**( 3 Hours )** **[ Total Marks : 80 ]**

**Notes :**

1. Question No **ONE** is **Compulsory**.
2. Answer any **THREE** from remaining.
3. Draw **FIGURES** wherever necessary. Figures to the right indicate full marks.
4. **WRITE** proper question / sub question numbers on the left margin allotted in answer sheet.
5. Each Question carries **EQUAL** marks.
6. **ASSUME** any additional data if necessary and state it clearly.

**1. Attempt (Any 4)**

**a)** Define SVI and its significance in the context of sewage treatment? **05**

**b)** The BOD of sewage for 5 days at 37°C is 360 ppm. What will be its BOD after 10 days at 20°C and 7 days at 30°C? Assume $K_D$ at 20°C as 0.1 **05**

**c)** What is the significance of the following from the point of water quality criteria also state the acceptable/desirable limit of each (IS 10500:2012) **05**
1) Fluorides 2) Hardness 3) Turbidity 4) Chlorides 5)MPN

**d)** Calculate the quantity of rain water harvested at Mumbai for a flat roof surface having tile finished area 200sqm. **05**
Given Data-Annual rain fall of Mumbai city 2147mm
Coefficient of roof surface=0.85
Runoff coefficient =0.80
Assume the required data.

**e)** Explain the 5R's of municipal solid waste management. **05**

**2. a)** Enumerate the various types of Intake structures and discuss in details any one of them. **10**

**b)** Design a sewer to serve a population of 32,000, the daily per capita water supply allowance being 150 litres of which 80 percent finds its way into the sewer. The slope available for the sewer to be laid is 1 in 625 and the sewer should be designed to carry four times the dry weather flow when running full. What would be the velocity of flow in the sewer when running full? **10**

**3. a)** Write the assumption for ideal sedimentation tank and prove with suitable derivation that the efficiency of sedimentation tank independent of depth of the tank. Explain the factors affecting sedimentation process. **10**

**b)** Design underdrainage system of Rapid sand filter beds having dimensions 7.4m x 4.2m. Assume data wherever necessary. **10**

**4.** **a)** What is activated sludge process? Explain the following terms **10**
1) Hydraulic retention time 2) Sludge Age 3) MLSS 4) SVI

**b)** Design high rate trickling filter for the following data. **10**
Sewage flow- 6 MLD
Recirculation ratio-1:5
$BOD_{5\ of}$ raw sewage- 300 mg/lit.
BOD removal in PST- 25%
Final effluent $BOD_5$ desired - 30mg/lit.

**5.** **a)** Design septic tank for the small colony of 150 persons. **10**
Given data
Sewage/capita/day=130lit
Desludging period=2 years
Length: width=3:1.
Explain any one method used for disposal of septic tank effluent.

**b)** What are the factors affecting for self- purification of polluted streams? Draw DO sag curve. What measures would you recommend to control stream pollution in India? **10**

**6.** **a)** 1)Differentiate one pipe and two pipe system of plumbing. **10**
2) Water softening Zeolite process

**b)** 1) Effects of Air Pollution on human health and the environment **10**
2)Break point Chlorination

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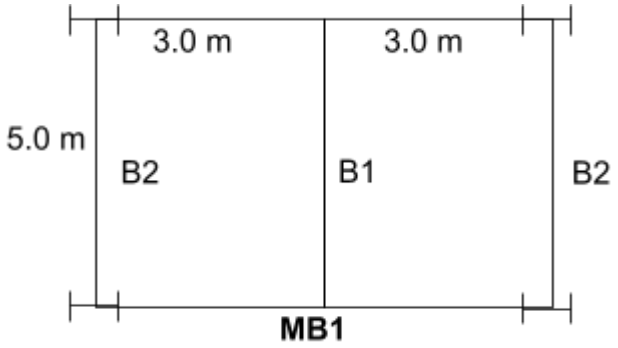
**(4 Hr)** **[Maximum Marks - 80]**

