KATHMANDU UNIVERSITY
End Semester Examination [C]
April/May 2023

Marks Scored:

Level : B.E.
Year : III

Course : CIEG 304
Semester : I

Exam Roll No.:

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 26 APR 2023

SECTION "A"

[20Q. × 0.5 = 10 marks]

Encircle the most appropriate alternative from each set of choices.

1. If the U/S face of concrete gravity dam is vertical and height of water in reservoir is 30 meter from river bed. Then the hydrodynamic force acts at
   a. 12.73 meter above the base
   b. 10 meter above the base
   c. 30 meter above the base
   d. Anywhere in the dam height

2. Horizontal earthquake acceleration acts towards downstream of the river, then
   a. Horizontal inertia force due to earthquake acts towards downstream
   b. Horizontal inertia force due to earthquake acts towards upstream
   c. Vertical inertia force due to earthquake acts towards anti-gravity direction
   d. Vertical inertia force due to earthquake acts towards gravity direction

3. For concrete gravity dam there is wave pressure due to blowing wind. If the height of wave is $h_w = 3$ meter. Then the incorrect statement is
   a. Total force acting on dam due to wave is proportional to the square root of wave height
   b. Wave force acts at a distance of 1.125 meter above the reservoir base
   c. Wave force acts at a distance of 1.125 meter above the reservoir surface
   d. Wave height depends upon the wind velocity and straight length of water expansion

4. Concrete dam are usually placed in blocks. The size of blocks depends upon the joints provision consideration of cracking of concrete. The incorrect statement is
   a. Maximum height of single pour of concrete is usually about 1.5 meter or so
   b. Horizontal joints of dam are known as longitudinal joints
   c. Vertical joints are called as transverse joint
   d. Shear keys are always provided in transverse joint if the dam is constructed in good rock foundation

5. In case, no water in reservoir, horizontal earthquake inertia force acting towards upstream and vertical inertia force acting towards gravity direction. Then
   a. Heel of the dam base may be in more compression
   b. Toe of the dam may be in more compression than heel
   c. Toe and heel may be in tension
   d. Toe may be in more tension than heel

6. Minimum height of the freeboard of earth dam does not depend upon
   a. Height of dam
   b. Controlled or uncontrolled condition of spillway
   c. Height of the water wave to be produced in the reservoir
   d. Condition of foundation soil

7. Which of the following statement is **INCORRECT**?
   a. Dam base is equipotential line
   b. U/S face of the dam is equipotential line
   c. In flow net, equipotential lines are also known as lines of equal energy
   d. Stream line and flow channels are perpendicular to each other

8. For the homogeneous earth dam, if the focal distance is 6 meter and the coefficient of permeability is 5×10^{-4} (m/sec), then the seepage discharge through the dam section is
   a. 3×10^{-3} (m3/ m run/ sec)
   b. 1.5×10^{-3} (m3/ m run/ sec)
   c. 3×10^{-3} (cumecs/ cm run/ sec)
   d. Depends upon head

9. For the stability of the foundation against shear of earth dam, photo elastic studies found that
   a. Maximum stress is 1.6 times the average stress and it occurs at 0.6B from the toe
   b. Maximum stress is1.4 times the average stress and it occurs at 0.4B from the toe
   c. Maximum stress is 1.6 times the average stress and it occurs at 0.4B from the toe
   d. Maximum stress is 1.4 times the average stress and it occurs at 0.6B from the toe

10. Which of the following statement is **INCORRECT** about an arch dam?
    a. Elastic theory considers temperature and shrinkage stress
    b. Thin cylinder theory is more accurate than elastic design theory
    c. Economical central angle is 133 degree 34 minute but restricted to about 150 degree.
    d. Double curvature arch dam is also known as shell-arch dam

11. Which of the following statement is **INCORRECT** for the buttress dam?
    a. Buttress spacing depends on Mean dam height
    b. Buttress spacing depends on Inclination angle of deck slab
    c. Height, thickness and spacing of buttress can be controlled by slenderness ratio and massiveness factor
    d. Buttress dam may not be Continuous support type

12. On moderate foundations, and particularly in seismic area, the type of dam which can preferable be considered for construction is
    a. Masonry gravity dam
    b. Earthen dam
    c. Rock fill dam
    d. Arch dam

13. A shaft spillway is located
    a. Inside the body of the gravity dam
    b. Inside the upstream reservoir
    c. Inside the downstream reservoir
    d. On side flanks of the main dam

14. The portion of a chute spillway, which is known as its control structure is
    a. Low ogee weir
    b. Chute channel
    c. Approach channel leading the water from the reservoir to the ogee weir
    d. Stilling basin at its bottom

15. The load from the deck of buttress dam is transmitted to eh foundation, through the
    a. Corbels
    b. Buttress
    c. Deck slab
    d. Lateral braces

16. Multiple arch dam are generally used for
    a. High dam
    b. Low dam
    c. Medium dam
    d. Gravity dam with buttress dam

17. The most preferred type of an earthen dam section is the one, in which the
    a. Entire embankment is made of one type of soil
    b. Inner embankment is made of highly porous soil, surrounded by the outer shell of highly impervious soil, both separated by transition filter material of mediocre permeability
    c. Inner embankment is made of highly impervious soil surrounded by the outer shell of highly pervious soil, both separated by transition filer material of mediocre permeability
    d. Rectangular cross section with entire embankment with highly pervious soil

