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10CV61

Sixth Semester B.E. Degree Examination, June/July 2018
Environmental Engineering – I

Time: 3 hrs.

Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting*
at least TWO questions from each part.
2. *Assume any missing data suitably.*

PART – A

1 a. Explain the importance and necessity for protected water supply. **(05 Marks)**
   b. Discuss the various types of water demand. **(05 Marks)**
   c. List various methods of population forecasting. Estimate the population expected at the end of 3 decades using the following population statistics by:
      (i)   Arithmetical increase method.
      (ii) Geometrical increase method. **(10 Marks)**

Year	1970	1980	1990	2000	2010
Populations	1,25,000	1,80,000	2,50,000	3,10,000	3,77,000

2 a. Briefly discuss different types of sources of water with respect to quality and quantity. **(06 Marks)**
   b. What are intake works and their types and factors affecting the selection and location of a suitable site for intake works construction? **(06 Marks)**
   c. A town with a prospective population of 1 lakh is to be supplied with water from a river, 3 km away and 25 m below the level of the water works. Design the economical section of the rising main and pumping unit when electricity is available. Rate of water supply is 140 lit/head/day, friction coefficient 0.01, efficiency of the pumping unit = 0.75. Pumping is done for 18 hrs/day. **(08 Marks)**

3 a. Write a note on:
      (i)   Water quality management.
      (ii) Water borne diseases.
      (iii) Sampling of water for examination.
      (iv) Physical, chemical and microbiological quality parameters. **(16 Marks)**
   b. Indicate the maximum permissible limits of the following in drinking water:
      (i)   Turbility
      (ii) Fluorides.
      (iii) Chlorides.
      (iv) Nitrates. **(04 Marks)**

4 a. Draw a typical layout of a water treatment plant and mention the function of each unit of the plant. **(08 Marks)**
   b. What is aeration and its objectives in the water treatment? **(04 Marks)**
   c. What is coagulation? Design a circular settling tanks for a city of population of 2 lakhs and supplying water at the rate of 150 lpcd. The detention period is 3 hours. If the alum is used as coagulant at the rate of 1.5 mg/l, calculate the monthly requirement of alum. **(08 Marks)**

PART – B

5   a. Explain the theory of filterations. **(04 Marks)**
    b. Compare slow sand filters with rapid sand filters. **(08 Marks)**
    c. Design a set of eight slow sand filter beds for a town of 1.0 lakhs; per capita water demand = 135 lpcd. Rate of filteration is 200 lit/hour/m². Assume maximum demand as 1.5 times the average demand. Out of eight units are unit is standby. Sketch your design. **(08 Marks)**

6   a. What is disinfection of water? Briefly explain different methods of disinfecting water. **(08 Marks)**
    b. For disinfecting 10 million litres of water per day, bleaching powder containing 25% available chlorine is used. Chlorine demand of water is 1.2 mg/l and a residual chlorine of 0.2 mg/l should be maintained. Calculate the monthly requirement of bleaching powder. **(04 Marks)**
    c. Give a comparison of lime soda process and zeolite process of softening of water. **(08 Marks)**

7   a. Briefly explain Fluoridation and DeFluoridation of water with any one method of Defluoridation. **(08 Marks)**
    b. Discuss the various methods of distribution systems of water? With their merits and demerits. **(12 Marks)**

8   Write a note on any four of the following:
    a. Fire Hydrants.
    b. Types of valves used in water supply.
    c. Layout of water supply in buildings.
    d. Break point and chlorination.
    e. Operation troubles in filters. **(20 Marks)**

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Sixth Semester B.E. Degree Examination, June/July 2018
Design and Drawing of RCC Structures

Time: 4 hrs.

Max. Marks:100

Note: *1. Answer any TWO full questions form Part – A*
ONE full question from Part –B.
2. Use of IS : 456 – 2000 and SP – 16 is permitted.

