B.Tech Odd Semester (CBCS) Exam., December—2017

AGRICULTURAL ENGINEERING

(5th Semester)

Course No. : AE–502 (C)

(Machine Design)

Full Marks : 75
Pass Marks : 30

Time : 3 hours

Note : 1. Attempt **one** question from each Unit.
2. Begin each answer in a new page.
3. Answer parts of a question at a place.
4. Assume reasonable data wherever required.
5. The figures in the margin indicate full marks for the questions.

UNIT—1

1. *(a)* Design a cotter joint to connect piston rod to the crosshead of a double-acting steam engine. The diameter of the cylinder is 300 mm and steam pressure is 1 N/mm^2. The allowable stresses for the material of cotter and piston rod are as follows :

σ_t 50 MPa; 40 MPa and σ_c 84 MPa 10

(b) Explain limits of fits and tolerance. 5

2. A circular bar of 500 mm length is supported freely at its two ends. It is acted upon 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. The material properties of bars are given by— ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa. 15

UNIT—2

3. A hollow shaft of 0·5 m outside diameter and 0·3 m inside diameter is used to drive a propeller of a marine vessel. The shaft is mounted on bearing 6 m apart and transmits 56 kW at 1500 r.p.m. The maximum axial propeller thrust is 500 kN and the shaft weighs 80 kN. Determine—

(a) the maximum shear stress developed in the shaft;

(b) the angular twist between the bearings. 15

4. Find the efficiency of the following riveted joints :

(a) Single-riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 50 mm

(b) Double-riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 65 mm

Assume permissible tensile stress in plate as 120 MPa, permissible shearing stress in rivets as 90 MPa and permissible crushing stress in rivets as 180 MPa. 15

UNIT—3

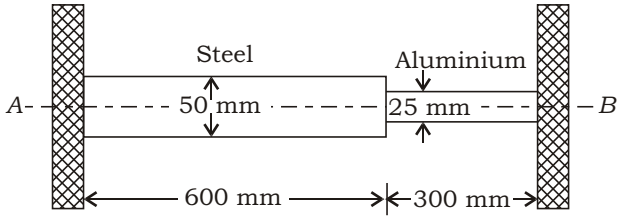
5. *(a)* What is factor of safety? Discuss various factors to be considered while selecting the factor of safety. 8

(b) Derive an expression for deflection of helical spring of circular wire. 7

6. A composite bar made of aluminium and steel is held between the supports as shown in figure below. The bars are stress-free at a temperature of 37 °C. What will be the stress in the two bars, when the temperature is 20 °C , if *(a)* the supports are unyielding and *(b)* the supports yield and come nearer to each other by 0·10 mm? It can be assumed that the change of temperature is

uniform all along the length of the bar. [Take E_s 210 GPa; E_a 74 GPa; $_s$ 11 7 10 ^{6}/ C; and

$_a$ 23 4 10 ^{6}/ C.] 15



UNIT—4

7. Find the efficiency of the following riveted joints : 15

(a) Single-riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 50 mm

(b) Double-riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 65 mm

Assume permissible tensile stress in rivets = 90 MPa, permissible crushing stress in rivets 180 MPa.

8. *(a)* Explain with sketch, different types of shaft couplings. 10

(b) Derive an expression for the length of belt for pulley drive. 5

UNIT—5

9. A spiral spring is made of a flat strip 6 mm wide and 0·25 mm thick. The length of the strip is 2·5 metres. Assuming the maximum stress of 800 MPa to occur at the point of greatest bending moment, calculate the bending moment, the number of turns to wind up the spring and the strain energy stored in the spring. [Take E 200 kN/mm^2.] 15

10. A helical torsion spring of mean diameter 60 mm is made of a round wire of 6 mm diameter. If a torque of 6 N-m is applied on the spring, find the bending stress induced and the angular deflection of the spring in degrees. The spring index is 10 and modulus of elasticity for the spring material is 200 kN/mm^2. The number of effective turns may be taken as 5·5. 15

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