Total No. of Questions : 10] SEAT No. :

P4311 [Total No. of Pages : 3

[4760] - 116

M.E. (Mech.) (Design Engg. & Automotive Engg.)

MATHEMATICAL MODELING AND ANALYSIS

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) *Solve any three questions from section - I and any three questions from section - II.*
2) *Answers to each section should be written in separate answer book.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data wherever necessary but mention it clearly.*
5) *Use of scientific calculator is allowed.*

SECTION - I

Q1) a) Linearize the differential equation given below for a small excursion about $x = \pi/4$. $\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + \cos x = 0$ **[12]**

b) Explain the followings : **[6]**

i) Time invariant system

ii) Discrete time system

Q2) a) State the physical laws governing a fluid system. **[4]**

b) Derive the differential form of the momentum equation for a fluid system. **[12]**

Q3) For an electrical circuit shown in Figure 1, obtain a mathematical model and an equation for the current i(t). Assume that the switch S is open for $t < 0$, closed at $t = 0$ and is opened again at $t = t_1 > 0$. **[16]**

Q4) a) Draw linear graphs for the systems shown in Figure 2. **[6]**

b) Explain explicit and implicit numerical techniques. **[10]**

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Q5) Figure 3 shows an input x[n] to a linear time invariant system and its impulse response h[n]. Determine the convolution of x[k] and h[n]. **[16]**

SECTION II

Q6) Solve the following initial value problem using Laplace transform technique.

$y''(t)-3y'(t)+2y(t)=4e^{2t}$ when $y(0)=-3$ and $y'(0)=5$ **[16]**

Q7) Determine z transforms of the following signals : **[16]**

a) $x(m)=1$ for m $=0$ and $x(m)=0$ for m $\neq 0$.

b) $x(m)=1$ for m $=k$ and $x(m)=0$ for m $\neq k$.

c) $x(m)=1$ for m $=-k$ and $x(m)=0$ for m $\neq -k$.

d) $x(m)=1$ for m $=\pm k$ and $x(m)=0$ for m $\neq \pm k$.

Q8) Construct a wavelet set for a map defined by $T(x)=x/2$ for all $x\in Q=[-\pi,\pi)$. **[16]**

Q9) Write short notes : **[16]**

a) Deterministic simulation

b) Monte Carlo Simulation

Q10) Compare the followings : **[18]**

a) Analytical and monte Carlo simulations

b) Deterministic model and stochastic model

Figures :

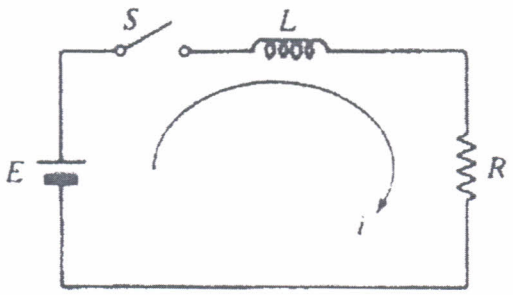

Figure 1

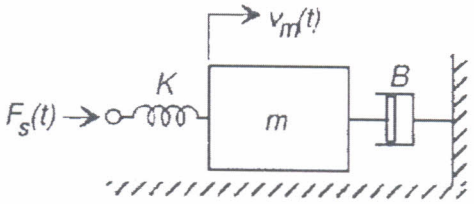

Figure 2

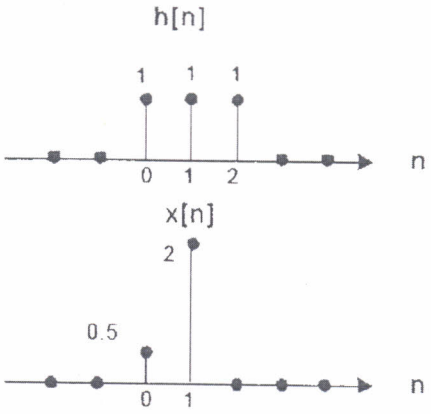

Figure 3