Heaven's Light is Our Guide

DEPARTMENT OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering **THIRD** Year **ODD Semester** Examination, **2018**

CE 3131

Geotechnical Engineering-I

Full Marks: 72 **Time: 3 Hours**

N.B.:-
(i) Answer any **SIX** questions, taking **THREE** from each section.
(ii) Figure in the margin indicate full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable value for any data missing.

SECTION-A

Q.1(a) Briefly explain the fields of Geotechnical Engineering. 4.00

(b) For a given soil, show that 4.00

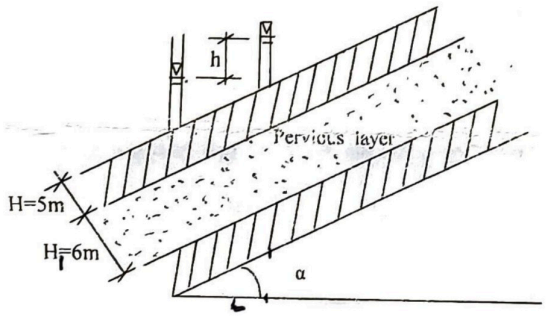
$\gamma_d = \frac{es\gamma_w}{(1+e)w}$, *where the symbols bear their usual meanings.*

(c) In its natural state, a moist soil has a volume of $0.33ft^3$ and weights 39.93lb. The oven dried weight of the soil is 34.54 lb. If Gs =2.67, calculate void ratio and degree of saturation. 4.00

Q.2. (a) Define hydraulic conductivity. Discuss the factors that affect hydraulic conductivity. 3.00

(b) Deduce an expression for determining hydraulic conductivity of clayey soil. 4.00

(c) Find the flow rate in m^3/sec/m length through the permeable soil layer shown in figure below. Given H =5m, H_1 = 6m, h = 3.4 m, L= 20 m, $\alpha = 10^0$, k = 0.08cm/sec. 5.00

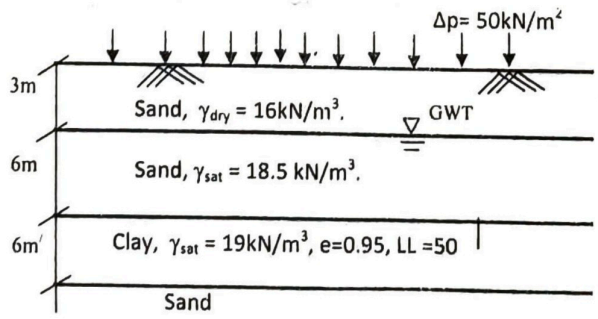


Q.3(a) Draw typical plot of e against logp showing loading, unloading and reloading branches. Define preconsolidation pressure and determine the preconsolidation pressure from e-logp plot. 4.00

(b) Briefly explain one-dimensional laboratory consolidation test procedure with consolidometer- schematic diagram. 4.00

(c) A soil profile is shown in figure below. If a uniformly distributed load, Δp , is applied at the ground surface, what is the settlement of the clay layer caused by primary consolidation if 4.00

(i) The preconsolidation pressure = 190 kN/m^2
(ii) The preconsolidation pressure = 170 kN/m^2



P.T.O.

Q.4 (a) What is coefficient of consolidation? How would you determine coefficient of consolidation from one dimensional consolidation test. 4.00

(b) What do you mean by "normally consolidated" and 'over –consolidated soil? 3.00

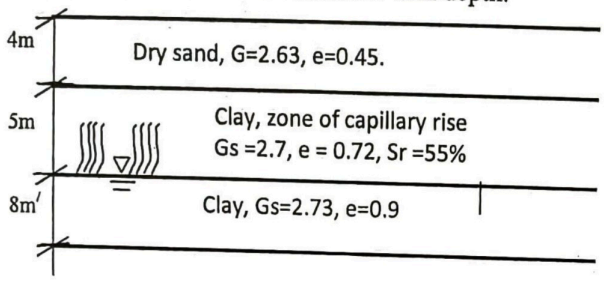
(c) For a normally consolidated clay, P_o = 2 ton/ft^2, $P_o + \Delta P$ = 6 ton/ft^2 , e_o =1.25 e_1 = 0.95. The co-efficient of permeability of the clay is 1.5×10^{-4} ft/day. How long will it take for a 15 ft thick clay layer in the field to reach 90% consolidation? Assume the clay is drained both side. 5.00

