Code No:R2022032 **R20** **SET - 1**

II B. Tech II Semester Regular/Supplementary Examinations, July - 2023

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) Explain with a neat sketch the functioning of a belt transmission dynamometer. [7M]

b) Determine the axial force required to engage a cone clutch transmitting 25 kw of power at 750 rpm. Average friction diameter of the cone is 400 mm, and the average pressure intensity is 60kN/m^2. Semi cone angle is 10^0 and the coefficient of friction is 0.25. [7M]

Or

2 a) Name different types of dynamometers. Explain the function of Prony in brief. [7M]

b) Derive the expression for the torque transmitting capacity of a single plate clutch by considering uniform pressure. [7M]

UNIT-II

3 a) Explain about coefficient of fluctuation of speed and coefficient of fluctuation of energy. [7M]

b) Discuss in brief about piston effort and crank effort. [7M]

Or

4 a) Draw the turning moment diagrams for the following different types of engines, neglecting the effect of inertia of the connecting rod: 1. Single cylinder double acting steam engine; 2. Four stroke cycle. I.C. engine [7M]

b) Discuss about Dynamic force analysis of slider crank mechanism. [7M]

UNIT-III

5 a) State the different methods to determine the equilibrium speed of a Porter Governor. [7M]

b) The following particulars refer to a Wilson-Hartnell governor: [7M]
Mass of each ball = 2 kg; minimum radius = 125 mm; maximum radius = 175 mm; minimum speed = 240 rpm; maximum speed = 250 rpm; length of the ball arm of each bell crank lever = 150 mm; length of the sleeve arm of each bell crank lever =100 mm; combined stiffness of the two ball springs = 0.2kN/m. Find the equivalent stiffness of the auxiliary spring referred to the sleeve.

Or

6 a) Explain the effect of precession motion on the stability of moving vehicles such as motor cycle. [7M]

b) Write a short note on Gyroscope and derive an expression for Gyroscopic couple in standard form. [7M]
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UNIT-IV

7 a) Explain the effect of Gyroscopic couple on a Naval ship during pitching. [7M]

b) The moment of inertia of an aero plane air screw is 20 kg-m^2 and the speed of rotation is 1000 rpm clockwise when viewed from the front. The speed of the flight is 200 km per hour. Find the gyroscopic reaction of the air screw on the aero plane when it makes a left-handed turn on a path of 150 m radius. [7M]

Or

8 a) Discuss how a single revolving mass is balanced by two masses revolving in different planes. [7M]

b) Four masses M1, M2, M3 and M4 are 200kg, 300kg, 240kg and 260kg respectively. The corresponding radii of rotation are 0.2m, 0.15m, 0.25m and 0.3m respectively and the angle between successive masses are 45°, 75° and 135°. Find the position and magnitude of balance mass required if its radius of rotation is 0.25m. [7M]

UNIT-V

9 a) A shaft of 100 mm diameter and 1 m long is fixed at one end, and the other end carries a flywheel of mass 1 tonne. The radius of gyration of the flywheel is 0.5m. Find the frequency of torsional vibrations, if the modulus of rigidity of the shaft material is 80 GN/m^2? [7M]

b) Explain about free vibration of spring mass system. [7M]

Or

10 a) Describe about vibrations of beams with concentrated and distributed loads. [7M]

b) A coil of spring stiffness 60 N/mm supports vertically a load of 3 kN at the free end. The motion is resisted by the oil dashpot. It is found that the amplitude at the beginning of the fourth cycle is 0.6 times the amplitude of the previous vibration. Find the ratio of the frequencies of damped and un damped vibrations. [7M]

Code No:R2022032 **R20** **SET - 2**

II B. Tech II Semester Regular/Supplementary Examinations, July - 2023

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks

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UNIT-I

1 a) Derive from first principles, the expression for the frictional moment (or torque due to friction) of a conical pivot assuming uniform pressure. [7M]

b) A multi-disc clutch has 5 plates having four pairs of active friction surfaces. If the intensity of pressure is not to exceed 127 kN/m^2 , find the power in kW transmitted at 500 rpm, if the outer and inner radii of friction surfaces are 1.25 mm and 75 mm respectively. Assume uniform wear and take coefficient of friction as 0.3. [7M]

