# QUESTION BANK
# SUBJECT NAME: DESIGN OF MACHINE ELEMENTS-II
# SUBJECT NAME: BTME-601

## SHORT QUESTIONS

1. What are journal bearings?
2. What is the main function of a flywheel in an engine?
3. What is meant by 'Self-contained bearings'?
4. What is a positive clutch?
5. Define 'coefficient of fluctuation of speed' and 'coefficient of steadiness'
6. What is meant by wear load of a gear tooth?
7. Define bearing and its types based on contact.
8. What is a clutch? Discuss the various applications of clutches.
9. Describe the principle of operation of a centrifugal clutch
10. Describe the various stages of friction in the case of plain bearings.
11. Define coefficient of fluctuation of energy
12. Name any two materials that are used for the lining of friction surfaces in clutches.
13. What is meant by hydrodynamic lubrication?
14. Why cross-section of the flywheel arms is usually elliptical?
15. Why it is necessary to dissipate the heat generated when clutches operate?
16. Name the factors on which selection of bearing for a particular application depends.
17. What are lubricants and name lubricants used in bearing?
18. Define Reliability & Life of a Bearing.
19. How does the function of a brake differ from that of a clutch
20. What are the materials used for brake linings.
21. Discuss the different types of brakes giving atleast one practical application for each.
22. List the important factors upon which the capacity of a brake depends.
23. What is a self-energizing brake ? When a brake becomes self-locking.
24. What is the difference between roller and slide bearings?
25. What are bearings?
26. Why is a bearing used?
27. Define Principle of hydrodynamic lubrication?
28. How selection of bearing is done?
29. What is load carrying capacity of a bearing?
30. Where is chain generally used?
31. What are Transmission Drives?
32. What is module?
33. What surge in spring?
34. What are the various factors that are to be considered for design of belt drives?
35. What is design procedure of spur gears?
36. What are advantages of standardization?
37. What are the three basic types of gears?
38. What is nipping?
39. What are the standard proportions of a flat key?
40. What is permissible shear stress as per the ASME code of transmission shaft design.

# LONG QUESTIONS

1. Determine the maximum, minimum and average pressure in a plate clutch when the axial force is 4 kN. The inside radius of the contact surface is 50 mm and the outside radius is 100 mm. Assume uniform wear.
2. Design a journal bearing for a centrifugal pump. The load on the bearing is 3.5kN and the journal diameter is 75mm. The shaft runs at 900 *r.p.m.* and the heat of friction is to be dissipated from the bearing housing. The ambient temperature may be taken as 25°C.
3. A cone clutch transmits a power of 5 kW at 240 rpm. The smaller radius of the cone is 200 mm and the face width is 50 mm. The cone has a face angle of 15°. Determine the axial force necessary to engage the clutch, if the coefficient of friction at the contact surfaces is 0.25. Also, determine the maximum pressure on the contact surfaces, assuming uniform wear.
4. What are journal bearings? Give a classification of these bearings
5. A centrifugal clutch is to be designed to transmit 15 kW at 900 *r.p.m*. The shoes are four in number. The speed at which the engagement begins is 3/4th of the running speed. The inside radius of the pulley rim is 150 mm. The coefficient of friction may be taken as 0.25. Determine: 1. mass of the shoes, and 2. size of the shoes.
6. A centrifugal clutch is to be designed to transmit 15kW at 900 rpm. The shoes are four in number and the speed at which the engagement begins is 3/4th of the running speed. The inside radius of the pulley rim is 150 mm. Taking coefficient of friction as 0.25, find out the mass and size of the shoes.
7. Discuss the different types of brakes giving at least one practical application for each type.
8. An open belt 100 mm wide connects two pulleys mounted on parallel shafts with their centres 2.4 m apart. The diameter of the larger pulley is 450 mm and that of smaller pulley is 300 mm. Coefficient of friction is 0.3 and the maximum stress in the belt is limited to 14 N/mm width. If the larger pulley rotates at 120 rpm, find the maximum power that can be transmitted.
9. Design a helical compression spring for a maximum load of 1000 N and deflection of 25mm taking Wahl's factor into consideration. Assume spring index as 5, maximum permissible shear stress for spring wire as 420 MPa and modulus of rigidity as 84 kN/mm2.
10. a) Mention four important types of gears and discuss their applications.
    b) Explain the phenomenon of interference in involute gears. What are the conditions tobe satisfied in order to avoid interference?
11. Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 rpm for an average life of 5 years at 10 hours per day. Assume uniform and steady load
12. What are rolling contact bearings? Discuss their advantages over sliding contact bearings
13. A full journal bearing of 50 mm diameter and 100 mm long has a pressure of 1.4 N/mm2. The speed of the journal is 900 r.p.m. and the ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s & room temperature is 35°C.Find: 1. The amount of artificial cooling required, and 2. The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of the oil as 1850 J / kg / °C
14. Explain with sketches the working of different types of thrust bearing.
15. A single cylinder double acting steam engine delivers 185 kW at 100 r.p.m. The maximum fluctuation of energy per revolution is 15 per cent of the energy developed per revolution. The speed variation is limited to 1

