Heaven's Light is Our Guide

DEPARTMET OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering THIRD Year ODD SEMESTER Examination, 2019

CE 3121

Engineering Hydraulics

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

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

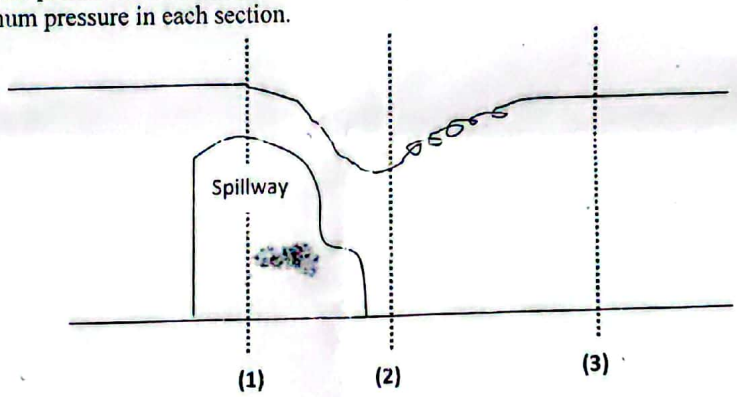
Q.1 (a) Prove that for maximum discharge in a circular channel, the depth of flow is 0.95 times the diameter of the channel section. 4.0

(b) Define open channel flow. 'Open channel flow is more complicated than pipe flow' explain. 4.0

(c) State continuity equation for unsteady flow in open channel and show that $\frac{\partial Q}{\partial x} + T\frac{\partial y}{\partial t} = 0$ is the basic equation of continuity for unsteady flow in open channel. Where symbols have their usual meanings. 4.0

Q.2(a) Draw a specific energy curve and define critical flow in a rectangular channel. Show the followings on the curve (i) Critical depth (ii) Alternate depth (iii) Sub-critical flow and (iv) Super critical flow. 4.0

(b) Draw the pressure distribution curve on the section (1), (2) and (3) and mention the maximum pressure in each section. 3.0



(c) The velocity distribution in a ~~rectangular~~ circular channel of diameter 2Ro. Follows the law $\frac{u}{u_0} = \left(\frac{y}{R_0}\right)^{2/3}$ in which y is the distance normal to the surface at which the velocity is u and u_0 at the centre of semi-circle. If R_0 = 2.0 m and u_0 = 2.0m/s, find u, α and β where u, α and β indicate their usual meanings. 5.0

Q.3 (a) What is critical tractive force? Deduce the relationship and show that the tractive force ratio is function of the inclination of the sloping side and of the angle of repose of the material forming the channel body. 4.0

(b) What is the most efficient channel section? Write down the conditions for most efficient trapezoidal channel section. Deduce any one of them. 4.0

(c) A trapezoidal channel has side slope of 2 vertical to 3 horizontal. It is discharging water at the rate of 20 cumecs with a back slope of 1 in 2000. Design the channel for its best form. Use Manning's formula, take n = 0.01. 4.0

Q.4 (a) What is the channel transition? Write the functions of channel transition. Show the variation of depth y_1 and y_2 in sub critical and super critical flow over a hump. 4.0

(b) A low dam 5ft high having a broad horizontal crest built with a rectangular channel 20ft wide, assuming that a depth of 2.5ft measured on a crest is critical depth. Compute the discharge and depth of flow upstream from the dam. 4.0

(c) Describe Shield's analysis and deduce the relationship for the determination of critical tractive stress. 4.0

SECTION B

Q.5 (a) Define hydraulic jump. Classify the hydraulic jump based on Froude number and sketch their wave pattern. Also write practical applications of hydraulic jump. 5.0

(b) Classify the gradually varied flow profile. 2.0

(c) A trapezoidal channel having bottom width of 22ft, side slopes 1V:2H, bed slope 0.0016 and Manning's roughness coefficient is 0.025 carries a discharge of 450 cfs. Compute the backwater profile created by a dam which backs up the water to a depth of 5ft immediately behind the dam. The upstream end of the profile is assumed at a depth equal to 1% greater than the normal depth. Take, $\alpha = 1.10$, $y_n = 3.40$ft, $y_c = 2.32$ ft. Use direct step method. 5.0