PART – A

1   A square RCC column and footing has the following details :
   Column size   = 300×300 mm
   Size of footing   = 1.5 M × 1.5 M, thickness of footing 450mm near column face
                            and tapered to 200mm near the edges
   Depth of foundation below ground level = 1M
   Height of column to be shown above ground level = 1M
   Column reinforcement   = 8 numbers of 16mm ϕ as main bars with 8mm ϕ@ 150mm
                            c/c lateral ties
   Footing reinforcement   = 12 mm ϕ @ 150mm c/c on both ways
   Draw to a suitable scale, the following :
  a. Sectional plan of column and footing
  b. Sectional elevation of column and footing.   **(20 Marks)**

2   A rectangular beam of size 230mm × 500mm is continuous over number of columns spaced at 4.5 M c/c. The width of column is 300 mm main reinforcement:
   @ mid span of +ve steel $\rightarrow$ 4 # 20
   @ support of –ve steel $\rightarrow$ 4 # 20
   Shear reinforcement : 2L 8 mm ϕ vertical stirupps @ 140mm c/c
   Draw to a suitable scale, the following :
  a. Longitudinal sectional elevation of beam
  b. Cross section of beam @ mid span and end section.   **(20 Marks)**

3   A RCC doglegged staircase has the following details :
   Staircase bars size (clear) = 5m × 2.5m
   Floor to floor height   = 3.15m
   Rise   = 150mm
   Tread   = 250mm
   Waist slab thickness   = 150mm
   Width of staircase   = 1.2m
   Bearing   = 230mm
   Main steel   = 12mm ϕ @ 150 mm c/c
   Dist. Steel   = 10 mm ϕ @ 180 mm c/c
   Two landing beams of size 230mm × 250mm are provided with 2# 12mm ϕ steel @ top and bottom, stirupps : 8mm ϕ @ 200mm c/c.
   Draw to a suitable scale, the following :
  a. Plan
  b. Sectional elevation of two flights.   **(20 Marks)**

PART – B

4 Design a RCC cantilever retaining wall to retain the levelled earth embankment 5m high above the ground level. The unit weight of earth is 16 kN/m^3 and its angle of repose is 30°. The S.B.C of soil is 145 kN/m^2. The co-efficient of friction between soil and concrete is 0.55. Use M20 grade of concrete and steel grade Fe415. **(40 Marks)**
Draw the following to a suitable scale :
  a. Sectional elevation of retaining wall showing the details of steel in stem, and base slab. **(10 Marks)**
  b. Longitudinal section for 2m showing reinforcement of stem and base slab. **(06 Marks)**
  c. Plan of base slab through center showing all reinforcements. **(04 Marks)**

5 Design combined footing for two RCC columns A and B, separated by a distance of 4m c/c column A is 500mm × 500mm and carries a load of 1250 kN and column B is 600mm × 600mm and carrier a load of 1600 kN. Take S.B.C of soil as 200 kN/m^2. Use M20 grade concrete and Fe415 steel. **(40 Marks)**
Draw the following to a suitable scale :
  a. Sectional elevation **(10 Marks)**
  b. Plan of bottom and top reinforcement **(05 Marks)**
  c. c/s at two different places to show the maximum details of reinforcement. **(05 Marks)**

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Sixth Semester B.E. Degree Examination, June/July 2018
Transportation Engineering - II

Time: 3 hrs.   Max. Marks:100

Note:1. *Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. *Draw neat sketches wherever required.*
3. *Assume any missing data suitably.*

PART – A

1   a. Discuss the factors governing the choice of gauge for a railway track.   **(06 Marks)**
    b. List the requirements of an ideal rail joint.   **(06 Marks)**
    c. Draw the cross section of double line BG track in cutting (straight stretch).   **(08 Marks)**

2   a. Explain the functions of sleepers.   **(06 Marks)**
    b. List the requirements of a good ballast.   **(06 Marks)**
    c. Calculate the maximum train load that a BG locomotive with 4 pairs of driving wheels with axle load of 20 tonnes each, can hour along a straight level track at a speed of 80 kmph. Calculate the reduction in speed on an upgradient of 1 in 50. What would be the further reduction in speed along of 3^0 curve on the upgradient.   **(08 Marks)**

3   a. Discuss the classification of gradients on Indian Railways indicating the adopted values.   **(06 Marks)**
    b. Calculate the maximum permissible speed on a 3^0 BG track if the length of transition curve is 60m and super elevation is 7cm. The maximum values of cant deficiency and speed likely to be sanctioned are 6cm and 70 kmph respectively.   **(06 Marks)**
    c. On a BG track, a 6^0 cure diverger in an opposite direction from a 3^0 main curve. Calculate the allowable speed on the branch line, if the permissible speed on the main line is 65 kmph.   **(08 Marks)**

