B.Tech. Degree VI Semester Examination, April 2010

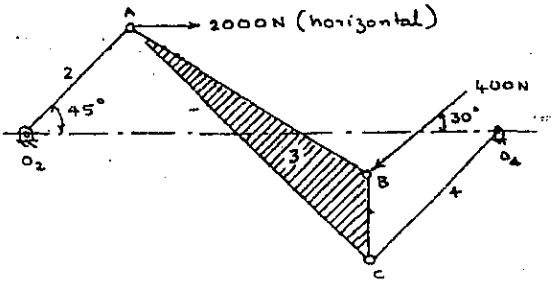
ME 601 DYNAMICS OF MACHINERY

(2002 Scheme)

Time: 3 Hours Maximum Marks: 100

I. (a) Explain the effect of friction on the force analysis of mechanisms. (7)

(b) Figure below shows a four bar linkage with external forces acting at points A and B. Find the couple that must be applied to the link 4 to maintain equilibrium. Draw a free body diagram of each link including the frame and mark all forces and couples acting upon each of them. (13)



O_2O_4 = 530 mm
O_2A = 100 mm
AB = O_4C = 275 mm
AC = 400 mm
BC = 200 mm

OR

II. (a) Explain the terms inertia force and inertia torque in a slider crank mechanism. (5)

(b) The following data refer to a steam engine:-

Bore of cylinder	- 240mm
Stroke	- 600mm
Length of connecting rod	- 1.5m
Mass of reciprocating parts	- 3000 N
Mass of connecting rod	- 2500 N
Speed	- 125 rpm
C.G of the connecting rod from the crank pin	- 500mm
Radius of gyration of the connecting rod about an axis is through CG	- 650mm

Determine the magnitude and direction of the inertia torque on the crank shaft when the crank has turned through 30^0 from inner dead center.
Determine also the radial force along the crank and the side thrust between the cross head and guide bars acting at right angles to the line of stroke. (15)

III. (a) Explain the terms 'co-efficient of fluctuation of speed' and 'co-efficient of fluctuation of energy'. (5)

(b) Describe the procedure for determining the weight of flywheel for reducing the fluctuations of turning moment of IC engines. (5)

(c) A turbine rotor of a ship weighing 35 kN has a radius of gyration of 45cm. It rotates at a uniform speed of 300 rpm clockwise when viewed from the stern. Determine the gyroscopic couple and it's effects upon the ship under the following conditions:

(i) When the ship is taking a curve of radius 100m to the left at a cruising speed of 35 km/hr.

(ii) When the ship is pitching in 8 HM, the bow falling with it's maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees. (10)

OR

(Turn Over)

IV. (a) Derive an expression for gyroscopic couple. (5)

(b) Discuss the use of gyroscope for stabilizing of vessels. (5)

(c) A four wheeled trolley car of total weight 20 kN runs on rails 1.6m gauge. It takes a curve of radius 30m at a speed of 54 km/hr. The truck is banked at an angle of 8^0. The wheel diameter is 0.7m. The axles weigh 2 kN, each. The height of the center of gravity of the car above wheel base is 1m. Allowing for centrifugal and gyroscopic effects, determine the pressure on each wheel. Take radius of gyration of each pair as 0.3. (10)

V. (a) Derive expressions for the maximum variation in tractive effort and also for swaying couple in an uncoupled locomotive. (8)

(b) A four cylinder inline marine oil engine has cranks at angular displacement of 90^0. The outer cranks are 3.5m apart and inner cranks are 1.5m apart. The inner cranks are placed symmetrically between the outer cranks. The length of each crank is 500mm. If the engine runs at 120 rpm and the mass of the reciprocating parts for each cylinder is 8 KN, find the firing order of the cylinders for the best primary balancing forces of reciprocating masses. Determine the maximum unbalanced primary couple for the best arrangement. (12)

OR

VI. (a) What are the advantages and disadvantages of partial balancing of reciprocating masses in a reciprocating engine by revolving balance weights? (7)

(b) A 90^0 twin cylinder V-engine has a stroke of 12.5cm. The connecting rods are equal in length and measure 24.5cm. The crankpin and crank webs are equivalent to 10N at crank radius and each piston weighs 8 N. The weight of each connecting rod is 15N and the center of gravity of each connecting rod is 4.5cm from the crank pin centre. Show that the effect of the revolving mass and the primary effect of the reciprocating masses may be balanced by a revolving weight. Find it's magnitude and position if the distance of the center of gravity of the balance weight from the crank shaft center line is 4.5cm. What is the nature and magnitude of the resultant secondary forces, when the crank makes 1600 rpm? (13)

VII. (a) Explain vibration isolation. (6)

(b) A centrifugal fan of mass 5 kg has a rotating unbalance of 0.25 kgm. When the dampers having a damping factor of 0.2 are used, specify the spring for mounting such that only 10% of the unbalance force is transmitted to the floor and force transmitted. The fan is running at a constant speed of 1000 rpm. (14)

OR

VIII. (a) Differentiate between viscous and coulomb damping. (5)

(b) A door 2m high, 1m wide and 40mm thick and weighing 350N is fitted with an automatic door closer. The door opens against a spring with a modulus of 0.1 Nm/rad. If the door is opened 90^0 and released, how long will it take the door to be within 1^0 of closing? Assume the return spring to the door to be critically damped. (15)

IX. (a) Explain the terms: (i) mass coupled (ii) stiffness coupled (5)

(b) In an automobile the propeller shaft, differential axles and wheels is considered as an equivalent rotor having a mass moment of inertia of 6.2 kgm^2. The engine, the flywheel and the above equivalent rotor form a three rotor torsional vibration system. The mass moment of inertia of the engine and flywheel are 0.15 kgm^2 and 0.7kgm^2 respectively. The stiffness of shafts connecting the three rotors are 0.15 MNm/rad and 0.8 MNm/rad. Determine the natural frequencies of tortional vibration. (15)

OR

X. (a) Sketch a viscously damped two degree of freedom system and represent its differential equation in matrix form. (5)

(b) The vibrations of a cantilever are given by $y = y_l\left[1-\cos\frac{\pi x}{2l}\right]$, calculate the frequency with following data for the cantilever using Rayleigh's method. Modulus of elasticity of the material = 2 x 10^{11}N/m^2, second moment of area about bending axis = 0.02m^3, Mass = 6 x 10^4 kg, Length = 30m. (15)

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