Q.6 (a) Show that the maximum efficiency of a jet exerted force on series of moving flat vanes is 50%. 2.5

(b) A jet of water impinges on a symmetrically curved vane at its centre. The velocity of the jet is 50 m/s and the diameter is 100 mm. The jet is deflected through an angle of 120^0. Calculate the force on the vane if the vane is fixed. Also determine the force if the vane moves with a velocity of 25 m/s in the direction of the jet. What will be the power and efficiency? 4.5

(c) A jet of water having a velocity of 15 m/s strikes a curved vane which is moving with a velocity of 5 m/s. The vane is symmetrical and it so shaped that the jet is deflected through 140^0. Find the angle of the jet at inlet of the vane so that there is no shock. What is the absolute velocity of the jet at outlet in magnitude and direction, and the work done per unit weight of water? Assume, jet diameter is 75 mm. 5.0

Q.7 (a) What is an indicator diagram? Derive the equation of a acceleration pressure head for a reciprocating pump. 4.0

(b) What is an air vessel and why it is used in a reciprocating pump? Draw a reciprocating pump and indicate its various components. 4.0

(c) A double acting reciprocating pump delivering 0.2 m^3/s of water against a static head of 90 m. The diameter and stroke length of the cylinder are 50 cm and 75 cm respectively. Friction losses amount to 1 m in the suction pipe and 10 m in the delivery pipe. Take, elbow loss coefficient $k_e = 2.5$. If the velocity of water in the delivery pipe is 1.4 m/s, pump efficiency 90% and slip 2%, determine the rotational speed and the power required. The diameter of piston rod is 25 mm. 4.0

Q.8 (a) Write short notes on: (i) Specific speed (ii) Affinity laws (iii) NPSH 4.5

(b) Explain the procedure for determination of best efficiency point of a centrifugal pump with neat sketch. 2.5

(c) A centrifugal pump running at 1000 rpm under current operating condition. The pump and system curve data are given in the table. Estimate the speed when the flow reduced to one-third of the operating condition. 5.0

Discharge (m^3/s)	:	0	4.5	9.0	13.5	18.0	22.5
Head available (m)	:	22.5	22.2	21.6	19.5	14.1	0
Head required (m)	:	15.0	15.4	16.6	18.6	21.4	25.0

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DEPARTMENT OF CIVIL ENGINEERING
RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering THIRD year ODD SEMESTER Examination, 2019

CE 3111
Structural Analysis & Design-I

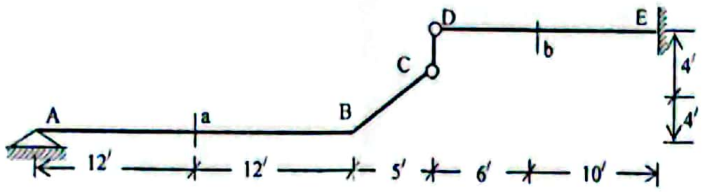
Full Marks: 72 **Time: 3 Hours**

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 not given.

SECTION-A

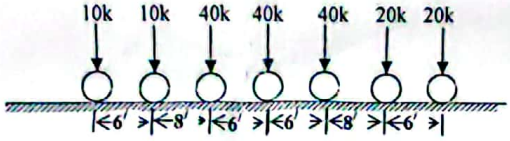
Q.1(a) Define influence line. Why is it drawn? 2.0

(b) Draw influence lines for M_a, M_b, V_a, and V_b, of the structure shown in figure below as a unit load moves from A to B and D to E. 10.0

