**R15**

Code No: 125DY

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech III Year I Semester Examinations, November/December - 2017**

**DYNAMICS OF MACHINERY**

**(Common to AME, MSNT, ME, MCT)**

**Time: 3 hours** **Max. Marks: 75**

**Note:** This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.



**PART - A**

**(25 Marks)**

1.a) What is the gyroscopic effect on aeroplanes, when it is steered right-hand side on horizontal plane. [2]

b) Write the formula for velocity of the piston in reciprocating engine, and explain how does velocity is related to crank angle θ. [3]

c) What is principle of clutches, list out different types of clutches? [2]

d) How does differential band brake works, write the condition for self locking when drum rotates clockwise. [3]

e) Explain the term "Coefficient of fluctuation of energy" what are the parameters required to calculate coefficient of fluctuation of energy. [2]

f) Define the term "sensitiveness" in governors. [3]

g) What is secondary balancing in multi-cylinder in-line engine? [2]

h) What are primary and secondary forces in the reciprocating engine? [3]

i) Write the formula for natural frequency "f" and static deflection "δ" of the cantilever beam loaded at free end( shaft is of negligible mass). [2]

j) Write about the terms "free vibrations", "forced vibrations" and damped vibrations. [3]



**PART - B**

**(50 Marks)**

2. The rotor of the turbine of a ship has a mass of 2500 kg and rotates at a speed of 3200 rpm counter-clockwise when viewed from stern. The rotor has radius of gyration of 0.4m. Determine the gyroscopic couple and its effect when
a) The ship steers to the left in a curve of 80m radius at a speed of 15 knots (1 knot = 1860 m/h)
b) The ship pitches 5 degrees above and 5 degrees below the normal position and the bow is descending with its maximum velocity. The pitching motion is simple harmonic with a periodic time of 40 seconds. [5+5]

**OR**

3. In a four-link mechanism shown in Figure 1. Torque $T_3$ and $T_4$ have magnitudes of 30 N.m and 20 N.m respectively. The link lengths are AD = 800 mm, AB = 300 mm, BC = 700 mm and CD = 400 mm. For the static equilibrium of the mechanism, determine the required input torque $T_2$. [10]

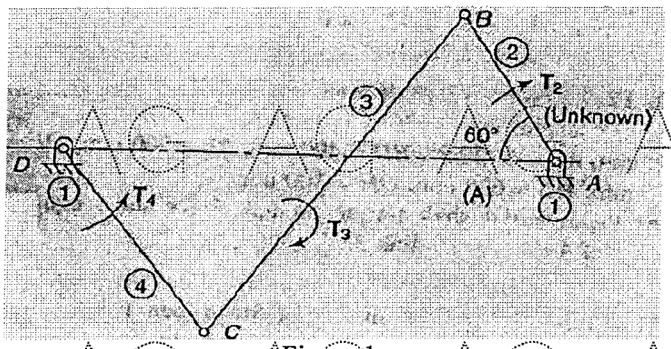


Figure 1

4. Derive an expression for the efficiency of an inclined plane when a body moves
a) up a plane,
b) down a plane. [5+5]

**OR**

5.a) Explain uniform pressure and solve the following problem.

b) A conical pivot with angle of cone as $100^0$ supports a load of 18 KN. The external radius is 2.5 times the internal radius. The shaft rotates at 150 rpm. If the intensity of pressure is to be 300 KN/m$^2$ and coefficient of friction as 0.05, what is the power lost in working against the friction? [5+5]

6. The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm = 325 Nm vertically and 1 mm = $3^0$ horizontally. The areas above and below the mean torque line are -26, +378, -256, +306, -302, +244, -380, +261 and -225 mm$^2$. The engine is running at a mean speed of 600 r.p.m. The total fluctuation of speed is not to exceed ±1.8% of the mean speed. If the radius of flywheel is 0.7 m, find the mass of the flywheel. [10]

**OR**

7. The lengths of the upper and lower arms of a Porter governor are 200 mm and 250 mm respectively. Both the arms are pivoted on the axis of the 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 30N at the sleeve. If the limiting inclinations of the upper arms to the vertical are $30^0$ and $40^0$. Determine the range of the speed of the governor. [10]

8. The cranks of a two-cylinder uncoupled inside cylinder locomotive are at right angles and are 300 mm long. The distance between the centre lines of the cylinder is 650 mm. The wheel centre lines are 1.6 m apart. The reciprocating mass per cylinder is 300 kg. The driving wheel diameter is 1.8 m. If the hammer blow is not to exceed 45 kN at 100 km/hr, determine:
a) The fraction of the reciprocating masses to be balanced,
b) The variation in tractive effort
c) The maximum swaying couple. [10]

**OR**

9. A shaft carries four rotating masses A, B, C and D which are completely balanced. The masses B, C and D are 50 kg, 80 kg and 70 kg respectively. The masses C and D make angles of $90^0$ and $195^0$ respectively with mass B in the same sense. The masses A, B, C and D are concentrated at radius 75 mm, 100mm, 50 mm and 90 mm respectively. The plane of rotation of masses B and C are 250 mm apart. Determine: (a) the mass A and its angular position (b) the position of planes of A and D. [5+5]

10. An electric motor is to drive a centrifuge, running vat four times the motor speed through a spur gear and pinion. The steel shaft from the motor to the gear wheel is 54 mm diameter and L meter long; the shaft from the pinion to the centrifuge is 45 mm diameter and 400 mm long. The masses and radii of gyration of motor and centrifuge are respectively 37.5 kg, 100 mm; 30 kg and 140 mm. Neglecting the inertia effect of the gears, find the value of L if the gears are to be at the node for torsional oscillation of the system and hence determine the frequency of torsion oscillation. Assume modulus of rigidity for material of shaft as 84 $GN/m^2$. [10]

**OR**

11. A shaft 1.5 m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the center of the shaft and the other at distance of 375 mm from the center towards left. The shaft is hollow of external diameter 75mm and internal diameter 40 mm. The density of the material is $7700kg/m^3$ and its modulus of elasticity is 200 $GN/m^2$. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. [10]

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