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**BACHELOR OF TECHNOLOGY IN
MECHANICAL ENGINEERING
(COMPUTER INTEGRATED
MANUFACTURING)**

**Term-End Examination
June, 2011**

**BME-024 : MECHANICAL ENGINEERING
DESIGN**

Time : 3 hours

Maximum Marks : 70

Note : Answer any five questions. All questions carry equal marks. Use of calculator is permitted. Use of design data book is permitted. Assume any missing data.

1. Define the following with their physical significance in Mechanical Design. **2x7=14**
- (a) Elastic constants
 - (b) Toughness and Resilience
 - (c) Fatigue
 - (d) Creep
 - (e) Strain energy
 - (f) Factor of safety
 - (g) Stress concentration and stress concentration factor

2. (a) What is a welded joint ? Compare welded joint with riveted joint. Give examples of eccentrically loaded welded joint. How are they analysed ? 7+7
- (b) A machine part subjected to tension carries a stress concentration whose stress concentration factor $k_t = 2.0$. The UTS of steel is 700 MPa and notch radius is 1.5 mm. The element in the form of a bar is subjected to $\sigma_{\max} = 80$ MPa and $\sigma_{\min} = 20$ MPa. The diameter of the bar is 12 mm. Find factor of safety.
3. (a) Mention four important types of gears and discuss their applications. What condition must be satisfied in order that a pair of spur gears may have a constant velocity ratio ? 7+7
- (b) Calculate dimensions of a helical spring for a spring loaded safety valve (Rams bottom type) from following data.
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|--|---|-----------|
| Dia of valve | : | 63.5 mm |
| Maximum Pressure when the valve blows off freely | : | 0.71 MPa |
| Valve lift when pressure increases from 0.68 MPa to 0.71 MPa | : | 3.175 mm |
| Permissible stress in spring material (shear) | : | 550 MPa |
| Spring index | : | 6 |
| Modulus of rigidity of spring material | : | 81600 MPa |

4. (a) How do you calculate stresses in a flat belt ? Discuss the factors that will affect power to be transmitted by leather belt. 7+7
- (b) A vertical screw thread with single start square thread of 50 mm mean diameter and 10 mm pitch is used to raise a load of 5.5 kN by rotating in a fixed nut. The top of the screw carries a cup resting on collar of mean dia 65 mm with a coefficient of friction of 0.18. A arm of length 200 mm from the mean diameter of screw is used to apply the torque on the screw to raise the load. Calculate the effort required at the end of the arm if coefficient of screw friction is 0.15. Also calculate the efficiency with and without collar friction.
5. (a) What are the materials used for making shafts ? What are the loads that come upon shaft ? Under what condition the deflection and twist of shaft become important ? 7+7
- (b) A plate 100 mm wide and 12.5 mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of the weld so that the maximum stress does not exceed 56 MPa. Consider the joint first under static loading and then under fatigue loading.

6. (a) Describe, with the help of neat sketch, the functioning of a centrifugal clutch. Deduce an expression for the total frictional torque transmitted. 7+7
- (b) A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 rpm. 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.
7. (a) What do you understand by a hydrodynamic bearing ? How do you calculate the load carrying capacity of a hydrodynamic bearing ? Explain with the help of a sketch. 7+7
- (b) The load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter running at 1800 rpm. Determine the following :
- (i) Length of the bearing if the allowable bearing pressure is 1.6 N/mm^2 , and
- (ii) Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60°C and viscosity of the oil at 60°C is 0.02 kg/m-s and the bearing clearance is 0.25 mm.
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