

CEH583 - IRRIGATION AND WATER RESOURCE ENGINEERING

UNIT I: IRRIGATION AND ITS METHODS

Part-A Objective Questions (30)

1. The branch of engineering that deals with the artificial application of water to land for raising crops is called

- (A) Hydrology
- (B) Irrigation Engineering
- (C) Geotechnical Engineering
- (D) Environmental Engineering

Answer: B

2. In India, the largest irrigation potential has been created through

- (A) Tank irrigation
- (B) Canal irrigation
- (C) Well irrigation
- (D) Sprinkler irrigation

Answer: B

3. Protective irrigation aims at

- (A) Maximising the yield per hectare of a small area
- (B) Extending irrigation benefits to as large an area as possible
- (C) Storing maximum water in a reservoir
- (D) Reducing the cropped area

Answer: B

4. Productive irrigation aims at

- (A) Spreading water over the largest possible area
- (B) Obtaining maximum agricultural output from the available irrigated area
- (C) Preventing floods
- (D) Reducing crop water requirement

Answer: B

5. Which of the following is a gravity (flow) irrigation method?

- (A) Tube well irrigation
- (B) Canal irrigation from a weir
- (C) Pump irrigation from a river
- (D) Lift irrigation from a sump

Answer: B

6. Wild flooding is also known as

- (A) Border irrigation
- (B) Uncontrolled flooding
- (C) Basin irrigation
- (D) Furrow irrigation

Answer: B

7. Check basin method of irrigation is generally adopted for

- (A) Orchard crops
- (B) Row crops such as maize
- (C) Tea plantations on hill slopes
- (D) Lawns

Answer: A

8. Furrow irrigation is most suitable for

- (A) Paddy
- (B) Row crops such as cotton, sugarcane and maize
- (C) Grass lawns
- (D) Orchards only

Answer: B

9. In drip irrigation, water is applied to the plant

- (A) As a continuous sheet over the entire field
- (B) Drop by drop near the root zone through emitters
- (C) By flooding the whole basin
- (D) By overhead high pressure jets

Answer: B

10. Sprinkler irrigation is best suited to soils having

- (A) Very high water holding capacity and low infiltration
- (B) High infiltration rate, such as sandy soils
- (C) Heavy clay with poor drainage
- (D) Waterlogged conditions

Answer: B

11. A method of irrigation that closely simulates natural rainfall is

- (A) Basin irrigation
- (B) Sprinkler irrigation
- (C) Furrow irrigation
- (D) Free flooding

Answer: B

12. Which irrigation method causes least loss of water due to evaporation and deep percolation?

- (A) Basin flooding
- (B) Drip irrigation
- (C) Wild flooding
- (D) Furrow irrigation

Answer: B

13. Sub-surface irrigation is adopted mainly when

- (A) A permeable soil overlies an impervious sub-stratum at shallow depth with the water table maintained artificially
- (B) The land is highly undulating
- (C) The soil is rocky
- (D) The crop is paddy

Answer: A

14. Zig-zag method of irrigation is preferred where

- (A) The land is perfectly levelled
- (B) The ground has an uneven or irregular topography
- (C) The soil is very sandy
- (D) The crop is orchard trees only

Answer: B

15. One of the ill-effects of excessive canal irrigation without proper drainage is

- (A) Lowering of the water table
- (B) Water logging and soil salinity
- (C) Reduction in crop yield due to lack of water
- (D) Decrease in soil moisture

Answer: B

16. Command area development programme is mainly intended to bridge the gap between

- (A) Irrigation potential created and irrigation potential utilised
- (B) Rainfall and runoff
- (C) Duty and delta
- (D) Supply and demand of fertiliser

Answer: A

17. Irrigation is defined as the artificial application of water to soil for the purpose of

- (A) Drainage of excess water
- (B) Assisting crop production
- (C) Preventing soil erosion
- (D) Cooling the atmosphere

Answer: B

18. Which river basin is considered the largest source of irrigation water in India?

- (A) Krishna
- (B) Godavari
- (C) Ganga
- (D) Cauvery

Answer: C

19. Command area development mainly aims at

- (A) Reducing the area under cultivation
- (B) Optimum utilisation of available irrigation water
- (C) Increasing rainfall
- (D) Decreasing crop yield

Answer: B

20. An ill-effect of over-irrigation is

- (A) Improved soil fertility
- (B) Water logging and salinity
- (C) Increased crop yield always
- (D) Reduced seepage

Answer: B

21. Which of the following is NOT a benefit of irrigation?

- (A) Increase in crop yield
- (B) Insurance against drought

- (C) Rise of water table causing water logging
- (D) Improvement in cash crop cultivation