SECTION B

Q.5(a) What are the different methods of compaction adopted in the field? How would you select the type of roller to be used? 3.00

(b) Write short notes on (i) placement water content (ii) Relative compaction (iii) optimum moisture content (iv) CD and CU test. 4.00

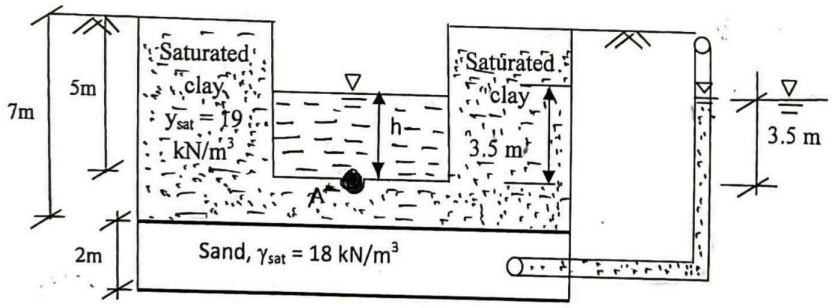
(c) A layered soil profile is shown in figure below. Determine and plot total stress, pore water pressure and effective stress variations with depth. 5.00



Q.6(a) Explain Darcy's law and Prove that $v_s = v/n$, where v_s = seepage velocity v = discharge velocity and n = porosity. 4.00

(b) Explain permeability test in the field by pumping from wells with sketches. 4.00

(c) A cut is made in a stiff saturated clay that is underlain by a layer of sand shown in figure below. What should be the height of the water, h, in the cut so that the stability of the saturated clay is not lost? 4.00



Q.7(a) What is flow net? What are the properties of flow net. 3.00

(b) Prove that the discharge through an earth mass is given by 4.00

$q = \frac{khN_f}{N_d}$, *where the symbols bear their usual meanings.*

(c) What is soil structure? Discuss with neat sketches the structures that obtained in cohesive soil. 5.00

Q.8(a) Briefly explain the Mohr-Coulmb failure criteria and prove that 5.00
$\sigma_1 = \sigma_3 \tan^2(45 + \varphi/2) + 2c\tan(45 + \varphi/2)$, where the symbols bear their usual meanings.

(b) In foundation design problem, you need to determine the angle of friction between the soil and foundation material. How can you determine it? Explain. 3.00

(c) The results of two drained triaxial test on a saturated clay follow: 4.00

Specimen- I: Confining pressure, σ_3 = 10 lb/in^2
deviator stress at failure, $(\Delta\sigma_d)_f$ = 24.7 lb/in^2

Specimen- II: Confining pressure, σ_3 = 15 lb/in^2,
deviator stress at failure, $(\Delta\sigma_d)_f$ = 33.5 lb/in^2.

Determine the shear strength parameters.

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DEPARTMENT OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering **THIRD** year **ODD SEMESTER** Examination, 2018

CE 3141

Environmental Engineering-I

Full Marks: 72 **Time: 3 Hours**

N.B.:-
(i) Answer SIX questions, taking THREE from each section.
(ii) Figure in the margin indicates full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable value for any data not given.

SECTION-A

Q.1(a) What is intake? Write down the important considerations for design of an intake. 4.00

(b) Write down the desirable qualities of pressure pipe for water transportation from source. 4.00

(c) Discuss the different causes of corrosion of metal pipe. How corrosion can be controlled? Explain. 4.00

Q.2(a) Write down the general considerations for water distribution system. 4.00

(b) Explain the purposes of service reservoir in water supply system. 4.00

(c) Compare the contact times necessary to obtain 99.99% kill of bacteria in water under the following conditions: (i) free chlorine residual of 0.15 mg/l and $k = 1.1 \times 10^{-2}$ per second (ii) combined chlorine residual of 2 mg/l with $k = 1.2 \times 10^{-5}$ per second. 4.00

Q.3(a) Describe the Grid-iron method of layout of water distribution system with its advantages and disadvantages. 3.00

