B.Tech Odd Semester (CBCS) Exam., December—2018

AGRICULTURAL ENGINEERING

(5th Semester)

Course No. : AE-CC–21

(Machine Design)

Full Marks : 50
Pass Marks : 15

Time : 2 hours

Note : 1. Answer *any* **five** questions.

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.

1. *(a)* Explain the selection criteria of materials for engineering purposes. 3

(b) 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—

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

(ii) the angular twist between the bearings. 7

2. *(a)* What are the manufacturing considerations in machine design? 4

(b) An unknown weight falls through 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 600 mm^2 in section. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight? Take E 200 kN/mm^2. 6

3. *(a)* Give account of different types of bearings and their specific uses. 5

(b) A steel spindle transmits 4 kW at 800 r.p.m.; angular deflection should not exceed 0·25° per m of spindle. If the modulus of rigidity for the material of the spindle is 84 10^3 N/mm^2, find the diameter of the spindle and the shear stress induced in the spindle. 5

4. *(a)* A shaft is transmitting 100 kW at 160 r.p.m. Find a suitable diameter for the maximum torque transmitted exceeds the mean by 25%. Take maximum allowable shear stress as 70 MPa. 6

(b) Explain sleeve and cotter joint. 4

5. A cast iron pulley transmits 10 kW at 400 r.p.m. The diameter of the pulley is 1·2 metre and it has four straight arms of elliptical cross-section, in which the major axis is twice the minor axis. Determine the dimensions of the arm if the allowable bending stress is 15 MPa. 10

6. A double riveted lap joint is made between 15 mm thick plates. The rivet diameter and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are 400 MPa in tension, 320 MPa in shear and 640 MPa in crushing,

find the minimum force per pitch which will rupture 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 the rivets. 10

7. 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. 10

8. Design a helical spring for a spring loaded safety valve for the following conditions :

Diameter of valve seat = 65 mm, operating pressure = 0·7 N/mm^2, maximum pressure when the valve blows off freely 0 75 N/mm^2, maximum lift of the valve when pressure rises from 0·7 to 0 75 N/mm^2 3 5 mm, maximum allowable stress 550 N/mm^2, modulus of rigidity 84 10^3 N/mm^2, spring index 6.

Draw a neat sketch of the free spring showing the main dimensions. 10

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