KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

Marks scored:

Level : B.E.
Year : III

Course : CIEG 304
Semester : I

Exam. Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date 30 MAY 2019

SECTION "A"
[20 Q × 0.5 = 10 marks]

Choose the most appropriate answer among the given options and ***encircle*** *the letter of your choice.*

1. Hydrodynamic pressure of water on the dam as per **Von Karman** is (if the height of stored water is 40 meter, horizontal gravity factor k_h is 0.1 and unit weight of water is 10 kN/m^3).
   a. 880 kN/m^2 b. 1600 kN/m^2 c. 8000 kN/m^2 d. 800 kN/m^2.

2. Leakage through the transverse joint in earthen dam is prevented by
   a. Shear keys b. Key ways c. Water stop d. Concrete grout

3. Oroville dam, an earthen dam in USA, failed recently some year ago mainly because of
   a. Overturning b. Spillway erosion c. Sliding d. Seepage

4. As per Indian Standard (IS; 1893:2002), for seismic zone V and for Seismic intensity as very severe, the zone factor is?
   a. 0.1 b. 0.16 c. 0.24 d. 0.36

5. As per **IS 6512-1984,** what is the **name of load combination** for the design of Gravity dam if reservoir if full, weather is normal dry with tail water, uplift is normal and there is ice and silt too?
   a. Load combination B b. Load combination A
   c. Load combination C d. Load combination D

6. If the summation of the resisting moment in dam body is 1547377 kNm and the summation of overturning moment is 1161849 kNm, the dam is .....in overturning.
   a. Safe b. Unsafe c. Critical d. Slightly safe

7. Photo electric studies show that, the maximum intensity of shear stress occurs at the distance of ..... from the inner point of vertical projection of the U/S face of the dam (in case of slope stability analysis of U/S face of earthen dam during sudden drawdown considering the effect of the horizontal shear stress developed at the base of U/S face).
   a. 0.4B b. 0.6B c. 0.5B d. 0.3B

   Where B is the vertical projection of the U/S face of the dam on the horizontal plane.

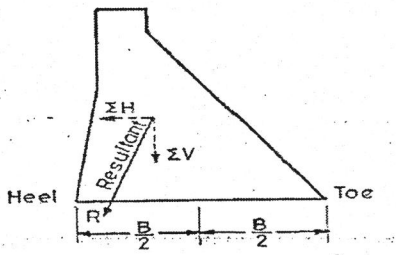
8. If height of the elementary profile of dam is 100 meter, assuming that the specific gravity of concrete is 2.4, uplift pressure factor is of 0.5 and coefficient of friction between dam base and foundation is 0.7, then what will be the base of elementary profile of the dam?
   a. Greater than or equal to 65 meter b. Less than or equal to 65 meter
   c. Greater than or equal to 75 meter d. Less than or equal to 75 meter

9. For the homogeneous earth dam section with a horizontal filter inward from toe of the dam what will be the seepage discharge per meter of the dam if coefficient of permeability is 5×10^{-4} (cm/sec.) and the distance of the directrix from the vertex of the parabolic phreatic line is 3 meter?

a. 0.12 m^3/sec b. 0.06 m^3/sec c. 0.9 m^3/sec d. 0.09 m^3/sec

10. Vertical stress distribution for reservoir empty case as in figure shown may be

a. Maximum compressive at heel and tension at toe
b. Maximum compressive at heel and minimum compression at toe
c. Maximum compression at toe and minimum compression at heel
d. Both (a) and (b)

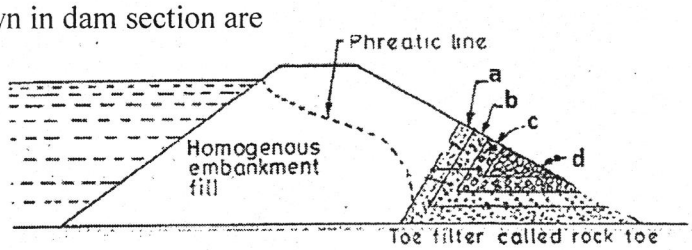


11. The limiting height of the concrete gravity dam is….. , if strength of concrete is 3000 kN/m^2, unit weight of water is 10 kN/m3 and specific gravity of concrete is 2.4.

