

Fifth Semester B.E. Degree Examination, June/July 2013
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. State the conditions for a link to be in equilibrium when (i) Two forces act (ii) Three forces act and (iii) Two forces and a torque act. (06 Marks)
- b. Refer to Fig.Q1(b), determine the couple T_2 for the equilibrium of the system. (14 Marks)
 AB = 10 cm ; BC = 70 cm ; BD = 25 cm.

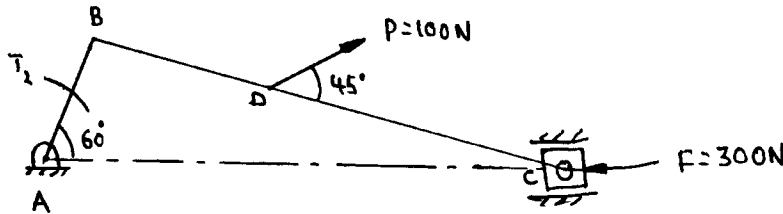


Fig.Q1(b)

- 2 a. State and explain D' Alembert's principle. (04 Marks)
- b. A single cylinder single acting 4 stroke gas engine develops 20 kW at 300 rpm. The workdone by the gas during expansion stroke is three times the work done on the gas during compression stroke, the workdone during suction and exhaust strokes being negligible. If the fluctuation of speed not to exceed $\pm 2\%$ of the mean speed and the turning moment diagram during compression and expansion is assumed to be triangular in shape, find the moment of inertia of a flywheel. What is the mass of the flywheel required if its radius of gyration is 0.6 m. (16 Marks)
- 3 a. Draw a sketch of single collar bearing. Write the expression used to find frictional torque on the bearing assuming uniform pressure case. (04 Marks)
- b. Show that condition for maximum power transmission by flat belt with centrifugal tension accounted is, $V_{\max} = \left[\frac{T_{\max}}{3m} \right]^{1/2}$, where V_{\max} – maximum speed of belt, m – mass of belt/length
 T_{\max} – Maximum belt tension. (05 Marks)
- c. A flat belt is required to transmit 35 kW from a pulley of 1.5m effective diameter running at 300 rpm. The angle of contact is spread over $11/24$ of the circumference and the coefficient of friction between belt and pulley surface is 0.3. Determine width of the belt required taking centrifugal tension into account. It is given that the belt thickness is 9.5mm, density of its material is $1.1 \times 10^3 \text{ kg/m}^3$ and the permissible working stress for belt is 2.5 N/mm^2 . (11 Marks)

- 4 a. Explain why a single disturbing rotating mass in a plane can't be balanced by another single mass in a different plane. And also show the position of the balancing masses with respect to the disturbing mass if
- Planes of both balancing masses are on the same side. (06 Marks)
 - Planes of balancing masses are on either side of disturbing mass plane. (06 Marks)
- b. A shaft carries four masses P, Q, R and S at the extremities of arms of radii 0.20m, 0.24m, 0.3m and 0.24m respectively. The planes containing Q, R and S are at 0.3m, 0.48m and 0.72m respectively from the plane containing P. Masses of P, Q, R & S are 20kg, 50kg, 30kg and 15 kg respectively. Determine the necessary alternation to mass Q and angular position of all the masses so that the shaft is in complete balance. (14 Marks)

PART – B

- 5 a. Write an expression to find resultant unbalanced primary force in V-engine. Also, prove that in 90° V-engine primary force can be balanced completely by a rotating mass. (04 Marks)
- b. Examine for unbalanced primary and secondary forces and couples for a four stroke, six cylinder inline engine with firing order 1-5-3-6-2-4. Take mass of reciprocating parts of each cylinder = 2.5 kg, crank radius = 120 mm, pitch of cylinders = 300 mm, length of connecting rod = 420 mm. Speed of engine = 600 rpm. Assume central plane of the engine as reference plane. (16 Marks)
- 6 a. Define height of governor (h). (02 Marks)

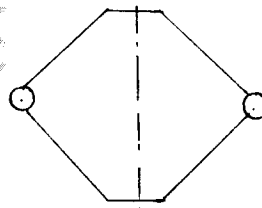


Fig.Q6(a)

- b. Define 'Lift' with respect to governor. What is the relationship between 'Lift' and 'Height of governor'? (02 Marks)
- c. 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. (16 Marks)
- 7 a. With neat sketch, explain the effect of gyroscopic couple of ship under pitching. (04 Marks)
- b. Derive an expression for heel angle of a motor cycle taking a turn. (10 Marks)
- c. Write expressions for total vertical reaction at each inner wheel and each outer wheel, when a four wheel automobile is taking left turn. (06 Marks)
- 8 For a tangent cam with roller follower, derive the expressions for the velocity and acceleration of the follower when i) roller is on the flank ii) roller is on the nose. (20 Marks)

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