Code No: **R31033**

R10

Set No. 1

III B.Tech I Semester Supplementary Examinations, May/June - 2015

DYNAMICS OF MACHINERY

(Common to ME and AME)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1 a) Derive the expression for Gyroscopic Couple? [7]

b) A disc with radius of gyration of 60mm and a mass of 4kg is mounted centrally on a horizontal axle of 80mm length between the bearings. It spins about the axle at 800rpm counter-clockwise when viewed from the right hand side bearing. The axle processes about a vertical axis at 50rpm in the clockwise direction when viewed from above. Determine the resultant reaction at each bearing due to the mass and the gyroscopic effect. [8]

2 a) Derive the expression for coefficient of friction [7]

b) The force required just to move a body on a rough horizontal surface by pulling is 320N inclined at 30^0 and by pushing 380N at the same angle. Find the weight of the body and coefficient of friction. [8]

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

b) The inner and outer radii of a single plate clutch are 40mm and 80mm respectively. Determine the maximum, minimum and average pressure when the axial force is 3kN. [8]

4 a) What is turning movement diagram? Mention its uses [5]

b) Derive the equation K Where K=coefficient of fluctuation of speed, explain [10]

5 a) Derive the expression for the height of Proell governor [5]

b) Calculate the minimum speed of a proell governor, which has equal arms each 20mm 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 parallel to the axis when the minimum radius of the ball is 20mm. [10]

6 a) What is the necessity of balancing? [5]

b) Three masses of 8kg, 12kg and 15kg attached at radial distances of 80mm, 100mm and60mm respectively to a disc on a shaft are in complete balance. Determine the angular positions of the masses of 12kg and 15kg relative to 8kg mass [10]

7 a) Explain the balancing of outside cylinder locomotive. Develop the expressions for hammer blow, swaying couple and variation in an tractive effort. [7]

b) A three cylinder radial engine driven by a common crank has the cylinders speed at 120^0.The stroke is 100mm, length of the connecting rod 200mm and the reciprocating mass per cylinder 1.5kg. Calculate the primary and secondary forces at crank shaft speed of 1500rpm. [8]

8 a) Define free vibrations, forced vibrations and damping. [5]

b) A rigid massless bar of length L is hinged at its ends and carries a spring k_2 with mass in at its right end. The bas is also supported by a spring k_1 at a distance from the lift. Hinge Determine the natural frequency of the bar. [10]

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1 a) Define gyroscopic effect on pitching. [7]
b) A ship is pitching through a total angle of 15^0, the oscillation may be taken as simple harmonic motion and the complete period is 32sec. The turbine rotor weighs 6 tonnes. Its radius of gyration is 45cm and it is rotating at 2000rpm. Calculate the maximum value of gyroscopic couple set up by the rotor. If the rotation of rotor is clockwise looking form left, in which direction will the bow tend to turn while falling what is the maximum angular acceleration to which the ship is subjected while pitching? [8]

2 a) Define Friction and explain the various kinds of frictions and laws of friction. [6]
b) A body is to be moved up by an inclined plane by applying a force parallel to the plane surface. It is found that a force of 3kN is required to just move it up the plane when the angle of inclination is 10^0 where as the force needed increases to 4kN hen the angle of inclination is increased to 15^0. Determine the weight of the body and coefficient of friction. [9]

3 a) Derive the expression for the torque transmitting capacity of a multi-plate cultch. [7]
b) A multi-plate disc clutch transmits 55kW of power at 1800rpm. Coefficient of friction for the friction for the friction surface is 0.1. Axial intensity of pressure is not to exceed $160N/m^2$. The internal radius is 80mm and is 0.7 times the external radius find the number of plates need to transmit the required torque. [8]

4 A horizontal steam engine 20cm diameter by 40cm stroke, connecting rod 100cm makes 160rpm. The mass of the reciprocating parts is 50kg. When the crank has turned through an angle of 30 degrees. The steam pressure is 4.5 bar. [15]
(a) Calculate the turning moment of crankshaft.
(b) if the mean resistance torque is 30N-m and the mass of flywheel is 50kg and the radius of gyration 70cm. Calculate the acceleration of flywheel.

