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10AE53

Fifth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain the principle of virtual work with an example. **(04 Marks)**

b. Fig.Q1(b) shows a quaternary link ABCD under the action of forces F_1, F_2, F_3 and F_4 acting at A, B, C and D respectively. The link is in static equilibrium. Determine the magnitude of forces F_2 and F_3 and direction of F_3. **(05 Marks)**

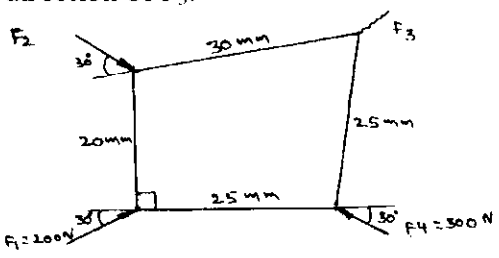
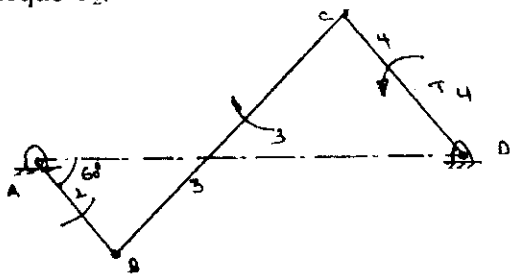


Fig.Q1(b)

c. In 4-bar chain mechanism shown in Fig.Q1(c), the torques T_3 and T_4 have magnitudes of 50 Nm and 40 Nm respectively. For static equilibrium of the mechanism, determine the required input torque T_2. **(11 Marks)**



AB = 30 mm
BC = 74 mm
CD = 35 mm
AD = 70 mm

Fig.Q1(c)

2 a. State and explain D' Alembert's principle. **(05 Marks)**

b. The turning moment curve for an engine is represented by the equation $T = 2000 + 950 \sin 2\theta - 570 \cos 2\theta$ kg-m where θ is the angle moved by the crank from inner dead centre. If the resisting torque is constant. Find:

i) Power developed by the engine

ii) Moment of inertia of flywheel if total fluctuation of speed is not to exceed 1% of mean speed which is 180 rpm and

iii) Angular acceleration of the flywheel when the crank has turned through 45° from IDC. **(15 Marks)**

3 a. State the assumptions made in uniform pressure theory and uniform wear theory. Which theory is preferred for safe design of bearing and why? **(04 Marks)**

b. A belt embraces the shorter pulley 165° and runs over at a speed of 1700 m/min. Dimensions of the belt are width 20 cm, thickness 8 mm. If weighs 1 gm/cm^3. Determine the maximum power that can be transmitted at the above speed, if the maximum permissible stress in the belt not to exceed 25×10^5 N/m^2. Take $\mu = 0.25$. **(10 Marks)**

c. A shaft has a number of collars integral with it. External diameter of collars is 400 mm and the shaft diameter is 250 mm. If the uniform intensity of pressure is 35×10^4 N/m^2 and $\mu = 0.05$, estimate: (i) Power absorbed in overcoming friction when the shaft runs at 105 rpm and carries a load of 15×10^4 N; and (ii) Number of collars required. **(06 Marks)**

4 a. A shaft with 3 meters span between two bearings carries two masses of 10 kg and 20 kg at the extremities of arms 0.45 m and 0.6 m long respectively. The planes in which these masses rotate are 1.2 m and 2.4 m respectively from the left end bearing. The angle between these arms is 60°. The speed of rotation of the shaft is 200 rpm. If the masses are balanced by two counter masses rotating with the shaft at radii of 0.3 m and 0.3 m from each bearing centres, estimate the magnitude of the two balance masses and their orientation with respect to mass A. **(15 Marks)**

b. Explain the procedure of balancing a disturbing mass, if the planes of balancing masses are one side of plane of disturbing mass. **(05 Marks)**

PART – B

5 a. In a 4 cylinder in line reciprocating engine, the masses of the reciprocating parts per cylinder are 1 kg. The stroke is 12 cm. The length of connecting rod is 22 cm. the cylinders are spaced at 12 cm pitch. If the cylinders are numbered from 1 to 4 from one end then in the end view, the cranks appear at successive intervals of 90° in the order 1, 4, 2, 3. Find with reference to the central plane of the engine, the maximum value of any primary and secondary out of balance effects when the engine is running at 2000 rpm. **(15 Marks)**

b. Write a short note on direct and reverse crank method of balancing. **(05 Marks)**

6 a. The lengths of the upper and lower arms of a porter governor are 20 cm and 25 cm respectively. Both the arms are pivoted on the axis of rotation. The central load is 150 N, the weight of each ball is 20 N and the friction of the sleeve together with the resistance of the operating gear is equivalent to a force of 30 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, determine the range of speed of the governor. **(14 Marks)**

b. Draw controlling force diagram for spring controlled governor and discuss stable, unstable and isochronas conditions. **(06 Marks)**

7 a. A disc with radius of gyration 60 mm and a mass of 4 kg is mounted centrally on a horizontal axle of 80 mm length between the bearings. It spins about the axle at 800 rpm CCW when viewed from the right hand side bearing. The axle processes about a vertical axis at 50 rpm in the CCW direction, when viewed from above. Determine the resultant reaction at each bearing due to the mass and gyroscopic effect. **(12 Marks)**

b. Discuss the stability of an automobile while moving in a curved path considering effect of weight of vehicle (W), gyroscopic couple (C) and centrifugal force (C_F). **(08 Marks)**

8 The following particulars relate to a symmetrical circular cam operating a flat faced follower; least radius = 25 mm, nose radius = 8 mm, lift of the valve = 10 mm, angle of action of cam = 120°, cam shaft speed = 1000 rpm. Determine the flank radius and the maximum velocity, acceleration and retardation of the follower. If the mass of follower and valve with which it is in contact is 4 kg, find the maximum force to be exerted by the spring to overcome inertia of the valve parts. **(20 Marks)**

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