**N.B. 1.** Question **No. 01 is compulsory**,
attempt any **three** out of the remaining four questions.
**2.** Draw neat and proportionate **sketches** whenever necessary.
**3.** Use of **IS 800 and steel tables** is permitted.
**4.** Assume **suitable data** if necessary, and justify the same.
**5.** Use steel of **grade Fe410** and bolts of **grade 4.6.**

**Q.1 a** For the following flooring system, design laterally supported beams B1 and MB1 using appropriate ISMB sections, also design a beam-to-beam connections between them, assuming the top flange of the beam is embedded in the slab. Design flooring systems for the following data, **32**

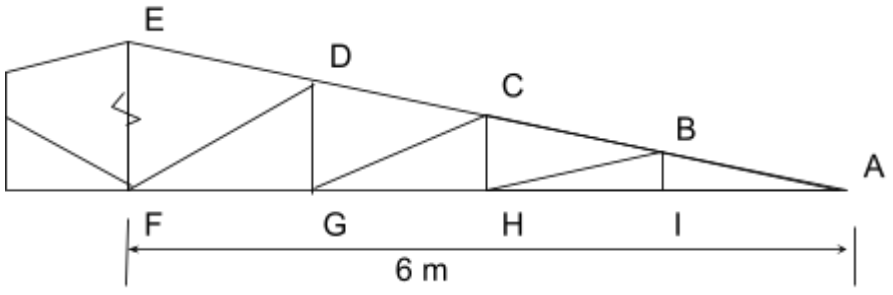
- The thickness of the Slab - is 150 mm
- The thickness of the wall - 200 mm.
- Height of wall over all beams - 1.2m
- Unit weight - (Concrete-25 kN/$m^3$ , Brick Wall - 20 kN/$m^3$ )
- All beams are laterally restrained.
- All columns are ISHB 350 @ 661.2 N/m




**OR**

**Q.1 b** Find the panel point load for a given roof truss for DL, LL, and WL and design members AB, AL, and BL. Considering the truss to be constructed in the industrial area of Bhopal. The angle at joint A is 20°. **32**
Assume $K_1$ = 1.0, $K_2$ = 0.98, $K_3$ = 1.0, and and ($C_{pe}$ - $C_{pi}$) = -0.3,

- Spacing between trusses - 5.0 m; the span of truss - 12.0 m
- wt of GI sheets - 180 N/$m^2$ .
- Self-weight of Purlin - 200 N/m, Assume suitable data.
- The Basic wind Speed of Bhopal 'Vb' = 39 m/s




**PTO**

**Q.2** **a)** A column ISHB 350 @ 661.2 N/m; carries a factored axial load of 1600 kN. Calculate the size and thickness for the bolted **gusseted base**, also calculate the number of bolts required if bolt diameter = 20 mm, assume M20 grade of concrete. *(Design of gusset base 08 marks, detailed drawing - 02 marks)* **10**

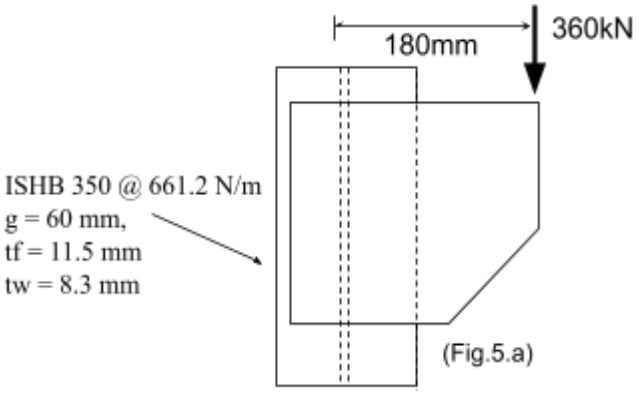
**b)** Determine the design capacity of the column section in kN for the section ISHB 350 @ 661.2 N/m, used as a column with an effective height 4.0 m. **06**

