R20 Regulation *Subject code: 3P5CA*

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous, Accredited by NAAC with 'A' Grade)

B.Tech V Semester Regular Examinations, January 2023

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Maximum Marks: 70 Date:06.01.2023 Duration: 3 hours

Note: 1.This question paper contains two parts A and B.
2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.
3. Part B consists of 5 Units. Answer any one full question from each unit which carries 10M.
4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks (10x2M=20 Marks)

1 Define precessional angular velocity of spin vector.
2 Define angle of heel in the case of a two-wheeler negotiating curve.
3 Define turning moment diagram with a neat sketch of an engine
4 How does a governor differ from that of flywheel?
5 What is the difference between brake and clutch?
6 Describe a transmission type dynamometer.
7 What is the equilibrium speed of a Porter governor?
8 Define effort and power of a Proell governor.
9 Explain the terms under damping and over damping in vibrating system.
10 What is a torsionally equivalent shaft?

Part-B

Answer All the following questions. (5X10M=50Marks)

11 A. Explain axis of spinning, axis of precession and axis of gyroscopic couple. (5M)
B. Explain the gyroscopic effect on a ship during pitching. (5M)

OR

12 The mass of turbine rotor of a ship is 8 tonnes and has a radius of gyration of 0.6 meters. It rotates at 1800 rpm clockwise when looking from the front. Determine the gyroscopic effect if i) The ship is travelling at 100 km/h and steers to the right in a curve of 70 meters radius. ii) The ship is pitching and the bow descends with maximum velocity. The complete oscillation takes 20seconds.The pitching is simple harmonic and the total angular movement between the extreme positions is 10 degrees. iii) The ship is rolling and at a certain instant has an angular velocity of 0.03 radians/second clockwise when looking from bow. (10M)

13 Derive the relation for the coefficient of fluctuation of speed in terms of maximum fluctuation of energy and the kinetic energy of the flywheel at mean speed. (10M)

OR

14 The turning moment diagram for a multi cylinder engine has been drawn to a scale of 1mm to 500 Nm of torque and 1mm to 60 of crank displacement The intercepted areas between the output torque curve and the mean resistance line taken in order from one end of the engine are -30, +410, -280+320, -330, +250, -360, +280, -260 mm^2 when the engine runs at 800 rpm. The engine has a stroke of 300mm and the fluctuation of speed is not to exceed 2% of mean speed. Determine suitable diameter and cross section of the flywheel rim for a limiting value of safe centrifugal stress of 7 Mega Pascal. The material density is 720kg/m^3. Width of the rim is 5 times the thickness. (10M)

15 A. Explain shoe brake with a neat sketch. (4M)
B. Deduce the relation for ratio of tight side and slack side tensions. (6M)

OR

16 Determine the axial force required to engage a cone clutch transmitting 20kW of power at 750 rpm. Average friction diameter of the cone is 400mm and average pressure intensity 60 kN/m^2. Semi cone angle is 100 and coefficient of friction is 0.25. Also find the width of the friction cone. (10M)

17 A. What are centrifugal governors? How do they differ from inertia governors? (5M)
B. Describe the function of a Proell governor with a neat sketch. (5M)

OR

18 Four masses P, Q, R and S are completely balanced. Masses R and S make angles of 90^0 and 210^0 respectively with Q in the same sense. The planes containing Q and R are 300 mm apart. Masses P, Q, R and S are supposed to be concentrated at radii of 360mm, 480mm, 240mm and 300mm respectively. The masses Q, R and S are 15kg, 25kg and 20kg respectively. Determine The mass P and its angular position, The planes in which the masses P and S are placed. (10M)

19 A. Define free and forced vibrations of a vibrating system. (4M)
B. Derive an expression for the natural frequency of free longitudinal vibrations. (6M)

OR

20 A stepped shaft of 0.05 m in diameter for the first 0.6 m length, 0.08 m diameter for the next 1.8 m and 0.03 m diameter for the remaining 0.25 m length. While the 0.05 m diameter end is fixed, the 0.03 m diameter end of the shaft carries a rotor of mass moment of inertia 14.7 kg-m^2. If the modulus of elasticity of the shaft material is 0.83 x 10^{11} N/m^2, find the natural frequency of torsional oscillations, neglecting the inertia effect of the shaft. (10M)