BT-MRE-V(S)/12.15.1081 Reg. No. | | | | | | | | | A

B.Tech. Degree V Semester Supplementary Examination in Marine Engineering December 2015

MRE 501 DYNAMICS OF MACHINERY

Time: 3 Hours Maximum Marks: 100

(5 × 20 = 100)

I. (a) Derive an expression for the inertia force in the reciprocating parts, neglecting the weight of the connecting rod. (6)

(b) Construct free body diagrams for each elements of the linkage and determine the magnitude and direction of the forces acting on each part. The dimensions of various links are as follows: AB = 5 cm, BC = AD = 30 cm, CD = 17 cm and angle BAD = 60°. Link AD is fixed. The frictional forces may be neglected. A torque of magnitude 3000 N.cm is acting on link CD in the counter-clockwise direction. What input torque must be applied to link AB for equilibrium? (14)

OR

II. (a) What is meant by shaking force? Explain. (6)

(b) The following data relate to a four-link mechanism: (14)

Link	Length	Mass	Moment of Inertia about centre of mass
AB	60 mm	0.2 kg	80 kg.mm^2
BC	200 mm	0.4 kg	1600 kg.mm^2
CD	100 mm	0.6 kg	400 kg.mm^2
AD	140 mm	-	-

AD is the fixed link. The centre of mass of the links lies at their mid points. Link AB rotates with a constant angular velocity of 47.5 rad/s in the counter clockwise direction. $\angle DAB = 135°$. Determine the shaking force acting on the frame of the mechanism.

III. (a) Derive an expression for the Gyroscopic Couple in a spinning disc. (6)

(b) A racing car weighs 20 kN. It has a wheel base of 2m, track width 1m and height of C.G.300 mm above the ground level and lies midway between the front and rear axle. The engine flywheel rotates at 3000 rpm clockwise when viewed from the front. The moment of inertia of flywheel is 4 kg.m^2 and the moment of inertia of each wheel is 3 kg.m^2. Determine the reactions between the wheels and the ground when the car takes a curve of 15 m radius towards right at 30 km/hr, taking into consideration the gyroscopic and centrifugal effects. Each wheel radius is 400 mm. (14)

OR

IV. (a) Explain the terms 'fluctuation of energy' and 'fluctuation of speed' as applied to flywheels. (6)

(b) A multi-cylinder engine is to run at a speed of 600 rpm. On drawing the crank effort diagram to scale of 1 cm = 2500 N.m and 1 cm = 30°, the areas above and below the mean torque line in sq.cm. are as follows: (14)
+1.6, -1.72, +1.68, -1.91, +1.97, -1.62. The speed is to be kept within 2% of the mean speed of the engine. Calculate the necessary moment of inertia of the fly-wheel. Determine the suitable dimensions of a rectangular fly-wheel rim if the breadth is twice its thickness. The density of cast iron is 7.25 gm/cm^3 and the hoop stress is 600 N/cm^2.

(P.T.O.)

V. (a) Explain the effects of partial balancing of reciprocating parts of two cylinder locomotives. (6)

(b) A shaft carries 5 masses. A, B, C, D and E which revolve at the same radius in planes which are equidistant from one another. The magnitude of the masses in plane A, C and D are 50 kg, 40 kg, and 80 kg respectively. The angle between A and C is 90° and that between C and D is 135°. Determine the magnitude of the masses in planes B and E and their positions to put the shaft in complete rotating balance. (14)

OR

VI. (a) Explain the direct and reverse cranks method in the balancing of radial engines. (6)

(b) A three cylinder radial engine driven by a common crank has the cylinders spaced at 120°. The stroke is 125 mm, length of the connecting rod 25 mm and the mass of the reciprocating parts per cylinder 2 kg. Calculate the unbalanced primary and secondary forces at a crank shaft speed of 1200 rpm. (14)

VII. (a) Derive an expression for the displacement of mass as a function of time in an under-damped vibrating system. (6)

(b) A door 2 m high, 1 m wide and 40 mm thick and weighing 350 N is fitted with an automatic door closer. The door opens against the torsional spring of stiffness 0.1 N.m/rad. If the door is opened 90° and released, how long will it take the door to be within 5° of closing. Assume the return spring to the door to be critically damped. (14)

OR

VIII. (a) Explain the working principle of Seismometer and Accelerometer. (6)

(b) Determine the displacement of mass as a function of time for the spring mass damper system when (i) damping factor $\zeta = 1.0$, *(ii)* $\zeta = 0.3$ *and (iii)* $\zeta = 2.0$, if the mass 'm' is displaced by a distance of 3 cm and released. (14)

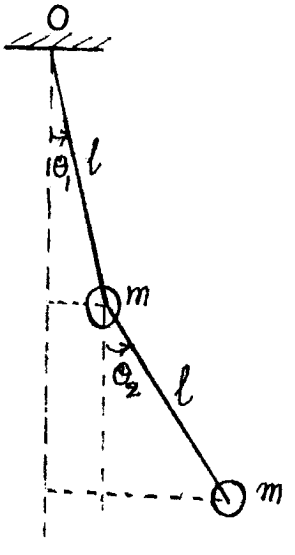
IX. (a) What is meant by a torsionally equivalent shaft? Explain. (6)

(b) Two rotors A and B are attached to the end of a shaft 50 cm long. Weight of the rotor A is 300 N and its radius of gyration is 30 cm and the corresponding values of B are 500 N and 45 cm respectively. The shaft is 7 cm in diameter for the remainder of its length. Modulus of rigidity for the shaft material is 8×10^{11} N/m^2. Determine the position of the node and the frequency of torsional vibration. (14)

OR

X. (a) Explain the Dunkerley's method in determining the frequency for transverse vibrations. (6)

(b) Determine the natural frequency of oscillation of the double pendulum as shown in figure, when $m = 5$ kg and $l = 25$ cm. (14)



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