4   a. Draw a neat line diagram of a left hand turnout showing all the components.   **(06 Marks)**
    b. Calculate the elements of a BG turnout of heel divergence is 11.43 cm. Number of crossing is 16 and angle of switch is $1^08' 0''$. Straight arm distance is 0.9m.   **(06 Marks)**
    c. Explain the working procedure of automatic block system of controlling the movement of train.   **(08 Marks)**

PART – B

5   a. List the factors to be considered for an airport site selection. What is a preferential runway?   **(06 Marks)**
    b. Discuss the functions of the components of an airport.   **(06 Marks)**
    c. Determine the best direction for orienting the runway for the wind data given. If the permitted deviation of wind from the direction of landing and take – off is $33^0.75$. Determine the percentage of time in a year during which the runway can be used. **(08 Marks)**

Wind direction	Duration percent	Wind direction	Duration percent	Wind direction	Duration percent	Wind direction	Duration percent
N	7.3	E	5.7	S	7.4	W	3.9
NNE	8.9	ESE	1.7	SSW	5.9	WNW	1.7
NE	14.6	SE	0.6	SW	10.5	NW	1.2
ENE	10.3	SSE	0.4	WSW	8.3	NNW	0.5

6 a. List the assumed conditions under which basic runway length is determined. Sketch and explain the normal take – off case of determining the basic runway length. **(06 Marks)**

b. An airport is planned at an elevation of 380m above MSL. The monthly mean of average and maximum daily temperature for the hottest month of the year are 28^0C and 40^0C respectively. The effective gradient is 0.178 percent. Determine the length of runway required if the basic runway length is 1900m. **(06 Marks)**

c. Explain the flight procedure in an I LS with the help of a schematic diagram. **(08 Marks)**

7 a. List the advantages of tunnels over open cuts **(06 Marks)**

b. Discuss the features and suitability of the different shapes adopted for tunnel cross - section. **(06 Marks)**

c. Discuss the three methods of mechanical ventilation. **(08 Marks)**

8 a. Tabulate the comparisons between mound type and wall type breakwater. **(06 Marks)**

b. Enumerate the forces acting on a graving dock. **(06 Marks)**

c. Draw a neat layout of an artificial harbor and list the functions of the components. **(08 Marks)**

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Sixth Semester B.E. Degree Examination, June/July 2018
Geo – Technical Engineering - II

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Define Representative and Undisturbed samples. Also explain area ratio with its recommended values. **(06 Marks)**
   b. What are the objectives of soil exploration? List and explain any one indirect method of soil exploration. **(08 Marks)**
   c. Estimate the position of ground water table from the following data obtained from the field. Depth upto which water is boiled out is 10.67m. Rise in water levels :
   On first day 64cm , Second day 57.9cm and Third day 51.8cm. **(06 Marks)**

2 a. Write a note on : i) Isobar   ii) Contact pressure   iii) Newmark's chart. **(09 Marks)**
   b. Differentiate between Boussenesq's and Westergards theory of stresses in soils. **(04 Marks)**
   c. Plot the vertical pressure at a point center 1m, 2m 4m horizontally away from the axis of loading at a depth of 3m, for a point load of 25kN. Use Boussinesq's equation. **(07 Marks)**

3 a. What is Flownet? List the characteristics and use of flownets. **(06 Marks)**
   b. For a homogeneous earthen dam 52m height and 2m free board. The flownet has 22 potential lines and 5 flow channels. Calculate discharge per meter length of dam. The coefficient of permeability in X and Y directions are 8×10^{-5} m/s and 3.6×10^{-5} m/s respectively for earthen embankment. **(04 Marks)**
   c. An earthen dam has the following details. Top width 8m upstream slope 2.75H:1V and downstream slope 2.5 H:1V. Total height of dam 60m. The height of water stored 57.5m. Downstream filter 120m long. K for dam material 4×10^{-7} m/sec. Draw the phonetic line and calculate the discharge through the dam. **(10 Marks)**