per cent either way from the mean. The mean diameter of the rim is 2.4 m. Design and draws two views of the flywheel.

16. Define Friction Clutches and different types of Friction Clutches.
17. What is the procedure followed in designing a journal bearing?
18. In an application, a 360° hydrodynamic bearing having journal diameter of I 00 mm and lid ratio of I was used to support a radial load of 50000 N, acting on the shaft running at 1440 r.p.m. A lubricant with a viscosity maintained at 20 cP was used to avoid direct contact of journal and bearing surface which maintained radial clearance of 0.12 nun. Calculate the magnitude of (i) minimum film thickness, (ii) coefficient offriction and (iii) power lost in friction.
19. Prove that the bending stresses induced in the full-length leaves of leaf spring are 50% more than those in the graduated leaves.
20. Design an open belt drive to transmit 100 kW for a system consisting of two pulleys of diameters 0.9 m and 1.2 m, centre distance of 3.5 m, a belt speed 19 m/s, coefficient of friction 0.3, a slip .of 1.2% at each pulley, 5% friction loss at each shaft. The drive is to be designed for 20% over load.
21. A pair of straight bevel gears with 24 and 36 teeth is mo_unted on shafts which are at right angle to each other. An electi:ic mntei• mnriing at 14fJ.Orprn supplies ,lJ:6-kW power to pinion shaft. The pair of gears is to be designed for 140% of the•rated• torque. The face width of the gear tooth is to be taken as six times the module. Both gears are made of steel ( su1=600 MPa) and has 20° involute profile. Based on the preliminary design and assuming factor of safety as 2, detennine (i) beam strength and (ii) surface hardness of gears, if Sw=Sh.
22. A simple band brake operates on a drum of 0.5 m in diameter that is running at 300 r.p.m. The coefficient of friction is 0.3. The brake band has a contact of 270°, one end is fastened to a fixed pin and the other end to the brake arm, 0.1 m from the fixed pin. The straight brake arm is 0.7 m long and placed perpendicular to the diameter that bisects the angle of contact. (a) What is the pull necessary on the end of the brake arm to stop the wheel if 30 kW is being absorbed? (b) What width of steel band of 2.5 mm thick is required for this brake if the maximum tensile stress
23. Explain design procedure of Cone clutch.
24. A punching press pierces 35 holes per minute in a plate using 10 kN-m of energy per hole during each revolution. Each piercing takes 40 per cent of the time needed to make one revolution. The punch receives power through a gear reduction unit which in turn is fed by a motor driven belt pulley 800 mm diameter and turning at 210 r.p.m. Find the power of the electric motor if overall efficiency of the transmission unit is 80 per cent. Design a cast iron flywheel to be used with the punching machine for a coefficient of steadiness of 5, if the space considerations limit the maximum diameter to 1.3 m.Allowable shear stress in the shaft material = 50 MPa Allowable tensile stress for cast iron = 4 MPa Density of cast iron = 7200 kg / $m^3$
25. Design a journal bearing for a centrifugal pump running at 1440 r.p.m. The diameter of the journal is 100 mm and load on each bearing is 20 kN. The factor *ZN/p* may be taken as 28 for centrifugal pump bearings. The bearing is running at 75°C temperature and the atmosphere temperaturic is 30°C. The energy dissipation coefficient is 875 W/$m^2$/°C. Take diametral clearance as 0.1 mm.
26. A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 r.p.m. Determine the outer and inner diameters of frictional surface if the coefficient of friction is 0.255, ratio of diameters is 1.25 and the maximum pressure is not to exceed 0.1 N/$mm^2$. Also, determine the axial thrust to be provided by springs. Assume the theory of uniform wear.
27. A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.4 N/$mm^2$. The speed of the journal is 900 r.p.m. and the ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil whose operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35°C. Find: 1. The amount of artificial cooling required, and 2. The mass of the lubricating oil required, if

the difference between the outlet and inlet temperature of the oil is 10°C. (Specific heat of the oil as 1850 J / kg / °C)

