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

Dynamics of Machines

P. Pages : 4 **NJR/KS/18/4538/4564**

Time : Three Hours * 0 7 8 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) Explain with neat sketch how the gyroscopic couple exerts on the bearings of a rotor if the rotor is rotating about the shaft in clockwise direction if viewed from the left side. Show when the axis is precened in (a) clockwise (b) anticlockwise **4**

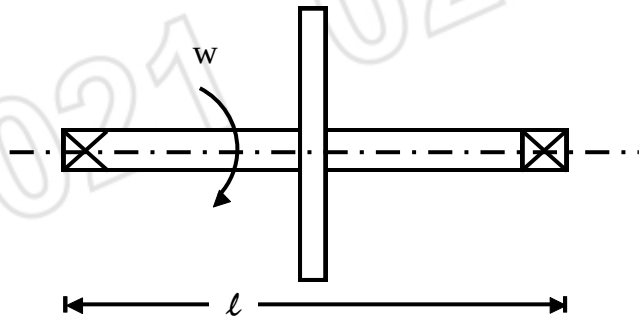


Fig. 1 (a)

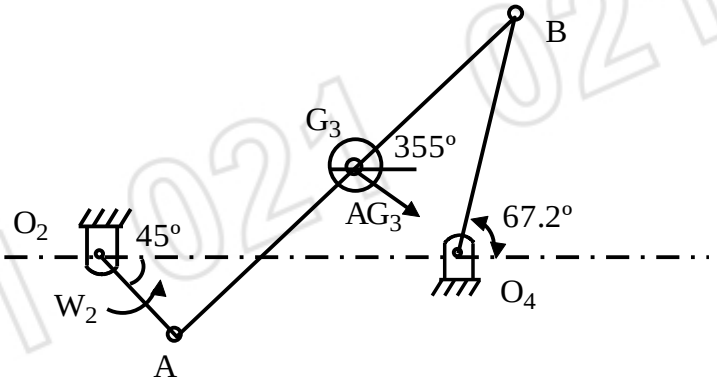
b) The wheel of a motor cycle and the engine parts have a moment of inertia 2.5 kgm^2/0.15 kgm^2 and respectively. The axis of rotation of the engine Crank shaft is parallel to that of the road wheels. If the gear ratio is 5 : 1 and the diameter of the road wheels 0.65 m, find the magnitude and direction of the gyroscopic couple when the motor cycle rounds a curve of 30 m radius at 16 m/s. **9**

OR

2. a) An aeroplane makes a complete half circle of radius 50 m towards left, when flying at 200 km / hr. The rotary engine and the propeller of the plane has a mass of 400 kg with radius of gyration 300 mm. The engine runs at 24000 rpm clockwise, when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. What will be the effect, if the aeroplane turns to its right instead of the left. **8**

b) The turbine rotor of a ship weighs 5000 kg. It has a radius of gyration 0.75 m. The rotor rotates at 1800 rpm clockwise when seen from rear. Determine the gyroscopic effects set up. When the ship travelling at 80 km/hr, steers to left in a curve of 100 m radius. **5**

3. For the given angular velocity of link 2, Find the forces acting at each joint and the external torque that must be applied to link 2. **14**



$O_2A - 50\,\text{mm}$, $O_2O_4 - 325\,\text{mm}$, $AB - 425\,\text{mm}$, $BO_4 - 200\,\text{mm}$, $AG_3 = BG_3$,

$M_3 = 1.2\,\text{kg}$ $IG_3 = 0.0066\,\text{Nms}^2$, $\alpha_3 = 6500\,\text{rad/s}^2$ (clockwise), $AG_3 = 951\,\text{m/s}^2$ L3550

4. A cam and follower mechanism causes the mass to move to the right a distance of 25 mm with harmonic motion in 150° of cam rotation, dwell for 30°, then return to the starting position in 180° of cam rotation also with harmonic motion. The spring is assembled with 22 - N preload and it has a rate of $4.4\,\text{kN/m}$. The follower mass is 17.5 g. Compute the cam speed in revolutions per minute at which jump would begin. Also show the lift off point on the diagram drawn without calculation. **14**

5. a) What are different types of governors? Give practical applications. What are new technological changes in latest governors? **5**

b) A porter governor has all four arms 25 cm long. The upper arms are attached on the axis of rotation and the lower arms are attached to the sleeve at a distance of 3 cm from the axis. The mass of each ball is 5 kg and mass of sleeve 50 kg. The extreme radii of rotation are 15 cm and 20 cm. Determine the range of speed of governor. **8**

OR

6. a) Explain with neat sketch how flywheel works in mechanical presses. **4**

b) In a turning moment diagram, the areas above and below the mean torque line taken in order are 395, 785, 140, 440, 1060 and 370 mm^2, having scales of 1 mm = 5 Nm and 1 mm = 10° a long Y and X axis respectively. Find mass of flywheel at a radius of gyration 150 mm and maximum fluctuation of speed is limited to $\pm 1.5\%$ of mean speed which is 1800 rpm. **9**

7. a) What is difference between static balancing and dynamic balancing. **2**

b) A shaft carries four masses in parallel planes A, B, C and D in order, along a shaft. The masses at B and C weigh 18 kg and 12.5 kg respectively and each has an eccentricity of 6 cm. The masses at A and D have an eccentricity of 8 cm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190° (both angles measured in **12**

the same sense) The axial distance between the planes A and B is 10 cm and between B and C 20 cm. If the shaft is in complete dynamic balance,
determine :

i) the weight of the masses at A & D.
ii) the distance between the planes C & D.
iii) the angular position of the mass at D.