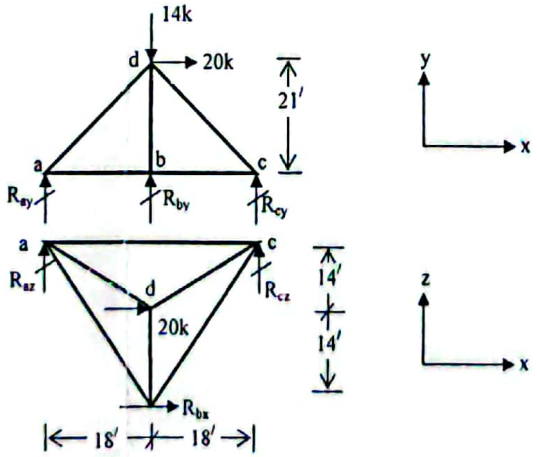


Q.2(a) Deduce the general criterion to obtain the position of moving loads for maximum shear at any section of a simply supported beam. 4.0

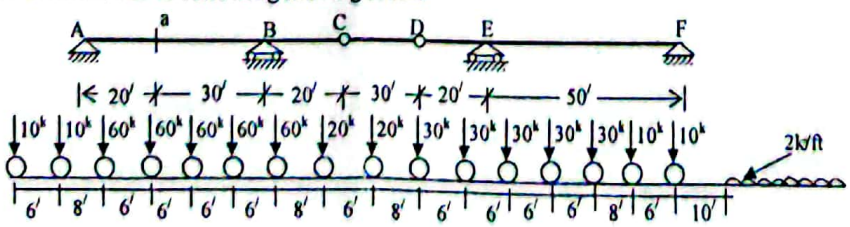
(b) For a simple span of 60ft, calculate the maximum moment at mid-span and the absolute maximum moment due to the following loads as shown below. 8.0



Q.3 Determine the reactions and bar forces of the space truss shown in figure below. 12.0

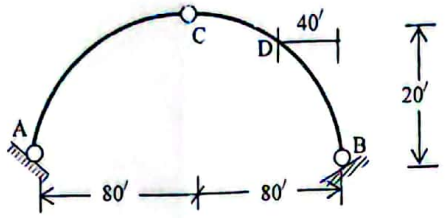


Q.4 Derive a criteria to obtain the position of moving loads for a section 'a' of the balanced cantilever bridge as shown in figure below. Hence, determine the maximum positive and negative moment due to following moving loads. 12.0

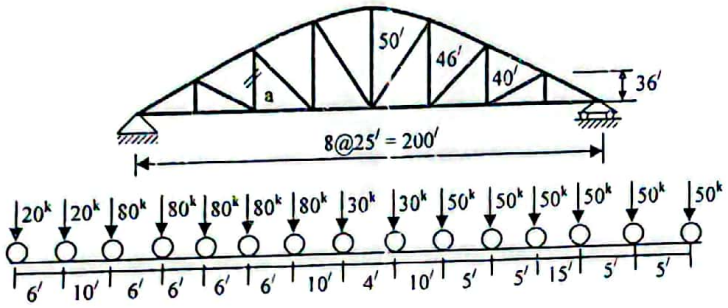


SECTION-B

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 calculate the maximum moment at section D for H_{15} loading. 12.0

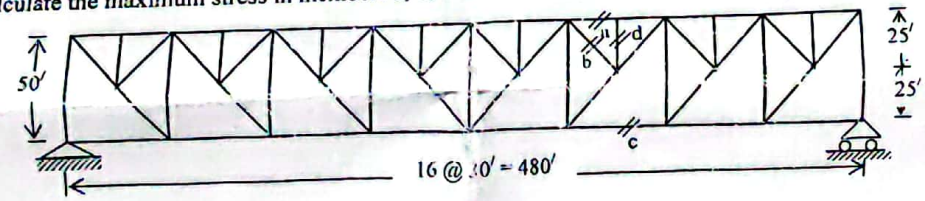


Q.6 Deduce the criterion for the maximum stress in the member 'a' of the non-parallel chord truss shown in figure below. Find out the maximum stress in the same member of the truss due to a series of moving concentrated load. 12.0