(b) Explain the different mechanisms involve in the filtration process. 3.00

(c) Write down the design consideration of rapid sand filter. 3.00

(d) A settling tank is designed to remove spherical particles of 0.80 mm diameter with specific gravity 1.20 at 22^0C. Determine the removal of spherical discrete particles of 0.40 mm diameter with specific gravity 1.4 by this tank. Assume ideal settling conditions. 3.00

Q.4(a) How does water become hard? Write down the various softening processes with their reactions. 4.00

(b) Discuss the Arsenic removal processes from groundwater. 4.00

(c) A water sample with p^H 9 and a caustic alkalinity of 90 mg/l, Bicarbonate alkalinity of 80 mg/l and a total hardness are formed by Ca, Mg, K, Na and Sr with 60,, 50, 20, 105 and 45 mg/l, respectively. Find out total hardness, total alkalinity, carbonate hardness of non-carbonate hardness. 4.00

SECTION-B

Q.5(a) What is unaccounted for water? How can you estimate the unavoidable annual real losses of water? 3.00

(b) Mention the controlling measures of water loss. 3.00

(c) Briefly discuss three leak detection methods. 3.00

(d) Write a short note on a solar still. 3.00

Q.6(a) State the hydraulics of groundwater flow in wells. Deduce mathematical expressions for yield of artesian as well as ordinary wells. 4.00

(b) Explain the problems in groundwater development in Bangladesh. 4.00

(c) The diameter of a tube well is 50 cm. It is constructed in an aquifer of thickness 14m. The radius of circle of influence is 225m. Assuming permeability as 30 m^3 per unit area per day, calculate the drawdown when the yield of well is 1900 m^3 per day. 4.00

Q.7(a) Briefly discuss the sanitation system in Bangladesh. 4.00

(b) Draw a clear diagram of a very shallow shrouded tubewell. Discuss the usefulness of SST and VSST under condition in the coastal areas of Bangladesh. 4.00

(c) A rapid sand filter is to be designed for a capacity of 27,000 m^3/day. What should be the number and size of the units? Calculate the percentage of filtered water required to wash the filter bed and the capacity of the wash water tank. Assume rate of filtration 5 $m^3/hr/m^2$, rate of washing: 35 $m^3/hr/m^2$, length of the filter run: 24 hrs. including 5 min. for filter washing and 10 min for resettlement of sand bed. 4.00

Q.8(a) Discuss briefly the low cost alternative water supply technologies in Bangladesh. 5.00

(b) Discuss the advantages and disadvantages of rainwater collection system. 3.00

(c) Design a strainer for a 30 mm diameter tubewell to be operated by a No. 6 hand pump at the rate of 25 lpm. A slot No. 12 strainer having 50% open area to be used. The entrance velocity should not exceed 0.015 m/sec. 4.00

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DEPARTMENT OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering **THIRD** year **ODD SEMESTER** Examination. 2018

CE 3115

Reinforced Concrete-I

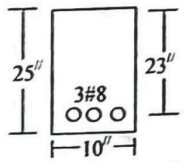
Full Marks: 72 **Time: 3 Hours**

N.B.:- (i) Answer SIX questions, taking THREE from each section.
(ii) Figure in the margin indicates full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable value for any data not given.

SECTION-A

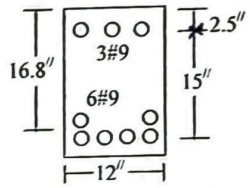
Q.1(a) What is balanced steel ration 'ρ_b'? Why does the ACI Code recommend a maximum steel ration less than ρ_b? 3.00

(b) Calculate the moment capacity of the beam section shown in figure below for (i) uncracked section and (ii) cracked section. Assume $f_c' = 5000$ psi and $f_y = 60{,}000$ psi. 9.00



Q.2(a) What is doubly reinforced section? Explain how it differs from a singly reinforced section. 3.00

(b) Compute the nominal moment and ultimate moment for the beam section shown in figure below. Assume $f_c' = 4$ ksi and $f_y = 60$ ksi. 9.00



Q.3(a) Explain how 'T-beam' is formed? What are the differences between 'T' and rectangular beams? 3.00

