ARUNACHAL PRADESH PUBLIC SERVICE COMMISSION, 2007

SUBJECT : CIVIL ENGINEERING

Time : 3 Hours.
Total Marks : 200.
[Section A – 100 + Section B – 100]

NOTES : There are 12 (Twelve) questions in 3 (Three) printed pages.
Answer ten questions selecting any five questions from each sections.
The figures in the margin indicate full marks of the questions.

SECTION – 'A'

1. [a] Explain water absorption test for acceptance of first class bricks. (5)
   [b] What are different constituents of cement clinker? Discuss their effects on hydration and hardening of cement. (5)
   [c] Discuss water soluble preservatives commonly used for protecting timber from decay and damage. (5)
   [d] Enumerate different constituents of paint and discuss their functions. (5)

2. [a] Bending moment of 450 kN.m and shear force of 400 kN are applied at a section of an I beam with flanges 200 mm X 20 mm and web 600 mm X 12 mm. Calculate bending stresses at a point 20 cm above the neutral axis. (4)
   [b] A cantilever of length l is loaded with udl (w/unit length) over length a from the fixed end. Find deflection at the free end. (4)
   [c] A hollow shaft of diameters ratio 2/3 transmits 375 kW at 250 r.p.m. at allowable shear stress 45 N/mm^2. If expected maximum torque is 30% higher than mean torque, find out diameters of the same shaft. (6)
   [d] A 5.0 m high masonry dam is 1.0 m wide at top and 3.5 m at base. Face of the dam exposed to water is vertical and water is expected to rise to the top of the dam. Taking density of masonry and water as 20 kN/m^3 and 10 kN/m^3, calculate the maximum and minimum normal stress intensities at the base of the dam. (6)

3. [a] Describe detailed procedure for laying of A. C. sheets roof covering over an industrial building. (4)
   [b] Discuss detailed specifications of cement plaster with a floating coat of neat cement. (4)
   [c] Explain different principles of supervision for construction of one brick thick wall in English bond. (6)
   [d] A 30 cm thick and 3.30 m high (above plinth) L-shaped wall measures 3.00 m and 6.00 m on its external sides. Depth and width of excavation are 90 cm and 70 cm respectively. Width of brick masonry is 50 cm for 40 cm height above 20 cm thick PCC and 40 cm upto 30 cm high plinth. Work out the quantity of earth work in excavation, PCC in foundation and first class brick work in foundation – plinth and super structure. (6)

4. [a] As per Indian Standard, suggest spacing of bore holes for building sites and large industrial areas. (4)
   [b] Explain suitability and process of soil investigation by Indian Standard split spoon sampler and Indian Standard thin wall sampler. (8)
   [c] An isolated column carries 2000 kN load and has 2.0 m X 2.0 m footing resting on dense sand at 1.3 m depth. Water table is located at a larger depth below ground and density of moist sand is 20.0 kN/m^3. For ϕ value of dense sand to (8)

be 36°, calculate factor of safety of the above column footing. (For ϕ = 36° take N_γ = 42, and N_q = 35)

5. [a] Derive expressions for flexural and anchorage bond stresses. (5)

[b] A column of size 400 mm X 600 mm has unsupported length of 3.00 m. It is braced against side sway in both directions and carries an axial load of 2000 kN. Using M_{20} grade concrete and Fe-415 HYSD bars, design longitudinal reinforcements for the column. (7)

[c] In a 150 mm thick RCC slab, 10 mm dia reinforcement is provided @ 200 mm centre to centre with an effective cover of 25 mm. Using M_{20} grade concrete and Fe-415 HYSD reinforcement, calculate ultimate moment of resistance of the section. (8)

6. [a] A boiler shell of diameter 2.0 m has to withstand an internal pressure of 1.20 N/mm^2. Design a longitudinal double riveted, double cover butt joint in 1.72 cm thick boiler shell plate considering safe stresses as f_t=100 N/mm^2; f_s=85 N/mm^2 and f_b=160 N/mm^2. (6)

