

2006 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

III B.TECH I SEMESTER SUPPLEMENTARY EXAMINATIONS
DYNAMICS OF MACHINES
 (COMMON TO MECHANICAL ENGINEERING, MECHATRONICS AND
 PRODUCTIONENGINEERING)

NOVEMBER 2006

TIME - 3 HOUR
 MARK - 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Explain the gyroscopic effect of pitching and rolling of a ship in the sea water. [6]
- (b) A ship is pitching through a total angle of 150° , the oscillation may be taken as simple harmonic and the complete period is 32 sec. The turbine rotor weighs 6 tones, its radius of gyration is 45 cm and it is rotating at 2400 rpm. Calculate the maximum value of gyroscopic couple set up by the rotor. If the rotation of the rotor is clockwise looking from 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? [10]
2. The turning moment requirement of a machine is represented by the equation $T = (1000 + 500 \sin 2\theta - 300 \cos 2\theta) \text{ N-m}$. Where θ is the angle turned by the crankshaft of the machine. If the supply torque is constant, determine:
- (a) The moment of inertia by the flywheel. The total fluctuation of speed is not to exceed one percent of the mean speed of 300 rpm.
- (b) Angular acceleration of the flywheel when the crankshaft has turned through 45° from the beginning of the cycle.
- (c) The power required to drive the machine. [4+4+8]
3. (a) Derive conditions for self locking, when force applied at the end of lever on differential band brake when brake drum rotate in both clockwise and anticlockwise directions.
- (b) Explain how to calculate the distance travelled by a car before coming to rest, when brakes are applied to rear wheels only. [16]
4. A load of 20kN is supported by a conical pivot. The angle of cone is 120° and intensity of pressure is not to exceed 3.5 bar. The external radius is 3 times the internal radius. Find the diameter of the bearing surface. If coefficient of friction is 0.06 and speed of the shaft is 120 r.p.m, find the power absorbed by friction. [16]
5. (a) Explain the terms: Hunting in connection with governors.
- (b) A governor of the Proell type has each arm 250mm long. The pivots of the upper and lower arm are 25mm from the axis. The central load acting on the sleeve has a mass of 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 radius of the path of rotation of the masses is 175mm. The vertical height of the governor is 200mm. If the governor speed is 160rpm when in mid-position, find

i. Length of the extension link

ii. Tension in the upper arm.

[8+8]

6. (a) What is the necessity of the balancing

(b) A rigid rotor has all its unbalance in one plane and can be considered to consist of three masses $m_1 = 5\text{kg}$, $m_2 = 3\text{ kg}$ at an angle 165° counter clock wise from m_1 , and $m_3 = 8\text{ kgs}$ at angle 85° clock wise from m_1 . The radii $a_1 = 20\text{ cm}$, $a_2 = 8\text{ cm}$, $a_3 = 14\text{ cm}$. Determine the balancing mass required at a radius of 10 cm. Specify the location of this mass with respect to m_1 . [4+12] 7. The six cylinders of a single acting, two stroke cycle diesel engines are pitched 1m apart and the cranks are spaced at 60° . The connecting rod length 300 mm and the crank is 60mm. The reciprocating mass per line is 1.35 kg and the rotating mass is 1 kg. The speed is 250 r.p.m. Show that only secondary moment unbalance takes place, if the firing order is 1-4-5-2-3-6 [16]

8. (a) Explain briefly the phenomenon of the whirling of shafts.

(b) A steel shaft 6 cm diameter and 50 cm long fixed at one end carries a flywheel of mass 100 kg and radius of gyration 30 cm at its free end. Find the frequency of free longitudinal and transverse vibration.