2002 SCHEME

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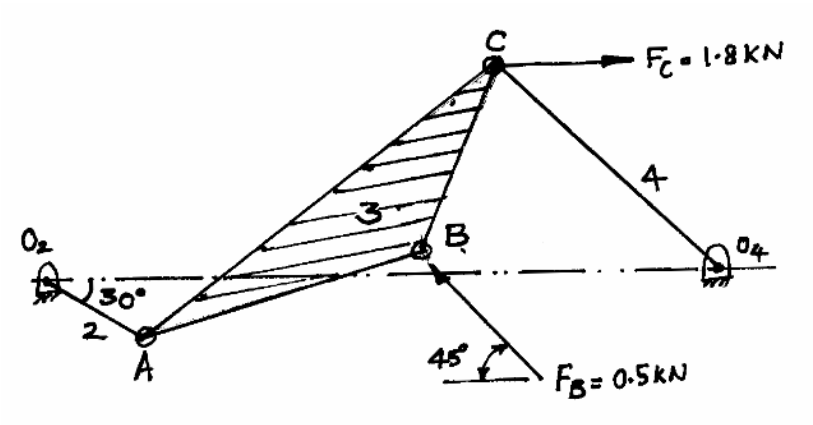
ME52

Fifth Semester B.E. Degree Examination, June 2012
Dynamics of Machinery

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 The Fig. Q1 shows a four bar linkage with external forces applied at points B and C. Draw free body diagram of each link and show all the forces acting on each. Find the torque that must be applied to link 2 to maintain equilibrium. **(20 Marks)**



O_2A = 75mm.
AC = 300 mm,
O_2O_4 = 400 mm,
O_4C = AB = 200 mm,
BC = 150 mm

Fig. Q1

2 a. State the laws of solid friction. **(04 Marks)**

b. Obtain the condition for maximum power transmission by a belt drive and the corresponding belt speed. **(06 Marks)**

c. The cross sectional area of a V-belt driving a 300 mm dia pulley is 750 mm^2 each. Semi groove angle of pulley is 15°. Angle of lap is 165° and the pulley runs at 1500 rpm. The mass density of belt material is 1.2×10^{-6} kg/mm^3. μ = 0.12. The safe working stress in the belt is 7.2 N/mm^2. Calculate the power transmitted by the belt drive when there are three belts. **(10 Marks)**

3 a. Show for a flywheel, the coefficient of fluctuation of energy is twice the coefficient of fluctuation of speed. **(04 Marks)**

b. The power developed by a 4 stroke engine is 100 kN at a mean speed of 300 rpm. The work done during the power stroke is 25% more than the average work done during the whole cycle. The hoop stress in the flywheel used is limited to 6 MPa, and the fluctuation of speed is limited to 2% of the mean speed on either side. The density of material of flywheel is 7200 kg/m^3. The cross section of the rim is rectangular with width twice the depth. Assuming that only 90% of the total energy is stored in the rim find the diameter, and width and depth of the cross section of rim type flywheel. **(16 Marks)**

4 a. In the Fig. Q4 (a)(i), (ii), m_A = 6 kg, r_a = 150 mm, r_b = 100 mm, r_c = 120 mm, x = 250 mm, y = 150 mm. Find the masses m_B and m_C required in planes B and C respectively and their angular position for complete balance. **(06 Marks)**

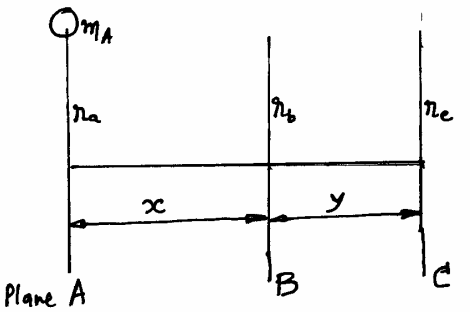


Fig. Q4 (a) – (i)

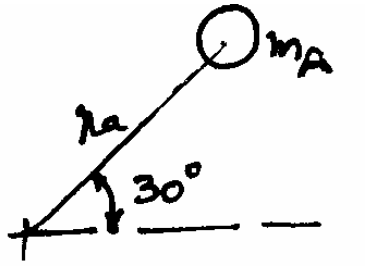


Fig. Q4 (a) – (ii)

b. Four revolving masses m_A, 20 kg, 30 kg and 25 kg are in parallel planes A, B, C and D respectively and their radii of rotation are 0.3 m, 0.5 m, 0.2 m and 0.4 m respectively. Planes containing masses B and C are 0.4 m apart. Angular position of masses B and D are 90° and 210° in counter clockwise direction from mass C which is horizontal. Determine:

i) Mass m_A in plane A and its angular position,

ii) Position of planes A and D,

for complete balance. **(14 Marks)**

5 a. Show, for a 2 cylinder 90° V-engine the primary inertia force due to reciprocating parts can be balanced by a revolving mass. **(06 Marks)**

b. The data for a 2 stroke 6 cylinder in line engine is as follows: mass of piston = 20 kg, stroke of piston = 200 mm, length of each connecting rod = 400 mm, speed of engine = 300 rpm, pitch of cylinders = 300 mm. Determine the unbalanced primary and secondary forces and couples if any with reference to central plane of the engine. The firing order of the engine is 1–4–5–2–3–6. **(14 Marks)**

6 a. Write short notes on: i) Inertia governor ii) Controlling force curves with respect to governors. **(06 Marks)**

b. A porter governor has all the arms of length 200 mm. Upper arms are pivoted to the axis of rotation while the lower arms are fixed at a distance of 25 mm from the axis of rotation. The radius of rotation of the balls at a speed of 250 rpm is 100 mm. Find the governor speed when the sleeve has lifted by 50 mm. **(14 Marks)**

7 The mass of a 4 wheeled car is 1200 kg and its Cg. is 0.6 m above the ground and lies centrally with respect to the four wheels. Its track width is 1.5 m and wheel base is 2 m. The M.I. of each wheel is 3 kg.m^2 and effective radius is 0.4 m. The M.I. of rotating parts of engine is 0.75 kg.m^2 and rotates at 2000 rpm in clockwise direction when seen from the front. The car takes right turn around a bend of 30 m radius at a speed of 60 kmph. Calculate the gyroscopic couples and centrifugal couple acting on the vehicle. Also calculate the road reaction on each wheel. **(20 Marks)**

8 A symmetrical circular cam operating a flat-faced follower has the following particulars: Minimum radius of cam = 30 mm, Lift = 20 mm, Angle of lift = 75°, Nose radius = 5 mm, Speed = 600 rpm. Find

i) Principal dimensions of the cam and

ii) Acceleration of the follower at the beginning of the lift, at the end of contact with the circular flank, at the beginning of contact with nose and the apex of the nose.

(20 Marks)

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