OR

8. The firing order in a six cylinder four stroke inline engine is 1 - 4 - 2 - 6 - 35. The piston stroke is 12 cm and length of each connecting rod is 25 cm. The pitch distance between cylinder centre lines are 8 cm, 16 cm, 12 cm, 16 cm, 8 cm respectively. The reciprocating mass per cylinder is 0.62 kg and the engine runs at 2800 rpm. Determine the out of balance primary and secondary force and couples on the engine taking a plane midway between cylinder 3 and 4 as a reference plane. **14**

9. a) For a spring mass system in horizontal position determine the equation of motion using energy method also derive relation for natural frequency. **4**

b) Answer the following questions. **6**

i) State the parameters corresponding to m, c, k and x for a torsional system.

ii) What effect does a decrease in stiffness of the system have an the natural period.

iii) Why is it important to find the natural frequency of a vibrating system.

c) Explain with neat sketch how a vibrator in a mobile phone works. **3**

OR

10. a) How can you find the natural frequency of a system by measuring its static deflection? An industrial press is mounted on a rubber pad to isolate it from its foundation. If the rubber pad is compressed 5 mm by the self - weight of the press, find the natural frequency of the system. **4**

b) The free vibration response of an electric motor of weight 500 N mounted on a foundation is shown in fig. 10 (b). Identify the following : **9**

i) the nature of damping provided by foundation.
ii) the spring constant and damping coefficient of the foundation, and
iii) undamped and damped natural frequencies of the electric motor.

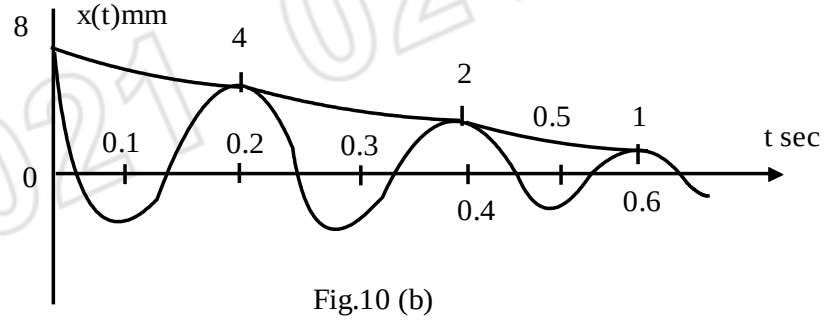


Fig.10 (b)

11. Find the natural frequencies of the system shown in fig. 11 with $m_1 = m$, $m_2 = 2m$, $k_1 = k$ and $k_2 = 2k$. Determine the response of the system when $k = 1000\,N/m$, $m = 20\,kg$, and the initial values of the displacements of the masses m_1 and m_2 are 1 and -1 respectively. **13**

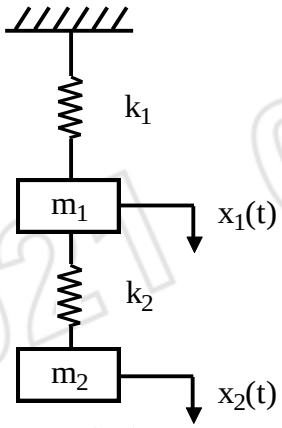


Fig. (11)

OR

12. a) Two rotors A & B are attached to the ends of a shaft 50 cm long. Weight of the rotor A is 300 N and it's radius of gyration is 30 cm and the corresponding values of B are 500 N and 45 cm respectively. The shaft is 7 cm in diameter for the first 25 cm; 12 cm diameter for the next 10 cm and 10 cm diameter for the remaining length. The modulus of rigidity of the shaft material is $8\times10^{11}\,N/m^2$. **10**

Find :

i) the position of the node and

ii) the frequency of torsional vibration.

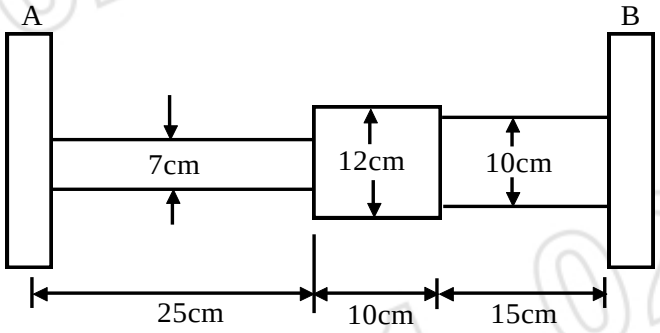


Fig. 12 (a)

b) Write short note on **any one.** **3**

i) FFT Analyser.

ii) Vibration Absorber.

****