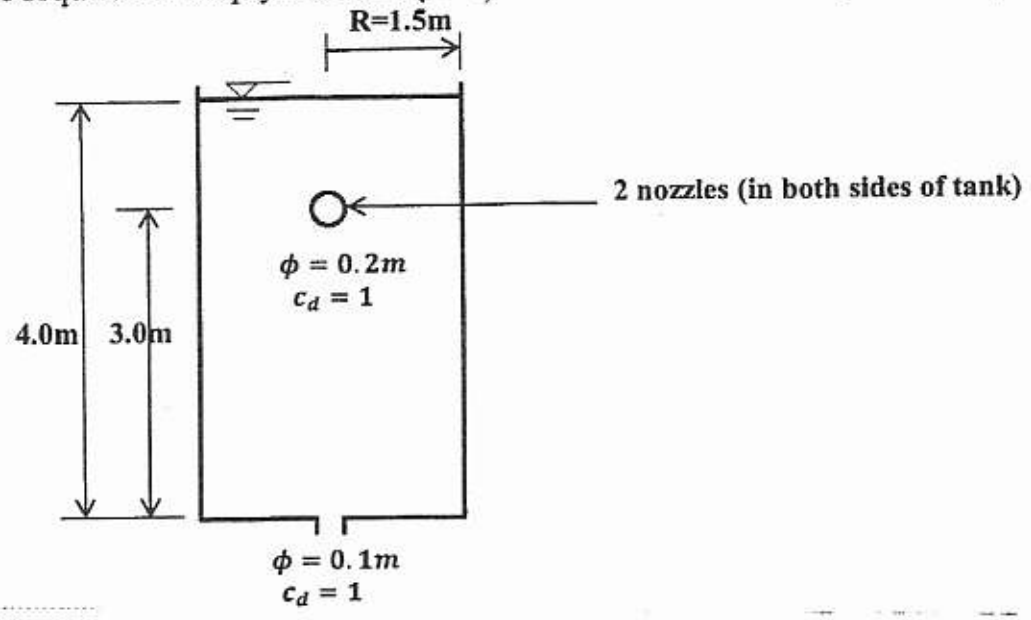
University of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2010/2011

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-Write the differential equation for the function of depth y(t) with respect to time (t).(8 %)
2- Find the time required to empty the tank. (2 %) ***(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:

$$x^2 . y'' + 2x(x-1) \cdot y' + 2y = 0$$ ***(16 marks)***

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

$$f(x) = x \qquad 0 \le x \le 1$$

(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).

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

(8 marks)

Q6 /B : Use Newton-Raphson method with $x_\circ = 1.5$ 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 .

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

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

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

(16 marks)