Answer: C

22. Perennial irrigation supplies water to crops

- (A) Only during floods
- (B) At regular intervals throughout the crop period
- (C) Only once a season
- (D) Only during monsoon

Answer: B

23. Flow irrigation refers to supply of water

- (A) By lifting water using pumps
- (B) By gravity flow from a higher level source
- (C) Only through tube wells
- (D) Only through tanks

Answer: B

24. Lift irrigation is generally adopted when

- (A) The source is at a higher elevation than the field
- (B) The source is at a lower elevation than the field
- (C) Rainfall is sufficient
- (D) Canals are available nearby

Answer: B

25. Uncontrolled flooding is a method in which

- (A) Water is confined to check basins
- (B) Water spreads over the field without any control by embankments
- (C) Water is applied through furrows
- (D) Water is applied through pipes

Answer: B

26. Border strip method of irrigation is best suited for

- (A) Steep and undulating land
- (B) Fairly leveled land with uniform slope
- (C) Waterlogged land
- (D) Rocky terrain

Answer: B

27. Basin flooding method is commonly used for irrigating

- (A) Orchards and fruit trees
- (B) Wheat only
- (C) Sugarcane rows
- (D) Vegetable seed beds

Answer: A

28. Check flooding differs from free flooding mainly because it

- (A) Uses no embankments at all
- (B) Confines water within small compartments formed by low levees
- (C) Is used only for sprinkler systems
- (D) Requires no water source

Answer: B

29. The furrow method of irrigation is best suited for

- (A) Row crops such as maize and cotton
- (B) Paddy fields
- (C) Lawns and turf
- (D) Forest plantations

Answer: A

30. Contour laterals are used in irrigation of

- (A) Flat plains
- (B) Hilly and undulating terrain
- (C) Deltaic regions
- (D) Coastal sandy soils

Answer: B

PART B (10- Marks)

1. Explain the necessity and benefits of irrigation in India, and discuss its ill-effects if not properly managed.
2. Describe any four surface methods of irrigation with neat sketches, stating the field conditions suitable for each.
3. Explain drip irrigation and sprinkler irrigation systems with sketches, and compare their advantages over surface irrigation.
4. Discuss command area development and the impact of irrigation on the environment.
5. Suggest a suitable irrigation method for a hilly region with undulating topography and sandy soil, and give reasons for your choice.

UNIT II: SOIL WATER PLANT RELATIONSHIP AND WATER REQUIREMENTS OF CROPS

Part-A Objective Questions (30)

1. The maximum quantity of water that a soil can retain against gravity is termed

- (A) Saturation capacity
- (B) Field capacity
- (C) Permanent wilting point
- (D) Specific yield

Answer: B

2. The moisture content of soil at which a plant permanently wilts and cannot recover even in a saturated atmosphere is called

- (A) Field capacity
- (B) Permanent wilting point
- (C) Optimum moisture content
- (D) Saturation point

Answer: B

3. Available moisture in the soil is given by the difference between

- (A) Saturation capacity and field capacity
- (B) Field capacity and permanent wilting point
- (C) Wilting point and saturation capacity
- (D) Infiltration rate and percolation rate

Answer: B

4. The area of land that can be irrigated with a unit discharge of water flowing continuously for the base period of a crop is called

- (A) Delta
- (B) Duty
- (C) Base period
- (D) Consumptive use

Answer: B

5. The total depth of water required by a crop during its complete growth period is termed

- (A) Duty
- (B) Delta
- (C) Base period
- (D) Field capacity

Answer: B

6. The relation between duty (D), delta (Δ) and base period (B) is expressed as

- (A) $\Delta = 8.64 B / D$
- (B) $D = 8.64 B / \Delta$
- (C) $B = 8.64 D / \Delta$
- (D) $\Delta = D / 8.64 B$

Answer: A

7. The duty of water is generally expressed at the

- (A) Head of the field only

- (B) Head of the watercourse, main canal or field, as specified
- (C) Reservoir outlet only
- (D) Tail end of the drain

Answer: B

8. Which of the following does NOT influence the duty of water?

- (A) Type of crop
- (B) Method of irrigation and canal transmission losses
- (C) Type of soil and climatic conditions
- (D) Colour of the canal lining

Answer: D

9. Kharif crops in Tamil Nadu are generally sown with the onset of the

- (A) North-east monsoon
- (B) South-west monsoon
- (C) Winter season
- (D) Summer season

Answer: B

10. Rabi crops are sown mainly during

- (A) The onset of monsoon
- (B) The winter season after the monsoon
- (C) Peak summer
- (D) Heavy flood periods

Answer: B

11. Consumptive use of water by a crop refers to

- (A) Water lost only by evaporation from the soil surface
- (B) Water used in transpiration by the plant plus evaporation from the adjoining soil
- (C) Water lost in canal seepage
- (D) Water stored in the reservoir