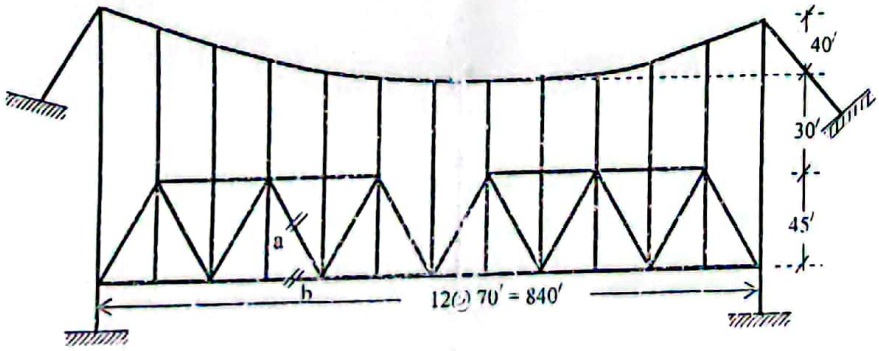
Q.7(a) Deduce the criteria for maximum stress in the upper chord of truss without vertical. 3.0

(b) Calculate the maximum stress in members *a, b, c* and *d* of the following truss due to H_{15} loading. 9.0



Q.8(a) What are the advantages and disadvantages of suspension bridges? 2.0

(b) Draw the influence lines for hanger tension, maximum cable tension and stress in the members 'a' and 'b', of the suspension bridge shown in figure below. Calculate the maximum stress of the same members due to a uniform load of 4.8 k/ft with a concentrated load of 35 k. 10.0



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DEPARTMENT OF CIVIL ENGINEERING
RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering **THIRD** year **ODD SEMESTER** Examination, 2019

CE 3115
Reinforced Concrete-I

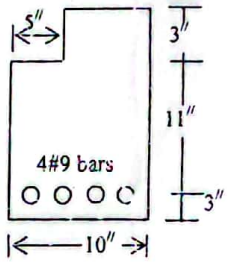
Full Marks: 72 **Time: 3 Hours**

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

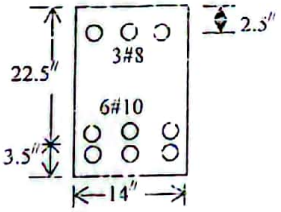
Q.1(a) Define reinforced concrete. Explain with necessary diagrams the behavior of a reinforced concrete beam loaded to failure. 4.0

(b) Determine the working and ultimate moment capacity of the beam section shown in figure below. Assume $f_c' = 5000$ psi and $f_y = 50{,}000$ psi and neglect lack of symmetry. 8.0



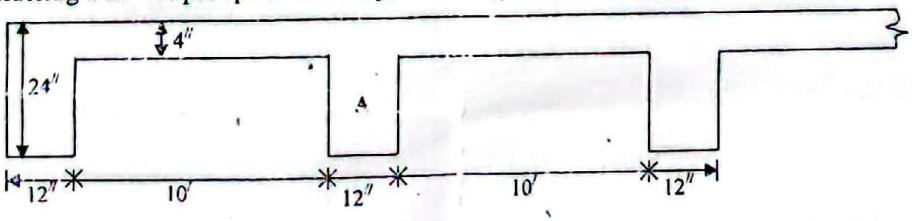
Q.2(a) Describe different types of uncertainties in analysis, design and construction of RC structures. How these uncertainties are encountered in design? 4.0

(b) Determine the ultimate moment capacity of section shown in figure below using $f_c' = 5$ ksi and $f_y = 60$ ksi. 8.0



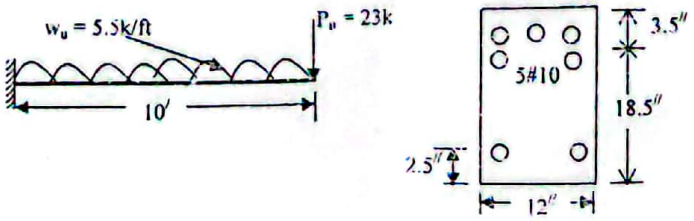
Q.3(a) What is balanced steel ratio? Derive the expression for balanced steel ratio in a beam in USD. 4.0

(b) A floor slab 4″ thick is supported by RC beams 11′ c/c as shown in figure. The slab supports a service live load of 180psf and a superimposed dead load of 60psf. Design the beam A considering a 25′ simple span. Assume $f_c' = 3$ ksi, $f_y = 60$ ksi and follow WSD method. 8.0