28. Select a suitable chain drive to transmit 50 kW from an electric motor to a line shaft. The motor shaft *r.p.m.* are 1200, line shaft *r.p.m.* are 250 and approximate center distance is 600 mm. Assume service is 10hr/day, 6 days per week.
29. A 20° full depth spur pinion is to transmit 2 kW at a speed of 950 rev/min. If the pinion has 18 teeth, determine suitable values for module and face width. The bending stress should not exceed 80 MPa.
30. Design a journal bearing for a centrifugal pump. The load on the bearing is 3.5kN and the journal diameter is 75mm. The shaft runs at 900 *r.p.m.* and the heat of friction is to be dissipated from the bearing housing. The ambient temperature may be taken as 25°C.
31. a) Discuss the various stresses induced in a flywheel rim.
    b) Explain the procedure for determining the size and mass of a flywheel with the help of a turning moment diagram.
32. Design a leaf spring for the following specifications :Total load is 150 kN, Number of spring supporting the load is 4, Maximum number of leaves is 10, Span of spring is lm, Permissible deflection is 85 mm. Take young's Modulus to be 200 kN/mm2 and the allowable stress in the spring material is 600 MPa.
33. A centrifugal clutch is to be designed to transmit 15 kW at 900 *r.p.m*. The shoes are four in number. The speed at which the engagement begins is 3/4th of the running speed. The inside radius of the pulley rim is 150 mm. The coefficient of friction may be taken as 0.25. Determine: 1. mass of the shoes, and 2. size of the shoes
34. What is the design procedure of flywheel and its parts?
35. A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20 × 106 revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing. An otto cycle engine develops 50 kW at 150 r.p.m. with 75 explosions per minute. The change of speed from the commencement to the end of power stroke must not exceed 0.5% of mean on either side. Design a suitable rim section having width four times the depth so that the hoop stress does not exceed 4 MPa. Assume that the flywheel stores 16/15 times the energy stored by the rim and that the work done during power stroke is 1.40 times the work done during the cycle. Density of rim material is 7200 kg / $m^3$.
36. Design a journal bearing for a centrifugal pump from the following data: Load on the journal = 20 000 N; Speed of the journal = 900 r.p.m.; Type of oil is SAE 10, for which the absolute viscosity at 55°C = 0.017 kg / m-s; Ambient temperature of oil = 15.5°C ; Maximum bearing pressure for the pump = 1.5 N / mm2. Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/$m^2$/°C
37. The intercepted areas between the output torque curve and the mean resistance line of a turning moment diagram for a multi-cylinder engine, taken in order from one end are as follows:– 35, + 410, – 285, + 325, – 335, + 260, – 365, + 285, – 260 $mm^2$. The diagram has been drawn to a scale of 1 mm = 70 N-m and 1 mm = 4.5°. The engine speed is 900 r.p.m. and the fluctuation in speed is not to exceed 2% of the mean speed. Find the mass and cross-section of the flywheel rim having 650 mm mean diameter. The density of the material of the flywheel may be taken as 7200 kg / $m^3$. The rim is rectangular with the width 2 times the thickness. Neglect effect of arms, etc.
38. A band brake as shown in Fig. 25.42, is required to balance a torque of 980 N-m at the drum shaft. The drum is to be made of 400 mm diameter and is keyed to the shaft. The band is to be lined with ferodo lining having a coefficient of friction 0.25. The maximum pressure between the lining and drum is 0.5 N/mm2. Design the steel band, shaft, key on the shaft, brake lever and fulcrum pin. The permissible

stresses for the steel to be used for the shaft, key, band lever and pin are 70 MPa in tension and compression and 56 MPa in shear.

39. In a band and block brake, the band is lined with 14 blocks, each of which subtends an angle of 20° at the drum centre. One end of the band is attached to the fulcrum of the brake lever and the other to a pin 150 mm from the fulcrum. Find the force required at the end of the lever 1 metre long from the fulcrum to give a torque of 4 kN-m. The diameter of the brake drum is 1 metre and the coefficient of friction between the blocks and the drum is 0.25.
40. A flywheel of mass 100 kg and radius of gyration 350 mm is rotating at 720 r.p.m. It is brought to rest by means of a brake. The mass of the brake drum assembly is 5 kg. The brake drum is made of cast iron FG 260 having specific heat 460 J / kg°C. Assuming that the total heat generated is absorbed by the brake drum only, calculate the temperature rise.