Code.No: 07A60304 | R07 | SET-1

III B.TECH – II SEM EXAMINATIONS, DECEMBER - 2010
DYNAMICS OF MACHINERY
(MECHATRONICS)

Time: 3hours **Max.Marks:80**

Answer any FIVE questions
All questions carry equal marks
- - -

1.a) State and explain D'Alembert's principle.
b) What do you mean by dynamical equivalent system? Explain.
c) What do you mean by spin, precession and gyroscopic planes? Explain. [4+5+7]

2.a) What is meant by friction circle? Deduce an expression for the radius of friction circle in terms of the radius of the journal and angle of friction.
b) A pivot bearing of a shaft consists of a frustum of a cone. The diameters of the frustum are 200 mm and 400 mm, and its semi-cone angle is 60^0. The shaft carries a load of 40 kN and rotates at 240 rpm. The coefficient of friction is 0.02. Assuming the intensity of pressure to be uniform, determine
a) The magnitude of pressure, and
b) The power lost in friction. [16]

3. **Fig.1** shows a simple band brake which is applied to a shaft carrying a flywheel of 300 kg mass, and of radius of gyration 280 mm. The drum diameter is 220 mm, and the shaft speed 240 rpm. The coefficient of friction is 0.3. Find the brake torque when a force of 100 N is applied at the lever end. Also, determine the number of turns of the flywheel, and the time taken by it before coming to rest. [16]

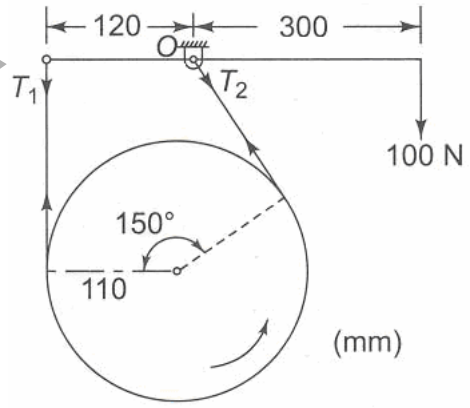

Fig. 1

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. [16]

5.a) What are the differences between Porter and Proell governor? Why is the speed range of Proell governor is less than that of a similar Porter type.

b) Porter governor has equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5Kg and the mass of the central load on the sleeve is 25Kg. The radius of rotation of the ball is 150mm when the governor begins to lift and 200mm when the governor is at maximum speed. Find the maximum and minimum speeds and range of speed of the governor. [16]

6. Two weights of 8Kg and 16Kg rotate in the same plane at a radius of 1.5 and 2.25m respectively. The radii of the these weights are 60^0 apart. Find the position of the third weight of the magnitude of 12Kg in the same plane which can produce static balance of the system. [16]

7. Determine the unbalanced forces and couples in the case of following is line engines.
a) Four cylinder four stroke engine.
b) Six cylinder four stroke engine. [16]

8.a) Explain briefly the phenomenon of the whirling of shafts.
b) A steel shaft 6cm diameter and 50cm long fixed at one end carries a flywheel of mass 100Kg and radius of gyration 30cm at its free end. Find the frequency of free longitudinal and transverse vibrations. [8+8]

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III B.TECH – II SEM EXAMINATIONS, DECEMBER - 2010
DYNAMICS OF MACHINERY
(MECHATRONICS)

Time: 3hours **Max.Marks:80**

Answer any FIVE questions
All questions carry equal marks

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1.a) A flywheel having a mass of 20 kg and radius of gyration of 300 mm is given a spin of 500 rpm about its axis which is horizontal . The flywheel is suspended at a point that is 250 mm from the plane of rotation of the flywheel. Find the rate of precession of the wheel.
b) What is the principle of a gyroscope? Discuss the factors that affect the stability of an automobile while negotiating a curve. [8+8]