a. 88.23 m b. 90 m c. 89 m d. 87 m

12. Materials layers **a, b, c & d** in the filter shown in dam section are

a. Rock toe, gravel, coarse sand & fine sand
b. Fine sand, coarse sand, gravel & rock toe
c. Coarse sand, fine sand, rock toe & gravel
d. Gravel, rock toe, coarse sand & fine sand

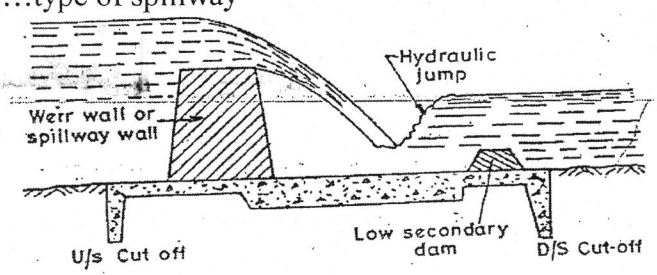


13. Chute spillway is also known as

a. Open channel spillway b. Shaft spillway
c. Syphon spillway d. Ogee spillway

14. The section of spillway shown is called ……type of spillway

a. Overflow spillway
b. Straight drop spillway
c. Ogee spillway
d. Inclined drop spillway with D/S protection



15. The D/S profile of 'Water Experimental Station" (WES) recommendation is, $X^n = K H_d^{n-1} y$. What will be the value of ***K and n if slope of the U/S face of the spillway is Vertical***

a. 1.936 and 1.836 b. 1.931 and 1.81 c. 2 and 1.85 d. 1.85 and 0.85

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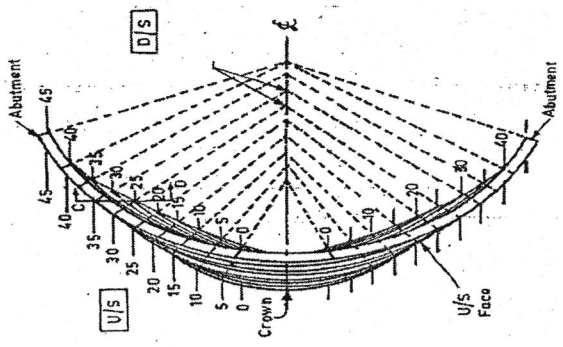
16. The plan shown is an arch dam. Which type of arch dam is this?
    a. Constant radius arch dam
    b. Variable radius arch dam
    c. Single curvature arch dam
    d. Double curvature arch dam



17. No reinforcement is necessary for
    a. Fix deck buttress dam
    b. Simple deck buttress dam
    c. Cantilever deck buttress dam
    d. Massive head buttress dam

18. The only spillway among the following, through which the discharge does not increase as fast as it increases in all other, is:
    a. Chute spillway
    b. Side channel spillway
    c. Ogee spillway
    d. Shaft spillway

19. Which of the following is incorrect about the buttress dam?
    a. It requires less construction material than solid gravity dam for the same height of the dam
    b. It is less susceptible to deliberate damage or sabotage
    c. Ice pressure is not significant, because ice slides over the sloping deck
    d. The factor of safety is usually greater than for a gravity dam

20. A trash rack is not required at the entrance of a:
    a. Syphon spillway
    b. Drum gate installation
    c. Morning glory spillway
    d. High head gate installation

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SECTION "B"

Attempt *ALL* questions.