4 a. List the assumptions made in Rankine's earth pressure theory and explain active earth pressure and passive earth pressure. **(06 Marks)**
   b. Explain Cullman's graphical method of finding out the active earth pressure. **(06 Marks)**
   c. For retaining wall 8m height supports sandy back fill with e = 0.6 , G = 2.65 , $\phi = 30^0$. Water table is at a depth of 2m from ground surface. Draw active earth pressure diagram and find magnitude and point of application of total earth pressure. Assume soil above water table has a degree of saturation of 50%. **(08 Marks)**

PART – B

5 a. Define Finite Slope. What are the causes for failure of slopes? List various types of failure of slopes with sketches. **(06 Marks)**
   b. Explain the method of slice to determine the factor of safety against failure of finite slope. **(08 Marks)**
   c. An embankment is to be constructed with C = 20kN/m^2 , $\phi = 20^0$, $\gamma = 18$kN/m^3 , Fs = 1.25 and H = 10m. Estimate side slope required. Taylor's stability numbers are as follows for the slope number. **(06 Marks)**

Slope angle	60^0	45^0	30^0	20^0
Sn	0.097	0.062	0.025	0.005

Also determine factor of safety if side slope changes to IV : 2H.

6 a. Write a note on : i) General shear failure ii) Local shear failure iii) Effect of water table on bearing capacity. **(09 Marks)**

b. What are the assumptions made on Terzaghis theory? Write the expressions for ultimate bearing capacity of strip footing, square and circular footing. **(05 Marks)**

c. Compute the safe bearing capacity of a square footing 1.5m × 1.5m located at a depth of 1m below the ground level in a sandy soil of average density 20kN/m³ , $\phi = 20^0$, $N_c = 17.7$, $N_q = 7.4$, $\gamma = 5$. Take factor of safety = 3 and that the water table is very deep. Also compute the reduction in safe bearing capacity of the footing if the water table rise to the ground level. **(06 Marks)**

7 a. What is the importance of settlement analysis? List remedial measures to be taken against harmful settlement. **(06 Marks)**

b. Estimate the immediate settlement of a footing of size 2 × 3m resting at a depth of 1.5m in a sandy soil whose compression modulus is 10N/mm². Footing transmits a pressure of 200kN/m². Take $\mu = 0.3$ and influence factor as 1.06. **(06 Marks)**

c. A soft normally consolidated clay layer is 18m thick. The natural water content is 45%. The saturated unit weight is 18kN/m³ ; The grain specific gravity is 2.70 and liquid limit is 63%. The vertical stress increment at the centre of the layer due to the foundation load is 9kN/m². The ground water level is at the surface of the clay layer. Determine the settlement of the foundation. **(08 Marks)**

8 a. What are the different types of foundation? And list the factors influencing the choice of foundation. **(08 Marks)**

b. Enumerate the factors influencing the selection of depth of foundation. **(06 Marks)**

c. With a neat sketch, explain the types of piles classified based on its function. **(06 Marks)**

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Sixth Semester B.E. Degree Examination, June/July 2018
Hydraulic Structures and Irrigation-Design Drawing

Time: 4 hrs.   Max. Marks:100

Note: *Answer any TWO full questions from Part-A and ONE question from Part-B.*

PART – A

1   a.   Explain the storage zones of a reservoir. **(04 Marks)**
    b.   Define the terms:
       (i) Density current   (ii) Trap efficiency **(04 Marks)**
    c.   The monthly yield of water from a catchment is given below. Assuming uniform rate of flow, estimate the reservoir capacity by mass curve method.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inflow Volume (Mm^3)	1.4	2.1	2.8	8.4	11.9	11.9	7.7	2.8	2.52	2.24	1.91	1.68

(07 Marks)

2   a.   Explain the various forces acting on a gravity dam. **(07 Marks)**
    b.   The stability analysis of a gravity dam gave the following data:
       (i) Over turning moment = 10^8 kN-m
       (ii) Resisting moment = $2*10^8$ kN-m
       (iii) Total vertical force above the base = $5*10^6$ kN
       (iv) Base width = 50 m
       (v) D/s side slope (ϕ) = 0.8H : 1V
    Calculate the vertical stresses on the foundation and maximum vertical principal stresses at the tow assuming no tail water. **(08 Marks)**

3   a.   Explain the design criteria for earthen dams. **(07 Marks)**
    b.   With a neat sketch, explain Casagrande's method of determining the phreatic line through homogenous earthen dams provided with horizontal filter. **(08 Marks)**

PART – B

4   Design a sluice taking off from a tank irrigating 200 hectares at 1000 duty. The tank bund through which the sluice is talking off has a top width of 2 meter with 2:1 side slopes. The top level of the bank is +40.00 and the ground level at site is +34.50. Good hard soil for foundation is available at +33.50.

