**R13**

**Code No: 115DY**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**B. Tech III Year I Semester Examinations, May/June - 2019**
**DYNAMICS OF MACHINERY**
**(Common to ME, MCT, AME)**

**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.

**Illustrate your answers with NEAT sketches wherever necessary**

**PART - A**

**(25 Marks)**

1.a) Explain what is meant by applied torque and reaction torque. [2]
b) What do you mean by 'dynamically equivalent system'? Explain. [3]
c) Though cone clutches provide high frictional torque, yet they have become obsolete – why? [2]
d) What is a brake? What is the difference between a brake and a clutch? [3]
e) Explain the difference in the construction features of a Watt governor, Porter governor, and Proell governor. [2]
f) Explain the terms**:** Piston effort, Crank effort. [3]
g) What is meant by static unbalance and dynamic unbalance in machinery? [2]
h) Define the terms 'Variation in tractive force', 'Swaying couple', and 'Hammer blow' for an uncoupled two – cylinder locomotive engine. [3]
i) What is a 'compound pendulum'? Write the expression for the equivalent length of a compound pendulum in terms of its radius of gyration and the distance of its C.G. from the axis of suspension for the same frequency of oscillation of a simple pendulum. [2]
j) Distinguish between longitudinal, transverse, and torsional vibrations. [3]

**PART - B**

**(50 Marks)**

2. A motor cycle along with the rider weighs 2 KN, the C.G. of the machine and rider combined being 60 cm above the ground, with the machine in vertical position. The M.I. of each road wheel is 1030 N/mm$^2$, and the rolling diameter is 60 cm. The engine rotates at 6 times of the road wheels and in the same sense. The M.I. of rotating parts of the engine is 165 N/mm$^2$. Determine the angle of heel necessary if the unit is speeding at 62.5 km/h round a curve of 30.4 m. [10]

**OR**

3. In a vertical petrol engine, the crank radius is 6 cm, and the connecting rod is 22 cm long. The piston weighs 9.8 N. The connecting rod may be regarded as being equivalent to a mass of 0.5 kg at the piston together with a mass of 1 kg at the crank pin. Find the amount and the direction of the force exerted on the crank pin when the crank has moved 30$^0$ from the top dead centre. The engine speed is 2000 rpm, and in this position the force on the piston due to gas pressure is 7.35 N. [10]

4. A thrust bearing has contact surfaces of 40 cm and 30 cm external and internal diameters respectively. Calculate the number of collars required for an end thrust of 16 tonnes. The coefficient of friction is 0.04 and the maximum intensity of allowable pressure is 0.35 MPa. What is the HP lost in friction at a speed of 120 rpm? [10]

**OR**

5. Sketch an internal expanding shoe brake and derive the expression for friction torque of such a brake. [10]

6. With reference to a reciprocating engine mechanism, derive the relations for:
a) The angular velocity and angular acceleration of the connection rod, and
b) Turning moment on the crank shaft. [5+5]

**OR**

7. The upper and lower ends of the links of a Proell governor are pivoted on the axis of rotation of the governor. Each of the upper and lower links are each 25 cm long between centers, and the lower links carry extension arms each 10 cm long and parallel to the governor axis when the radius of the ball path is 15 cm. Determine the equilibrium speed of the governor for this configuration, if each ball weighs 60 N and the central load weighs 390 N. [10]

8. A shaft carries five masses *A*, *B*, *C*, *D* and *E* which revolve at the same radius in equidistant planes. The masses in planes *A*, *C* and *D* weigh respectively 500, 400 and 800 N. The angle between *A* and *C* is $90^0$ and that between *C* and *D* is $135^0$. Find the weights in planes *B* and *E* and their angular positions so that the shaft may be completely balanced. [10]

**OR**

9. A shaft carries four revolving masses *A*, *B*, C and *D* in that order along the axis. The mass *A* may be assumed to be concentrated at a radius of 12 cm, *B* at15 cm, *C* at 14 cm, and *D* at 18 cm. The weights of *A*, *C* and *D* are 150 N, 100 N and 80 N respectively. The planes of revolution of *A* and *B* are 15 cm part, and those of *B* and *C* are 19 cm apart. The angle between the masses *A* and *C* is $90^0$. Determine (a) the angles between masses *A*, *B*, and *C*, and (b) the distance between the planes of revolution of *C* and *D*, (c) the weight of mass *B*, so that the shaft may be completely balanced. [10]



10.a) Draw the sketches of amplitude of displacement *vs* time for the cases of under – damped, over – damped, critically damped, and undamped vibrations. Comment on the behavior of the graphs.
b) A shaft supported freely at its ends has a load of 1.2 kN placed at the centre of the shaft. The diameter of shaft is 40 mm and its length is 700 mm. Find the frequency of its natural transverse vibrations, if $E$ = 200 GN/m$^2$. [6+4]

**OR**

11.a) Explain the Dunkerley's method for finding the frequency of natural transverse vibrations of a simply supported shaft carrying several concentrated loads.
b) Given that the undamped natural frequency of longitudinal vibrations of a spring– mass system (where the mass of spring is assumed to be negligible) is $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$ , where *k* is the stiffness of the spring and *m* is the mass attached at the end of the spring, find the natural frequency of vibrations when the mass of the spring is considered to be $m_1$ per unit length of the spring. [5+5]

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