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 30^0 to the plane. If normal stress on the plane is $50N/mm^2$, find the value of shear stress on the plane.

G. A simply supported beam of span 4m carries a concentrated load 40KN at is mid-point. If flexural rigidity is $5\times10^4 KNm^2$, 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. $E= 2\times10^5 N/mm^2$.

J. For rectangular section b×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 25^0 and 50^0 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 δL with respect to AB. Prove that shear strain, $\emptyset=\frac{\delta L}{h}$.

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^3/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 γ=18KN/m^3, C'=15KN/m^2, $\Phi'=25^0$, N'_c=14.8, N'_q=5.6, N'_γ=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^2, calculate the safe load W.

Q. No. 4 Attempt any 4 (four) **4×10=40**

A. A continuous beam ABCD fixed at A & D, and continuous over B & C. AB=5m, BC=4m, CD=5m. Load acting 6KN/m on BC, 12KN on AB at mid-span point and 10KN at 2m from D on CD. Analyse the beam by KANI's method for bending moment.

B. Describe the various methods of chaining on a sloping ground along with their advantages and disadvantages.

C. Determine the average co-efficient of permeability in the horizontal and vertical directions for a deposit consisting of three layers of thickness 4m, 3m, 2m and having co-efficient of permeability of 3×10^{-2}mm/sec, 3×10^{-4} mm/sec and 4×10^{-2}mm/sec respectively. Assume the layers are isotropic.

D. A uniformly distributed load 10KN/m and of length 8m is to crosses over a girder of 18m span. Find the maximum bending moment at distance 8m on the beam from right end. Use influence line diagram.

E. When a shaft is subjected to a torque show that $\frac{f_s}{R} = \frac{C\theta}{L} = \frac{q}{r}$

Q. No. 5 Attempt any 2 (two) **2×20=40**

A. What are minor losses? Under what circumstances will they be negligible?

For a sudden expansions in pipe flow, workout the optimum ratio between the diameter of the pipe before expansion and the diameter of pipe after expansion so that the pressure rise is maximum.

B. The following bearings were observed in running a compass traverse.

Line	FB	BB
AB	$66^0 15'$	$244^0 00'$
BC	$129^0 45'$	$313^0 00'$
CD	$218^0 30'$	$37^0 30'$
DA	$306^0 45'$	$126^0 45'$

Find the correct FB & BB and the true bearings of the lines, given that the magnetic declination is $1^0 40'$E.

C. A portal frame ABCD consisting verticals AB & DC and horizontal BC is supported at A in hinge & at D fixed. AB=4m, BC=8m, DC=6m. I_{AB}=I, I_{BC}=1.2I, I_{DC}=1.5I. BC is subjected to udl of 10KN/m for length 2m from B & a concentrated load of 10KN at 1m from C. Analyse the frame & draw BMD.

Q. No. 6 The elevations of two proposed triangulation stations A & B 100km apart are 150m & 425m above mean sea level, respectively. The elevation of an intervening Peak at C, 60km from A, which is likely to obstruct the line of sight is 180m. Ascertain if A & B are intervisible and if not, find the height required for the Scaffold at B, so that the line of sight clears 'C' by 4.5m.

Also solve the Problem by Captain Macaw's method.

During the process of the Triangulation Survey, at a satellite station 'S' 6.8m from the main triangulation A, the following directions were observed:

$\angle A = 0^0 0' 0''$

$\angle B = 135^0 20' 30''$

$\angle C = 232^0 26' 05''$

$\angle D = 298^0 10' 15''$

The length AB, AC and AD were computed to be 3200.7m, 4120.5m and 2998.6m, respectively. Determine the directions of AB, AC & AD. **40**

Q. No. 7 A retaining wall 6m high, has a vertical smooth back and supports a horizontal sand backfill with $\Phi = 30^0$ and $\gamma = 17 KN/m^3$. The backfill carries a uniform surcharge load of $35 KN/m^2$. It is resting on a soil which has the following properties, $\gamma = 18 KN/m^3$, $c = 25 KN/m^2$ and $\Phi = 36^0$. The water table is 1m below the base of the retaining wall. The weight of the wall is 260KN/m and its line of action passes at a distance of 0.75m from the heel. The base width of the retaining wall is 2.5m.

Determine the magnitude and point of application of active earth pressure acting on the retaining wall. Use Rankines theory.

Determine the ultimate bearing capacity per metre length of the wall, using IS recommendations. ($N_c = 50.6$, $N_q = 37.8$, $N_\gamma = 56.5$)

Determine the maximum and minimum base pressures of the wall, the factor of safety against overturning and the factor of safety against sliding. Hence comment on the stability of the retaining wall. **40**

Q. No. 8

a) What do you understand by laminar and turbulent flow? Describe how you can determine the nature of flow in a pipe with the help of Reynold's experiment.

Using conventional symbols, obtain an expression for the velocity u at a radius r in a circular pipe of radius R and length l in terms of the pressure difference at the two ends of the pipe.

Using this expression, find the magnitude of the maximum velocity. State the location of this maximum velocity.

b) Obtain an expression for the velocity of laminar flow u at a distance y from the centre of two plates of width b and length l separated by a distance 2t. What is the maximum velocity and where does it occur?

c) Water leaks through a horizontal crack 5cm wide and 0.2mm deep in a wall of thickness 12cm. If the difference of pressure intensity between the two ends of the crack is $0.0025 kg/cm^2$, find the rate of leakage of water through the crack. Take viscosity of water equal to 0.01 poise. **40**