Code :RR320304 **RR**

III B.Tech II Semester(RR) Supplementary Examinations, April/May 2011
DYNAMICS OF MACHINES
(Mechanical Engineering)

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

Answer any FIVE questions
All questions carry equal marks
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1. The turbine rotor of a ship has a mass of 20 tones and a radius of gyration of 0.75m. Its speed is 2000 rpm. The ship pitches 6^0 above and below the horizontal position. One complete oscillation takes 18 seconds and the motion is simple harmonic. Determine.
   (a) The maximum couple tending to shear the holding down bolts of the turbine
   (b) The maximum angular acceleration of the ship during pitching and
   (c) The direction in which the bow will tend to turn while rising, if the rotation of the rotor is clockwise when looking from rear.

2. An engine is coupled to a machine. The engine produces a torque given by the expression $T_E = (8000 + 1000 \sin 2\theta)$ N-m where θ is the angle of rotation of shaft. The machine requires a torque to run it and is given by the expression $T_M = (8000 + 800 \sin \theta)$ N-m where θ is angle of rotation of shaft. The engine runs at a mean speed of 250 rpm and has a flywheel of mass 400 kg and radius of gyration 0.4 m fixed to it. Determine
   (a) The fluctuation of energy
   (b) Percentage fluctuation of speed, and
   (c) The maximum and minimum acceleration of the flywheel and the corresponding angular positions of the engine shaft.

3. (a) Differentiate between brake and clutch.
   (b) A lorry is moving on a level road at a speed of 36 kmph. Its centre of gravity lies at a distance of 60 cm from the ground level. The sheel base is 2.4 metres and the distance of C.G from the rear wheels is 900 mm. Find the distance travelled by the car before coming to rest when brakes are applied,
      i. to the rear wheels only and
      ii. to all the four wheels. Take $\mu = 0.45$.

4. (a) A 200mm diameter valve, against which a steam pressure of $2MN/m^2$ is acting, is closed by means of a square threaded screw 50mm in external diameter with 5mm pitch. If the coefficient of friction is 0.1, find the torque required to turn the handle.
   (b) Describe with a neat sketch the working of a single plate friction clutch.

5. (a) Derive an expression for the height of watt governor and prove that the height of the governor is inversely proportional to the square of the speed of the governor.
   (b) Each arms of a Porter governor is 250mm long. The upper and lower arms are pivoted to links of 40mm and 50mm respectively from the axis of rotation. Each ball has a mass of 5kg and the sleeve mass is 50kg. The force of friction on the sleeve of the mechanism is 40N. Determine the range of speed of the governor for extreme radii of rotation of l25mm and l50mm.

6. The cranks 2 to 9 of a nine cylinder engine running at 1000 r.p.m. make 240, 120, 160, 280, 40, 80, 320 and 2000 respectively with crank 1, when measured in a counter clock direction. The rotating masses for each cylinder are estimated to be 20 kg at 0.15m radius. The distance between centre lines of cranks is 0.4 m. Determine the unbalanced movement due to the rotating parts about the mid plane (cylinder S) of the crank craft.

7. (a) Prove that maximum secondary unbalanced forces is l/n times maximum primary unbalanced for n cylinder reciprocating engine.
   (b) For radial engines with an odd number of cylinders prove that the primary force may be balanced by attaching single mass of km where 'k' is number of cylinders and 'm' is mass of reciprocating parts.

8. The moment of inertia of three rotors A,B and C are respectively 100, 225 and 20 $kg.m^2$. The distance between A and B is 100 cm and between Band C is 14.1 cm and the shaft is 8 cm diameter. If the modulus of rigidity is 80 GN/m^2, find the frequencies of the free torsional vibration of the system.

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