Or

2 a) A single plate clutch having both sides effective is required to transmit 45 kW at 1500 rpm. The outer diameter of the plate is limited to 300 mm and the intensity of pressure between the plates is not to exceed 0.07 MPa. Assuming uniform wear and a coefficient of friction 0.35, determine the inside diameter of the plate? [7M]

b) Explain about boundary friction and film lubrication. [7M]

UNIT-II

3 In a Proell governor, each ball weighs 2.5 kg; length of each of the main four arms in 20cms, the extended arm is 8 cm long. The pin joints of the main arm are 4 cm from the axis of the governor. For the sleeve to be on its bottom stop the distance between the top and bottom hinge points of the main arms is 30 cm and then the extended arm is vertical. Find the weight of central load when the sleeve just leaves the bottom stop at 150 rpm. What will be the speed of the governor after the sleeve has been raised to 4 cm? [14M]

Or

4 For a spring controlled Hartnell type governor, following data is provided: mass of the governor ball is 2 kg, length of the vertical arm of bell crank lever is 800 mm, and length of the other arm of bell crank lever is 90 mm. The speeds corresponding to radii of rotations 120 mm and 130 mm are 300 rpm and 310 rpm respectively. Determine the stiffness of spring. [14M]

UNIT-III

5 a) Derive the expression for Gyroscopic Couple. [7M]

b) Each wheel of a motor cycle is of 600 mm diameter and has a moment of inertia of 1.2 kg m^2. The total mass of the motor cycle and the rider is 180 kg and the combined center of mass is 580 mm above the ground level when the motor cycle is upright. The moment of inertia of the rotating parts of engine 0.2 kgm^2. The engine speed is 5 times the speed of the wheel and is in the same sense. Determine the angle of heel necessary when the motor cycle takes a turn of 35 m radius at a speed of 54 km/hr. [7M]

Or
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6 a) What do you mean by Spin, Precession and gyroscopic planes? [7M]

b) The rotor of a marine turbine has a moment of inertia of 750 kg.m^{2}and rotates at 3000 rpm clockwise when viewed from the front. If the ship pitches with angular simple harmonic motion having a periodic time of 16 sec and amplitude of 0.1 radian find [7M]

i) The maximum angular velocity of the rotor axis

ii) The maximum value of the gyroscopic couple

iii) The gyroscopic effect as the bow dips.

UNIT-IV

7 a) Define and explain the term 'Balancing of Rotating Masses'. What will be the harm if the rotating parts of high speed engine are not properly balanced? [7M]

b) A number of masses (say four masses) are attached to a shaft which is rotating at an angular speed of ω rad/s. If all the masses are in the same plane, then describe the analytical method of balancing these four masses by a single mass only. [7M]

Or

8 a) Three masses of 8kg, 12kg and 15kg attached at a radial distances of 80,100 and 60mm respectively to a disc on a shaft are in complete balance. Determine the angular positions of the masses 12kg and 15kg relative to the 8kg mass. [7M]

b) Briefly explain the terms [7M]

(i) Variation of tractive force

(ii) Swaying couple and

(iii) Hammer blow

UNIT-V

9 a) Differentiate between free vibrations and forced vibrations. [7M]

b) Derive an expression for vibration response of a single degree of freedom system if the damping provided is over damped system. [7M]

Or

10 a) Explain, with sketches the different cases of damped vibrations. [7M]

b) Describe about vibrations of beams with concentrated and distributed loads. [7M]

Code No: R2022032 **R20** **SET - 3**

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DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 70**

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UNIT-I

1 a) Describe with a neat sketch the working of a single plate friction clutch. [7M]

b) A flat foot step bearing 300mm in diameter supports a load of 8kN. If the coefficient of friction is 0.1, and the speed of the shaft is 80 rpm, find the power lost in friction, assuming uniform wear. [7M]

