

ARUNACHAL PRADESH PUBLIC SERVICE COMMISSION ITANAGAR

SUBJECT: CIVIL ENGINEERING

Time: 3 hours

Full Marks: 200

Note: Question No. 1 is compulsory and any four from the remaining seven questions. All questions carry equal marks.

Q. No. 1 Attempt any 10 (ten)

10×4=40

- A. If void ratio is 'e' and porosity is 'n' establish,  $e = \frac{n}{1-n}$
- B. Write four conditions where pile foundation is more suitable.
- C. Write the conditions which lead to adopt strap footing.
- D. What is meant by end overlap and side overlap in Aerial Photograph?
- E. Explain how will you set a simple circular curve using chain and tape.
- F. On a plane resultant stress is inclined at an angle of  $30^\circ$  to the plane. If normal stress on the plane is  $50\text{N/mm}^2$ , find the value of shear stress on the plane.
- G. A simply supported beam of span 4m carries a concentrated load 40KN at its mid-point. If flexural rigidity is  $5 \times 10^4 \text{KNm}^2$ , what is maximum deflection in the beam?
- H. Prove that strain energy stored due to bending is  $\int \frac{M_x^2 dx}{2EI}$
- I. A steel bar 100mm long is subjected to a tensile force P. If the change in length of the bar is 0.05mm, find the value of P.  $E = 2 \times 10^5 \text{N/mm}^2$ .
- J. For rectangular section  $b \times d$ , Moment of Inertia,  $I_{xx} = \frac{bd^3}{12}$ . Prove it.
- K. State the laws of fluid friction for steady streamline flow in pipes. What are uniform and non-uniform flows?
- L. What do you understand by major and minor losses in pipes? Using standard notations, write expressions for each type of loss.

Q. No. 2 Attempt any 8 (eight)

8×5=40

- A. Two forces 80KN and 70KN are acting on a point of a body in same direction at angles of inclination  $25^\circ$  and  $50^\circ$  respectively. Determine the resultant of the two forces.
- B. Define Perfect, Deficient and Redundant frames.
- C. For a block ABCD of dimension, horizontal length  $AB=CD=L$  & vertical height  $AD=BC=h$ . Due to applied shear force, DC displaces by  $\delta L$  with respect to AB. Prove that shear strain,  $\phi = \frac{\delta L}{h}$ .

- D. A cantilever beam of length 2m carries udl of 2KN/m throughout the length together with a point load 2KN at distance 0.6m from free end, find bending moment and shear force at point 1.2m from free end.
- E. What are the characteristics of flow net?
- F. Explain Compression index, Expansion index and Recompression index.
- G. What do you mean by balancing of traverse? Discuss briefly the common methods of balancing a traverse.
- H. After contraction of jet, the flow has an average velocity of 2.4m/sec and depth of flow 2.0m. Find the height of Jump.
- I. A fixed beam of uniform cross-section of length 7m subjected to load 80KN at 2m from left support and 60KN at 1m from right supports. Find fixed end moments.
- J. Explain how the failure of a short and a long column takes place.

**Q. No. 3 Attempt any 5 (five)**

**5×8=40**

- A. Derive the expression for Euler's Crippling Load for a long column with one end fixed and other end hinged.
- B. A pipe is proposed to be laid on a slope of  $\frac{1}{2500}$  to carry fluid at 1.6 m<sup>3</sup>/sec. What should be the diameter of the pipe if the flow is half/full. Take n=0.015.
- C. What are the advantages and disadvantages of compass survey? State the limits of precision of compass survey.
- D. What are different causes of preconsolidation in soils? What is the effect of preconsolidation on settlement?
- E. Determine allowable gross-load and the net allowable load for a square footing of 2m side and with a depth of foundation 1.2m. Use Terzaghi's theory and local shear failure. Take a factor of safety of 3. Assume following extra data  $\gamma=18\text{KN/m}^3$ ,  $C'=15\text{KN/m}^2$ ,  $\Phi'=25^\circ$ ,  $N'_c=14.8$ ,  $N'_q=5.6$ ,  $N'_\gamma=3.2$ .
- F. A continuous beam ABC fixed at A & C and continuous over B, subjected to 10KN/m throughout length BC. Using Slope Deflection method find moment induced at B.
- G. A simply supported beam of span 2.6m having cross-section 200×400 carries a point load W at mid-span. If maximum shear stress that can be allowed is 1.2N/mm<sup>2</sup>, calculate the safe load W.