Q.4(a) Explain why the strength reduction factor φ for shear is less than that for flexure. 3.0

(b) Design the cantilever beam for shear considering $f_c' = 4$ ksi and $f_y = 60$ ksi. 9.0



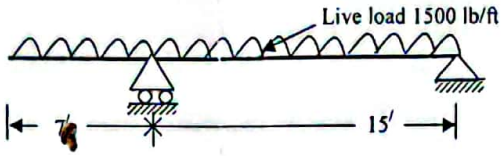
SECTION-B

Q.5(a) What is shrinkage reinforcement? Why and where are these reinforcements provided? 3.0

(b) Design a continuous one-way slab for a clear span of 13ft to support a live load of 20 psf. 9.0
Use $f_c' = 4000$ psi and $f_y = 60{,}000$psi. Beam width is 12 in.

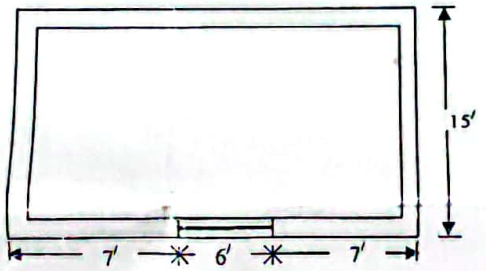
Q.6(a) Define factor of safety. Why do you consider it for the structural design of reinforced concrete member? 3.00

(b) The overhanging beam shown in the figure is subjected to a uniform live load 1500lb/ft. Design the beam by WSD method for flexure if $f_c' = 3000$ psi and $f_s = 20{,}000$psi. 9.00

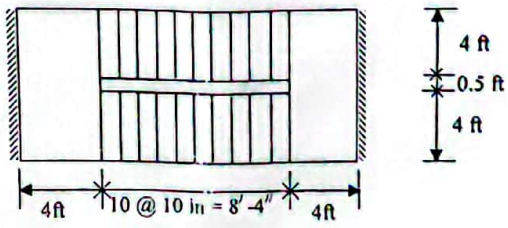


Q.7(a) Explain the behavior of a diagonally cracked beam. 2.0

(b) Design a lintel over a window opening of 6ft as shown in figure below. Assume (i) width of wall = 10inch (ii) height of wall above opening = 4ft (iii) thickness of slab = 4inch (iv) live load on slab = 50psf (v) $f_c' = 2{,}500$ psi and (vi) $f_y = 40{,}000$psi. 10.0



Q.8 Design the stair shown in figure below for a live of 100 psf. Assume rise = 6 inch, tread = 10″, $f_c' = 3{,}000$ psi and $f_y = 60{,}000$ psi. 12.0



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DEPARTMET OF CIVIL ENGINEERING

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering THIRD Year ODD SEMESTER Examination, 2019

CE 3141

Environmental 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) Write down the consideration for designing and locating intake. 4.0

(b) Discuss about the different types of intake based on source of surface water. 4.0

(c) Design a pumping unit capable of lifting 5mgd of water from an intake well to the treatment plant against a static head of 60ft, length of suction main is 120ft and that of rising main is 400ft. The pump will work in two shifts of 8 hours each. Assume velocity of flow is 6fps, friction factor is 0.01 and efficiency is 75%. 4.0

Q.2(a) What is corrosion? Describe the causes of corrosion of metal pipe in water supply line. 4.0

(b) What are the forces acting on pressure pipe in water supply system? Discuss elaborately. 4.0

(c) A tube well having diameter of 20cm taps an artesian aquifer of thickness 25m. If drawdown is 4.5m with radius of zone of influence is 300m and permeability is $40m^3$/unit area per day, calculate the yield of tube well in liters per hour. What variation will take place for drawdown if zone of influence is restricted to 200m for two times of yield? 4.0

Q.3(a) Write down the necessity of community participation in development project. 4.0