5 a) Derive the expression for speed of porter governor. [7]
b) Each arm of a porter governor is 200mm long and is pivoted on the axis of the governor. The radil of rotation of the balls at the minimum and maximum speeds are 120mm and 160mm respectively. The mass of the sleeve is 24kg and each ball is 4kg find the range of speed of governor. Also determine the range of speed if friction at sleeve is 18N [8]

6 Four masses m_1,m_2,m_3 and m_4 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 75^0,135^0 and 200^0 taken in the same sense. The distances of planes 2,3 and 4 from plane 1 are 60cm, 186cm and 24cm 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 planes 3 and 4 respectively. [15]

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7 a) Describe reasons for partial balancing of reciprocating masses. [5]
b) Prove that maximum secondary unbalanced forces are 1/n times maximum primary unbalanced for n cylinder reciprocating engine. [10]

8 a) Explain magnification factor. [5]
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. [10]

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Code No: **R31033** **R10** **Set No. 3**

III B.Tech I Semester Supplementary Examinations, May/June - 2015

DYNAMICS OF MACHINERY

(Common to ME and AME)

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1 a) Differentiate between natural and forced precessions [5]

b) The rotary engine and the propeller of an aircraft weigh 3.6kN and have a radius of gyration of 35cm. when viewed form the front the engine rotates in the clockwise direction at 1500rpm. When propelling at 560 m/s the air craft takes a right hand turn on a circle of 20m radius. Determine the magnitude and direction of the gyroscopic torque acting on the aircraft. [10]

2 a) Differentiate between static and dynamic friction. [5]

b) An electric motor driven power screw moves a nut in a horizontal plane against a force of 75kN at a speed of 300mm/min. the screw has a single square thread of 6mm pitch on a major diameter of 40mm. the coefficient of friction at the screw thread is 0. Estimate power of the motor.

3 a) Derive the expression for the torque transmitting capacity of a cone clutch by considering uniform pressure. [7]

b) A cone clutch with a semi cone angle of 15^{0} transmits 10kW at 600rpm. The normal pressure intensity between the surfaces in contact is not to exceed $10kN/m^2$. The width of the friction surfaces is half of the mean diameter. Assume coefficient of friction as 0.25. Determine outer and inner diameters of the plate. Width of the cone face and axial force to engage the clutch. [8]

4 Discuss dynamic force analysis of slider crank mechanism. [15]

5 In a spring loaded Hartnell type of governor, the mass of each of the ball is 4kg and the lift of the sleeve is 40mm. the governor begins to float at 200rpm when the radius of the ball path is 90mm. the mean working speed of the governor is 16 times the range of speed when friction is neglected. The lengths of the bil and roller arms of the bell crank layer are 100mm and 80mm respectively. The pivot center and the axis of governor are 115mm apart. Determine the initial compression of the spring. Taking into account the obliquity of arms. Assuming the friction at the sleeve to be equivalent to a force of 15N, determine the total alteration in speed before the sleeve begins to move from the mid position. [15]

6 a) Derive an expression for balancing of several masses in different planes. [10]

b) What are the effects of partial balancing in locomotives? [5]

7 A three cylinder radial engine driven by a common crank has the cylinders spaced at 120^0. The stroke is 100mm, length of the connecting rod 200nn and the reciprocating mass per cylinder 1.5kg. Calculate the primary and secondary forces at crank shaft speed of 1500rpm [15]

8 A shaft of 50mm diameter and 3m long it is simply supported at the ends and carries three masses 100kg. 120kg and 80kg at 1m 1.75m and 2.5m respective from the left support Taking $E=20GN/m^2$, find the frequency of transverse vibrations using Rayleigh's method. [15]

