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BIEEE-009

B.Tech. – VIEP – ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

00959

December, 2017

BIEEE-009 : DIGITAL CONTROL SYSTEM DESIGN

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. Each question carries equal marks. Use of scientific calculator is permitted.*

1. (a) Draw the block diagram of a variable speed DC drive digital control system. Explain the function of each block. 7

(b) Define First Order Hold (FOH) for the power series expansion given by

$$fk(t) = f(kT) + f^{(1)}(kT)\,(t - kT) + \frac{f^{(2)}(kT)}{2!}(t - kT)^2 + \ldots$$

where $fk(t) = f(t)$ for $kT \le t \le (k + 1)T$

and $f^{(n)}(kT) = \left.\frac{d^n f(t)}{dt^n}\right|_{t=kT}$ for $n = 1, 2, \ldots$

and draw the impulse response. 7

2. (a) What are the factors affecting choice of sampling rate in a discrete system ? *4*

(b) Consider the difference equation

$$y(k+2) + a_1 y(k+1) + a_2 y(k) = b_0 r(k+2) + b_1 r(k+1) + b_2 r(k)$$

Assuming that the system is initially at rest and $r(k) = 0$ for $k \geq 0$, obtain the transfer function $G(z) = \frac{Y(z)}{R(z)}$. *10*

3. Using Jury's stability test, check the stability of the system given by characteristics equation *14*

$$P(z) = z^4 - 1{\cdot}2z^3 + 0{\cdot}07z^2 + 0{\cdot}3z - 0{\cdot}08 = 0$$

4. (a) What is deadbeat response in controller design ? *7*

(b) Explain the operation of a deadbeat controller having manipulated variable. Draw the complete block diagram. *7*

5. (a) Write the steps for the computation of state transition matrix using Cayley-Hamilton theorem. *7*

(b) Establish the correlation between state variable and transfer function models for discrete data systems. *7*

6. (a) Discuss the system response between sampling instants using the state variable method for a system having state transition equation

$$x(t) = \phi(t - t_0)\, x(t_0) + u(t_0) \int_{t_0}^{t} \phi(t - \tau) B \, d\tau$$

where $x(t_0)$ is the initial state of the system and $u(t)$ is the external input. *10*

(b) How can there be loss of controllability due to bad sampling ? *4*

7. Write short notes on any ***two*** of the following : *2×7=14*

(a) Multirate Discrete Data System

(b) Cascade Compensators

(c) Pole Placement Design using State Feedback for SISO Systems