    The sill of the sluice at off take is +34.00 and the maximum water level is +38.00. The full tank level is at +37.00. Average low water level is +35.00.

    Details of the channel below the sluice are:
    Bed level = +34.00, FSL = +34.50
    Bed width = 1.25 m
    Side slope 1.5 : 1 with top of the bank at +35.00 **(25 Marks)**
    Draw to suitable scale:
    (i) Half plan at top and half plan at foundation. **(20 Marks)**
    (ii) Sectional elevation **(15 Marks)**
    (iii) Side elevation. **(10 Marks)**

5   Design a canal drop of 2m from the following data:

Hydraulic particulars	Upstream	Down stream
· Full Supply discharge	4 m³/sec	4 m³/sec
· Bed width	6 m	6 m
· Bed level	+10.00	+8.00
· Full Supply depth	1.50m	1.50m
· Full Supply level	+11.50	+9.50
· Top of bank	+12.50	+10.50
· Width of Bank	2.00 m	2.00 m

· Half supply depth = 1.00 m
· Ground level at site = +10.50 m
· Hard rock level (HRL) = +8.50 m   **(25 Marks)**
Draw :
(i)   Half plan at top and half plan at foundation   **(20 Marks)**
(ii) Sectional elevation   **(15 Marks)**
(iii) Half sectional side elevation   **(10 Marks)**

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Sixth Semester B.E. Degree Examination, June/July 2018
Rural Water Supply and Sanitation

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1   a. Discuss the investigation for selection of water sources for Rural Water Supply. **(06 Marks)**
    b. List the water borne diseases and their controlling measures. **(08 Marks)**
    c. Discuss the health significance and desirable permissible limits of the following parameters
        i) Fluoride   ii) Nitrate   iii) Sulphate   iv) Chloride. **(06 Marks)**

2   a. Define disinfection. Explain the various methods of disinfection. **(10 Marks)**
    b. Mention the various methods of defluoridation and explain any two methods. **(06 Marks)**
    c. Explain the sources of Ground water contamination. **(04 Marks)**

3   a. Explain the following : i) Two pit Latrines   ii) Aqua privy. **(10 Marks)**
    b. Design a septic tank for the following data :
        i)   No. of people = 100   ii)   Sewage/Capita/day = 120 litres.
        iii) Desludging period = 1 year   iv)   Length to width ratio of septic tank = 4:1.
        v)   Detention period = 24 hours   vi)   Rate of sludge deposited = 30 litres/capita/day.
        vii) Depth of septic tank = 1.5m
        viii) Per colation rate = 1250 ℓ/m^3/day   ix)   Depth of soak pit = 2m.
        What would be the size of soak well? **(10 Marks)**

4   Write short notes on :
    a. Storm water and sullage disposal.
    b. Rain water harvesting.
    c. Public Latrine.
    d. Composting. **(20 Marks)**

PART – B

5   a. Explain different methods of communication of communicable diseases with examples. **(10 Marks)**
    b. Define the communicable diseases and explain the general methods of control of communicable diseases. **(10 Marks)**

6   a. Explain the following terms :
        i) Refuse   ii) Garbage   iii) Rubbish   iv) Ashes. **(08 Marks)**
    b. Describe the following methods of disposal :
        i) Dumping   ii) Land filling   iii) Salvaging. **(06 Marks)**
    c. Explain with sketch, bio – gas plant. **(06 Marks)**

7   a. Explain all the essentials necessary to obtain the objectives of milk sanitation. **(08 Marks)**
    b. Describe the important points to be considered for planning the construction of a cow shed. **(04 Marks)**
    c. Discuss the milk pasteurization. **(08 Marks)**

8   a. Explain the life cycle of a House fly. **(08 Marks)**
    b. Explain the various Fly control measures in detail. **(08 Marks)**
    c. Mention the diseases transmitted by the mosquito. **(04 Marks)**

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Sixth Semester B.E. Degree Examination, June/July 2018
Traffic Engineering

Time: 3 hrs.   Max. Marks:100

Note: *Answer FIVE full questions, selecting*
at least TWO questions from each part.