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DYNAMICS OF MACHINERY

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1 a) Define gyroscope and give its applications [7]

b) Each wheel of a four wheeled rear engine automobile has a moment of inertial of 2.4 kgm^2 and an effective diameter of 660mm. The rotating parts of the engine have a moment of inertia of 1.2 kgm^2. The gear ratio of engine to the back wheel is 3.1. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The mass of the vehicle is 2200kg and the centre of the mass is 550mm above the road level. The track width of the vehicle is 1.5m. Determine the limiting speed of the vehicle around a curve with 80m radius so that all the four wheels maintain contact with the road surface. [8]

2 a) Derive the expression for uniform wear and uniform pressure for flat collar. [7]

b) In a thrust bearing the external and internal diameters of the contacting surfaces are 320mm and 200mm respectively. The total axial load is 80kN and the intensity of pressure is $350kN/m^2$. The shaft rotates at 400rpm. Taking the coefficient of friction as 0.06, calculate the power lost in overcoming the friction. Also find the number of collars require for the bearing. [8]

3 a) Derive the expression for the torque transmitting capacity of a centrifugal clutch by considering uniform wear. [7]

b) A centrifugal clutch has four shoes which slide radially in a spider keyed to the driving shaft and make contact with the internal cylindrical surface of a rim keyed to the driven shaft. When the clutch is at rest, each shoe is pulled against a stop by a spring so as to leave a radial clearance of 5mm between the v shoe and the rim. The pull exerted by the spring is then 600N. The mass centre of the shoe is 160mm from the axis of the clutch. If the internal diameter of the rim is 400mm, the mass of each shoe is 8kg, the stiffness of each spring is 50N/mm and the coefficient of friction between the shoe and the rim is 0.3 find the power transmitted by the clutch at 500rpm. [8]

4 The torque delivered by two stroke engine represented by $T=1000+300 \sin 2\theta - 500 \cos\theta$ N-m where θ is the angle made by the crank from IDC. The engine speed is 250rpm. The mass of flywheel is 400kg and radius of gyration is 400mm. Determine [15]
(i) Total percentage of fluctuation of speed.
(ii) The angular acceleration of flywheel when the crank has rotated through an angle of 60^0 from IDC
(iii) The maximum angular retardation of flywheel.

5 a) Explain the terms sensitiveness, Hunting, Stability, Effort, Power and isochronisms in connection with governors. [7]

b) Calculate the speed range of a porter governor, Where each arm is 180mm long and is pivoted on the axis of rotation. The mass of each ball is 4kg and the central mass on the sleeve is 18kg. The radius of the ball is 100mm when sleeve begins to rise and 140mm when at top. [8]

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6 a) Distinguish between static balance and dynamic balance with examples. [5]

b) A circular disc mounted on a shaft carries three attached masses of 4kg, 3kg and 2.5kg at radial distances of 75mm, 85mm and 50mm and at the angular positions of 450, 1350 and 2400 respectively. The angular positions are measured counter clockwise from the reference line along the x-axis. Determine the amount of the counter mass at a radial distance of 75mm required for the static balance. [10]

7 The cylinders of a twin V-engine are set at 60^0 angle with both pistons connected a single crank through their respective connecting rods. Each connecting rod is 600mm long and the crank radius is 120mm. The total rotating mass is equivalent to 2kg at the crank radius and the reciprocating mass is 1.2 kg per piston. A balance mass is also fitted opposite to the crank equivalent to 2.2kg at radius of 150mm. Determine the maximum and minimum values of the primary and secondary forces due to inertia of the reciprocating and rotating masses if the engine speed is 800rpm. [15]

8 A rotor has a mass of 12kg and is mounted midway on a 24mm diameter horizontal shaft supported at the ends by two bearings. The bearings are 1m apart. The shaft rotates at 2400rpm. If the centre of mass of the rotor is 0.11mm away from the geometric centre of the rotor due of a certain manufacturing defect. Find the amplitude of the steady state vibration and the dynamic force transmitted to the bearing E=200GN/m^2. [15]

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