(b) A simply supported T-beam is carrying a LL of 40 psf and super imposed dead load of 110 psf on a 20′ span. Design the beam if it carries a 4″ thick slab. The transverse distance between beams = 10′ and web dimension = 10″ x 20″. Assume $f_c' = 3$ ksi and $f_s = 20$ ksi. 9.00

Q.4(a) Explain the terms web-shear crack and flexural shear crack. 2.00

(b) What is development length? Mention the factors affecting the development length of bars in tension. 3.00

(c) A simply supported beam is carrying a dead load of 1.5 k/ft in addition to its self weight and a live load of 2.0 k/ft on a 20 ft. span. Width of the beam = 10″ and overall depth = 24″ with an effective depth = 20″. Design the beam for shear if $f_c' = 3$ ksi and $f_y = 50$ ksi. 7.00

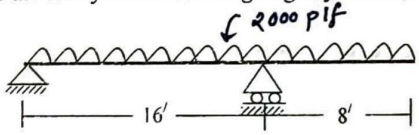
SECTION-B

Q.5(a) Write the functions of distribution reinforcement in one-way slab. Why is it placed on the top of the main reinforcement in case of simple span? 3.00

(b) Design a continuous one-way slab for a clear span of 14ft to support a live load of 100 psf. Use f_c = 3000 psi and f_y = 40,000psi. Assume beam width is 12 in. Follow USD method. 9.00

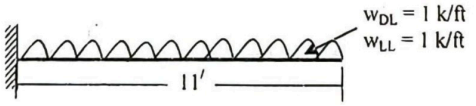
Q.6(a) Define structural safety. Why do you consider the safety factor for designing any structure? 3.00

(b) The overhanging beam shown in figure below is 12 in wide and 20 in effective depth. Design by WSD method, the reinforcement for different points using f_c' = 3000 psi and f_y = 20,000psi. 9.00

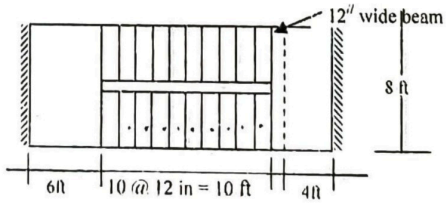


Q.7(a) Explain why mild steel is used as good reinforcement? 2.00

(b) A cantilever beam as shown in figure below is to be designed for a LL = 1 k/ft and DL = 1 k/ft. The section is limited to 12″ x 14″. Design the beam considering f_c' = 4 ksi and f_y = 60ksi. Follow USD method. 10.00



Q.8 Design the stair shown in figure below for a live of 120 psf. Assume f_c' = 3,000 psi, f_y = 20.000psi, and rise of step = 6in. 12.00



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DEPARTMENT OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering **Third** Year **Odd** Semester Examination, 2018

CE- 3111

Structural Analysis & Design - I

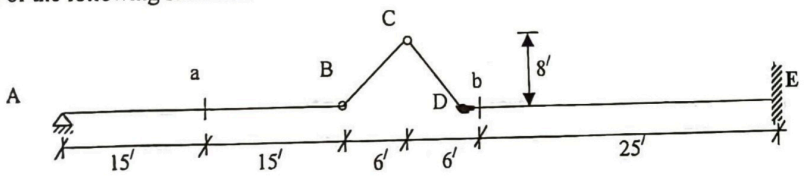
Full Marks: 72 **Time: 3 Hours**

N.B.:-
(i) Answer **SIX** questions, taking **THREE** from each section.
(ii) Figure in the margin indicates full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable value for any data missing.

SECTION-A

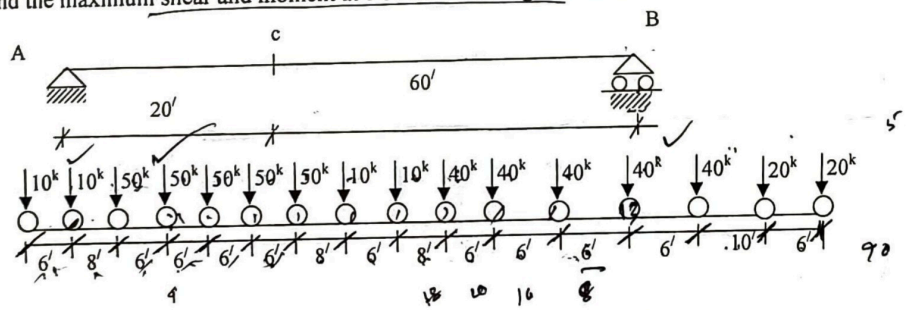
Q.1(a) Define influence line. How can you construct influence line? 3.00

