B.E. Sixth Semester (Mechanical Engineering / Power Engineering) (C.B.S.)

Dynamics of Machines

P. Pages : 4 **NKT/KS/17/7399/7425**

Time : Three Hours * 0 5 6 7 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.

1. a) Discuss the effect of reactive Gyroscopic couple on aircraft. **4**

b) The mass of a turbine rotor of a ship is 10 tonnes and has a radius of gyration 0.8 m. It rotates at 1600 rpm clockwise when looking from stern. Determine gyroscopic effect in - **9**

i) If the ship travelling at 120 kmph steers to left in a curve of 80 m radius.

ii) If the ship is pitching and the bow is descending with the maximum velocity. The pitch is SHM, the periodic time being 20 seconds, and total angular movement between the extreme positions is 10°.

iii) If the ship is rolling and at a certain instant has an angular velocity of 0.04 rad/sec clockwise when looking from stern.

OR

2. a) Explain Gyroscopic analysis of Gyrocrusher. **4**

b) A four wheeled trolley car of total mass 2000 kg running on rails of 1.6 m gauge, rounds a curve of 30 m radius at 54 kmph. The track is banked at 8°. The wheels have an external diameter of 0.7 m and each pair the axle has a mass of 200 kg. The radius of gyration for each pair is 0.3 m. The height of centre of gravity of car above the wheel base is 1 m. Determine, allowing for centrifugal force and gyroscopic couple actions, the pressure on each rail. **9**

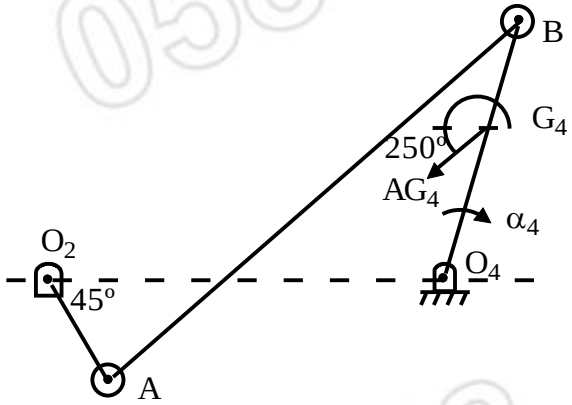
3. a) Discuss various methods of force analysis. **5**

b) In a cam mechanism following are the specification. Cam speed is 1500 rpm, follower stroke is 50 mm, cam angles for outstroke and return stroke are 130° and 100° respectively. Follower is moving with uniform acceleration and retardation with acceleration equal to retardation during outstroke and during return stroke. Mass of the follower is 4 kg. Determine the necessary spring stiffness so as to ensure the contact of the follower and cam throughout the cycle of motion of the mechanism. **8**

OR

4. For the mechanism shown find the forces acting at each joint and the external torque that must be applied to link 2. **13**

O_2A = 50 mm,
O_2O_4 = 325 mm
AB = 425 mm
O_4B = 200 mm
O_4G_4 = 100 mm
M_4 = 3 kg. IG_4 = 0.059 kg m^2, α_4 = 240 rad/s^2 clockwise.
AG_4 = 677 m/s^2 < 250°



5. The firing order of a four cylinder vertical four stroke inline engine 1-3-4-2. The piston stroke is 120 mm. The distance between cylinder centerlines are 100 mm each. The reciprocating masses per cylinder is 2 kg and the Engine speed is 2000 rpm. Determine the out of balance primary and secondary forces and couples in the engine taking a plane midway between the cylinder 2 & 3 as the reference plane. Is it possible to balance the engine completely with proper firing order ? Comment. **14**

OR

6. a) Discuss static and dynamic balancing machine. **4**

b) A, B, C and D are four masses carried by a rotating shaft at radii 110mm, 140 mm and 175 mm & 150 mm respectively. The planes in which the masses rotate are spaced at 400 mm apart and the magnitude of the masses B, C and D are 10 kg, 6 kg and 3 kg respectively. Find the required mass 'A' and the relative angular setting of the four masses so that the shaft will be in complete dynamic balance. **10**

7. a) Discuss the operation of flywheel in punching machines with neat sketch & also state its different equations. **6**

b) A punching machine has a capacity of producing 30 holes of 20 mm diameter per minute in a steel plate of 16 mm thickness. The material of plate has ultimate of shear strength of 360 N/mm^2. The actual punching operation lasts for a period of 36° rotation of the crank shaft. This crank shaft is powered by a flywheel through a reduction gear having a ratio of 1:8 η_{mech} = 80%. **8**

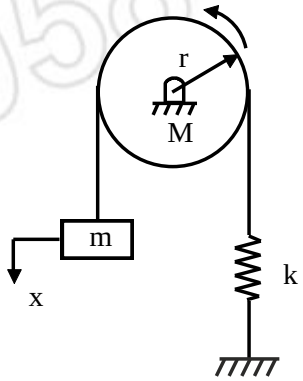
Speed fluctuation = 10%
Mean dia. Of flywheel = 0.75 m
Determine :

i) Power required
ii) Fluctuation of energy
iii) Cross section of rim if no width to thickness ratio is 1.3.

8. a) Explain Hartnell governor in detail & derive the expression for stiffness of spring. **7**

b) The mass of each ball of a proell governor is 3 kg & the weight on the sleeve is 20 kg. Each arm is 220 mm long & the pivots of the upper & the lower arms are 20 mm from the axis. For the mid position of the sleeve, the extension links of the lower arms are vertical, the height of the governor is 180 mm & the speed is 150 rpm. Determine the lengths of the extension links. **7**

9. a) Determine the natural frequency of the spring mass pulley system as shown in figure. **7**



b) A circular disk of mass 2 kg and diameter 0.2 m is attached to lower end of an elastic vertical shaft of brass material for which modulus of rigidity, $C = 4.4 \times 10^{16}\ N/m^2$ and the diameter, d = 5 mm and length, L = 1m. Calculate the natural frequency of torsional pendulum. **6**

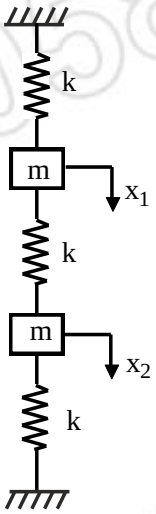
OR

10. a) A spring mass system consists of a spring of stiffness 350 N/m. The mass is 0.35 kg The mass is displaced 20 mm beyond the equilibrium position and released. The damping coefficient is 14 N-s/m Determine - **8**

i) Critical damping coefficient
ii) Damped natural frequency
iii) Logarithmic decrement.

b) Explain vibration isolation and critical speed of shaft in brief. **5**

11. a) If two masses 'm' are displaced as shown in figure by linear distance X_1 and X_2 such that $x_2 > x_1$, when attached to three springs of same stiffness 'K'. Determine two natural frequencies and equation of motion. **8**



b) Explain FFT analyser in short. **5**

OR

12. a) A centrifugal pump rotating at 400 rpm is driven by an electric motor at 1200 rpm through a single stage reduction gearing. The moments of inertia of the pump impeller and the motor are 1500 kg m^2 and 450 kg m^2 respectively. The lengths of the pump shaft and motor shaft are 500 mm and 200 mm and their diameters are 100 mm and 50 mm respectively. Neglecting the inertia of the gears, find the frequency of torsional oscillations of the system G = 85 GN/m^2. **10**

b) Explain vibration absorber. **3**

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