

THEORY OF STRUCTURE*Time Allowed: 2.5 Hours**Full Marks: 60*

Answer to Question No. 1 & 2 are compulsory and to be answered first. This answer is to be made in separate loose script(s) provided for the purpose. Maximum time allowed is 30 minutes, after which the loose answer scripts will be collected and fresh answer scripts for answering the remaining part of the question will be provided. On early submission of answer scripts of Question Nos. 1 & 2, a student will get the remaining script earlier.
Answer any Eight (08) Questions from the rest.

1. CHOOSE THE CORRECT ALTERNATIVE (any ten)**1x10=10**

- i. The RANKINE'S CONSTANT for mild steel is [a. 1/1600, b. 1/8500, c. 1/7500, d. 1/9000]
- ii. The fixed end moments of a 6-meter span fixed beam carrying a central point load of 120 KN is [a. 40 KNM, b. 90KNM, c. 360 KNM, d. 120 KNM]
- iii. Analysis two span continuous beam is performed by using [a. Maxwell's Theorem, b. Clapeyron's Theorem, c. Castigliano's Theorem, d. All of these]
- iv. When a cantilever of L length & EI flexural rigidity, loaded by a point load Wat the mid span, the slope at the free end is [a. $WL^2/2EI$, b. $WL^2/8EI$, c. $WL^2/4EI$, d. $WL^2/6EI$]
- v. The limit of eccentricity for no tension condition for a circular column section of diameter D is [a. D/4, b. D/8, c. D/12, d. D/16]
- vi. Equivalent length of a chimney of height 20 meter is [a. $(20\sqrt{2})$ m, b. $(20\sqrt{2})$ m, c. 40 m, d. 10 m]
- vii. A 8.5 m high & 10 m long dam retains water of unit weight of 10 KN/m^3 at its vertical face with a free board of 500 mm. The hydrostatic thrust is [a. 800 KN, b. 320 KN, c. 3200 KN, d. None of these]
- viii. The shape of core for a compression member of rectangular cross section is [a. rectangular, b. square, c. rhombus, d. parallelogram]
- ix. A long column fails by [a. crushing, b. buckling, c. both crushing & buckling, d. any one of the previous options]
- x. The summation of DISTRIBUTION FACTORS for different members meeting at a moment resisting joint is [a. 1.5, b. 1.0, c. 0.5, d. 0]
- xi. For a column with both ends fixed, EULER'S CRIPPLING LOAD is [a. $\pi^2EI/(4L^2)$, b. $4\pi^2EI/L^2$, c. $2\pi^2EI/L^2$, d. $\pi^2EI/(2L^2)$]
- xii. The Rotational stiffness of a beam member whose one end is fixed & the other end is pinned is [a. $3EI/L$, b. $4EI/L$, c. $3EI/4L$, d. EI/L]
- xiii. The CARRYOVER FACTOR in moment distribution method is [a. 1.0, b. 2.0, c. 0.5, d. 0.3]
- xiv. For short column the slenderness ratio is less than [a. 8, b. 30, c. 32, d. 120]
- xv. The ratio of maximum deflection of a cantilever due to a point load at the free end, to the deflection due to UDL of same total load on the entire cantilever length, is [a. 3/8, b. 8/3, c. 3/2, d. 3/4]

2. FILL IN THE BLANKS (any ten)**1x10=10**

- i. With usual meanings of M, E, & I; EI/M gives _____.
- ii. For Long Column, SLENDERNESS RATIO is greater than _____.
- iii. The product of E & I is called _____.
- iv. Moment required to rotate the end of the beam by unit rotation, is termed as _____.
- v. The number of point of contraflexures in a fixed beam is/are _____.
- vi. The differential equation of elastic curve is given by _____.
- vii. The maximum deflection magnitude of a simply supported beam of L length & EI flexural rigidity; carrying W load per unit length for entire span, will be _____.

- viii. The ratio of original length to equivalent length of column, having one end fixed & other end hinged is _____.
- ix. Clapeyron's Theorem relates _____ numbers of consecutive support moments.
- x. As the slenderness ratio increases, load carrying capacity of the column _____.
- xi. The prop reaction of propped cantilever of span L & subjected to UDL @ W per unit length for entire span, is _____.
- xii. A dam with vertical water retaining face has top width ' a ', bottom width ' b ' & height ' H ' then the C.G. distance of the dam from water retaining face is _____.
- xiii. The area of the core of an eccentrically loaded circular column of diameter D is _____.
- xiv. The slope of BM diagram at any point gives _____ at that point.
- xv. The area of the M/EI diagram between any 2 points gives the _____ between the said 2 points.
3. Compare the safe Euler's Critical loads for 2 circular columns of same length, same material & equal areas of cross sections. One of them is hollow with external diameter to internal diameter ratio 2:1 & the other solid. In each case one end is fixed & other hinged and have same factor of safeties. 5
4. A propped cantilever AB, fixed at A & roller supported at B. It is 8 m long & carries a point load of 15 KN at mid span. Find the support reactions using AREA MOMENT THEOREM. 5
5. A continuous beam ABC, simply supported at A, B & C. $AB = 7\text{m}$, $BC = 6\text{m}$. Entire BC span loaded by an UDL of 12 KN/m & AB span carries a point load of 21 KN at an intermediate point D, such that $AD = 2\text{m}$ & $DB = 5\text{m}$. Analyze the beam using 3 MOMENT THEOREM. Draw BM diagram (superimposed) only. EI is constant throughout. 5
6. With reference to the previous problem (Q5) if support A is fixed & other support & load conditions remain same, then analyze the beam to find support moments & forces using MOMENT DISTRIBUTION METHOD. No SF & BM diagrams required. <https://www.wbscteonline.com> 5
7. A concrete dam ($\gamma_{\text{concrete}} = 25 \text{ KN/m}^3$) of trapezoidal section is retaining water ($\gamma_{\text{water}} = 10 \text{ KN/m}^3$) throughout its vertical face. The dam is 10 m high, 2 m wide at top & 5 m wide at base. Determine the magnitude & direction of the resultant thrust at the dam base per 1 m run. Draw the stress diagram at its base. 5
8. A simply supported beam of 5 m span has rectangular section 150 mm wide & 250 mm deep. It carries a central point load of 10 KN & suffers a central deflection of 12.5 mm. Neglecting the self-weight of the beam, calculate: (a) value of E & (b) slope at the supports. 5
9. A FIXED BEAM of 6 m span carries UDL @ 15 KN/m up to the mid span from one of the fixed support end. Calculate the support reactions (support moments & forces). 5
10. A vertical RCC ($\gamma_{\text{RCC}} = 25 \text{ KN/m}^3$) wall is 7.5 m high & 2.2 m thick. Find the stress produced at the base per 1 m run of the wall, when a wind pressure is 1.4 KN/m^2 , acting in the direction parallel to 2.2 m wall dimension. Draw the stress diagram at the base. 5
11. 1.5 m long cast iron solid circular column of 5 cm diameter, with one end fixed & other end free. Taking factor of safety as 3, calculate the safe loads using (I) RANKINE'S FORMULA & (II) EULER'S FORMULA. Take $E = 120 \text{ GPa}$, ultimate crushing stress = 560 N/mm^2 , Rankine's Constant (α) = $1/1600$. 5
12. a) State 3 assumptions of EULERS THEORY for crippling load.
 b) Define: (I) EFFECTIVE LENGTH of column (II) KERN or CORE
 c) State the 2nd theorem of AREA MOMENT.
 d) State any 3 conditions for the stability of a dam.

(1+2+1+1=5)