Code.No: 07A5EC03 | R07 | SET-1

III B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
DYNAMICS OF MACHINERY
(COMMON TO ME, MEP, AME)

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

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

1. The moment of inertia of a pair of locomotive driving wheels with the axle is 200kg.m^2. The distance between the wheel centres is 1.6m and the diameter of the wheel treads is 1.8m. Due to defective ballasting, one wheel falls by 5mm and raises again in a total time of 0.12seconds while the locomotive travels on a level track at 100 km/h. assuming that the displacement of the wheel takes place with simple harmonic motion, determine the gyroscopic couple produced and the reaction between the wheel and rail due to this couple. [16]

2. Do you recommend the uniform pressure theory or uniform wear theory for the friction torque of a bearing? Explain. [16]

3. 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 5/8th 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. [16]

4. A machine has to carry out punching operation at the rate of 10 holes per minute. It does 6 kN-m of work per mm^2 of the sheared area on cutting 25 mm diameter holes in 20mm thick plates. A flywheel is fitted to the machine shaft which is driven by a constant torque. The fluctuation of speed is between 180 and 200 rpm. The actual punching takes 1.5 seconds. The frictional losses are equivalent to 1/6 of the work done during punching. Find: 1. power required to drive the punching machine, and 2. Mass of the flywheel, if the radius of gyration of the wheel is 0.5m. [16]

5. The lengths of the upper and lower arms of a Porter governor are 200mm and 250mm respectively. Both the arms are pivoted on the axis of the rotation. The central load is 150N, the weight of each ball is 20N and the friction of the sleeve to gether with the resistance of the operating gears is equivalent to a force of 30N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30^0 and 40^0, determine the range of speed of the governor. [16]

6.a) Explain the role of reference plane in balancing masses of rotation in different planes.

b) A,B,C and D are from masses carried by a rotating shaft at radii 100mm, 150mm, 150mm and 200mm respectively. The planes in which masses rotate are spaced at 500mm apart and the magnitude of the masses, B,C, and D are 9Kg, 5Kg and 4Kg respectively. Find the required mass A and the relative angular settings of the 4 masses so that the shaft shall be in complete balance. [16]

7. Briefly explain direct and reverse crank methods of solving balancing problem in 'V' type engines. [16]

8.a) Distinguish between longitudinal, transverse and torsional free vibrations.

b) Explain two rotor and three rotor vibrations. [6+10]

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III B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
DYNAMICS OF MACHINERY
(COMMON TO ME, MEP, AME)

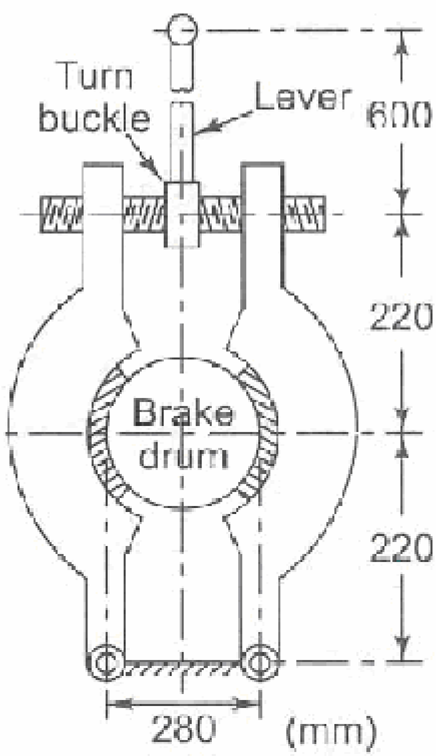
Time: 3hours **Max.Marks:80**

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

1. The rotor of a marine turbine has a moment of inertia of $750 kg.m^2$ and rotates at 3000rpm clockwise when viewed from aft. If the ship pitches with angular simple harmonic motion having a periodic tile of 16 seconds and an amplitude of 0.1 radian, find the
   (i) maximum angular velocity of the rotor axis
   (ii) maximum value of the gyroscopic couple
   (iii) gyroscopic effect as the bow dips (0.0393 rad/s; 9261 N.m; bow swings to port(left) as it dips). [16]