2.a) Derive from first principles, the expression for the frictional moment (or torque due to friction) of a conical pivot assuming uniform wear.
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. [8+8]

3.a) What do you understand by 'self-locking brake' and 'self-energized brake'? Should we have self-locking brake or self-energized brake? Justify your answer.
b) A simple band brake is operated by a lever of length 450 mm. The brake drum has a diameter of 600 mm, and the brake band embraces $5/8^{th}$ of the circumference. One end of the band is attached to the fulcrum of the lever while the other end is attached to a pin on the lever 120 mm from the fulcrum. The effort applied to the end of the lever is 2 kN, and the coefficient of friction is 0.30. Find the maximum braking torque on the drum. [8+8]

4.a) Discuss the effect of inertia force on the reciprocating engine mechanism by drawing the free body diagram of each link.
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 112 kN-m. The mean speed of the engine is 240rpm. [8+8]

5.a) Discuss the merits and demerits of spring controlled and gravity controlled governors.
b) Calculate the minimum speed of a Proell governor, which has equal arms each 200mm and are pivoted on the axis of rotation. The mass of each ball is 4Kg and the central mass on the sleeve is 20Kg. The extension arms of the lower links are each 60mm long and paralled to the axis when the minimum radius of the ball is 100mm. [8+8]

6.a) Four weights A, B, C and D revolve at equal radius and are equally spaced along a shaft. The weight B Weighs 70N and the radii of C and D makes angles of 90^0 and 220^0 respectively with the radius of B. Find the magnitude of weights A, C, and D.
b) Why balancing of rotating parts necessary for high speed engines. [8+8]
7.a) Prove that maximum secondary unbalanced forces is l/n times maximum primary unbalanced for n cylinders reciprocating engine.

b) Describe the reasons for partial balancing of reciprocating masses. [8+8]

8.a) Derive an equation for the natural frequency of free transverse vibration of a shaft loaded with a number of concentrated loads, by energy method.

b) Defined forced vibration with a neat sketch. [8+8]

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III B.TECH – II SEM EXAMINATIONS, DECEMBER - 2010
DYNAMICS OF MACHINERY
(MECHATRONICS)

Time: 3hours **Max.Marks:80**

Answer any FIVE questions
All questions carry equal marks
- - -

1.a) Explain what do you understand by gyroscopic stabilization. Illustrate with the help of a sketch how this is carried out in ships.
b) Describe the effect of the gyroscopic couple on pitching, rolling and steering of a ship with neat sketches indicating the direction of couple vector, spin vector and precession vector. [8+8]

2.a) What do you mean by film friction? State its laws.
b) A body of weight 150 N is placed on a rough horizontal plane. If the coefficient of friction between the body and the horizontal plane is 0.4, determine the horizontal force required to just slide the body on the plane. [6+10]

3.a) 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 average pressure intensity is 60 kN/m^2. Semi cone angle is 10^0 and coefficient of friction is 0.25. Also find the width of the friction cone.
b) Which of the two assumptions, uniform intensity of pressure or uniform rate of wear, would you make use of in designing a friction clutch and why? [8+8]

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.
b) What is the function of a flywheel? How does it differ from that of a governor? [10 +6]

5. A governor of the Proell type has each arm is 250mm long. The Pivots of the upper and lower arms are 25mm form the axis. The central load acting on the sleeve has a mass 25Kg and each rotating ball has a mass of 3.2Kg when the governor sleeve is in mid position, the extension link of the lower arm is vertical and the radius of path of the rotation of the masses is 175mm, the vertical height of the governor is 200mm, if the speed of the governor is 160rpm, when in the mid position, find:
a) Length of the extension link.
b) Tension in upper arm. [8+8]

6. Three cylinders of an air compressor have their axes 120^0 to one another and their connecting rods are coupled to a single crank. The stroke is 12cm and the length of each connecting rod 20cm. The mass of the reciprocating parts per cylinders is 2Kg. Determine the maximum primary and secondary forces acting on the frame of the compressor when running at 2500 rpm. Describe the method by which such forces may be balanced. [16]