Or

2 a) In a belt transmission dynamometer, the driving pulley rotates at 300rpm. The distance between the centre of the driving pulley and the dead mass is 800mm. The diameter of each of the driving as well as the intermediate pulleys is equal to 360mm. Find the value of the dead mass require to maintain the lever in a horizontal position when the power transmitted is 3kW. Also find its value when the belt just begins to slip on the driving pulley. Coefficient of friction being 0.25 and the maximum tension in the belt 1200N. [7M]

b) Explain the working of internal expanding shoe break with the help of neat sketch [7M]

UNIT-II

3 a) Explain the function of a flywheel from a crank effort diagram. [7M]

b) An engine flywheel has mass of 6.5 tonnes, and the radius of gyration is 2 m. If the maximum and minimum speeds are 120 rpm and 118 rpm respectively, find the maximum fluctuation of energy. [7M]

Or

4 a) Explain the effect of inertia force on the reciprocating engine mechanism by drawing the free body diagram of each link. [7M]

b) Find the maximum and minimum speeds of a flywheel of mass 3250 kg and radius of gyration 1.8 m, when the fluctuation of energy is 112kN-m. The mean speed of the engine is 240rpm. [7M]

UNIT-III

5 a) Explain the working of Gyroscope along with an example of its use and give its merits and demerits. [7M]

b) The moment of inertia of an aero plane air screw is 20 kg-m^2 and the speed of rotation is 1000 rpm clockwise when viewed from the front. The speed of the flight is 200 km per hour. Find the gyroscopic reaction of the air screw on the aero plane when it makes a left-handed turn on a path of 150 m radius. [7M]

Or
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6 a) State the different methods to determine the equilibrium speed of a Porter Governor. [7M]

b) A Porter governor has arms 250 mm each and four rotating fly balls of mass 0.8kg each the sleeve movement is restricted to 20 mm from the height when the mean speed is 100 rpm. Calculate the central dead load and sensitivity of the governor neglecting friction when the fly ball exerts the centrifugal force of 9.81 N. Determine also the effort and power of the governor for 1% speed change [7M]

UNIT-IV

7 a) Describe reasons for partial balancing of reciprocating masses. [7M]

b) Four masses m1,m2,m3 and m4 having 100, 175, 200, and 25kg fixed to cranks of 20cm radius and revolve in places 1, 2, 3 and 4. The angular position of the cranks in planes 2, 3 and 4 with respect to the crank in plane 1 are 750 same sense. The distances of planes 2, 3 and 4 from plane 1 are 60cm, 186cm and 240cm respectively. Determine the position and magnitude of the balance mass at a radius of 60cm in plane L and M located at the middle of the plane 1 and 2 and the middle of the planes3 and 4 respectively. [7M]

Or

8 The following data refers to a two- cylinder uncoupled locomotive: Rotating mass per cylinder = 280kg Reciprocating mass per cylinder = 300kg Distance between wheels = 1400mm Distance between cylinder centres = 600mm Diameter of treads of driving wheels =1800mm Crank radius = 300mm Radius of centre of balance mass = 620mm Locomotive speed = 50Km/hr Angle between cylinder cranks = 90^o Dead load on each wheel = 3.5 tonne. Determine the: i) Balancing mass required in the planes of driving wheels if whole of the revolving and two-third of the reciprocating mass are to be balanced ii) Swaying couple iii) Variation in tractive force iv) Maximum and minimum pressure on the rails v) Maximum speed of locomotive without lifting the wheels from the rails. [14]

UNIT-V

9 a) Explain the vibrations of beams with concentrated and distributed loads. [7M]

b) A coil of spring stiffness 60 N/mm supports vertically a load of 3 kN at the free end. The motion is resisted by the oil dashpot. It is found that the amplitude at the beginning of the fourth cycle is 0.6 times the amplitude of the previous vibration. Find the ratio of the frequencies of damped and undamped vibrations. [7M]

