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Question Paper Code: U6A02

B.E. / B.Tech. DEGREE EXAMINATION, APRIL/MAY 2025

Sixth Semester

Agricultural Engineering

21UAG602 – DESIGN OF BASIC MACHINE ELEMENTS

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. In cyclic loading, stress concentration is more serious in CO1- U
(a) brittle materials (b) ductile materials
(c) brittle as well as ductile materials (d) elastic materials
2. The ratio of the ultimate stress to the design stress is known as CO1- U
(a) Elastic limit (b) Strain (c) Factor of safety (d) Bulk modulus
3. If the diameter of a solid shaft is increased two times, the torque CO1- U
transmitted will be
(a) two times (b) four times (c) eight times (d) sixteen times
4. When a ductile material is loaded in excess of a certain value, a gradual CO2-App
increase in elongation takes place with time. this phenomenon is known as
(a) creep (b) fatigue (c) stress concentration (d) overstrain
5. In order to avoid tearing of the plate at edge, the distance from the centre line of CO2-App
the rivet hole to the nearest edge of the plate in terms of dia of rivet d should be
equal to
(a) d (b) 1.25 d (c) 1.5 d (d) 2 d
6. If shearing stress in nut is half the tensile stress in a bolt, then nut length should CO2-App
be equal to
(a) Diameter of bolt (b) .75 X diameter (c) 1.5 X diameter (d) None of the above
7. The springs made in the form of a cone disk to carry a high compressive force is CO1- U
(a) Helical (b) Belleville (c) Leaf (d) none of these

8. The longest leaf in Semi-elliptic leaf spring is known as CO1- U
 (a) Chief leaf (b) Master leaf (c) Major leaf (d) Higher leaf
9. What is the most important feature of lubrication that determines the life of a bearing? CO1- U
 (a) viscosity (b) grade of grease (c) E.P. additives (d) viscosity index
10. What two items are used to determine the proper oil viscosity for a bearing? CO1- U
 (a) bearing width and bearing speed (b) bearing speed and bearing outside diameter
 (c) bearing width and bearing bore (d) bearing speed and bearing pitch diameter

PART – B (5 x 2= 10 Marks)

11. Differentiate the stress distribution in a bar subjected to axial force and beam subjected to bending. CO1-U
12. A line shaft rotating at 200rpm is to transmit 20kW. It may be assumed to be made of mild steel with an allowable shear stress of 42MPa. Determine the diameter of the shaft, neglecting the bending moment on the shaft. CO2-App
13. Explain about the ways to produce bolts of uniform strength. CO1-U
14. When two concentric springs of stiffness 200 N/mm respectively are subjected to an axial load of 1500 N, what will be the deflection of each spring? CO2-App
15. Explain the term dynamic load carrying capacities of rolling contact bearing. CO1-U

PART – C (5 x 16= 80 Marks)

16. (a) A shaft of 200mm length is cantilever rod of circular section. It is subjected to a cyclic transverse load that varies from -50 to 150 KN. Determine the diameter of the shaft assuming a factor of safety of 2, size correction factor of 0.85 and surface correction factor of 0.9. The material properties are ultimate strength = 550MPa; yield strength = 320MPa and endurance limit = 275MPa. Theoretical stress factor = 1.4, Notch sensitivity factor = 0.9. CO2-App (16)
- Or
- (b) A circular bar of 500 mm length is supported freely at its two ends. It is acted up on by a central concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. CO2-App (16)
 The material properties of bar are given by: ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa.

17. (a) A shaft supported at the ends in ball bearings carries a straight tooth spur gear at its mid span and is to transmit 7.5KW at 300rpm. The pitch circle diameter of the gear is 150mm. The distance between the centre line of the bearings and gear are 100mm each. If the shaft is made of steel and the allowable shear stress is 45MPa, determine the diameter of the shaft. Show in a sketch how the gear will be mounted on the shaft, and also indicates the ends where the bearings will be mounted? The pressure angle of the gear may be taken as 20° . CO3-App (16)

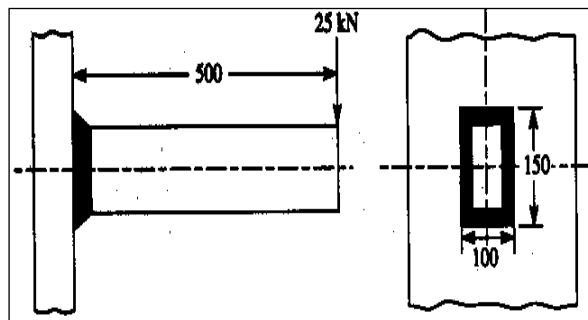
Or

- (b) Design a clamp coupling to transmit 30KW at 100rpm. The allowable shear stress for the shaft and key is 40 MPa and the number of bolts connecting the two halves are six. The permissible tensile stress for the bolts is 70 MPa. The coefficient of friction between the muff and the shaft surface may be taken as 0.3. CO3-App (16)

18. (a) Design a knuckle joint to transmit 100 kN. The design stresses may be taken as 55 MPa in tension, 40 MPa in shear and 120 MPa in compression. CO3-App (16)

Or

- (b) A rectangular cross-section bar is welded to a support by means of fillet welds as shown in Fig. Determine the size of the welds, if the permissible shear stress in the weld is limited to 75 MPa. All dimensions in mm. CO3-App (16)



19. (a) A railway wagon moving at a velocity of 1.5m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the wagon is 1500kg. The springs are compressed by 150mm in bringing the wagon to rest. The spring index can be taken as 6. The springs are made of oil hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm^2 and modulus of rigidity 81370 N/mm^2 . The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. Design the spring. CO4-App (16)

Or

- (b) A railway wagon moving at a velocity of 4.5m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the wagon is 1800kg. The springs are compressed by 190mm in bringing the wagon to rest. The spring index can be taken as 7. The springs are made of oil hardened and tempered steel wire with ultimate tensile strength of 1450 N/mm² and modulus of rigidity 81870 N/mm². The permissible shear stress for the spring wire can be taken as 60% of the ultimate tensile strength. Design the spring. CO4-App (16)
20. (a) Analyze the design process, in which the sliding action is along the circumference or arc of a circle and carrying radial loads. CO3-App (16)
- Or
- (b) Design and analyze the journal bearing for a centrifugal pump from the following data: Load on the journal = 10 000 N; Speed of the journal = 700 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 = 2.5 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/m²/°C. CO3-App (16)