Bengal Engineering and Science University, Shibpur

M.E.(C.E)1st Semester examination,2011

Elements of Design of Hydraulics Structures (C.E.-911)

Full Marks : 70 Time : Three hours

Candidates are allowed to use all text books and class notes in examination hall.
Answer any four questions. All questions carry equal marks.
Assume any data reasonably if required.

1 (a) The top width of a 100 m high gravity dam is 7.5 m, its u/s face is vertical up to a depth of 40 m from top after which it battered at a slope of 0.02 (H): 1(V) 40 m from top after which it battered at and its d/s face is vertical up to a depth of 10 m from top after which it battered at a slope of 0.7 (H): 1(V). A drainage gallery is provided at a distance of 7.5m from the heel. The free board provided is 5 m. Assuming no tail water find the water force on the u/s face of the dam and the uplift force the uplift force. Find also the increase in the uplift force if the drainage gallery is inoperative. Find also the silt force if the depth of silt deposited is 40 m.

(b)Find the wave force generated if the height of the wave is 2 m.

2. Find the horizontal shear and moment developed due to seismic inertia force at the base of the dam in problem1(a) by seismic co-efficient method. Assume 5% damping and location of the dam in seismic zone III. Assume specific weight of concrete, modulus of elasticity of concrete, and specific weight of water as 24.525 kN/m^3.

3. Find the horizontal shear and moment developed due to seismic inertia force at the base of the dam in problem1(a) by response spectra method. Assume 5% damping and location of the dam in seismic zone IV. Also find the hydrodynamic force and its moment at base level. Assume specific weight of concrete, modulus of elasticity of concrete, and specific weight of water as 24.525 kN/m^3, 20.6 N/mm^2, and 9.81 kN/m^3 respectively.

4. (a) For the gravity dam described in problem 1(a) find the factor of safety against sliding, the factor of safety against overturning and shear friction factor considering extreme uplift and water force only taking μ =o.7 and τ =1373.4 kN/m^2.

(b) Also calculate principal stresses developed at the toe and heel.

5. A 25m high homogeneous earth dam has a crest width 6 m, u/s slope 3.5 (H) : 1 (V) and d/s slope 3 (H) : 1 (V). Assuming the top shoulder of the u/s slope of the dam 4 m above the seepage line, check stability of u/s slope against horizontal shear. The saturated unit weight, submerged unit weight, angle of repose and cohesion of soil may be taken as 21.19 kN/m^3, 11.38 kN/m^3, 300, 39.24 kN/m^2 respectively.

6.(a)If the free board of the above dam is 3 m and co-efficient of permeability of the dam material is $4X10^{-6}$ m/s estimate the seepage loss per unit length of the dam when (i) no horizontal drainage blanket is provided near toe and (ii) horizontal drainage blanket of 25 m length is provided at d/s end.

(b) Discuss briefly how you check the stability of slopes of earth dams by slip circle method.

7. Design a suitable section for the spillway of a concrete gravity dam having d/s sloping at 0.7 (H):1 (V). The design discharge is 9000 m3/s. Spillway crest is to be kept at RL 200 m, the average bed level of the river being at RL 100 m. The spillway consists of 9 spans having a clear width of 9 m each. Thickness of each pier may be taken as 2.5m.