Answer: B

12. The overall efficiency of an irrigation system is the ratio of

- (A) Water stored in the root zone to water applied at the field
- (B) Water made use of by the crop to the water supplied at the head of the main canal
- (C) Length of canal to command area
- (D) Rainfall to runoff

Answer: B

13. If the base period of a crop is 120 days and the delta is 120 cm, the duty of water is

- (A) 72 hectares/cumec
- (B) 864 hectares/cumec
- (C) 8.64 hectares/cumec
- (D) 10.37 hectares/cumec

Answer: B

14. Growing different crops in a planned sequence on the same land to maintain soil fertility is known as

- (A) Crop rotation
- (B) Mixed cropping

- (C) Following
- (D) Command area development

Answer: A

15. As the efficiency of an irrigation system improves, the duty of water at the head of the system generally

- (A) Decreases
- (B) Increases
- (C) Remains unaffected
- (D) Becomes zero

Answer: B

16. The volume of water required per second to irrigate a crop continuously during its base period, expressed per unit area, is closely related to

- (A) Delta
- (B) Duty
- (C) Cropping pattern
- (D) Assessment of irrigation charges

Answer: B

17. Field capacity of soil refers to

- (A) Maximum water a soil can hold against gravity after free drainage
- (B) The water content at which plants permanently wilt
- (C) The total pore space of soil
- (D) The water lost by evaporation

Answer: A

18. Permanent wilting point is the soil moisture content at which

- (A) Plants can absorb water easily
- (B) Plants cannot extract water and wilt permanently
- (C) Soil becomes saturated
- (D) Infiltration rate is maximum

Answer: B

19. Available moisture for plant growth is the difference between

- (A) Saturation point and field capacity
- (B) Field capacity and permanent wilting point
- (C) Wilting point and saturation point
- (D) Infiltration rate and percolation rate

Answer: B

20. Infiltration is the process of

- (A) Water flowing over the ground surface as runoff
- (B) Water entering the soil surface and moving downward
- (C) Water evaporating from soil surface
- (D) Water being absorbed by plant roots only

Answer: B

21. Ultimate wilting point differs from permanent wilting point in that at ultimate wilting point

- (A) The plant recovers turgidity even in a saturated atmosphere
- (B) The plant fails to recover turgidity even in a saturated atmosphere

(C) Soil moisture is at field capacity

(D) Soil is fully saturated

Answer: B

22. Soil fertility mainly depends on

(A) Only mineral content of rock

(B) Physical, chemical and biological properties of the soil supporting plant nutrition

(C) Colour of the soil only

(D) Depth of ground water table only

Answer: B

23. Duty of water is defined as

(A) The volume of water required per second per hectare

(B) The area of crop that can be irrigated with a unit discharge of water flowing continuously during the base period

(C) The depth of water applied at each watering

(D) The total rainfall received during the crop period

Answer: B

24. Delta of a crop is defined as

(A) The total depth of water required by a crop during its entire growth period

(B) The discharge of the canal at the head

(C) The velocity of flow in a canal

(D) The area irrigated by unit discharge

Answer: A

25. The relationship between duty (D in hectares/cumec), delta (Δ in metres) and base period (B in days) is given by

(A) $\Delta = 8.64B/D$

(B) $D = 8.64B/\Delta$

(C) $B = D/\Delta$

(D) $\Delta = D/8.64B$

Answer: B

26. Which of the following factors affects the duty of water?

(A) Type of crop only

(B) Method of irrigation, type of soil, climatic conditions and canal transmission losses

(C) Colour of water

(D) Length of the canal only

Answer: B

27. Base period of a crop refers to

(A) The period between the first and last watering of the crop

(B) The germination period only

(C) The harvesting period only

(D) The period of land preparation only

Answer: A

28. Intensity of irrigation refers to

(A) The percentage of culturable command area proposed to be irrigated

(B) The depth of water applied per irrigation

(C) The number of canals in the command area

(D) The velocity of flow in the distributary

Answer: A

29. Consumptive use of water (evapotranspiration) refers to

(A) Water lost only through soil evaporation

(B) Total water used by the plant in transpiration plus evaporation from adjacent soil

(C) Water lost through canal seepage

(D) Water stored in the reservoir

Answer: B

30. Irrigation efficiency is defined as the ratio of

(A) Water delivered to the field to water lost in conveyance

(B) Water used beneficially by the crop to water supplied

(C) Total rainfall to total irrigation applied

(D) Area irrigated to total command area

Answer: B

PART B (10 Marks)

1. Explain the soil-water-plant relationship, defining field capacity, permanent wilting point and available moisture with a neat diagram.