(b) Draw influence line diagrams for R, V_a, M_a V_b and M_b due to a unit load moves from A to B and D to E of the following structure. 9.00

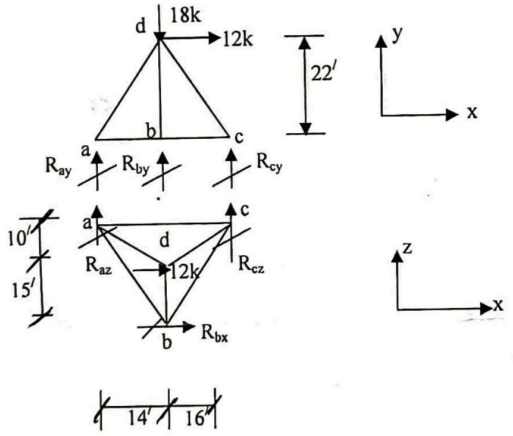


Q.2(a) Deduce a general criteria to obtain the position of wheel loads for the maximum shear force at any section of simply supported beam subjected to moving load. 4.00

(b) Apply appropriate criteria to obtain the position of loads and hence compute the maximum reaction at A and the maximum shear and moment at c of the following structure. 8.00

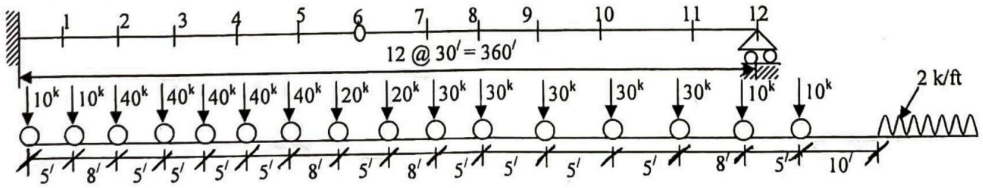


Q.3 Determine the reactions and bar forces of the space truss shown in figure below. 12.00



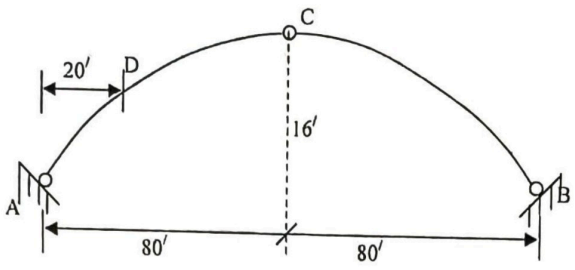
Q.4.(a) Prove that the shear in a panel is the maximum when the average load in the panel is equal to the average load in the span. 4.00

(b) Using proper criteria to determine the maximum shear in the panel 4-5 and the maximum moment at the panel point 3 due to the series of moving concentrated load as shown in figure below. 8.00