[b] An I-section beam, depth 300 mm and flange width 140 mm, is fabricated from a 12 mm thick plate by using 6 cm thick continuous fillet welding. For maximum permissible average shear stress (τ_{av}) in steel 100 MPa and permissible shear stress for the fillet weld 108 MPa, calculate the shear load capacity of the section. (7)

[c] A bridge compression member consisting of two channels, ISMC 400 X 49.5 kg/m, placed toe to toe has effective length of 8.0 m. For width over the backs of the channels to be 40 cm and the section be properly connected by lacings, calculate safe load carrying capacity of the member.
(For l/r = 40, 50 and 60; (σ_{ac}) may be taken as 139, 132 and 122 MPa respectively. For ISMC 400, cross sectional area A= 63.04 cm^2; Ixx = 15123.4 cm^4; Iyy = 506.3 cm^4; distance of CG of channel section from web = 2.42 cm. (7)

SECTION – B

7. [a] Derive expressions for stopping sight distance and length of summit curve for the same. (4)

[b] A 10.2 m wide road in flat terrain with design speed 80 km per hour has a horizontal curve of 400 m radius. Calculate length of transition curve and required extra widening for the same. (8)

[c] Determine the capacity of lane for vehicle per hour for a highway with designed speed 64 km per hour, coefficient of friction 0.5 and perception brake reaction time 1.0 sec. (8)

8. [a] Enumerate special factors to be considered for deciding alignment of hill road and economic route. (6)

[b] Explain various steps for construction of W.B.M. roads. (7)

[c] Discuss concepts and derive expressions for spacing of expansion and contraction joints in rigid pavement. (7)

9. [a] Enumerate different requirements and functions of bridge bearings. (4)

[b] What are different forces acting on a well foundation? Explain different criteria for selecting depth of a well foundation. Discuss advantages and disadvantages of a circular well foundation. (8)

[c] Sketch and explain roller bearing for steel bridges and fixed end bearing for

concrete bridges (8)

10. [a] The centre line of a circular portion of a road embankment has radius 610 m and it subtends an angle of 90° at the centre. Height of embankment is 1.2 m at one tangent point and 3.0 m at another tangent point. For crest width 12.0 m and side slope 1 : 2, calculate the quantity of earth work in circular portion of road. Transverse ground slope and super elevation of embankment are negligible. (10)

[b] An irrigation canal has bed width 5.0 m, top width of left bank 3.0 m, top width of right bank 1.5 m, side slope in cutting 1 : 1, side slope of both banks 1.5 : 1, height of banks from the bed 2.25 m and longitudinal slope of the bed 1 : 5000. The ground levels at three consecutive stations at 50 m interval are 100 m, 100.31 m and 100.52 m respectively. For bed level of canal at first station to be 98.50 m, estimate the earth work in cutting only. Transverse slope of ground and bed are negligible. (10)

11. [a] What are different requirements of a good distribution system? Discuss layout of two types distribution systems commonly used in India. (5)

[b] Define coagulation process. Discuss chemical reactions for Alum, Copperas and Sodium Aluminate as common coagulants. (7)

[c] Water is supplied in a town from a reservoir by a 6.4 km long pipe line. Full supply level and lowest water level of reservoir are R.L. 180.00 and R. L. 105.00. The population of the town is 800,000 and water is supplied at the rate of 140 litres per head per day. Half of the water is to be supplied in 8 hours at a delivery end at R.L. 22.50 with 12.00 m required head. For f value as 0.04, find the diameter of the pipe. (8)

12. [a] Enumerate different types of forces acting on a sewer pipe. (3)

[b] Sketch typical section of a circular drop manhole and discuss its functioning. (4)

[c] Draw flow diagram for a conventional Activated sludge plant giving high degree of treatment. Design a secondary sedimentation tank required for an activated sludge plant for treating 6 million litres of sewage per day. (6)

[d] A sewer is to serve a population of 36,000 with water supply 135 lpcd. Sewer is to be laid on 1 in 625 slopes and has to carry four times of the dry weather flow in full running condition. Design a circular section for the given sewer and find out the velocity for full running condition. (7)