2. Define duty and delta of irrigation water and derive the relationship between duty, delta and base period.

3. Explain the factors affecting duty of water and discuss methods of improving duty at the head of the watercourse.

4. Explain consumptive use of water and Various irrigation efficiencies,

5. A crop has a base period of 120 days and requires a total depth of water of 90 cm. Calculate the duty of water for this crop at the field. If conveyance losses amount to 25%, calculate the duty required at the head of the canal.

UNIT III: HYDROLOGY AND GROUND WATER

Part-A Objective Questions (30)

1. Hydrology deals with the occurrence, circulation and distribution of water

- (A) Only above the earth's surface
- (B) On, above and below the surface of the earth
- (C) Only in the oceans
- (D) Only in rivers

Answer: B

2. The continuous circulation of water between the atmosphere, land and oceans is known as

- (A) Runoff cycle
- (B) Hydrological cycle
- (C) Infiltration cycle
- (D) Evapotranspiration cycle

Answer: B

3. A Symons' type rain gauge is an example of a

- (A) Recording rain gauge
- (B) Non-recording (ordinary) rain gauge
- (C) Tipping bucket rain gauge
- (D) Weighing type rain gauge

Answer: B

4. The tipping bucket rain gauge is a type of

- (A) Non-recording rain gauge
- (B) Recording rain gauge
- (C) Staff gauge
- (D) Float gauge

Answer: B

5. The method that assigns weightage to each rain gauge station based on its area of influence for computing mean areal rainfall is the

- (A) Arithmetic mean method
- (B) Thiessen polygon method
- (C) Isohyetal method
- (D) Double mass curve method

Answer: B

6. The portion of precipitation that flows over the land surface and through channels to reach a stream is called

- (A) Infiltration
- (B) Runoff
- (C) Percolation
- (D) Evapotranspiration

Answer: B

7. A hydrograph is a graphical plot of

- (A) Rainfall intensity against time

- (B) Discharge of a stream against time
- (C) Soil moisture against depth
- (D) Temperature against altitude

Answer: B

8. A unit hydrograph is the direct runoff hydrograph resulting from

- (A) Any rainfall of arbitrary depth
- (B) A unit depth of effective rainfall occurring uniformly over the basin in a unit time
- (C) Zero effective rainfall
- (D) Snowmelt only

Answer: B

9. A geological formation capable of storing and transmitting a significant quantity of water is called

- (A) Aquiclude
- (B) Aquifer
- (C) Aquitard
- (D) Aquifuge

Answer: B

10. Porosity of a soil or rock mass is defined as the ratio of

- (A) Volume of solids to total volume
- (B) Volume of voids to total volume
- (C) Volume of water to volume of solids
- (D) Weight of water to weight of solids

Answer: B

11. Specific yield of an aquifer is the ratio of

- (A) Volume of water drained by gravity to total volume of the saturated aquifer
- (B) Volume of water retained to total volume
- (C) Total porosity to permeability
- (D) Discharge to drawdown

Answer: A

12. An aquifer bounded above and below by impermeable layers, with water stored under pressure, is termed

- (A) Unconfined aquifer
- (B) Confined aquifer
- (C) Perched aquifer
- (D) Water table aquifer

Answer: B

13. The zone of aeration lies

- (A) Below the water table
- (B) Above the water table
- (C) Within a confined aquifer only
- (D) Within impermeable rock only

Answer: B

14. The discharge per unit drawdown of a well is termed its

- (A) Specific yield

- (B) Specific capacity
- (C) Transmissibility
- (D) Coefficient of storage

Answer: B

15. A recuperation test on an open well is conducted to determine the yield of the well when

- (A) A pumping set is readily available
- (B) A pump is not available, by observing the rate of recovery of water level
- (C) The rainfall is very high
- (D) The aquifer is confined

Answer: B

16. Ground water exploration by measuring variation in electrical resistivity of sub-surface strata is known as

- (A) Test drilling method
- (B) Electrical resistivity (geophysical) method
- (C) Remote sensing method
- (D) Seismic refraction method only

Answer: B

17. Hydrology is the science that deals with

- (A) Only the study of ground water motion
- (B) Occurrence, circulation and distribution of water on, above and below the earth's surface
- (C) Only the design of dams
- (D) Only soil mechanics

Answer: B

18. Application of hydrology in civil engineering includes

- (A) Design of highways only
- (B) Estimation of design flood, reservoir capacity and drainage system design
- (C) Design of electrical circuits
- (D) Design of steel structures only

Answer: B

19. The hydrological cycle describes

- (A) A one-way movement of water from ocean to atmosphere
- (B) The continuous circulation of water between atmosphere, land and oceans through evaporation, precipitation and runoff
- (C) Only the flow of ground water
- (D) Only the process of transpiration

