Course Title: Modeling & Simulation	Date: 7/6/2010
Course No: (630573)	Time Allowed: 2 Hours
Lecturer: Dr. Mohammed Mahdi	No. of Pages: 1

Question 1:   *(12 Marks)*
Objectives: This question is about the classical and modern representation of mathematical models.

A) Decompose the following classical model representation into its equivalent stat-space representation, and then sketch the state-space analog computer simulation circuit diagram. $\dfrac{Y(s)}{R(s)} = \dfrac{2s^2 + 3s + 1}{s^2 + 4s + 5}$ **(6 Marks)**

B) When and why one can use Runge-Kutta numerical integration method? **(3 Marks)**

C) Physically what do the terms homogenous and non-homogeneous differential equations mean to you? **(3 Marks)**

Question 2:   *(12 Marks)*
Objectives: This question is about finding system's response and analog simulation.

A) Derive the time response of the transfer function mathematical model $\dfrac{Y(s)}{R(s)} = \dfrac{1}{s^2 + 6s + 8}$ for a unit step change in input, and then extract its parameters and characteristics. **(6 Marks)**

B) Develop an analog computer simulation circuit diagram to solve the following simultaneous differential equations. **(6 Marks)**

$$\ddot{x} + 5\dot{x} + 4\dot{y} + 6x = 2 \quad \textbf{And} \quad 2\ddot{y} + 3\dot{y} + 2\dot{x} + 2y = 0, \textbf{with } x(0) = y(0), \dot{x}(0) = \dot{y}(0) = 1$$

Question 3:   *(12 Marks)*
Objectives: This question is about the identification concepts.

A) Identification can be defined as the determination of a system model on the basis of input and output signals. It is required to show the identification procedures diagram that clarifies the ways of model extraction. Which way is always available? Why? **(6 Marks)**

B) Given a tank with level H, capacitance C, input flow rate Fi, output flow rate Fo through a valve with resistance R. It is required to use physical laws to extract its mathematical model. **(6 Marks)**

Question 4:   *(14 Marks)*
Objectives: This question is about MATLAB applications.

A) Show with example how one can use the MATLAB instruction subplot to plot 4-figure on the same portrait. **(7 Marks)**

B) Given the state-space system representation of $A = \begin{bmatrix} 0 & 1 \\ -0.5 & -0.5 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $C = \begin{bmatrix} 1 & 0 \end{bmatrix}$, $D = 1$,

It is required to: -
1. Find its transfer function model.
2. Use classical model to write a MATLAB code that plots its unit ramp response for ten seconds. Put suitable definitions for axis and title. **(7 Marks)**