1. Define hydraulic Structures? Explain about broad classifications of the hydraulic structure based on its application? As a dam engineer what factors would you consider for the selection of the suitable dam site? [2+2]

2. List out the modes of failure of gravity dam. Explain with expression in detail about crushing/ compression failure? Explain the effect of top width on the elementary profile of dam (in both reservoir empty and reservoir full case). [2+2]

3. Neglecting the hydrodynamic force due to earthquake, examine the stability of the dam section shown in Figure1. Also calculate the various kinds of the stresses on the heel and toe of the dam. (Unit weight of water and concrete γ_w and γ_c are 10 kN/m^2 and 24 kN/m^3 respectively and take allowable stress in the concrete as 3000 kN/m^2, given average shear at the dam base is 1400 kN/m^2 and Coefficient of friction between dam base and dam is 0.75).

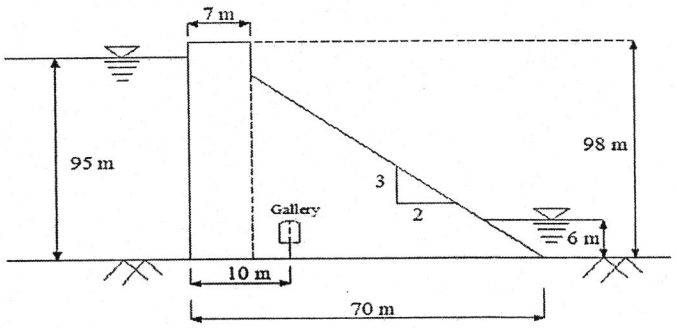

Figure 1 Section of Dam

Note: Consider the horizontal earthquake inertia force in downstream direction and Vertical earthquake inertia force in upward direction with a_h*=0. 2 &* a_v*=0. 1* [4+2]

4. Enumerate the two different methods which are adopted for construction of earthen dams. Which of these methods would you prefer and why? As a dam engineer how would you control seepage in earthen dam? How would you design multilayer filter in earthen dam? [1.5 + 2 + 0.75 +0.75]

5. How phreatic line of seepage is affected by the presence of horizontal drainage blanket in earthen dam & what would happen if drainage blanket is not provided?
An Earth Dam made up of homogeneous material has the following data,
Level of top of the dam = 200 m
Level of river bed U/S and D/S = 165 m
H.F.L. of reservoir = 195 m
Top width of the dam = 4.5 m
U/S slope = 3:1 (H: V) and D/S slope = 1.5:1 (H: V)
Coefficient of permeability of the dam material = 5 X 10^{-4} (cm/sec.)

Draw the seepage line if the horizontal filter of length equal to 20 m is provided inward from the downstream toe of the dam. [2+3]

6. Explain in brief the procedure to find the location of the center of the critical slip circle by ***Fellenius method.*** [3]

7. List out the limitation of the cylinder theory of arch dam analysis. If the dam site is narrow V shaped then which type of arch dam would you recommend and how would you design that particular type of dam? Write down detail procedure. [1+2]

8. Design a suitable section of Ogee Spillway with the following data. [5]
   i. D/S slope 0.8:1 (H:V)
   ii. Design discharge of 10000 m^3
   iii. Height of spillway crest at about R.L.=200.0 m
   iv. River bed level = 90 m.
   v. Spillway length consists of the 8 span having a clear width of 8 meter each
   vi. Thickness of the pier = 2.5 meter
   vii. Assume coefficient of discharge as C_d = 2.2, assume 90 degree cut water noise pier and round abutment so that coefficient of contraction of pier (K_p) is 0.01 & coefficient of contraction of abutment (K_a) as 0.1.
   viii. Assume suitable data (if needed)

   $x^{1.85} = 2\,y\,{H_d}^{0.85}$ (D/S profile of the spillway)

   $y = \frac{0.724\,(x+0.27H_d)^{1.85}}{{H_d}^{0.85}} + 0.126\,H_d - 0.4315\,{H_d}^{0.375}(x + 0.27\,H_d)^{0.625}$ (U/S profile of the spillway)

9. What are the components of buttress dam? List out the types of buttress dam with neat figures. [1+2]

10. Explain the types and components of the rock fill dam with neat figures. [2]