coupled to centrifugal pump through gearing. The shaft from the flywheel of the engine to the gear wheel is 6cm diameter and 95cm long. Shaft from the pinion to the pump is 4cm diameter and 30cm long. Engine speed is ¼ th the pump speed. Other particulars are the following: (20)

M.I. of the flywheel = 800 Kg.m^2
M.I. of the gear wheel = 15 kg.m^2
M.I of the pinion = 4 Kg.m^2
M.I. of the pump impeller = 17 Kg.m^2

Determine the natural frequency of the torsional oscillation of the system.



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