2.a) Explain the terms of friction circle, friction couple and friction axis.
b) A power screw driven by an electric motor moves a nut in horizontal plane when a force of 80 kN at a speed of 6mm/s is applied. This screw is of single thread of 8mm pitch and 48mm major diameter. Determine the power of the motor if the coefficient of the friction at the screw threads is 0.1. [16]

3. The arrangement of double block shoe brake is shown in fig. A turn buckle which has right and left-handed threads of six- start with a lead of 45mm is used to apply the force to each block. The diameter of the turn buckle is 30 mm, and it is rotated by a lever. Each block subtends an angle of 90^0 at the centre of the drum. The coefficient of friction for the brake blocks is 0.4, and for the screw and nut is 0.15. Find the brake torque applied by a force of 120 N at the end of the lever. [16]



4. The turning moment diagram for the engine is drawn to the following scales: Turning moment, 1 mm = 1000N-m and crank angle, 1 mm = 60. The area above and below the mean turning moment line taken in order are: 530,330,380,470,180,360,350and 280 mm^2. The mean speed of the engine is 150rpm and the total fluctuation of speed must not exceed 3.5% of mean speed. Determine the diameter and mass of the flywheel rim, assuming that the total energy of the flywheel to be 15/14 that of rim. The peripheral velocity of the flywheel is 15 m/s. Find also the suitable cross -sectional area of the rim of the flywheel. Take density of the material of the rim as 7200 kg/m^3. [16]

5. The mass of each ball of a spring controlled grainty governor is 1.4Kg. The bell crank lover has its vertical arm 90mm long and the horizontal arm 40mm long. The distance of the fulcrum from the axis of rotation is 45mm. The sleeve has a mass of 7.5Kg. The sleeve begins to rise at 200 rpm and rise of sleeve for 6% is 8mm. Find the initial thrust in the spring and its stiffness. [16]

6. Four masses m1, m2, m3 and m4 having 100, 175, 200 and 25Kg are fixed to cranks of 20 cm 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 distance of planes 2,3 and 4 from plane 1 are 60cm, 186cm and 240 cm respectively determine the position and magnitude of the balance mass at radius of 60cm in plane L and M located at middle of the plane 1 and 2 and the middle of the planes 3 and 4 respectively. [16]

7.a) Distinguish between balancing of inline engines and radial engines with appropriate examples.

b) Derive expression for Hammer blow as applied to a locomotive balancing. [8+8]

8. 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. [16]

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R07

SET-3

III B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
DYNAMICS OF MACHINERY
(COMMON TO ME, MEP, AME)

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

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

1. What is the effect of the gyroscopic couple on the stability of a four wheeler while negotiating a curve? In what way does this effect along with that of the centrifugal force limit the speed of the vehicle? [16]

2. A screw jack is used to raise a load of 5 tonnes (1 tonne = 9.81KN). The pitch of single start square threads used for the screw is 24mm. The mean diameter is 72mm. determine the force to be applied at the end of 1.2m long handle when the load is lifted with constant velocity and rotate with the spindle. Take μ= 0.2. Also find the mechanical efficiency of the jack. [16]

3.a) What are the different types of friction clutches? Describe with a neat sketch the working of a cone clutch.

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. [16]

4. A cast iron flywheel used for a four stroke I .C. engine is developing 187.5 kW at 250rpm. The hoop stress developed in the flywheel is 5.2 MPa. The total fluctuation of speed is to be limited to 3% of the mean speed. If the work done during the power stroke is 1/3 times more than the average work done during the whole cycle , find: 1. Mean diameter of the flywheel, 2. Mass of the flywheel and 3. Cross-sectional dimensions of the rim when the width is twice the thickness. The density of cast iron may be taken as 7220 kg/m. [16]

5. The arms of a porter governor are 300mm long. The upper arms are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 40mm from the axis of rotation. The load on the sleeve is 650N and the mass of each ball is 10Kg. Determine the equilibrium speed when the radius of the balls is 225m. What will be the range of speed for this position, if the frictional resistance to the motion of the sleeve are equivalent to a force of 30N. [16]

6.a) Explain why two balancing weights are required to balance the weight rotating in different planes, compared to balance the weight rotating in different planes, compared to single balance weight required to balance weights rotating in one plane.