**Q.3** **a)** **Design a built-up column** with two channel sections that are placed face to face to support a factored axial compressive load of 1450 kN; if the effective length of the column is 4.2 m, design a suitable bolted laced connection, provide all checks, and draw a detailed diagram. *(Design of column 08 marks; detailed drawing - 02 marks)* **10**

**b)** A column consists of ISHB 350 @ 661.2 N/m carrying a factored load of 1100 kN. Design a **rectangular slab base**, considering the M15 concrete grade. Dont design connections. *(Design of base 04 marks, detailed drawing - 02 marks)* **06**

**Q.4** Design a simply supported welded plate girder for span 30 m which is subjected to a UDL of 80 kN/m over the span, excluding the self-weight of the plate girder. **i)** Design the cross-section and classify, **ii)** provide check for shear buckling **iii)** Provide check for design bending strength, **iv)** provide appropriate curtailment at 5m and 10m of span. The plate girder is laterally supported throughout without intermediate stiffeners. **16**

**Q.5** **a)** Design a bolted bracket connection with an eccentricity of 180 mm from the web of the column. The column is of ISHB 350 @ 661.2 N/m; and carries an end reaction of 360 kN due to factored load. The thickness of the bracket plate is 12 mm, and the diameter of the bolts is 24 mm. (Fig.5.a) **08**



(Fig.5.a)

**b)** Determine the design bending strength ($M_d$) of a beam ISLB 300 @ 369.7 N/m which is used as a laterally **unsupported beam** using IS 800:2007 table No. 13(a) & 14; the effective length of the beam is 4.8 m. also determine the amount of **UDL** that can be applied over the span safely. **08**

**END…**

**Time: 3 Hours** **Marks: 80**

**Note 1. Question 1 is compulsory**
**2. Attempt any Three out of five questions**
**3. Assume any suitable data where ever required**
**4. Figures to the right indicates full marks**

| | | | |
|---|---|---|---|
| **Q.1** | | Attempt All the questions | |
| | **a.** | Classify the Shear test based on Drainage condition | **05** |
| | **b.** | A soil mass is retained by a smooth vertical wall of 5m height. The soil has a bulk unit weight of 20 kN/m$^3$ and angle of internal friction is 160.The top of the soil is level with the top of wall. If the surface carries uniformly distributed load of 4.5 kN/m$^2$. Determine total passive thrust on the wall and point of application. | **05** |
| | **c.** | Explain initial, Primary and secondary consolidation | **05** |
| | **d.** | What is the method of Improving Stability of Slope. | **05** |
| **Q.2** | **a.** | A 4m square footing is located in dense sand at a depth of 2m determine safe bearing pressure when water table is located at base of footing Take unit weight of soils 18 kN/m$^3$, saturated unit weight 20 kN/m$^3$, Nc=37.2, Nq=22.5 and Nγ=19.7 use Terzaghi Equation | **05** |
| | **b.** | Differentiate Between Rankine's and Coulomb's earth pressure Theory | **05** |
| | **c.** | Direct shear test was conducted on sand gave a failure shear stress of 80 kN/m$^2$when Normal stress was 170 kN/m$^2$, Draw Mohr's Circle and Mohr's Envelope and Find Principal Stresses at failure and Orientation of principal Planes | **10** |
| **Q.3** | **a.** | A 5.5 m high retaining wall retains soil having angle of internal friction 300, unit weight of 18 kN/m$^3$ and cohesion 6 kN/m$^2$. Determine the Rankine active pressure on the wall before the formation of crack | **05** |
| | **b.** | Explain plate load test and highlights its limitation | **05** |
| | **c.** | A Circular foundation is to be designed for total load of 675kN, if the load is inclined at angle of 18º to the vertical. Determine the width of foundation take unit weight of soils is 19 kN/m$^3$, angle of internal friction is 30º, cohesion 10 kN/m$^2$ with FOS=3 and depth of foundation is 1.5m use Vesic equation | **10** |
| **Q.4** | **a.** | Define Compression index and Coefficient of volume change. in a consolidation test void ratio decreased from 0.60 to 0.50 when the load was changed from 60 kN/m$^2$ to 110 kN/m$^2$ compute Compression index and Coefficient of Volume change | **05** |
| | **b.** | Differentiate between general, local and punching shear failure | **05** |
| | **c.** | A retaining wall 7m high Retains sand with angle of internal friction is 30º and unit weight of 24 kN/m$^3$ up to depth of 3.5m from top, from 3.5m to 7m the material is cohesive soil with cohesion is 20 kN/m$^2$ and angle of internal friction 20º and unit weight of cohesive soil is 18 kN/m$^3$. A uniform Surcharge of 110 kN/m$^2$ acts on top of soil. Determine the total active thrust on the wall and point of application | **10** |