Answer: B

20. Precipitation includes which of the following forms?

- (A) Only rainfall
- (B) Rain, snow, hail, sleet and dew
- (C) Only snow and hail
- (D) Only fog

Answer: B

21. A rain gauge is an instrument used to

- (A) Measure wind velocity
- (B) Measure the amount of rainfall at a point
- (C) Measure evaporation from a lake
- (D) Measure ground water level

Answer: B

22. The Symons' type rain gauge is an example of a

- (A) Recording rain gauge
- (B) Non-recording (ordinary) rain gauge
- (C) Radar based measurement system
- (D) Satellite based sensor

Answer: B

23. Recording rain gauges such as the tipping bucket type are useful because they

- (A) Only measure total seasonal rainfall
- (B) Provide continuous record of rainfall intensity and duration
- (C) Cannot be used for hydrograph analysis
- (D) Measure only snow

Answer: B

24. A rain gauge network density is planned mainly based on

- (A) Uniform spacing regardless of terrain
- (B) Number of gauges required per unit area depending on basin characteristics and topography as recommended by WMO
- (C) Number of villages in the district
- (D) Colour of soil in the region

Answer: B

25. Mean rainfall over a drainage basin can be estimated by

- (A) Arithmetic mean method, Thiessen polygon method and Isohyetal method
- (B) Only by adding all gauge readings without weighting
- (C) Only by radar measurement
- (D) Only by satellite imagery

Answer: A

26. The Thiessen polygon method of estimating mean areal rainfall assigns weightage based on

- (A) Equal weight to all rain gauges irrespective of area
- (B) Area of influence of each rain gauge station
- (C) Elevation of the rain gauge only
- (D) Distance from the river mouth

Answer: B

27. Radar measurement of rainfall is useful because it can

- (A) Measure rainfall only at a single point
- (B) Provide real-time spatial distribution of rainfall over large areas
- (C) Replace the need for any rain gauge
- (D) Measure only ground water level

Answer: B

28. Runoff is defined as

- (A) The portion of precipitation that infiltrates into soil only
- (B) The portion of precipitation that flows over land surface and through channels to a stream or outlet
- (C) Water lost through evaporation only
- (D) Water stored permanently in aquifers

Answer: B

29. Losses in the rainfall-runoff process include

- (A) Only evaporation
- (B) Interception, infiltration, evaporation and depression storage
- (C) Only channel flow
- (D) Only ground water recharge

Answer: B

30. A hydrograph is a graphical representation of

- (A) Rainfall intensity versus time only
- (B) Discharge of a stream plotted against time
- (C) Soil moisture versus depth
- (D) Ground water table versus season

Answer: B

PART B (10 Marks)

1. Explain the hydrological cycle with a neat sketch
2. Explain the different types of rain gauges and describe the methods of estimating mean rainfall over a drainage basin.
3. Define the terms unit hydrograph, porosity, permeability, specific yield and coefficient of storage.
4. Explain briefly the types of aquifers with neat sketch
5. Describe the pumping test and recuperation test for determining the yield of a well, and state their merits and limitations.

UNIT IV: DAMS AND SPILLWAYS, DIVERSION HEAD WORKS

Part-A Objective Questions (30)

1. A dam that resists the water pressure mainly by its own weight is known as a

- (A) Arch dam
- (B) Gravity dam
- (C) Buttress dam
- (D) Earthen dam

Answer: B

2. Earthen dams are generally preferred over gravity dams when

- (A) A strong rock foundation is available
- (B) The foundation is relatively weak and suitable earth material is locally available
- (C) A very high head reservoir with a narrow gorge is required
- (D) The spillway discharge required is extremely high

Answer: B

3. A cut-off trench provided in the foundation of an earthen dam serves to

- (A) Increase the height of the dam
- (B) Prevent seepage of water through the pervious foundation
- (C) Act as the spillway
- (D) Provide an inspection road

Answer: B

4. Failure of an earthen dam by progressive erosion of soil particles along a seepage path is called

- (A) Overtopping
- (B) Piping
- (C) Sliding
- (D) Settlement

Answer: B

5. Overtopping failure of an earthen dam occurs mainly due to

- (A) Inadequate spillway capacity or insufficient freeboard
- (B) Excess seepage through the foundation
- (C) Excess vegetation on the slope
- (D) Excess cut-off trench depth

Answer: A

6. The upstream point of contact of a gravity dam with its foundation is known as the

- (A) Toe
- (B) Heel
- (C) Crest
- (D) Free board

Answer: B

7. The gallery provided within the body of a gravity dam is mainly meant to

- (A) Increase the weight of the dam
- (B) Relieve uplift pressure and collect seepage water for inspection
- (C) Serve as a spillway chute

