

Design of Machine Elements

P. Pages : 2

Time : Three Hours



TKN/KS/16/7610

Max. Marks : 80

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

1. a) What are the general considerations in machine design? 5
 b) A solid circular shaft is subjected to a bending moment of 3000N-mtr and a torque of 10,000 N-mtr. The shaft is made of steel having ultimate tensile stress of 7000 N/mm² and a ultimate shear stress of 5000 N/mm². Assuming a factor of safety as 6. Determine the diameter of the shaft. 15
- OR**
2. a) State and explain at least five important mechanical properties of material to be considered in machine design. 5
 b) Design a muff coupling which is used to connect two steel shaft transmitting 25kw at 360RPM. The material for the shaft and key is plain carbon steel. ($S_{yt} = S_{yc} 400\text{N/mm}^2$). The sleeve is made of gray cast iron ($S_{ut} = 200 \text{ N/mm}^2$). The factor of safety for shaft and key is 4, for sleeve the factor of safety is 6 based on ultimate strength. 15
3. a) What is coupling? State the requirements of a good coupling. List the types of couplings. 6
 b) A double riveted lap joint is made between 15mm thick plates. The rivet diameter and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are 400N/mm² in tension, 320N/mm² in shear and 640 N/mm² in crushing. Find the minimum Force per pitch which will ruptures the joint. If the above joint is subjected to a load such that the factor of safety is 4. Find out the actual stresses developed in the plates and rivets. 14
- OR**
4. a) Explain the surge in spring. 6
 b) A machine consists of tension spring assembled with a preload of 30N. The wire diameter of spring is 2mm with a spring index of 6. The spring has 18 active coils. The spring wire is hard drawn and oil tempered having following material properties: 14
 - i) Design shear stress= 680 N/mm².
 - ii) Modulus of rigidity = 80KN/mm².
 Determine:
 - 1) The initial torsional shear stress in wire.
 - 2) Spring rate.
 - 3) The force to cause the body of the spring to its yield strength.

5. a) Design a journal bearing for centrifugal pump from following data: 14
 Load on journal = 20,000N, speed of the journal = 900rpm, 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 pump = 1.5 N/mm². calculate also the 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/m²/°C.
- b) Explain the terminology of gear with neat sketch. 6
- OR**
6. a) Design a pair of spur gears with 20° Full depth involute teeth based on Lewis equation. The velocity factor is to be used to account for dynamic load. The pinion shaft is connected to a 10kw, 1440 rpm motor. The starting torque of the motor is 150% of the rated torque. The speed reduction is 4:1. The pinion as well as the gear of steel ($S_{ut}=600\text{N/mm}^2$). The factor of safety is to be taken as 5. 15
- b) Explain the various important parameters for necessary selection of a belt drive for power transmission. 5
7. a) A Flat belt is required to transmit 30kw from a pulley of 1.5m effective diameter running at 300 rpm. The angle of contact is spread over $11/24$ of the circumference. The coefficient of friction between the belt and pulley surface is 0.3. Determine taking the centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5mm, density of its material is 1100 kg/m³ and the related permissible working stress is $2.5 \times 10^6 \text{ N/m}^2$. 14
- b) Sketch the cross section of a V-belt and label its main parts. What are the advantages and disadvantages of v-belt over flat belt drive? 6
- OR**
8. a) Discuss the various types of stresses induced in a flywheel rim. 6
- b) Design a cast iron flywheel used for two stroke IC engine developing 180 kw at 240 rpm. The hoop stress developed in a flywheel is 5.2 N/mm², the total fluctuation of speed is to be limited to 3% of the mean speed. The work done during the power stroke is 1/3 more than the average work done during the whole cycle. The maximum torque on the shaft is twice the mean torque. The density of cast iron is 7220 kg/m³. 14