(b) Differentiate between women empowerment and gender issues. 4.0

(c) A water treatment plant consumes ferrous sulphate ($FeSO_4$) and lime as coagulant at the rate of 10mg of $FeSO_4$ per liter of water. Find out the quantities of $FeSO_4$ and lime required to treat 9 million liters of water. 4.0

Q.4 (a) Write down the principle of coagulation flocculation process. What are the factors that influence coagulation? 4.0

(b) Discuss the theory of filtration. 4.0

(c) Determine the clear water head loss in a filter bed that consists of two layers of filter media; a uniform anthracite layer of depth of 0.6m with an average particle size of 1.6mm and a specific gravity of 1.5; the other layer is composed of uniform sand 40cm deep with an average particle size of 0.6mm and the specific gravity of 2.0; for a rate of filtration of 150 l/m^2/min. The operating temperature was found to be 15°C and the porosity is 0.35. Use Rose equation for evaluating the clear water head loss. 4.0

SECTION B

Q.5 (a) What do you mean by fire demand? Describe a fire hydrant with neat sketch. 4.0

(b) Draw a typical chlorination curve and explain the reaction zones. 4.0

(c) Find out the settling velocity of spherical discrete particles 0.05mm in diameter having specific gravity of 2.6 and kinematic viscosity at 20°C of 1.003 x $10^{-6}m^2/s$. 4.0

Q.6(a) What are the permanent hardness and temporary hardness of water? Discuss the removal techniques of them. 4.5

(b) Write down the Bangladesh Standard and WHO guidelines with respect to the following impurities: i) Hardness ii) Iron iii) Arsenic iv) TDS v) pH and vi) Color 3.0

(c) Determine the unavoidable annual real losses of a water supply system of 2km water main having 3km underground connection pipe for 60,000 house connections. The average operating pressure is 20m. 4.5

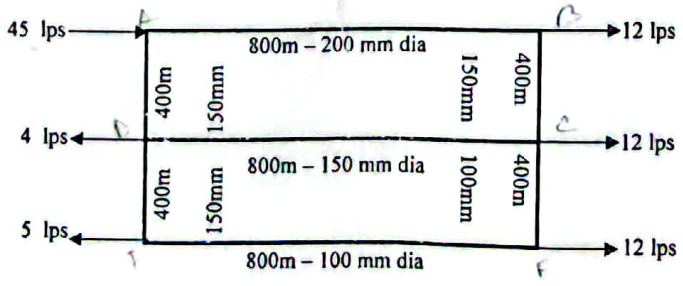
Q.7 (a) Deduce an expression for yield of a well for artesian aquifer. 3.5

(b) Write short notes on i) Infiltration gallery (ii) Infiltration well (iii) Spring 4.5

(c) Design a strainer for a 30mm diameter tubewell to be operated by a No.6 handpump at the rate of 25lpm. A slot No. 12 strainer having 50% open area is to be used. The entrance velocity should not exceed 0.015m/sec. 4.0

Q.8(a) Why is No.6 handpump tubewell the most popular in Bangladesh? Draw the sectional elevation of a No.6 handpump and level the different components of it. 4.0

(b) Find out the approximate flow in the pipe network by using Hardy Cross method shown in figure below. 8.0



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RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering **THIRD** Year **ODD SEMESTER** Examination, **2019**

CE 3131

Geotechnical Engineering -I

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

N.B.:-
(i) Answer any **SIX** questions, taking **THREE** from each section.
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SECTION-A

Q.1 (a) Define "Grain size distribution curve". Draw a typical grain size distribution curve and write the uses of it. 3.0

(b) What is soil structure? Discuss with neat sketches the structures that obtained in cohesive soil. 4.0

(c) The results of two drained triaxial tests on a saturated clay are given below: 5.0

Test-I Cell pressure, σ_3 = 100 kPa; Deviator stress at failure, σ_d = 215 kPa

Test-II Cell pressure, σ_3 = 200 kPa; Deviator stress at failure, σ_d = 260 kPa

Calculate the shear strength parameters of the soil.