(D) Store construction machinery

Answer: B

8. A spillway is provided in a dam to

(A) Store water permanently

(B) Safely discharge surplus flood water without endangering the dam

(C) Generate power only

(D) Facilitate navigation only

Answer: B

9. The spillway whose profile follows the shape of the lower nappe of a free-falling water jet is called a/an

(A) Chute spillway

(B) Ogee spillway

(C) Siphon spillway

(D) Shaft spillway

Answer: B

10. A shaft spillway is also popularly known as a

(A) Chute spillway

(B) Morning glory spillway

(C) Side channel spillway

(D) Straight drop spillway

Answer: B

11. Diversion head works are constructed across a river mainly to

(A) Store large volumes of water over years

(B) Raise the water level and divert water into a canal without large-scale storage

(C) Generate hydroelectric power exclusively

(D) Completely stop the river flow

Answer: B

12. A barrage differs from a weir mainly in that a barrage has

(A) A high raised crest with no gate control

(B) A low crest fitted with gates to regulate the pond level

(C) No provision for diverting water into a canal

(D) A height greater than that of a dam

Answer: B

13. Silt excluders are provided in a diversion head work to

(A) Trap coarse silt near the river bed before it enters the canal

(B) Remove silt already entered into the canal

(C) Increase the silt content of canal water

(D) Regulate flood discharge only

Answer: A

14. Silt ejectors, unlike silt excluders, are located

(A) Upstream of the head regulator in the river bed

(B) Within the canal, downstream of the head regulator

(C) Only in the reservoir

(D) Only at the tail end of the main canal

Answer: B

15. The function of a canal head regulator at a diversion head work is to
- (A) Regulate the supply of water entering the canal and exclude flood/silt
 - (B) Generate hydroelectric power
 - (C) Store water permanently
 - (D) Measure the annual rainfall

Answer: A

16. For dam safety, a gravity dam section must be checked against
- (A) Sliding, overturning and tension at the base
 - (B) Only its total weight
 - (C) Only its aesthetic appearance
 - (D) Only the spillway length

Answer: A

17. Dams are classified based on
- (A) Only their colour
 - (B) Materials of construction, structural behavior and function, such as earthen, gravity and arch dams
 - (C) Only their location
 - (D) Only their cost

Answer: B

18. A gravity dam resists the water pressure mainly by
- (A) Its own weight
 - (B) Arch action transferring load to abutments
 - (C) Buoyancy of the reservoir
 - (D) Tension in the dam body

Answer: A

19. Earthen dams are generally preferred over gravity dams when
- (A) A strong rock foundation is available and good quality stone is abundant
 - (B) Foundation conditions are relatively weak and suitable earth material is locally available
 - (C) The dam height required is very large with narrow valley
 - (D) Spillway capacity required is very high

Answer: B

20. Compared to gravity dams, earthen dams typically require
- (A) A wider base and flatter slopes due to lower shear strength of soil
 - (B) A narrower base similar to gravity dams
 - (C) No provision for seepage control
 - (D) Higher cost per unit volume of material

Answer: A

21. The components of an earthen dam include
- (A) Only the core wall
 - (B) Core, shell, filters, rip-rap, and drainage (toe drain)
 - (C) Only the spillway
 - (D) Only the outlet works

Answer: B

22. A cut-off trench in an earthen dam is provided to
- (A) Increase the height of the dam
 - (B) Prevent seepage of water through the foundation
 - (C) Serve as a spillway
 - (D) Provide access road

Answer: B

23. Rip-rap on the upstream slope of an earthen dam is provided to
- (A) Protect the slope from wave erosion
 - (B) Increase seepage
 - (C) Reduce dam height
 - (D) Serve as drainage gallery

Answer: A

24. Piping failure of an earthen dam occurs due to
- (A) Overtopping of the dam by flood water
 - (B) Progressive erosion of soil particles along a seepage path within the dam or foundation
 - (C) Excessive vegetation growth on the slope
 - (D) Excess spillway capacity

Answer: B

25. Overtopping is a failure mode of earthen dams caused by
- (A) Water flowing over the top of the dam due to inadequate spillway capacity or freeboard
 - (B) Excess porosity of foundation rock
 - (C) Excess side slope of the dam
 - (D) Deep cut-off trench

Answer: A

26. Remedial measure for piping failure in earthen dams includes
- (A) Increasing spillway width only
 - (B) Providing adequate filters and drainage to control seepage exit gradient
 - (C) Reducing the height of the dam only
 - (D) Removing the cut-off trench

Answer: B

27. A typical cross section of a gravity dam includes
- (A) Upstream and downstream faces, crest, heel, toe and galleries
 - (B) Only the crest
 - (C) Only the toe
 - (D) Only the spillway crest

