Code No: 09A50303 **R09**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD**
**B. Tech III Year I Semester Examinations, June/July - 2014**
**DYNAMICS OF MACHINERY**
**(Common to AME, ME, MCT, MIM)**

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

**Answer any five questions**
**All questions carry equal marks**
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1.a) Explain what is meant by applied torque and reaction torque.

b) A ship is pitching through a total angle of 15°, the oscillation may be taken as simple harmonic and the complete period is 30 sec. The turbine rotor weighs 6 tones, its radius of gyration is 45 cm and it is rotating at 2400 rpm. Calculate the maximum value of gyroscopic couple set up by the rotor. If the rotation of the rotor is clockwise looking from left, in which direction will the bow tend to turn while falling?
What is the maximum angular acceleration to which the ship is subjected while pitching?

2. A slider-crank mechanism with the following dimensions is acted upon by a force $F$= 2 kN at $B$ as shown in figure 1. Determine the input torque $T$ on the link $OA$ for the static equilibrium of the mechanism for the given configuration.
$OA$ = 100 mm, $AB$= 450 mm.

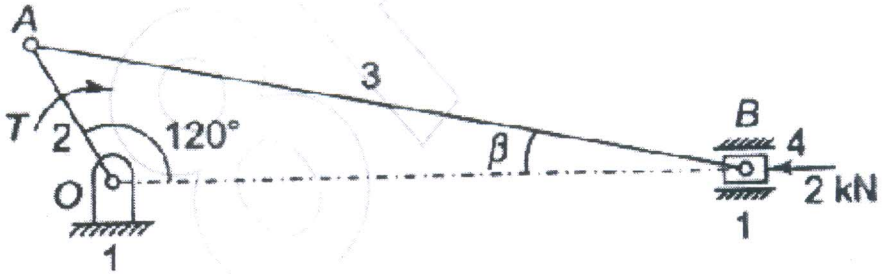


Figure 1

3. Design a four link mechanism when the motions of the input and output links are governed by the function $y = 2x^2$ and $x$ varies from 1 to 4. Assume $\theta$ to vary from 40° to 120° and $\varphi$ from 60° to 132°. Use Chebychev spacing of three precision points.

4. Figure 2 shows a simple band brake which is applied to a shaft carrying a flywheel of 300 kg mass and of radius of gyration 280 mm. The drum diameter is 220 mm and the shaft speed 240 rpm. The coefficient of friction is 0.3. Find the brake torque when a force of 100 N is applied at the lever end. Also, determine number of turns of the flywheel and time taken by it before coming to rest.

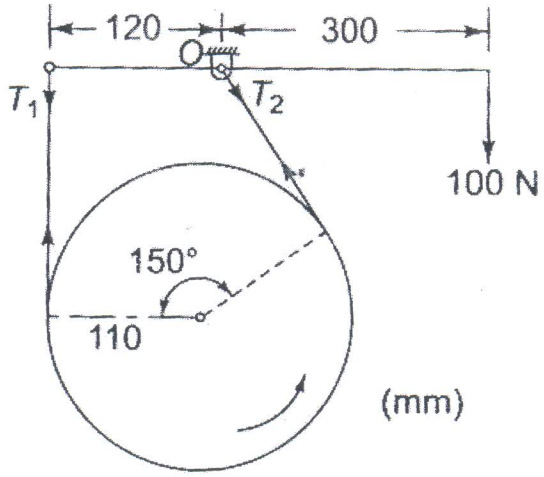


Figure: 2

5. The turning moment diagram for the engine is drawn to the following scales: Turning moment, 1 mm = 1000 N-m, and for crank angle is 1 mm = 6°. The areas above and below the mean turning moment line taken in order are: 550, 300, 380, 470, 200, 360, 380, 260 $mm^2$. The mean speed of the engine is 180 rpm and the total fluctuation of speed must not exceed 4% of mean speed. Determine the diameter and mass of the flywheel rim, assuming that total energy of the flywheel is to be 15/14 that of rim. The hoop stress in the rim is not to exceed 1.85 MPa. Find also the suitable cross sectional area of the rim of the flywheel. Take density of the rim material as 7200 $kg/m^3$.

6. A Hartnell governor having a central sleeve spring and two right-angled bell crank levers operates between 290 rpm and 310 rpm for a sleeve lift of 15 mm. The sleeve arms and ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine (i) loads on the spring at the lowest and highest equilibrium speeds and (ii) stiffness of the spring.

7. An uncoupled locomotive has three cylinders. The two outside cranks are 2130 mm apart and third one is in the centre. Each crank is 330 mm long and set at 120° apart from the others. All the revolving masses are balanced in their respective planes. The reciprocating masses of each cylinder are 450 kg and 2/3 of these are balanced by revolving masses placed at radius of 800 mm, in the plane of wheels 1525 mm apart. The static load on each wheel is 80000 N. Find the lowest speed in kilometers per hour at which each wheel lifts from rails. The diameter of the wheel tread is 1950 mm.

8. The barrel of a large gun recoils against a spring on firing. At the end of the recoil, a dashpot is engaged that allows the barrel to return to its initial position in the minimum time without oscillation. The gun has a mass of 400 kg and the initial recoil velocity of the gun barrel at the instant of firing is 20 m/s. The barrel recoils 1 m on firing. Find:
i) Proper spring stiffness in N/mm and
ii) Damping coefficient of dashpot.

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