Or

10 a) A shaft of 100 mm diameter and 1 m long is fixed at one end, and the other end carries a flywheel of mass 1 tonne. The radius of gyration of the flywheel is 0.5 m. Find the frequency of torsional vibrations, if the modulus of rigidity of the shaft material is 80 GN/m^2. [7M]

b) Explain about free vibration of spring mass system. [7M]

Code No:R2022032 **R20** **SET - 4**

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DYNAMICS OF MACHINERY

(Mechanical Engineering)

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UNIT-I

1 a) Which of the two assumptions: uniform intensity of pressure or uniform rate of wear, would you make use of in designing friction clutch and why? [7M]

b) Explain with a neat sketch the functioning of a belt transmission dynamometer. [7M]

Or

2 a) In a reciprocating engine, length of stroke is 30 cm and connecting rod is 60 cm long between centres. When the piston has travelled 8 cm from the inner dead center, Find: **i**) angular position of the crank; **ii**) velocity and acceleration of the piston; **iii**) angular velocity of connecting rod, if the engine speed is 240 rpm. [7M]

b) Draw the turning moment diagrams for the following different types of engines, neglecting the effect of inertia of the connecting rod: 1. Single cylinder double acting steam engine 2. Four stroke cycle I.C engine [7M]

UNIT-II

3 a) State the different types of governors. Explain about any one of them. [7M]

b) What are the differences between Porter and Proell governors? Why the speed range of Proell governor is less than that of a similar Porter type? [7M]

Or

4 The equation of the turning moment diagram for a three-crank engine is given by T (N-m) = 25000 - 7500 sin 3θ, where θ radians is the crank angle from the inner dead centre. The moment of inertia of the flywheel is 400 kg-m^2 , and the mean engine speed is 300 rpm. Calculate the power of the engine and the total percentage fluctuation of speed of the flywheel, if the resisting torque is constant. [14M]

UNIT-III

5 a) Explain the effect of Gyroscopic couple on a Naval ship during pitching. [7M]

b) What is the effect of the gyroscopic couple on the stability of a four-wheeler while negotiating a curve? In what way does this affect along with that of the centrifugal force limit the speed of the vehicle? [7M]

Or

6 a) State the different types of governors. Explain about any one of them. [7M]

b) What are the differences between Porter and Proell governors? Why the speed range of Proell governor is less than that of a similar Porter type? [7M]

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UNIT-IV

7 a) Four masses A, B, C & D are completely balanced. Masses C & D makes an angle of 900 and 1950 respectively with that of mass B in the counterclockwise direction. The rotating masses have the following properties: masses at B, C & D are 25 Kg, 40 Kg and 35 Kg respectively with their radii of rotations are 200 mm, 100 mm & 180 mm respectively. The radius of rotation of mass A is 150 mm. Planes B & C are 250 mm apart. Determine the i) mass A and its angular position with that of mass B, ii) position of all the planes relative to plane of mass A. [7M]

b) Explain why the reciprocating masses are partially balanced. [7M]

Or

8 a) Discuss how a single revolving mass is balanced by two masses revolving in different planes. [7M]

b) A number of masses (say four masses) are attached to a shaft which is rotating at an angular speed of ω rad/s. If all the masses are in the same plane, then describe the analytical method of balancing these four masses by a single mass only. [7M]

UNIT-V

9 a) What do you mean by whirling of shafts? What is critical speed? Explain. [7M]

b) The rotor of turbo super charger weighing 9 kg is keyed to the centre of a 25 mm diameter steel shaft 40 cm between bearings. Determine the i) critical speed of shaft, ii) amplitude of vibration of the rotor at a speed of 3200 rpm if the eccentricity is 0.015 mm and iii) vibratory force transmitted to the bearings at this speed. [7M]

Or

10 a) Explain about free vibration of spring mass system. [7M]

b) A shaft 50mm diameter and 3m long. It is simply supported at the ends and carries three masses 100Kg, 120Kg and 80Kg at 1.0mm, 1.75m and 2.5m respectively from the left support. Taking $E=20GN/m^2$. Find the frequency of transverse vibrations using Rayleigh's method. [7M]