Q.2(a) Define "compaction" and distinguish between "standard proctor compaction test" and "modified proctor compaction test" of soil. 4.0

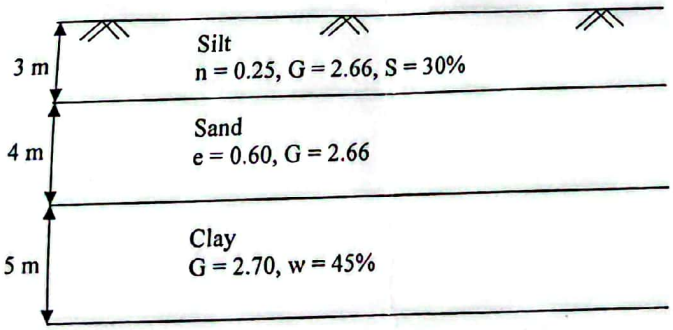
(b) Draw a typical compaction test result curve of a soil and explain it. 4.0

(c) A laboratory compaction test on soil having specific gravity equal to 2.66 gave a maximum dry density of 1.80 g/cm^3 for a water content of 15%. Determine the degree of saturation and percentage air voids at the maximum dry density. 4.0

Q.3(a) Define the following terms: (i) Relative compaction (ii) Relative density (iii) In-situ density (iv) Bulk density. 4.0

(b) What laboratory test would you do to determine the following parameters? Explain with graph. (i) Shear strength parameters – c & φ (ii) Compaction parameters – ρ_{max} & OMC (iii) Effective size of particle, D_{10}. 4.0

(c) A soil profile is shown in figure below. Determine the total pressure, effective pressure and pore water pressure, and draw the pressure diagram. 4.0



Q.4 (a) Define flow nets. What are the properties of flow nets. Draw a typical flow net. 3.0

(b) Derive the basic differential equation of Terzaghi's consolidation theory. 4.0

(c) Laboratory tests on a 25 mm thick clay specimen drained at both the top and the bottom, show that 50% consolidation takes place in 10 min. How long will it take for a similar clay layer in the field, 4 m thick and drained at the top only, to undergo 50% consolidation? 5.0

SECTION B

Q.5 (a) One of the important elements in soil classification is the Atterberg Limit. With assistant of a sketch, define the terms liquid limit, plastic limit and plasticity index. 4.0

(b) In a few sentences, and perhaps with a diagram, explain the physical meaning of effective stresses in soil. 4.0

(c) A sandy clay was compacted to bulk unit weight of 18.6 kN/m^3 and water content of 14.5%. Specific gravity of soil grains was 2.66. What is the air content of the compacted soil? Was the clay compacted to the dry of optimum or wet of optimum? Why? 4.0

Q.6(a) Describe the types of soil according to their formation and deposition. 4.0

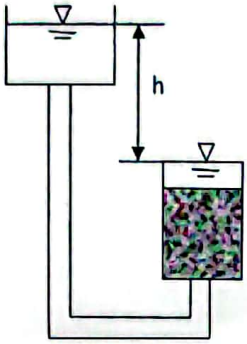
(b) Explain the clay minerals; Kaolinite and Montmorillonite. 4.0

(c) Derive the formula between soil moisture content, degree of saturation, specific gravity and void ratio. 4.0

Q.7 (a) Sketch neatly the Casagrande's plasticity chart indicating various aspects. How would you use it in classifying the fine grained soil? Give a couple of examples. 3.0

(b) State the various classification systems of soils for general engineering purposes. Briefly explain the USCS. 4.0

(c) Water flows through a silty sand sample as shown, where the water level is maintained constant on both sides. 5.0



Length of the sample = 20 cm
Diameter of sample = 10 cm
Void ratio = 0.78
Specific gravity = 2.66

When h = 10 cm, 120 ml of water flows through the sample in 30 minutes. What is the permeability of silty sand sample?

Q.8(a) Explain the meaning of the term 'seepage pressure'. Show how the effective pressure is altered when water is flowing through the soil vertically downwards and vertically upwards. 6.0

(b) With reference to figure below (i) plot the variation of elevation head, pressure head, and total head for the soil profile. (ii) determine the average Darcy seepage velocity across clay 1 and 2. 6.0