Fifth Semester B.E. Degree Examination, Dec.09-Jan.10
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, choosing atleast TWO questions form each part.*
2. *Use of drawing sheets is permitted.*

PART – A

1 a. A body shown in fig.Q1(a) is subjected to three forces F_1, F_2 and F_3. State the conditions for the static equilibrium of the body. If force F_1 is completely known, F_2 known in direction only and F_3 is completely unknown, explain how the problem can be solved. **(05 Marks)**

b. For the mechanism shown in fig.Q1(b), find the magnitude and direction of input torque T_2 for the static equilibrium. Take AB = 70mm, BC = 150mm, BD = 100mm and CD = 70mm, $\angle ABC = 90^0$. Also determine the forces at pinjoints A, B and C. **(15 Marks)**

Fig. Q1(a)

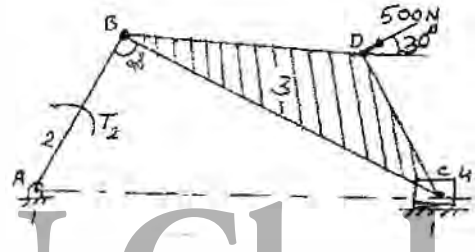

Fig. Q1(b)

2 a. Derive an expression for the maximum fluctuation of energy of a flywheel in terms of mean kinetic energy and coefficient of fluctuation of speed. **(05 Marks)**

b. The torque delivered by a two stroke engine is represented by
$T = (1000 + 300 \sin 2\theta - 500 \cos 2\theta)$ N – m,
where θ is the angle turned by the crank from inner dead center. The engine speed is 250 rpm. The mass of the fly wheel is 400kg and radius of gyration is 400mm. Determine i) the power developed ii) the total percentage fluctuation of speed iii) the angular acceleration of flywheel when the crank has turned through an angle of 60^0 from IDC. **(15 Marks)**

3 a. Define static and dynamic friction and state the laws of dry friction. **(06 Marks)**

b. A leather belt is required to transmit 9 kW from a pulley 1.2m in diameter running at 200 rpm. The angle embraced is 165^0 and the coefficient of friction between leather belt and pulley is 0.3. The safe working stress for the leather belt is $1.4 N/mm^2$, the mass of leather is $0.001 gm/mm^3$ and the thickness of the belt is 10mm. Determine the width of the belt taking centrifugal tension into account. **(14 Marks)**

4 a. What do you mean by static balancing and dynamic balancing? **(06 Marks)**

b. A shaft carries four rotating masses A, B, C and D which are completely balanced. The masses B, C and D are 50kg, 80kg and 70kg respectively. The masses C and D make angles of 90^0 and 195^0 respectively with mass B in the same sence. The masses A, B, C and D are concentrated at radius 75mm, 100mm, 50mm and 90mm respectively. The plane of rotation of masses B and C are 250mm apart. Determine i) mass A and its angular position
ii) Position of planes of A and D. **(14 Marks)**

PART – B

5 A four cylinder vertical engine has cranks 300mm long. The planes of rotation of the first, third and fourth cranks are 750mm, 1050mm and 1650mm respectively from that of the second crank and their reciprocating masses are 150kg, 400kg and 250kg respectively. Find the mass of the reciprocating parts for the second cylinder and the relative angular positions of the crank in order that the engine may be in complete primary balance. If each connecting rod of all four cylinders is 1.35m long and the speed is 300rpm, find the maximum unbalanced secondary force and couple. **(20 Marks)**

6 a. Define the following terms in connection with governors : i) Sensitiveness ii) Isochronism iii) Governor effort and iv) Governor power. **(08 Marks)**

b. The mass of each ball of a Hartnell type governor is 1.4kg. The length of ball arm of the bell – crank lever is 100mm whereas the length of arm towards sleeve is 50mm. The distance of the fulcrum of bell – crank lever from the axis of rotation is 80mm. The extreme radii of rotation of the balls are 75mm and 112.5mm. The maximum equilibrium speed is 6% greater than the minimum equilibrium speed which is 300rpm. Determine i) stiffness of the spring and ii) equilibrium speed when radius of rotation of the ball is 90mm. Neglect the obliquity of the arms. **(12 Marks)**

7 a. With neat sketches, explain the effect of gyroscopic couple on pitching, steering and rolling of a ship. **(06 Marks)**

b. A four – wheeled trolley car has a total mass of 3000 kg. Each axle with its two wheels and gears has a total M.I of 32 kgm^2. Each wheel is of 450mm radius. The centre distance between two wheels is 1.4m. Each axle is driven by a motor with speed ratio of 1:3. Each motor along with its gear has a moment of inertia of 16 $kg\text{-}m^2$ and rotates in the opposite direction to that of axle. The center of mass of the car is 1m above the rails. Calculate the limiting speed of the car when it has to travel around a curve of 250m radius without the wheels leaving the rails. **(14 Marks)**

8 The following particulars relate to a symmetrical tangent cam having a roller follower : Minimum radius of the cam = 40mm ; Lift = 20mm ; Speed = 360 rpm ; Roller diameter = 44mm ; Angle of ascent = 60^0. Calculate the acceleration of the follower : i) at beginning of lift ii) when the roller just touches the nose. **(20 Marks)**

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