



**KERALA AGRICULTURAL UNIVERSITY**  
**B. Tech. (Agrl. Engg.)**  
**III Semester Final Re - examination – February 2026**  
**2023 & Previous Admissions**

Fpme.2104

**Machine Design (2+0)**

**Marks: 50**

**Time: 2 hours**

**I**

**Answer the following**

1. Define machine design.

**(10x1=10)**

**Fill in the blanks**

2. A ..... is used to transmit rotary motion and torque between two shafts.
3. The ..... is the maximum stress that a material can withstand without permanent deformation under normal loading conditions.
4. The primary purpose of a cotter joint is to transmit ..... forces between two connected components.
5. The shaft diameter for a particular design is determined based on the ..... applied to the shaft, material strength, and safety factor.
6. For shafts subjected to bending, the shaft diameter is often calculated using the ..... stress formula.
7. The coefficient of friction in a flat belt drive is typically between ..... and .....
8. The pulley diameter in a V-belt drive is often designed to be slightly ..... to allow the belt to fit snugly into the pulley groove.
9. The term pitch circle refers to the imaginary circle on a gear where the ..... of two meshing gears occurs.
10. In gear design, the pressure angle typically ranges between ..... and ..... degrees.

**II**

**Write short notes on ANY FIVE of the following**

**(5x2=10)**

1. What do you mean by tension test? Name any three information, which are obtained from tension test.
2. Explain elasticity and plasticity.
3. Discuss the function of turnbuckle and its application.
4. What is the use of knuckle joint in mechanical systems? Write its key features.
5. Write down the main factors, which should be considered while designing threaded fasteners for direct static loads?
6. What is the difference between a sleeve coupling and a muff coupling?
7. What are the advantages of a V-belt drive over a flat belt drive?

**III**

**Answer ANY FIVE of the following**

**(5x4=20)**

1. What does the word "design" signify in engineering? Explain the various stages of design during the design process.
2. Discuss the fundamental ideas behind fatigue and creep in the context of materials.
3. What is welded joint? What factors should be considered while designing?
4. Explain design of shafts under combined bending and torsion. Write down the design procedure.
5. A semi-elliptic multi-leaf spring is used for the suspension of the rear axle of a truck. It consists of two extra full-length leaves and ten graduated-length leaves including the master leaf. The centre-to-centre distance between the spring eyes is 1.2 m. The leaves are made of steel 55Si2Mo90 ( $Syt = 1500 \text{ N/mm}^2$  and  $E = 207,000 \text{ N/mm}^2$ ) and the factor of safety is 2.5. The spring is to be designed for a maximum force of 30 kN. The leaves are pre-stressed so as to equalize stresses in all leaves. Determine
  - (i) the cross-section of leaves; and
  - (ii) the deflection at the end of the spring.

6. Write down the steps followed in selection of bearings.
7. Two rods are connected by means of a cotter joint. The inside diameter of the socket and outside diameter of the socket collar are 50 and 100 mm respectively. The rods are subjected to a tensile force of 50 kN. The cotter is made of steel 30C8 ( $Syt = 400 \text{ N/mm}^2$ ) and the factor of safety is 4. The width of the cotter is five times of thickness. Calculate width and thickness of the cotter on the basis of shear failure.

IV

**Write an essay on ANY ONE of the following**

**(1x10=10)**

1. Discuss the different types of belts and their material used for power transmission. Also explain the factors upon which the coefficient of friction between the belt and the pulley depends.
2. The standard cross-section for a flat key, which is fitted on a 50 mm diameter shaft, is  $16 \times 10$  mm. The key is transmitting 475 N-m torque from the shaft to the hub. The key is made of commercial steel ( $Syt = Syc = 230 \text{ N/mm}^2$ ). Determine the length of the key, if the factor of safety is 3.

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