Answer: A

28. The heel of a gravity dam refers to
- (A) The downstream point of contact of the dam with the foundation
 - (B) The upstream point of contact of the dam with the foundation
 - (C) The top of the dam
 - (D) The spillway gate

Answer: B

29. Drainage gallery in a gravity dam is provided mainly to

- (A) Relieve uplift pressure and collect seepage water for inspection and drainage
- (B) Increase the weight of the dam
- (C) Serve as the spillway chute
- (D) Store construction material

Answer: A

30. A spillway is a structure provided in a dam to

- (A) Store water permanently
- (B) Safely discharge surplus/flood water from the reservoir without damaging the dam
- (C) Generate hydroelectric power exclusively
- (D) Allow navigation of boats

Answer: B

PART B (10 Marks)

1. Explain the classification of dams and compare earthen dams with gravity dams.
2. Describe the components of an earthen dam with a neat typical cross section, and explain the various types of failures of earthen dams with remedial measures.
3. Explain the typical cross section of a gravity dam and describe the function of a drainage gallery.
4. Explain the different types of spillways with respect to their definition, function, location and components.
5. Explain the components, layout and function of a diversion head work. Differentiate between a weir and a barrage, and state which is more suitable for a silt-laden river.

UNIT V: DESIGN OF IRRIGATION CHANNEL, CROSS DRAINAGE WORKS AND CANAL REGULATION WORKS

Part-A Objective Questions (30)

1. A canal aligned along the ridge line of a catchment so that it can command areas on both sides is called a

- (A) Contour canal
- (B) Watershed (ridge) canal
- (C) Side slope canal
- (D) Lift canal

Answer: B

2. For a given cross-sectional area, slope and roughness, the most economical canal section is one that gives

- (A) Maximum wetted perimeter
- (B) Minimum wetted perimeter, i.e. maximum discharge
- (C) Minimum discharge
- (D) Minimum velocity

Answer: B

3. Kennedy's theory for the design of irrigation channels is based on the concept of

- (A) Critical velocity that just prevents silting and scouring
- (B) Tractive force distribution around the wetted perimeter
- (C) Manning's roughness coefficient alone
- (D) Regime slope determined solely by discharge

Answer: A

4. In Kennedy's theory, the ratio of the actual mean velocity of flow to the critical velocity is termed the

- (A) Silt factor
- (B) Critical velocity ratio (m)
- (C) Regime ratio
- (D) Roughness coefficient

Answer: B

5. Lacey's regime theory, unlike Kennedy's theory, additionally considers

- (A) Only the depth of flow
- (B) The wetted perimeter, hydraulic mean depth and a silt factor
- (C) Only Manning's 'n'
- (D) Only the bed slope, ignoring silt

Answer: B

6. Lacey's silt factor depends mainly on the

- (A) Mean particle size of the silt in the channel bed
- (B) Width of the canal
- (C) Bed slope of the channel
- (D) Type of lining material

Answer: A

7. Canal lining is provided mainly to

- (A) Increase seepage loss
- (B) Reduce seepage loss, control weed growth and increase carrying capacity
- (C) Increase construction cost with no functional benefit
- (D) Decrease the velocity of flow drastically

Answer: B

8. Which of the following is NOT a desirable property of good canal lining material?

- (A) Impervious and durable
- (B) Resistant to erosion and chemical attack
- (C) Economical and locally available
- (D) Highly permeable

Answer: D

9. Water logging in an irrigated command area is mainly caused by

- (A) Efficient canal lining
- (B) Excessive seepage from unlined canals and over-irrigation raising the water table
- (C) Proper sub-surface drainage
- (D) Adequate crop rotation

Answer: B

10. A cross drainage work in which the canal is carried over a drain in a trough, with the drain flowing freely below, is called an

- (A) Aqueduct
- (B) Super-passage
- (C) Syphon
- (D) Level crossing

Answer: A

11. A syphon aqueduct differs from a simple aqueduct in that the drainage water

- (A) Flows freely under gravity without any pressure rise
- (B) Is forced to flow under pressure below the canal trough
- (C) Is carried over the canal
- (D) Does not cross the canal at all

Answer: B

12. A cross drainage structure in which the drain is carried over the canal in a trough is known as a

- (A) Super-passage
- (B) Aqueduct
- (C) Canal fall
- (D) Cross regulator

Answer: A

13. A structure provided to safely lower the water surface of a canal where the ground slope is steeper than the designed bed slope is called a

- (A) Canal outlet
- (B) Canal fall
- (C) Canal escape
- (D) Head regulator

Answer: B

14. Canal escapes are provided mainly to
- (A) Increase the canal water level permanently
 - (B) Safely dispose of surplus canal water during emergencies such as breaches
 - (C) Regulate silt entry
 - (D) Serve as the main head regulator

