QUESTION BANK
SUBJECT NAME: THEORY OF MATERIALS-II
SUBJECT NAME: BTME-405-18

SHORT QUESTIONS

1. State the three applications of epicyclic gear train
2. Define balancing of rotating masses.
3. What is Gyroscopic Couple?
4. Why balancing of masses are required?
5. What is Differential gear of an automobile?
6. Define secondary balancing of reciprocating masses.
7. Reciprocating masses cannot be balanced completely. Why?
8. What is Compound Epicyclic Gear Train?
9. What do you understand precessional angular motion?
10. What are different cases of balancing of rotating masses?
11. Write the right hand screw rule for determining the gyroscopic motion parameters.
12. Differentiate between static and dynamic balancing.
13. Differentiate between primary and secondary balancing of reciprocating masses.
14. Classify gear train in brief.
15. How Velocity Ratio's of Epicyclic Gear Train can be calculated?
16. Explain the application of gyroscopic Couple.
17. Why is balancing of rotating parts necessary for high speed engines?
18. What are in-line engines?
19. Explain with a neat sketch the 'sun and planet wheel.
20. What do you mean by Hammer blow?
21. Define Static and dynamic forces
22. Define force and couple
23. What is dynamic equivalent systems?
24. Define flywheel and its energy diagrams
25. How we can determine forces and couples for a crank?
26. State D'Alembert's principle.
27. Write the phenomenon of dynamic balancing
28. What do you mean by Hammer blow
29. Write relationship between module and pitch of a gear.
30. Give two advantages of an Involute gear profile.
31. State the three applications of epicyclic gear train.
32. What do you mean by Gyroscope?
33. What is the meaning of number synthesis in a mechanism?
34. Write about addendum of a gear.
35. Write various methods to avoid interference in gears.

LONG QUESTIONS

1. Explain what is free body diagram & methods of static force analysis of simple mechanism?
2. Explain the analytical and graphical methods for balancing of several masses rotating in the same plane.
3. Explain the effect of the gyroscopic couple on an aeroplane.
4. Four masses m_1, m_2, m_3 and m4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45°, 75°, and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m
5. Explain how are the gear train classified. Give at least one distinguished feature of each type.
6. Explain the method of balancing of different masses revolving in the same plane.
7. In a epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed makes 300 r.p.m in the clockwise direction, what will be the speed of gear B?
8. Discuss the inertia force analysis of basic engine mechanism.
9. The turbine rotor of a ship has a mass of 8 tonnes and a radius of gyration 0.6 m. It rotates at 1800 r.p.m. clockwise, when looking from the stern. Determine the gyroscopic couple, if the ship travels at 100 km/hr and steer to the left in a curve of 75 m radius
10. Explain the effect of Effect of Gyroscopic Couple on Naval Ship during Steering & Pitching
11. Prove: Resultant unbalanced force is minimum when half of the reciprocating masses are balanced by rotating masses.
12. Derive the following expressions, for an uncoupled two cylinder locomotive engine: (*a*) Swaying couple and (*b*) Hammer blow .
13. What are in-line engines? How are they balanced? It is possible to balance them completely?
14. Explain the following :
    (a) Two and Three point synthesis. (b) Simple and compound gear trains. (c) balancing of *V*-engines
15. In an epicyclic gear of the 'sun and planet' type shown in Figure 1, the pitch circle diameter of the internally toothed ring is to be 224 mm and the module 4 mm. When the ring D is stationary, the spider A, which carries three planet wheels C of equal size, is to make one revolution in the same sense as the sunwheel B for every five revolutions of the driving spindle carrying the sunwheel B. Determine suitable numbers of teeth for all the wheels.
16. In an epicyclic gear train, Figure 2; the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. All the wheels have the same module and the number of teeth are : $T_C = 28$; $T_D = 26$;$T_E = T_F = 18$. 1. Sketch the arrangement; 2. Find the number of teeth on A and B ; 3. If the arm G makes 100 r.p.m. clockwise and A is fixed, find the speed of B ; and 4. If the arm G makes 100 r.p.m. clockwise and wheel A makes 10 r.p.m. counter clockwise; find the speed of wheel B.

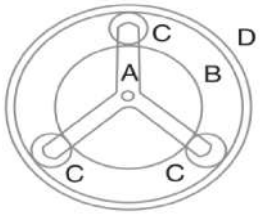

Figure 1

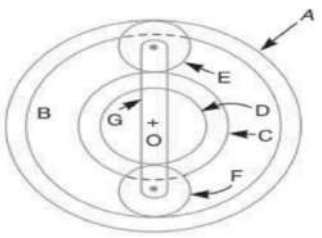

Figure 2

17. In a epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m in the clockwise direction, what will be the speed of gear B?
18. The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship : (a) when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. (b) when the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.
19. Prove that the resultant unbalanced force is minimum when half of the reciprocating masses are balanced by rotating masses
20. Calculate: a) Length of path of contact b) arc of contact c) the contact ratio when a pinion having 23 teeth drives a gear having teeth 57. The profile of the gear is involute with pressure angle 20°, module 8 mm and addendum equal to one module.
21. In a reverted epicyclic gear train, the arm F carries two wheels A and D and a compound wheel B-C. The wheels A meshes with wheel B and the wheel D meshes with wheel C. The numbers of teeth on wheel A, D and C are 80, 48 & 72 respectively: Find the speed & direction of wheel D when wheel A is fixed and arm F makes 200 rpm clockwise.
22. Explain the Gyroscopic effect on the stability of four wheel vehicle while taking a turn
23. Describe in detail the two positions synthesis of a four bar mechanism.
24. A rotating shaft carries four unbalanced masses 18 kg, 16 kg, 14 kg and 12 kg at radii 50 mm, 60 mm, 70 mm and 60 mm respectively. The 2^{nd}, 3^{rd} and 4^{th} masses revolve in planes 80 mm, 160 mm and 280 mm respectively measured from the plane of the first mass and are angularly located at 60^{0}, 135^{0} and 270^{0} respectively measured counter clockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 50 mm radii and revolving in planes mid-way between those of 1^{st} and 2^{nd} masses and mid-way between those of 3^{rd} and 4^{th} masses. Determine graphically or otherwise the magnitudes of the masses and their respective angular positions.
25. A vertical engine running at 1200 rpm with a stroke of 120 mm, has a connecting rod 300 mm long and of 1.5 kg mass. The mass center of the rod is 100 mm from the big end center. When the rod is suspended from the gudgeon pin as a pendulum, it makes 20 complete oscillations in 20 seconds.
    a) Calculate the radius of gyration of the rod about an axis through the mass center.
    b) When the crank is at 35^{0} from the top dead center and the position is moving downwards, find the acceleration of the piston and the angular acceleration of the rod. Hence, find the inertia torque on the crank shaft.
26. Explain the Gyroscopic effect on the stability of two wheel vehicle while taking a turn
27. An aeroplane makes a complete half circle of 50 metres radius, towards left, when flying at 200 km per hr. The rotary engine and the propeller of the plane has a mass of 400 kg and a radius of gyration of 0.3 m. The engine rotates at 2400 r.p.m. clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it.

28. What is meant by variation of traction force in a locomotive engine? Derive the expressions of its extreme value.
29. A five cylinder in-line engine running at 750 r.p.m. has successive cranks 144° apart, the distance between the cylinder centre lines being 375 mm. The piston stroke is 225 mm and the ratio of the connecting rod to the crank is 4. Examine the engine for balance of primary and secondary forces and couples. Find the maximum values of these and the position of the central crank at which these maximum values occur. The reciprocating mass for each cylinder is 15 kg.
30. A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance.