**43 (3) STRU (III) 3·5**

**2012**

# STRUCTURE – III

Paper : ENG 3·5

*Full Marks : 100*

*Pass Marks : 40*

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

*Q. No. 1 is* ***compulsory*** *and answer* ***any four*** *from the rest.*

1. Choose the correct answer. 2×10=20

   *(i)* Torque transmitted by a solid shaft of diameter (D), when to a shear stress ($\tau$) is equal to

   *(a)* $\pi/16\,\tau D^2$ *(b)* $\pi/16\,\tau D^3$

   *(c)* $\pi/32\,\tau D^2$ *(d)* $\pi/32\,\tau D^3$

(ii) A shaft revolving at *r.p.m.* transmits torque (T) in *kg.m*. The power developed is —

(a) $2\pi NT\ KW$ (b) $\frac{2\pi NT}{30}\ KW$

(c) $\frac{2\pi NT}{60}\ KW$ (d) $\frac{2\pi NT}{120}\ KW$

(iii) Polar moment of inertia of a solid shaft of diameter (D) is —

(a) $\pi/16\ D^3$ (b) $\pi/16\ D^4$

(c) $\pi/32\ D^3$ (d) $\pi/32\ D^4$

(iv) When a solid shaft is subjected to torsion, the shear stress induced in the shaft at its centre is —

(a) Zero (b) minimum

(c) maximum (d) average

(v) Strain energy stored in a hollow shaft of external diameter (D) and internal diameter (d) when subjected to a shearing stress ($\tau$) is equal to —

(a) $\frac{\tau^2}{C}\left(\frac{D^2+d^2}{D}\right)$ (b) $\frac{\tau^2}{4C}\left(\frac{D^2+d^2}{D}\right)$

(c) $\frac{\tau^2}{C}\left(\frac{D^2-d^2}{D}\right)$ (d) $\frac{\tau^2}{4C}\left(\frac{D^2-d^2}{D}\right)$



(vi) A column of length 'L' is hinged at its both ends. Its equivalent length will be equal to —

(a) $2l$ (b) $l$

(c) $0.5l$ (d) $0.707l$

(vii) The slenderness ratio of a long column is —

(a) 10 – 20 (b) 20 – 30

(c) 50 – 60 (d) above 80

(viii) Euler's Formula is given by —

(a) $\frac{\pi^2 EI}{le^2}$ (b) $\frac{\pi EI^2}{le}$

(c) $\frac{\pi l^2}{Ele}$ (d) $\frac{1}{P_{cs}}+\frac{1}{P_E}$

(ix) Crushing stress of mild steel is —

(a) 320 (b) 350

(c) 220 (d) 150

(x) A column of length 'L' is fixed at both ends, then the equivalent length will be —

(a) $l$ (b) $2l$

(c) $l/2$ (d) $l/\sqrt{2}$

2. (a) Define column and strut : 5+15=20

(b) A hollow alloy tube $4m$ long with external and internal diameter of $40mm$ and $25mm$ respectively was found to $4.8m$ under a tensile load of $60KN$. Find the buckling load for the tube with both ends pinned. Also find the safe load on the tube, taking factor of safety as 5.

3. (a) Write the assumptions for shear stress in a circular shaft subjected to torsion. 5+15=20.

(b) A circular shaft of $60mm$ diameter is running at 150 $r.p.m.$ If the shear stress is not to exceed $50\mu Pa$, find the power which can be transmitted by the shaft.

4. (a) A hollow shaft is to transmit $200KW$ at 80 $r.p.m.$ If the shear stress is not to exceed $60\mu Pa$ and internal diameter is 0.6 of the external diameter, find the diameter of the shaft.

(b) A $1.75m$ long steel column of rectangular cross-sections $120mm \times 100mm$ is rigidly fixed at one end and hinged at the other.



Determine the buckling load on the column and the corresponding axial stress using Euler's formula. Take 'E' for the column material as $200\ GPa$. 10+10=20

5. (a) Write down the assumptions in the Euler's Column Theory.

(b) Define buckling load.

(c) A steel rod $5m$ long and of $40mm$ diameter is used as column with an end fixed and the other free. Determine the crippling load by Euler's formula. Take $E$ as $200\ GPa$. 5+5+10=20

6. (a) Tabulate the relationship between the different end condition of a column with the equivalent length.

(b) A T-section $150mm \times 120mm \times 20mm$ is used as a strut of $4m$ long with hinged at its both ends. Calculate the crippling load, if Young's modulus for the material be $200\ GPa$. 5+15=20

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