**Q.5** **a.** Explain briefly pile load test **05**

**b.** A concrete pile 400mm diameter is deep in dense sand for a depth of 10m estimate safe load for the pile. Consider the following properties for the sand angle of internal friction is 30º, unit weight is 16 kN/m$^3$, Coefficient of friction between sand and pile is 0.7 and coefficient of earth pressure is 1. Take FOS=2.5 **05**

**c** A compressible layer is expected to have total settlement of 16 cm under a given loading. It settles by 4 cm at the end of two months, After the application of load increment how many months will be required to reach settlements of 8.5 cm? what will be settlements in 20 months. Assume double drainage in all case **10**

**Q.6** **a.** What is the basis on which the dynamic formula is derived? Mention two well-known Dynamic formula and also explain symbol involved. **05**

**b.** A canal with depth of 5m has bank with slope 1:1, The properties of soil are cohesion = 20 kN/m$^2$, Void ratio 0.7, Specific gravity of soils 2.6 and angle of internal friction =15$^0$.Calculate factor of Safety with respect to cohesion When canal runs full **05**

**c.** A group of 16 pile arrange in a square pattern diameter of each pile is 600mm and center to center distance is 1.1m. The length of pile is 16m Estimate the safe load of the group pile as shown in figure with FOS =2.5 **10**

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**(3 HRS)** **(Total Marks 80)**

Note: - 1. Q.No.1 is compulsory.
2. Attempt any three questions out of remaining five questions.
3. Assume any data if required stating clearly

Q.1 (a) Define Irrigation and explain the necessity, benefits and Ill effects of irrigation in India **[5]**

(b) Explain the term Aquifer, Aquiclude, Aquitard,and Perched Aquifer. **[5]**

(c) Explain ill effects of water logging **[5]**

(d) Explain the term Base period, Duty & Delta. Derive the relation between them. **[5]**

(e) What is meant by cross drainage works? Explain any one. **[5]**

Q.2 (a) Explain the mass curve of demand and supply for reservoir. **[10]**

(b) Table below gives the necessary data about the crop, their duty and area under each crop, commended by a canal taking off from a storage tank. Taking a time factor for the canal to be 0.65 and capacity factor 0.8. Calculate the design discharge required at the head of the canal. **[10]**

| Crop | Base period ( days) | Duty at the field ( ha/cumec) | Area under each crop ( Ha) |
|---|---|---|---|
| wheat | 120 | 1800 | 4800 |
| suagarcane | 360 | 800 | 5600 |
| Cotton | 200 | 1400 | 2400 |
| rice | 120 | 900 | 3200 |
| vegetables | 120 | 700 | 1400 |

Q.3 (a) What is hydrograph? Draw a single peaked hydrograph and explain its components. **[10]**

