B.Tech Odd Semester (CBCS) Exam., December—2016

AGRICULTURAL ENGINEERING

(3rd Semester)

Course No. : AECC–02

(Strength of Materials)

Full Marks : 50
Pass Marks : 15

Time : 2 hours

Note : 1. Attempt *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)* A copper wire of 2 mm diameter is required to be wound around a drum. Find the minimum radius of the drum if the stress in the wire is not to exceed 80 MPa. Take modulus of elasticity for the copper as 100 GPa. 5

(b) An I-section beam 350 mm×200 mm has a web thickness of 12·5 mm and a flange thickness of 25 mm. It carries a shearing force of 200 kN at a section. Sketch the shear stress distribution across the section. 5

2. *(a)* Derive the shearing stress equation over a rectangular section. 5

(b) Prove the relations

$$\frac{M}{I} \quad \frac{}{y} \quad \frac{E}{R}$$

where,

M bending moment
I moment of inertia
bending stress in a fibre at a distance y from the neutral axis
E Young's modulus
R radius of curvature 5

3. *(a)* Write down the Euler's column theory. Describe the assumptions in the Euler's column theory. 2+3

(b) A hollow alloy tube 4 m long with external and internal diameters of 40 mm and 25 mm respectively was found to extend 4·8 mm under a tensile load of 60 kN. Find the buckling load for the tube with both ends pinned. Also find the safe load on the tube, taking a factor of safety as 5. 5

4. *(a)* Write down the Johnson's straight line and parabolic formula for columns. 2+2

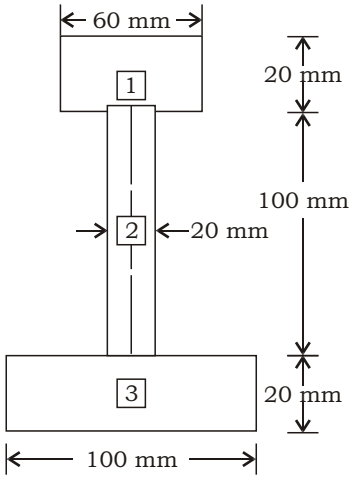
(b) What is Indian Standard Code for columns? Are you satisfied with the factor of safety of 1·68? Give explanation to your answer. 2+2

(c) What is resilience? 2

5. *(a)* What is a spring? What are the various types of springs? Distinguish clearly between bending springs and torsion springs. 1+2+2

(b) A leaf spring 750 mm long is required to carry a central point load of 8 kN. If the central deflection is not to exceed 20 mm and the bending stress is not greater than 200 MPa, then determine the thickness, width and number of plates. Also compute the radius to which the plates should be curved. Assume width of the plate equal to 12 times its thickness and E equal to 200 GPa. 5

6. *(a)* An I-section is made up of three rectangles as shown in the figure below :



Find the moment of inertia of the section about the horizontal axis passing through the centre of gravity of the section. 5

(b) A mild steel bar of 25 mm diameter, 20 cm gauge length and extension of 0·15 mm under a load of 7·5 tonnes. Load at elastic limit is 16 tonnes and maximum load is 25 tonnes. Total extension is 5·5 cm diameter at fracture is 1·85 cm. Find—

(i) the elastic limit stress;

(ii) Young's modulus;

(iii) percentage elongation;

(iv) percentage reduction in area. 5

7. *(a)* Draw a shear force and bending moment diagram for a cantilever beam with a uniformly distributed load. 2½+2½

(b) What is moment of inertia? How would you find out the moment of inertia of a plane area? 1+4

8. *(a)* Derive from fundamental, the relation for the deformation of a body, when it is subjected to—

(i) a tensile force;

(ii) its own weight. 2½+2½

(b) Derive the relationship between modulus of rigidity, Young's modulus of elasticity and bulk modulus. 5

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