b) Differentiate between static and dynamic balancing. [8+8]

7. For radial engines with an odd number of cylinders prove that the primary force may be balanced by attaching single mass of $\frac{1}{2}Km$ where k is the number of cylinders and 'm' is mass of reciprocating parts. [16]

8. A vertical shaft 30mm diameter and 1m long is mouted in long bearings and carries a pulley of mass 10Kg midway between the bearings. The centre of pulley is 0.5mm from the axis of the shaft. Find
   i) The whirling and
   ii) The bending stress in the shaft, when it is rotating at 200 rpm. Take youngs modulus of the material of the shaft as 200 GN.m^2. [16]

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III B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
DYNAMICS OF MACHINERY
(COMMON TO ME, MEP, AME)

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

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

1. A rear engine automobile is traveling along a curved track if 120m radius. Each of the four wheels has a moment of inertia of 2.2 kg/m^2 and an effective diameter of 600mm. The rotating parts of the engine have a moment of inertia of 1.25kg.m^2. The gear ratio of the engine to the back wheel is 3.2. The engine axis is parallel to the rear axle and the crank shaft rotates in the same sense as the road wheels. The mass of the vehicle is 2050kg and the centre of the mass is 520mm above the road level. The width of the track is 1.6m. What will be the limiting speed of the vehicle if all the four wheels maintain contact with the road surface? [16]

2. Determine the mechanical efficiency of a wedge used to raise loads if the angle of wedge is 20^0 and the coefficient of friction is 0.2 between the frame and the wedge and 0.15 between the slider and the guide. The height of the guide is 120mm and its lower end is 45mm above the lower point of the axis of the slider which has a width of a 50mm. [16]

3.a) Describe the working of a band and block brake with the help of a neat sketch. Deduce the relation for ratio of tight and slack side tensions.

b) The following data refer to a car in which brakes are applied to the front wheels:
   Wheel base = 2.8m
   Centre of mass from rear axle = 1.3m.
   Centre of mass above ground level = 0.96m.
   Coefficient of friction between road and tyres = 0.4.

If the speed of the car be 40km/h, find the distance traveled by the car before coming to rest. When the car
   (i) Moves up an incline 1 in 16
   (ii) Moves down an incline 1 in 16
   (iii) Moves on a level track.
[6+10]

4. A single cylinder double acting steel engine deli words 185kW at 100rpm. The maximum fluctuation of energy for revolution is 15% of energy developed for revolution. The speed variation is limited to 1% either way from the mean. The mean diameter of the rim is 2.4m. Find the mass and cross sectional dimensions of the flywheel rim when the width of the rim is twice the thickness. The density of flywheel material is 7200kg/m^2. [16]

5. A governor of the Hartnell type has equal balls of mass 3Kg, set initially at a radius of 200mm. The arms of the bell crank lever are 110mm vertically and 150mm horizontally Find i) The initial compressive force on the spring if the speed for an initial ball radius of 200mm is 240 rpm and ii) the stiffness of the spring required to permit a sleeve movement of 4mm on a fluctation of 7.5% in the engine speed. [16]

6. Three cylinders of an air compressor have their axes at 120^0 to one another and their connecting rods are coupled to a simple crank. The stroke is 10cm and the length of each connecting rod is 15cm. Mass of the reciprocating parts per cylinder is 1.5Kg. Determine the primary and secondary forces of the engine running at 3000rpm. [16]

7.a) Describe reasons in detail for partial balancing of reciprocating masses.

b) In a four cylinder petrol engine equally spaced, the cranks numbered from the front end are 1,2,3 and 4. The cranks 1 and 4 are in phase and ahead of cranks 2 and 3. The reciprocating mass of each cylinder is 1Kg. The cranks are 50mm radius and the connecting rod 200mm long. What are the resultant unbalanced forces and couples, primary and secondary, when viewed from the front. Take the reference plane midway between cylinders 2 and 3. [16]

8.a) A shaft of 10cm diameter and 100cm long is fixed at one end and other end carries a flywheel of mass 80Kg. Taking young's modules for the shaft material as $2x10^6$ Ks/cm^2. Find the natural frequency or longitudinal and transverse vibrations.

b) Define transmissibility ration and magnification factor. [12+4]

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