Answer: B

15. A cross regulator is generally located
- (A) At the head of the main canal only
 - (B) Across the main canal, downstream of a distributary off-take, to raise water levels for diversion
 - (C) Only at the tail end of the canal system
 - (D) Only within a cross drainage aqueduct

Answer: B

16. A structure that delivers water from a distributary to an individual field channel is known as a

- (A) Cross regulator
- (B) Canal outlet (module)
- (C) Canal fall
- (D) Head regulator

Answer: B

17. Canals are classified based on
- (A) Only their length
 - (B) Function (irrigation, power, navigation), alignment (contour, watershed, side slope) and discharge (main, branch, distributary)
 - (C) Only their construction material
 - (D) Only their age

Answer: B

18. A watershed canal is aligned
- (A) Along the ridge line so that it commands areas on both sides without requiring cross drainage works
 - (B) Along the valley bottom
 - (C) Perpendicular to the contour lines only
 - (D) Always parallel to the river

Answer: A

19. The most economical canal section is one which, for a given cross sectional area, slope and roughness, gives

- (A) Minimum discharge
- (B) Maximum discharge, i.e., minimum wetted perimeter
- (C) Maximum wetted perimeter
- (D) Minimum velocity

Answer: B

20. For a most economical trapezoidal channel section, the hydraulic radius equals

- (A) The full depth of flow
- (B) Half the depth of flow
- (C) One-third the depth of flow

(D) Twice the depth of flow

Answer: B

21. Kennedy's silt theory is based on the concept of

- (A) Regime channel with self-adjusting slope and section
- (B) Critical velocity that just prevents silting and scouring, related to the depth of flow
- (C) Tractive force distribution on the perimeter
- (D) Manning's roughness coefficient only

Answer: B

22. Lacey's regime theory differs from Kennedy's theory mainly in that Lacey considered

- (A) Only the depth of flow to determine critical velocity
- (B) The wetted perimeter, hydraulic mean depth and a silt factor to define a regime channel in equilibrium
- (C) Only Manning's 'n' value
- (D) Only the canal bed slope, ignoring silt characteristics

Answer: B

23. In Kennedy's theory, the 'critical velocity ratio' (m) is defined as

- (A) The ratio of actual mean velocity to critical velocity of the channel
- (B) The ratio of critical velocity to actual mean velocity
- (C) The ratio of bed slope to side slope
- (D) The ratio of discharge to wetted perimeter

Answer: A

24. Lacey's silt factor (f) depends primarily on

- (A) The mean particle size of the silt in the channel bed material
- (B) The width of the canal only
- (C) The bed slope only
- (D) The lining material used

Answer: A

25. Canal lining is provided mainly to

- (A) Increase seepage losses
- (B) Reduce seepage losses, prevent weed growth and increase carrying capacity due to reduced roughness
- (C) Increase construction cost with no benefit
- (D) Decrease the velocity of flow drastically

Answer: B

26. Types of canal lining include

- (A) Only earthen lining
- (B) Cement concrete lining, brick lining, boulder lining and geomembrane lining
- (C) Only asphalt lining
- (D) Only clay lining

Answer: B

27. A desirable property of good canal lining material is that it should be

- (A) Highly permeable and easily eroded
- (B) Impervious, durable, resistant to erosion and chemical attack, and economical
- (C) Very costly with short life

(D) Attractive to weed growth

Answer: B

28. Water logging in irrigated areas is primarily caused by

(A) Efficient canal lining preventing seepage

(B) Excessive seepage from unlined canals and over-irrigation raising the water table close to the ground surface

(C) Adequate surface and sub-surface drainage

(D) Proper crop rotation

Answer: B

29. Remedial measures for water logging include

(A) Increasing irrigation water supply further

(B) Providing canal lining, surface and sub-surface drainage, and adopting scientific water management

(C) Removing all drainage works

(D) Avoiding canal lining altogether

Answer: B

30. Cross drainage works are constructed where

(A) A canal crosses a natural drainage (stream/nalla) at an intersection, to safely pass both flows

(B) A canal runs parallel to a river without crossing it

(C) Two canals of the same command meet without any obstruction

(D) Only where a road crosses a canal

Answer: A

PART B (10 Marks)

1. Explain the classification of canals and derive the condition for the most economical trapezoidal canal section.

2. Compare Kennedy's silt theory and Lacey's regime theory for the design of irrigation channels.

3. Explain the types and advantages of canal lining, and describe the properties of good canal lining material.

4. Explain the causes of water logging in irrigated command areas and discuss the remedial measures to control it.

5. Describe the various types of cross drainage works (aqueduct, syphon aqueduct, super-passage and syphon) and explain the criteria used to select a suitable type at a given canal-drainage crossing.

