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

Dynamics of Machines

P. Pages : 3 **KNT/KW/16/7399/7425**

Time : Three Hours * 0 1 2 8 * 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 the gyroscopic effect in- **9**

1) If the ship travelling at 120 kmph steers to left in a curve of 80 m radius.
2) 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 10º.
3) 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 8º. The wheels have an external diameter of 0.7 m and each pair with axle has a mass of 200 kg. The radius of gyration for each pair is 0.3 m. The height of center of gravity of car above the wheel base is 1m. 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. **8**
Cam speed is 1500 rpm, follower stroke is 50 mm, Cam angles for outstroke and return stroke are 130º and 100º respectively. Follower is moving with uniform acceleration and retardation with acceleration equal to retardation during outstroke and with SHM 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.

OR

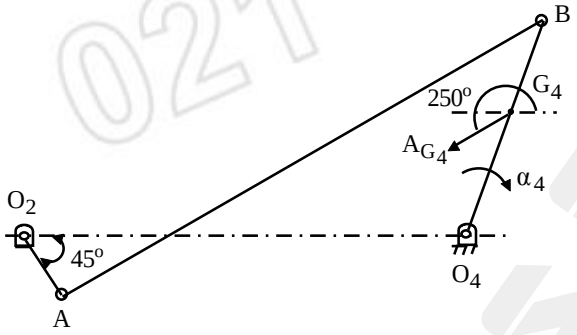
4. For the mechanism shown find the forces acting at each joint and the external torque that must be applied to link 2 **13**

$O_2A = 50\,mm, O_2O_4 = 325\,mm,\ AB = 425mm,$

$O_4B = 200\,mm,\ O_4G_4 = 100\,mm,\ M_4 = 3\,kg,$

$I_{G_4} = 0.059\,kgm^2, \alpha_4 = 240\ rad/s^2$ clockwise,

$A_{G_4} = 677\ m/s^2\ \angle 250^o$



5. The firing order of a four cylinder vertical four stroke inline engine is 1-3-4-2. The piston stroke is 120 mm The distance between cylinder centrelines are 100 mm each. The reciprocating masses per cylinder is 2kg 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. **12**

Is if possible to balance the engine completely with proper firing order? Comment. **2**

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

b) A, B, C and D are four masses carried by a rotating shaft at radii 110 mm, 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 settings of the four masses so that the shaft will be in complete dynamic balance. **10**

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

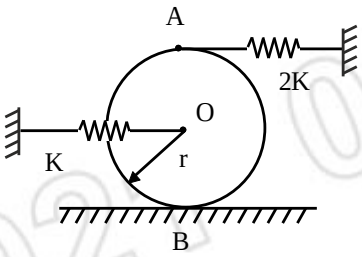
b) A punching press is driven by a constant torque electric motor. The press is provided with a flywheel that rotates at maximum speed of 225 r.p.m. The radius of gyration of the flywheel is 0.5 m. The press punches 720 holes per hour; each punching operation takes 2 seconds and requires 15 KN-m of energy. Find the power of the motor and the minimum mass of the flywheel if speed of the same is not to fall below 200 r.p.m. **7**

OR

8. a) Explain Hartnell governor in detail and derive the expression for stiffness of the spring. **6**

b) In a Wilson-Hartnell type of governor, the mass of each ball is 5 kg. The lengths of the ball arm and the sleeve arm of each bell-crank lever are 100 mm and 80 mm respectively. The stiffness of each of the two springs attached directly to the balls is 0.4 N/mm. The lever for the auxiliary spring is pivoted at its midpoint. When the radius of rotation is 100 mm, the equilibrium speed is 200 rpm. If the sleeve is lifted by 8 mm for an increase in speed by 6%, find the required stiffness of the auxiliary spring. **8**

9. a) Determine the undamped natural frequency of small oscillations of the system shown in the figure. The uniform disc of mass 'm' has two springs attached to it as shown in the figure. Assume that the disc rolls without slipping. **7**



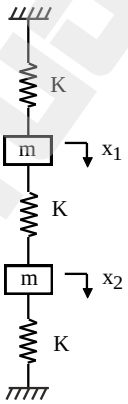
b) A circular disk of mass 2 kg and diameter 0.2 m is attached to lower end of an elastic vertical shaft of brass material for which modulus of rigidity, $C=4.4\times10^{16}\ N/m^2$ and the diameter, d = 5 mm and length, L = 1m. Calculate the natural frequency of torsional pendulum. **6**

OR

10. a) A steel shaft, 10 cm diameter supported by bearings, 1.2 m apart carries two pulleys weighing 300 N and 800 N are placed 0.25 m and 0.65 m from left hand bearing respectively. Determine the critical speed of the shaft. (Take $E = 2 \times 10^7\ N/cm^2$). **7**

b) Explain vibration isolation and critical speed of the shaft in brief. **6**

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. **7**



b) Explain FFT analyser in short. **6**

OR

12. a) A centrifugal pump rotating at 500 rpm is driven by an electric motor at 1500 rpm through a single stage reduction gearing. The moment of inertia of pump impeller and motor are 1400 kg. m^2 and 400 kg. m^2 respectively. The lengths of the pump shaft and motor shaft are 500 mm and 250 mm and their dimeters are 100 mm and 50 mm respectively. Find the frequency of torsional vibration of the system. **9**
Take, G = 84 GN/m^2.
Neglect inertia of gears.

b) Explain vibration Absorber. **4**

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