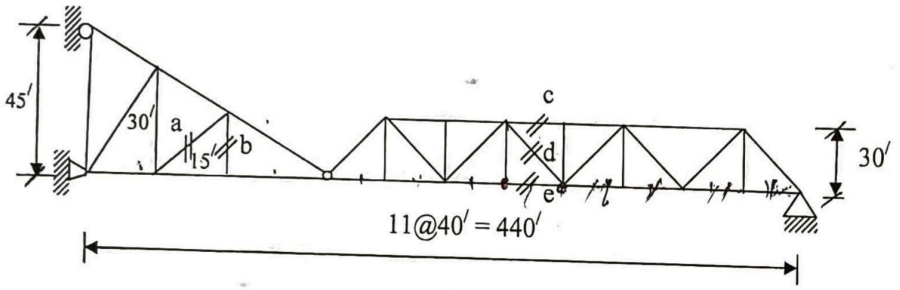


SECTION-B

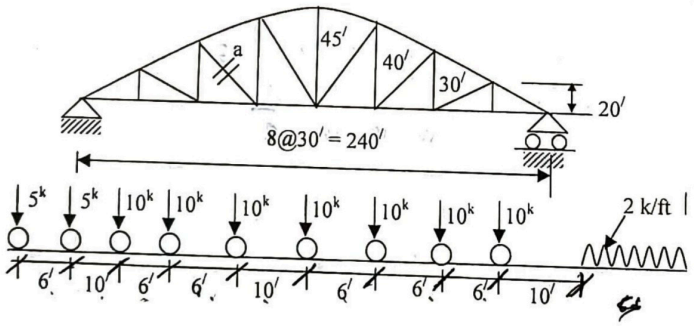
Q.5 Draw influence lines for bending moment, shear force, and normal thrust at a section D of the following three hinged parabolic arch. Also, compute the maximum moment and shear at section D for H_{20} loading. 12.00



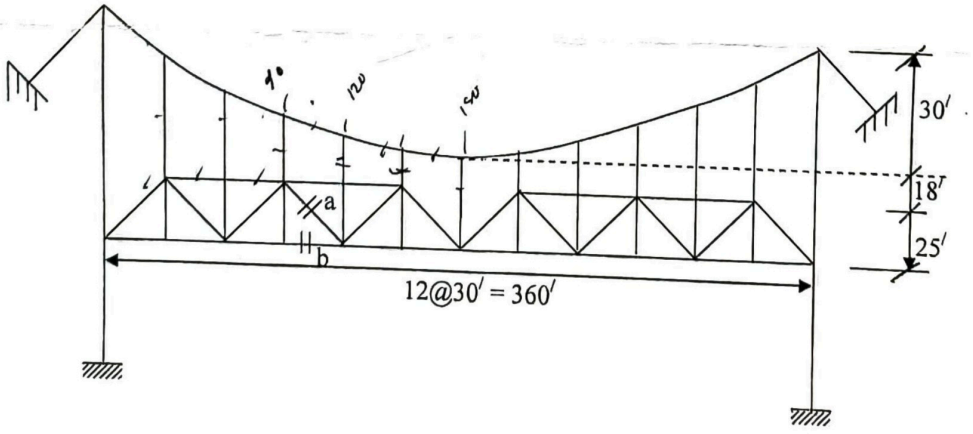
Q.6 Compute the maximum stress in member a, b, c, d and e of the following truss due to H_{15} loading 12.00



Q.7 Deduce the criteria for maximum tension in the member 'a' of non-parallel chord truss shown in figure below. Find out the maximum stress in the same member of the truss due to a series of moving concentrated and distributed load as shown below. 12.00



Q.8 Draw the influence lines for hanger tension, maximum cable tension and stress in the member 'a' & 'b' of the suspension bridge shown in figure below. Calculate the maximum stress of the same member due to a uniform load 2.5 k/ft with a concentrated load of 18 k. 12.00



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DEPARTMENT OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering **THIRD** year **ODD SEMESTER** Examination, 2018

CE 3121

Engineering Hydraulics

Full Marks: 72 **Time: 3 Hours**

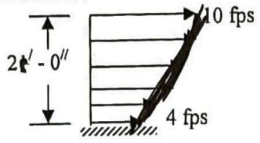
N.B.:-
(i) Answer SIX questions, taking THREE from each section.
(Ii) Figure in the margin indicates full marks.
(iii) Use separate answer script for each section.
(iv) Assume reasonable value for any data not given.

SECTION-A

Q.1(a) "Open channel flow is more complicated than pipe flow"- Explain why? Classify open channel flow depending on viscous force. 4.00

(b) Discuss pressure distribution in a channel section. Show with neat sketches. 3.00

(c) Determine the velocity distribution coefficient α and β for a wide open channel flow with velocity distribution shown in figure below. 5.00



Q.2(a) Write down the force equation. Draw specific curve and show different component parts of the curve. 4.00

(b) State continuity equation for unsteady flow in a open channel flow and show that $\frac{\partial \varphi}{\partial x} + T\frac{\partial \varphi}{\partial t} = 0$ is the basic equation of continuity for unsteady flow in open channel. Where symbols have their usual meaning. 3.00