7. A vertical shaft 1.25cm in diameter rotates in long bearings and a disc of mass 15 Kg is attached to the mid span of the shaft. The span of the shaft between bearings is 50cm. The mass centre of the disc is 0.05cm from the axis of the shaft. Neglecting the mass of shaft, and taking the deflection as for beam fixed on both ends, determine the critical speed of rotation. Determine the range of speed over which the stress in the shaft due to bending will exceed 1250 bar. Take $E = 2x10^6$ bar. [16]

8. A four trasses A of 10Kg, B of 8Kg, C of 15Kg D of 12 Kg are attached to a shaft and are revolveing in the same plane at radius of rotation as 35mm, 35mm, 40mm, 60mm. The angular position masses A,B,C, are 75^0, 150^0, 250^0, from D. Find the magnitude and position of the balancing mass at a radius of 120 mm. [16]

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III B.TECH – II SEM EXAMINATIONS, DECEMBER - 2010
DYNAMICS OF MACHINERY
(MECHATRONICS)

Time: 3hours **Max.Marks:80**

Answer any FIVE questions
All questions carry equal marks
- - -

1.a) Explain the application of gyroscopic principle to aircrafts.
b) A diesel locomotive moving at a speed of 100 km/h turns around a curve of radius 400 m to the right. The pair of driving wheels are 2 m in diameter, and along with the axle has a mass of 2000 kg . The radius of gyration of the wheels together with the axle may be taken as 0.6 m. Find the gyro effect on the pair of driving wheels. [8+8]

2.a) Explain the terms: friction circle, friction couple and friction axis.
b) A square threaded screw of mean diameter 30 mm and pitch of threads 5mm is used to lift a load of 15kN by a horizontal force applied at the circumference of the screw. Find the force required if the coefficient of friction between screw and nut is 0.02. [6+10]

3. 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. [16]

4. A Punching machine makes 20 working strokes per minute, and is capable of punching 20 mm diameter hole in a 15 mm thick steel plate having an ultimate shear strength of 240 MPa. The punching operation takes place during 1/10 th of a revolution of the crankshaft. Estimate the power required for the driving motor, assuming a mechanical efficiency of 95 % . Also determine the size of the rim of the flywheel having width equal to twice the thickness. The flywheel is to revolve 10 times the speed of the crankshaft. The fluctuation of speed is 10 %. Assume the flywheel to be made of cast iron having working stress of 6 MPa and density 7300 kg/m^3. The diameter of the flywheel should not exceed 1.5 m. Neglect the effect of arms and hub. [16]

5. In a spring controlled Hartnell type governor the mass of each ball is 4Kg and the lift of the sleeve is 50mm. The governor begins to float at 240 rpm, when radius of the ball path is 110mm. The mean working speed of the governor is 20 times the range of the speed when friction is neglected. The lengths of the ball and roller arms of the bell crank lever are 120mm and 100mm respectively. The point centre and the axis of governor are 140mm apart. Determine the initial compression of the springs, taking into consideration of arms. [16]

6. Explain in detail the produce for balancing of masses rotating in different planes. [16]

7. Explain terms:
   a) Variation in tractive effort
   b) Swaying couple
   c) Hammer blow as applied to locomotive balancing. Derive expression for these two cylinders uncoupled locomotive balancing. [16]

8. Two rotors A and B are attached to the ends of a shaft 600mm long. The mass of the rotor A is 400Kg and its radius of gyration is 400mm. The corresponding values of rotor B are 500Kg and 500mm respectively. The shaft is 80mm dia for the first 250mm, 120mm dia for next 150mm and 100mm dia for the remaining length. Modulus of rigidity of the shaft material is 0.8×10^5 MN/m^2.
   Find the position of the node, the frequency of torsional vibrations. [16]

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