**Code No: 134AU** **R16**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**B.Tech II Year II Semester Examinations, May - 2019**
**DYNAMICS OF MACHINERY**
**(Mechanical Engineering)**

**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) Obtain the expression for gyroscopic couple. [2]
b) Explain the D'Alembert's principle. [3]
c) Discuss the different types of friction. [2]
d) Discuss the different types of brakes with their applications. [3]
e) Explain the turning moment diagram of four stroke cycle internal combustion engine. [2]
f) Obtain the expression for speed of porter governor. [3]
g) What is the necessity of balancing? [2]
h) Explain with neat sketch the balancing of reciprocating masses. [3]
i) Discuss the types of free vibrations. [2]
j) Discuss the Raleigh's method. [3]

## PART-B
**(Marks 50)**

2. In a Four bar mechanism shown in Figure 1, torque T3 and T4 have magnitude of 3000 Nm and 2000 Nm respectively. The link lengths are AD = 800 mm, AB = 300 mm, BC = 700 mm, CD = 400 mm. For the static equilibrium of the mechanism determine the required torque T2 on link AB. [10]

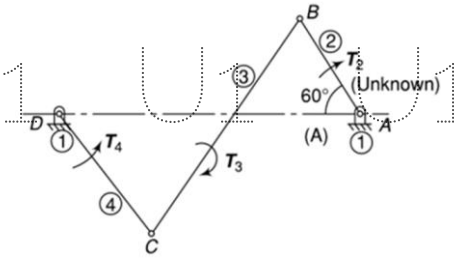


**Figure: 1**

**OR**

3. A multi-cylinder engine is to run at a speed of 600 r.p.m. On drawing the turning moment diagram to a scale of 1 mm = 250 N-m and 1 mm = $3^0$, the areas above and below the mean torque line in $mm^2$ are : + 160, – 172, + 168, – 191, + 197, – 162 The speed is to be kept within ± 1% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Determine the suitable dimensions of a rectangular flywheel rim if the breadth is twice its thickness. The density of the cast iron is 7250 $kg/m^3$ and its hoop stress is 6 MPa. Assume that the rim contributes 92% of the flywheel effect. [10]

4. Four masses A, B, C and D revolve at equal radii and are equally spaced along the shaft. The mass B is 6 kg and radii of masses C and D make $90^0$ and $240^0$ with respect to mass B. Determine the magnitude of the masses A,C and D and the angular position mass A so that system may be completely balanced. [10]

**OR**

5. A disc of mass 4 kg is mounted between bearings which may be assumed simply supports. The bearing span is 48 cm the steel shaft which is horizontal, is 9 mm in diameter. The C.G. of the disc is displaced 3 mm. from the geometric centre. The damping at the centre of the disc-shaft is 49 N-sec/m. If the shaft rotates at 760 r.p.m. Find the maximum dynamic force on the shaft also find the power required to drive the shaft at this speed. [10]

6. The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: a) when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. b) when the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees. [10]

**OR**

7. A car moving on a level road at a speed 50 km/h has a wheel base 2.8metres, distance of C.G. from ground level 600 mm, and the distance of C.G. from rear wheels 1.2metres. Find the distance travelled by the car before coming to rest when brakes are applied, a) to the rear wheels, b) to the front wheels, and c) to all the four wheels. The coefficient of friction between the tyres and the road may be taken as 0.6. [10]

8. A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 r.p.m. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and the maximum pressure is not to exceed 0.1 $N/mm^2$. Also determine the axial thrust to be provided by springs. Assume the theory of uniform wear. [10]

**OR**

9. The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 r.p.m. are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine: a) Unbalanced primary and secondary forces and b) Unbalanced primary and secondary couples with reference to central plane of the engine. [10]

10.a) A horizontal steam engine running at 120 r.p.m. has a bore of 250 mm and a stroke of 400 mm. The connecting rod is 0.6 m and mass of the reciprocating parts is 60 kg. When the crank has turned through an angle of 45° from the inner dead centre, the steam pressure on the cover end side is 550 kN/m and that on the crank end side is 70 kN/m. Considering the diameter of the piston rod equal to 50 mm, determine:
i) turning moment on the crank shaft,
ii) thrust on the bearings,
iii) acceleration of the flywheel, if the power of the engine is 20 kW, mass of the flywheel 60 kg and radius of gyration 0.6 m.

b) In a spring loaded governor of the Hartnell type, the mass of each ball is 1kg, length of vertical arm of the bell crank lever is 100 mm and that of the horizontal arm is 50 mm. The distance of fulcrum of each bell crank lever is 80 mm from the axis of rotation of the governor. The extreme radii of rotation of the balls are 75 mm and 112.5mm. The maximum equilibrium speed is 5 per cent greater than the minimum equilibrium speed which is 360 r.p.m. Find, neglecting obliquity of arms, initial compression of the spring and equilibrium speed corresponding to the radius of rotation of 100 mm. [4+6]

**OR**

11.a) A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass 100 kg at its free end. The Young's modulus for the shaft material is 200 $GN/m^2$. Determine the frequency of longitudinal and transverse vibrations of the shaft.

b) Find the fundamental natural frequency of transverse vibration for the system shown in figure 2 using Raleigh's method. Take E=196 GPa, I =$4\times10^{-7}$ $m^4$. [5+5]

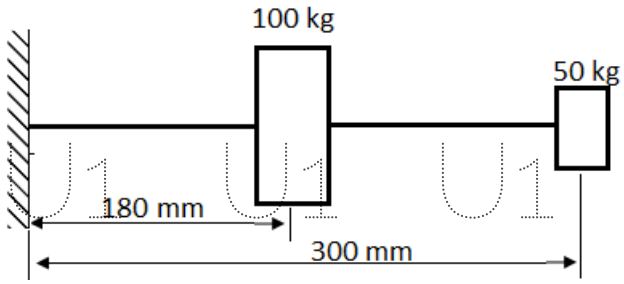


**Figure: 2**

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