(c) Applying momentum principles and continuity equation to the analysis of a sub-merged hydraulic jump which occurs at the sluice outlet in a rectangular channel. Prove that $\frac{y_s}{y_2} = \sqrt{1 + 2F_2^2\left(1 - \frac{y_2}{y_1}\right)}$ where y_s is the submerged depth, y_1 is the height of sluice gate opening, y_2 is he tail water depth and $F_2^2 = {q^2}/{gy_2^3}$ and q is the discharge intensity. 5.00

Q.3(a) Define channel transition. Write the functions of channel transition. Show with neat sketches the variation of y_1 and y_2 in sub critical and super critical flow over a hump. 4.00

(b) A low dam 5 ft high having a broad horizontal crest built with a rectangular channel 20ft wide. Assuming that a depth of 2.5ft measured on the crest in the critical depth. Compute the discharge and depth of flow upstream from the dam. 4.00

(c) A sluice gate discharges 11 m^3/s into a trapezoidal channel of side slope 1:1 and having bottom width of 6m the depth of the Vena-Contracta is equal to 0.17m. The channel downstream has a slope of 10^{-2} and n = 0.014. Find the type of surface curve formed downstream of the Vena-Contracta and plot the profile. 4.00

Q.4(a) Show that the unit tractive force $\tau_0 = wy_b$ and also derive the relationship for the tractive force ratio. Give necessary diagram. Symbols indicate usual meaning. 4.00

(b) Water flows at a depth of 0.30m in a wide stream having a slope of 1×10^{-3}. The median diameter of the sand on the bed is 1 mm. Determine whether the grain are stationery or moving. Given $\upsilon = 10^{-6}$ m^2/s. 4.00

(c) Sketch and name all the possible water surface profile in the following cases: 4.00
(i) Flow from a steep slope to a critical slope which is followed by a mild slope.
(ii) Flow from a sluice gate located on a horizontal floor to a steep slope which is followed by an adverse slope ending in a free fall.

SECTION-B

Q.5(a) What do you mean by the term 'jet of water'? Derive an expression for the force of jet impinging on a moving curved vane. 4.00

(b) A jet of water moving at 60 m/s is deflected by a vane moving at 25 m/s in a direction at 30° to the direction of the jet, the water leaves to blade normally to the motion of the vanes. Draw inlet and outlet triangles of velocities and find the vane angles for no shock at entry and exit. Take relative velocity of outlet to be 0.85 of relative velocity at inlet. 5.00

(c) Explain briefly the reasons for placing air vessels on delivery pipe of a reciprocating pump. 3.00

Q.6(a) Show that the best hydraulic trapezoidal section is one-half of a hexagon. 5.00

(b) What do you mean by control section and discharge rating curve? 3.00

(c) Design a trapezoidal channel laid on a slope of 0.0016 and carrying a discharge of 400 cfs. The channel is to be excavated in earth containing non-colloidal coarse gravel and pebbles, 25% of which is 1.25 in over diameter. Manning's roughness n=0.025, angle of repose $\theta = 33.5^{\circ}$ and side slope $\varphi = 26.5^{\circ}$. 4.00

Q.7(a) Derive the dynamic equation of gradually varied flow. 4.00

(b) With the help of a diagram explain the effect of acceleration and friction on both suction and delivery stroke. 4.00

(c) A single acting reciprocating pump, running at 60 r.p.m has a plunger of diameter 250mm and stroke of 500mm. The delivery pipe is 100mm diameter and 50m long. If the motion of the pump is simple harmonic, find the power required to overcome friction of delivery pipe when (i) no air vessel fitted and (ii) a large air vessel is fitted at the center line of the pump. 4.00

Q.8(a) From the first principle and writing down all steps of calculation, show that the theoretical pressure rise through impeller of a centrifugal pump is given $\frac{1}{2g}\left(V_f^2 + u_1^2 - V_f^2 cosec^2\emptyset\right)$, where the symbols bear their usual meaning. 5.00

(b) Each impeller of three-stage centrifugal pump has external diameter of 375mm and width 20mm. The pump is discharging 3600 liters of water per minute at 900 r.p.m. The vanes are curved back at 45° to the tangent at outlet. If manometric efficiency is 84%, find manometric head generated by the pump. 4.00

(c) A rectangular horizontal channel 2m wide, carries a flow of $4m^3/s$. The depth of water on the downstream side of the hydraulic jump is 1m, 3.00

(i) what is the depth at upstream?

(ii) what is loss of head?