PART – A

1 a. Define traffic engineering. What are the objectives of traffic engineering? Also explain the scope of traffic engineering.   **(10 Marks)**
   b. Discuss the road user characteristics in detail.   **(10 Marks)**

2 a. What are the objectives of traffic volume studies?   **(05 Marks)**
   b. A vehicle was stopped in 1.8secs by fully applying the brakes and the skid marks measured 9.0m. Determine the average skid resistance.   **(05 Marks)**
   c. The table below summarises the field data obtained for spot speeds.

Speed Mid Class (Kmph)	25	35	45	55	65	75	85	95	105	115
No. of vehicles observed	7	20	35	52	63	40	27	13	6	3

   Plot the analysed data and obtain the following :
   i) Speed limit for traffic regulation
   ii) Speed for geometric design.   **(10 Marks)**

3 a. Explain the uses of i) Spot speed studies   ii) Speed and delay studies.   **(06 Marks)**
   b. Discuss the purpose of parking studies. Explain the various aspects to be investigated during parking studies.   **(08 Marks)**
   c. List the applications of O and D studies.   **(06 Marks)**

4 a. Define PCU. List the factors which affect the PCU values of different vehicle classes.
                                                                                   (06 Marks)
   b. Explain the various preventive measures to reduce accidents.   **(06 Marks)**
   c. A vehicle of weight 25 tonnes skids through a distance equal to 50m, before colliding with another parked vehicle of weight 2.5 tonnes. After collision both the vehicles skid through a distance equal to 13m before stopping if the coefficient of friction is 0.5, compute
      i)   Speed after collision
      ii) Speed at collision
      iii) Speed before collision.   **(08 Marks)**

PART – B

5 a. Describe the Green – shield model of traffic flow.   **(06 Marks)**
   b. The data given below shows the occupancy of parking spaces in a parking lot consisting of 50 spaces. The count was taken at 15 min intervals during the 4 hours on 6 week days. Find whether the number of vacant spaces during any count follows a Poisson's distribution.

Occupancy of parking spaces	50	49	48	47	46	45	44	43	42	41	≤ 40
Frequency	6	15	21	20	15	10	5	2	1	1	0

                                                                                   (10 Marks)
   c. Explain Goodness of fit test.   **(04 Marks)**

6 a. The spot speeds at a particular location are normally distributed with a mean of 51.7kmph and a standard deviation of 8.3kmph. What is the probability that
   i) Speed exceeds 65 kmph
   ii) Speed lies between 40 and 70 kmph.
   The values from normal distribution tables are
   ϕ (1.6) = 0.952, ϕ (2.21) = 0.9864
   ϕ (1.41) = 0.9207, ϕ (Z) = 0.85 for which Z = 1.04 **(10 Marks)**
   b. Explain briefly: i) Phases of traffic regulation   ii) Regulatory signs. **(10 Marks)**

7 a. List the advantages and disadvantages of traffic signals. **(06 Marks)**
   b. The average normal flow on cross – roads A and B during design period are 500 and 300 PCU per hour. The saturation flow values on these roads are estimated as 1300 and 1000 PCU per hour respectively. The all red time required for pedestrian crossing is 13 secs. Design two phase traffic signal by Webster's method. **(10 Marks)**
   c. Design a street lighting system for the following conditions. Lane width = 20m, mounting height = 7m, Lamp size = 8000 lumen, Luminance type = II. Assume coefficient of utilization as 0.44 and maintenance factor as 0.8. Calculate the spacing between lighting units to produce average Lux – 6.0 **(04 Marks)**

8 a. Define ITS. What are its applications in traffic engineering? **(06 Marks)**
   b. Enumerate the design factors and the advantages of a rotary. **(08 Marks)**
   c. Explain the various design factors in road lighting. **(06 Marks)**

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