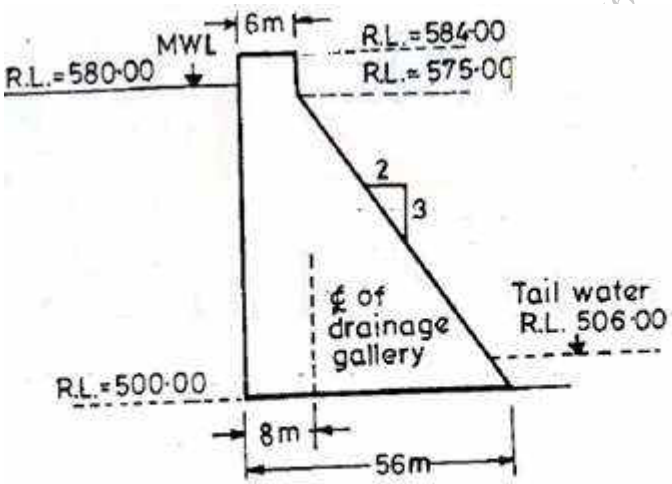
(b) Find out the ordinates of a storm hydrograph resulting from a 3 hour storm with rainfall of 3, 4.5, 1.5 cm during subsequent 3 hours intervals. The ordinates of unit hydrograph are given below in the table below: **[10]**

| Hours | 0 | 03 | 06 | 09 | 12 | 15 | 18 | 21 | 24 | 03 | 6 | 09 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ordinates UH ( cumecs | 0 | 90 | 200 | 350 | 450 | 350 | 260 | 190 | 130 | 80 | 10 | 20 | 0 |

Assume an initial loss of 5 mm, infiltration index of 5 mm / hour and base flow of 2 cumec.

Q.4 (a) Derive an expression for the steady state discharge of well fully penetrating into an unconfined aquifer. **[10]**

(b) Fig shows the section of gravity dam (non-overflow section) built of concrete. Calculate (neglecting earthquake effects). 1) The max vertical stress at heel & toe of the dam. 2) The major principal stress at toe of the dam. 3) Intensity of shear stress on horizontal plane. **[10]**




Q.5 (a) Design an irrigation channel in alluvial soil according to Laceys silt theory given following data: - slope of the channel = 1: 5000, lacey's silt factors = 0.9, Channel side slope – ½ : 1. **[10]**

(b) Explain in details modes of failures of Gravity dam **[10]**

Q.6 (a) What is Bhandara Irrigation? What are the advantages and disadvantages **[5]**

(b) Compare the Kennedy's theory and Lacey'stheory. **[5]**

(c) What is runoff? What are the factors that affect the runoff from a catchment area? **[5]**

(d) What is meant by Canal lining? What are its advantages and disadvantages? **[5]**

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**Time: 3 Hours** **Max. Marks: 80**

**N.B.:** **(1) Question No.1 is compulsory**
(2) Attempt any three from the remaining
(3) Draw neat sketches wherever essential
(4) Write answers in legible handwriting

Q. 1. Attempt **any four.** **(20)**

a) Define electrical energy and describe its expression.
b) Describe advantages and disadvantages of tidal energy.
c) Differentiate controlled and uncontrolled nuclear reactions.
d) Explain components and their functions of telecommunication tower.
e) What are the components of IT infrastructure?
f) What are the functions of smart grid components?

Q. 2. Attempt **any two.** **(20)**

a) Explain the functions with neat diagrams of ; i) Trash rack, ii) Surge tank, iii) Penstock, iv) Turbine and v) Draft tube.
b) Describe the components and their functions of tidal power plant.
c) State the functions of components of nuclear power plant with neat sketches.

Q. 3. Attempt **any two.** **(20)**

a) Describe factors to be considered in design of telecommunication tower.
b) Differentiate programme-controlled storage management and system-controlled storage management
c) Draw a neat and labelled diagram of electric power transmission and distribution system.

Q.4.a) Describe the types of electricity generation. **(05)**
b) Draw a neat and labelled sketch of tidal power plant. **(05)**
c) Differentiate nuclear fission and nuclear fusion. **(05)**
d) Classify telecommunication towers. **(05)**

Q.5. a) Define hydrograph and unit hydrograph. **(05)**
b) Describe factors affecting site selection of tidal power plant. **(05)**
c) Differentiate LAN and WAN. **(05)**
d) What are the merits of smart grid? **(05)**

Q. 6. Write short notes on **any four** of the following. **(20)**

a) Reduction of power loss
b) Anchor and mooring
c) Safety measures in nuclear power plant
d) Telecommunication signals.
e) Remote access.