18. The safety valve of a dam is
    a. Drainage gallery
    b. Inspection gallery
    c. Spillway
    d. Outlet sluices

19. If the operating head of an ogee spillway is more than the design head, then
    a. The pressure on the crest will be zero
    b. The pressure on the crest will be negative, causing cavitation
    c. The pressure on the crest will be positive
    d. The discharge coefficient of the spillway will be reduced

20. Which of the following component of the buttress dam is also called as counterfort?
    a. Corbel
    b. Buttress
    c. Lateral braces
    d. Sloping deck

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SECTION "B"

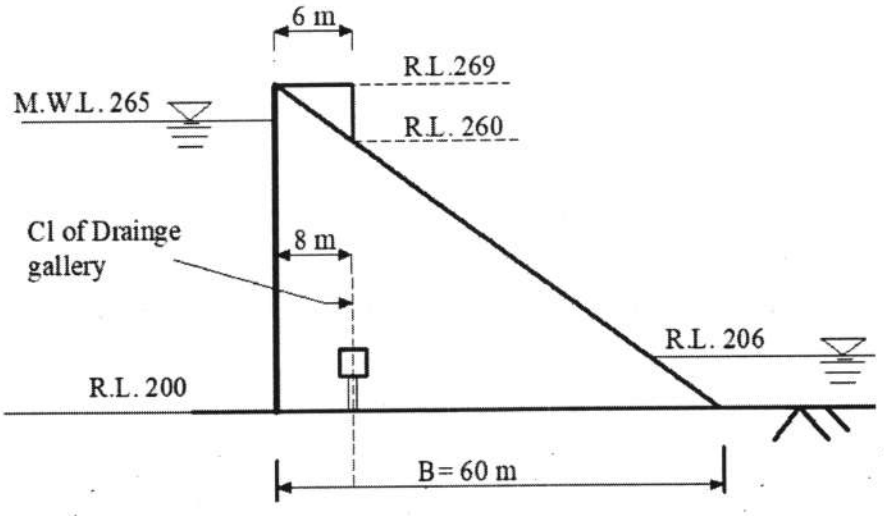
Attempt *ALL* questions. Assume data suitably if required.

1. a. Classify Dam with suitable example according to (i) use (ii) hydraulic design and (iii) materials. [2]

   b. Briefly describe the requisites of good sites for various types of dam. [3]

2. Design of Gravity dam should be done under different suitable load combinations. Write shortly about load combination as per (i) USBR and (ii) IS 6512-1984 [4]

3. For the given Concrete Gravity (non overflow) dam section. *(Horizontal earthquake coefficient $\alpha_h = 0.1$ & vertical earthquake coefficient $\alpha_v = 0.05$)* ***Considering only inertia effect of earthquake i.e. ignore hydrodynamic forces) Determine:***
   i. Different forces acting on the dam section [3]
   ii. Normal compressive stresses at toe and heel [1]
   iii. Principle stress and shear stress at toe [1]
   iv. Factor of safety against overturning, sliding, shear sliding [2]



(Assume unit weight of water and concrete γ_w and γ_c are 9.81 kN/m^3 and 24 kN/m^3 , unit shear of dam material C = 1400 kN/m^2 and Coefficient of friction (μ) between dam base and dam is 0.75, horizontal earthquake acceleration acts upstream and vertical earthquake acceleration acts downwards)

4. What are the factors, which governs the thickness of arch dam? List out the different theories for the design of arch dams and briefly explain about the theory of the trial load analysis of an arch dam. [1+1+2 = 4]

5. For a homogeneous earth dam of height of 60 meter including 2 meter of free board. A flow net was constructed and following results were obtained
   Number of potential drop = 30
   Number of flow channels = 6
   Calculate the discharge per meter length of the dam if the coefficient of permeability of the dam is 3×10^{-4} (cm/sec). [2]

6. An earth dam made up of homogeneous material has the following data
   i. Level of top of dam 220.0 m
   ii. Level of River bed 200.0 m
   iii. HFL of reservoir 218.0 m
   iv. Top width of dam 6 meter
   v. U/S slope (H:V, 4:1) and D/S slope (H:V, 3:1)
   vi. Length of horizontal filter from D/S toe inwards = 30 m
   vii. Dry density of dam material = 17.27 kN/m^3
   viii. Saturation density of dam material = 21.19 kN/m^3
   ix. Average angle of friction of dam material is 26 degree
   x. Average cohesion of dam material is 19.13 kN/m^2

   a. Determine and draw the phreatic line (in suitable scale in graph paper) [4]
   b. Furthermore, **check the stability** of dam section for stability of the D/S slope portion of the dam under steady seepage [2]

7. Draw plan and cross section of massive head buttress dam. Give its advantage and disadvantage. [3]

8. An ungated Ogee Crested spillway with vertical U/S face has a design discharge of 2500 m^3/sec. The total crest length is 200 m and comprise 11 span with 5 m wide pillars. The height of the dam up to normal reservoir level above the river bed level is 50 meter. Assume the coefficient of discharge as 1.8 and round nosed pillars ($k_p = k_a = 0.01$)
   Determine: [5]
   a. Crest height of the spillway
   b. Downstream profile of the spillway
      Given Expressions as per USACE for D/S profile of Ogee are:
      $x^n = K\, y\, [H_d]^{n-1}$; *for vertical upstream* $K = 2$ *and* $n = 1.85$

9. Write short notes on: [2 × 2 = 4]
   a. Structural failures of earth dam
   b. Flow net and its properties