Philadelphia University | **Student Name:**

Faculty of Engineering | **Student Number:**

Dept. of Mechatronics Engineering

Final Exam, First Semester: 2014/2015

Course Title: Advanced Engineering Mathematics	**Date: 12/2/2015**
Course No: (640711) – Msc. Course	**Time Allowed: 2 Hours**
Lecturer: Dr. Mohammed Mahdi	**No. of Pages: 2**

Question 1: **(30 Marks)**

Objectives: This question is about exponential matrix, state-space representation, and solution of dynamic equations using Laplace and Z transformations.

Choose three of the following

A) Given matrix A= $= \begin{bmatrix} 2 & 3 \\ 0 & 2 \end{bmatrix}$**. It is required to calculate A^5 using Cayley Hamilton theorem.** *(10 Marks)*

B) Solve the following difference equation using partial fraction and z-transform. *(10 Marks)*

x(k) – 3x(k-1)+2x(k-2)=e(k), with x(-2)=x(-1)=0, and e(k)=1 for k=0, 1 and e(k)=0 for e(k)≥2.

C) Given A, B, C, and D state-space matrices it is required to sketch its block diagram and then derive a formula for transfer function.(10 Marks)

D) Solve the given differential equation using Laplace transform.(10 Marks)

$$y'' + y = t \quad \text{with } y(0) = 1,\ y'(0) = -2$$

Question 2: **(20 Marks)**

Objectives: This question is about the solution of state space mathematical model.

Given the following transfer function: -

$$G(s) = \frac{(s-1)}{(s+1)(s+2)}$$

It is required to: -

1. **Extract its canonical state space matrices.**(5 Marks)
2. **Use Sylvester's criterion to find its state transition matrix (e^{At}).**(15 Marks)

<u>Question 3:</u> **(20 Marks)**

Objectives: This question is about numerical solutions.

<u>Choose two of the following</u>

A) Solve f(y) = y^{1000}, using <u>2-iteration of Newton-Raphson</u> iterative method take initial value for y = 0.1, calculate error relative for the last iteration.*(10 Marks)*

B) Apply <u>2nd order Lagrange</u> interpolating polynomial for the data given in the table below to estimate f (- 0.25).*(10 Marks)*

x	- 1.5	- 0.75	0
f(x)	- 1.41	- 0.9316	0

C) Find y (0.3) with step size h=0.1 for $\dot{y} = -2y + 3e^{-4t}$ **, with y(0) =1 using <u>Euler numerical integration method</u>.***(10 Marks)*

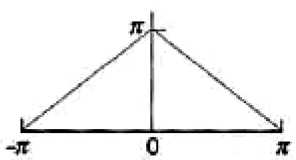
<u>Question 4:</u> **(30 Marks)**

Objectives: This question is about complex numbers and Fourier transform.

A) Given $z_1 = 3 + 2j$ **and** $z_2 = 3 - 3j$ **it is required to express both complex numbers in polar form and find** $z_1 z_2$ **and** $\frac{z_1}{z_2}$ **using both representations.**

(15 Marks)

B) Find the constant Fourier coefficients ($a_\circ$ **) for the periodic functions given below : -** (15 Marks)



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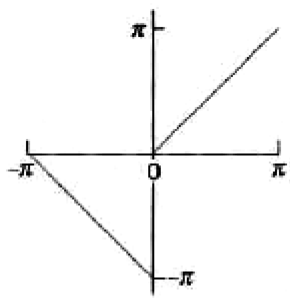

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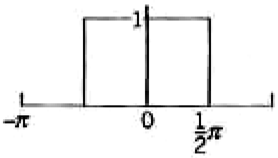

(3)

Good Luck