Code No: 115DY **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, March - 2017
DYNAMICS OF MACHINERY
(Common to AME, ME, MCT, MSNT)

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) Explain the application of gyroscopic principles to aircrafts. [2]
b) What will be the effect of the gyroscopic couple on a disc fixed at a certain angle to a rotating shaft? [3]
c) Distinguish between brakes and dynamometers. [2]
d) What is meant by the expression 'friction circle'? [3]
e) Define the terms 'coefficient of fluctuation of energy' and 'coefficient of fluctuation of speed', in the case of flywheels. [2]
f) What are the effects of friction and of adding a central weight to the sleeve of a Watt governor? [3]
g) Distinguish primary and secondary balancing. [2]
h) How do you balance V-engines? [3]
i) Define free vibrations, forced vibrations and damped vibrations. [2]
j) What do you understand by under damping, critical damping and over damping? [3]

PART - B

(50 Marks)

2. A four-wheeled trolley car of total mass 2000 kg running on rails of 1.6 m gauge, rounds a curve of 30 m radius at 54 km/h. The track is banked at 8^0. The wheels have an external diameter of 0.7 m and each pair with axle has a mass of 200 kg. The radius of gyration for each pair is 0.3 m. The height of centre of gravity of the car above the wheel base is 1 m. Determine, allowing for centrifugal force and gyroscopic couple actions, the pressure on each rail. [10]

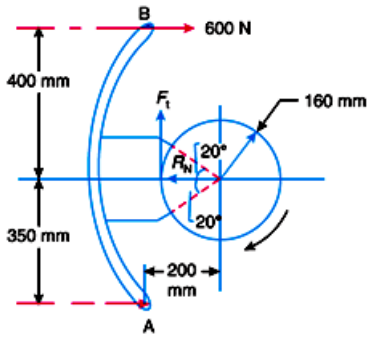
OR

3. A rear engine automobile is travelling along a track of 100 metres mean radius. Each of the four road wheels has a moment of inertia of 2.5 kg-m^2 and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of 1.2 kg-m^2. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle speed is 3 : 1. The automobile has a mass of 1600 kg and has its centre of gravity 0.5 m above road level. The width of the track of the vehicle is 1.5 m. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface. Assume that the road surface is not cambered and centre of gravity of the automobile lies centrally with respect to the four wheels. [10]

4. A rotor is driven by a co-axial motor through a single plate clutch, both sides of the plate being effective. The external and internal diameters of the plate are respectively 220 mm and 160 mm and the total spring load pressing the plates together is 570 N. The motor armature and shaft has a mass of 800 kg with an effective radius of gyration of 200 mm. The rotor has a mass of 1300 kg with an effective radius of gyration of 180 mm. The coefficient of friction for the clutch is 0.35. The driving motor is brought up to a speed of 1250 r.p.m. when the current is switched off and the clutch suddenly engaged. Determine
a) The final speed of motor and rotor
b) The time to reach this speed, and
c) The kinetic energy lost during the period of slipping.
How long would slipping continue if it is assumed that a constant resisting torque of 60 N-m were present? If instead of a resisting torque, it is assumed that a constant driving torque of 60 N-m is maintained on the armature shaft, what would then be slipping time? [10]

OR

5. The below Figure shows a brake shoe applied to a drum by a lever AB which is pivoted at a fixed point A and rigidly fixed to the shoe. The radius of the drum is 160 mm. The coefficient of friction at the brake lining is 0.3. If the drum rotates clockwise, find the braking torque due to the horizontal force of 600 N at B. [10]



6. A certain machine requires a torque of (1500 + 200 sin Θ) N.m to drive it, where Θ is the angle of rotation of the shaft. The machine is directly coupled to an engine which produces a torque of (1500 + 200 sin 2Θ) N.m. The flywheel and the other rotating parts attached to the engine have a mass of 300 kg at a radius of gyration of 200 mm. If the mean speed is 200 rpm. Find (a) the fluctuation of energy (b) the total percentage fluctuation of speed (c) the maximum and the minimum angular acceleration of the flywheel and the corresponding shaft positions. [10]

OR

7. In an engine governor of the Porter type, the upper and lower arms are 200 mm and 250 mm respectively and pivoted on the axis of rotation. The mass of the central load is 15 kg, the mass of each ball is 2 kg and friction of the sleeve together with the resistance of the operating gear is equal to a load of 25 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30^0 and 40^0, find, taking friction into account, range of speed of the governor. [10]

8. Four masses m1, m2, m3 and m4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45^0, 75^0 and 135^0. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. [10]

OR

9. A four crank engine has the two outer cranks set at 120^0 to each other, and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete primary balance, find the reciprocating mass and the relative angular position for each of the inner cranks. If the length of each crank is 300 mm, the length of each connecting rod is 1.2 m and the speed of rotation is 240 r.p.m., what is the maximum secondary unbalanced force? [10]

10. A machine mounted on springs and fitted with a dashpot has a mass of 60 kg. There are three springs, each of stiffness 12 N/mm. The amplitude of vibrations reduces from 45 to 8 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine (a) the damping coefficient (b) the ratio of frequencies of damped and undamped vibrations (c) the periodic time of damped vibrations. [10]

OR

11. An electric motor is to drive a centrifuge, running at 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 metre 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 torsional oscillation. Assume modulus of rigidity for material of shaft as 84 GN/m^2. [10]

---ooOoo---