

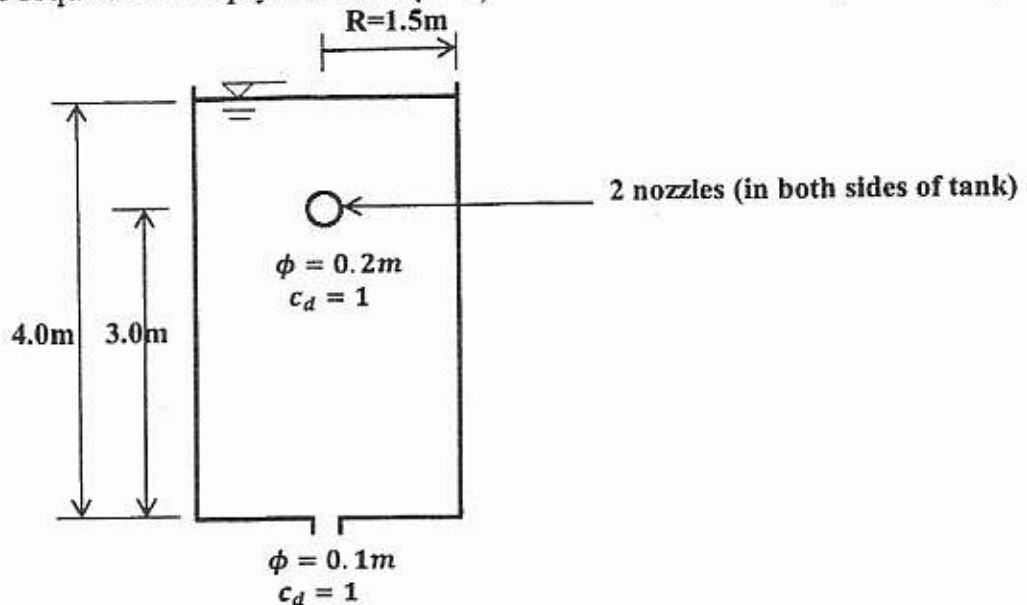


University of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2010/2011
Subject : Engineering Analysis **Class: 3rd year**
Branch : All branches **Time : 3 Hours**
Date :11/ 6 / 2011



Part One: Engineering Analysis – Q1 , Q2 , Q3 and Q4
Answer three questions including Q1 (52 marks)

- Q1:** At $t = 0$ the tank shown in the figure below is full up to the top level. 1
 1-Write the differential equation for the function of depth $y(t)$ with respect to time (t) . (8 marks)
 2- Find the time required to empty the tank. (2 marks) (20 marks)



- Q2:** An uniform metal bar 10 units long has $u(0, t) = u(10, t) = 0$, and at $t = 0$ the distribution of the temperature will be according to the function $f(x) = 10 - x$.
 Solve the heat equation $\frac{\partial^2 U}{\partial x^2} = \frac{1}{c^2} \cdot \frac{\partial U}{\partial t}$ using $C^2 = 4$ to determine $u(x, t)$ at any point in the bar at time t .

Note: Start your answer from this equation $u(x, t) = (A \sin \frac{\omega}{c} x + B \cos \frac{\omega}{c} x) \cdot e^{-\omega^2 t}$ (16 marks)

- Q3:** Find one of the solution of the following ordinary differential equation:

$$x^2 \cdot y'' + 2x(x - 1) \cdot y' + 2y = 0 \quad (16 \text{ marks})$$

- Q4:** Find out the half range cosine expansion for the following function: (Fourier series)

$$f(x) = x \quad 0 \leq x \leq 1$$

(16 marks)

Part Two: * Numerical Analysis – Q5 , Q6 , Q7 , and Q8
 * Answer three questions (48 marks)
 * Solve for 4 digits after decimal point.

Q5: By Gauss elimination solve the following equations:

$$8X_1 + 2X_2 + 3X_3 = 30$$

$$X_1 - 9X_2 + 2X_3 = 1$$

$$2X_1 + 3X_2 + 6X_3 = 31$$

(16 marks)

Q6 /A : Evaluate the following integral using Gaussian Quadratic method (k=3).

$$\int_{0.3}^{0.6} x^2 \cdot e^{2x} \cdot dx$$

(8 marks)

Q6 /B : Use Newton-Raphson method with $x_0 = 1.5$ to find the root of the equation $\ln x + x = 2$. (8 marks)

Q7: Use the 4th Runge – Kutta method to find y at x=0.2 for the following differential equation take a step size h=0.2 .

$$y' = \cos x + y \quad \text{if } y(0) = 2 \quad (16 \text{ marks})$$

Q8: For the loaded beam shown in the figure below, the deflection at pivotal point (3) equal to (0.02 m ↑) and $EI = 1 \times 10^4 \text{ kN} \cdot \text{m}^2$. Find :

(a) : The deflection at pivotal point (1) . (b) : The fixed end moment at pivotal point (0) .

(16 marks)

