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06MAT41

Fourth Semester B.E. Degree Examination, December 2010
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Any missing data may be suitably assumed.

PART – A

1 a. Given $\frac{dy}{dx}+y-x^2=0$, $y(0) = 1$, $y(0.1) = 0.9052$, $y(0.2) = 0.8213$. Find correct to four decimal places y(0.3) and y(0.4) using modified Euler's method. **(07 Marks)**

b. Apply Runge – Kutta method of order four, to compute y(2.0). Given $10\frac{dy}{dx}=x^2+y^2$, $y(0) = 1$, taking $h = 0.1$. **(07 Marks)**

c. The following table gives the solution of $\frac{dy}{dx}=x-y^2$. Find the value of y at x = 0.8, using Milne's predictor and corrector formulae.

X	0	0.2	0.4	0.6
Y	0	0.02	0.07	0.17

(06 Marks)

2 a. Show that polar forms of Cauchy's Riemann equation are $\frac{\partial u}{\partial r}=\frac{1}{r}\frac{\partial V}{\partial \theta}, \frac{\partial V}{\partial r}=-\frac{1}{r}\frac{\partial u}{\partial \theta}$. Deduce that $\frac{\partial^2 u}{\partial r^2}+\frac{1}{r}\frac{\partial u}{\partial r}+\frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2}=0$. **(07 Marks)**

b. Determine the analytic function $w = u + i\upsilon$ if $V = \log(x^2+y^2)+x-2y$. **(07 Marks)**

c. Find the Bilinear transformation which maps the points z = 1, i, -1 into w = 0, 1, ∞. **(06 Marks)**

3 a. State and prove Cauchy's integral formula. **(07 Marks)**

b. Find the Laurent series of $\frac{3x^2-6z+2}{z^3-3z^2+2z}$. i) $1<|z|<2$ ii) $|z|>2$. **(07 Marks)**

c. Evaluate $\int_c \frac{\sin \pi z^2+\cos \pi z^2}{(z-1)^2(z-2)}dz$, where c is $|z| = 3$ using Cauchy's residue theorem. **(06 Marks)**

4 a. Solve the equation in series $\frac{d^2y}{dx^2}+x^2y=0$. **(07 Marks)**

b. Obtain the series solution of Bessel's differential equation in the form $y=AJ_n(x)+BJ_{-n}(x)$. **(07 Marks)**

c. If $x^3+2x^2-x+1 = aP_0(x)+bP_1(x)+cP_2(x)+dP_3(x)$, find the value of a, b, c, d. **(06 Marks)**

PART – B

5 a. Fit a curve of form $y = ab^x$ and hence estimate y when x = 8.

X	1	2	3	4	5	6	7
Y	87	97	113	129	202	195	193

(07 Marks)

b. If θ is the angle between the lines of regression then show that

$$\tan\theta = \frac{\sigma_x \sigma_y}{\sigma_x^2 + \sigma_y^2}\left(\frac{1-r^2}{r}\right)$$ **(07 Marks)**

c. State and prove Baye's theorem. **(06 Marks)**

6 a. The pdf of a variate X is given by the following table :

X	0	1	2	3	4	5	6
P(x)	k	3k	5k	7k	9k	11k	13k

For what value of k, this represents a valid probability distribution?
Also find : i) $P(x \geq 5)$ ii) $P(3 < x \leq 6)$. **(07 Marks)**

b. Given that 2% of the fuses manufactured by a firm are defective, find by using Poisson distribution, the probability that a box containing 200 fuses has
i) No defective fuses ii) 3 or more defective fuses iii) At least one defective fuse. **(07 Marks)**

c. The marks of 100 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students whose marks will be i) less than 65 ii) more than 75 iii) between 65 and 75. **(06 Marks)**

7 a. Explain the following terms :
i) Null hypothesis ii) Type I and type II error iii) Confidence limits. **(07 Marks)**

b. A sample of 100 days is taken from a coastal town of a certain district and of 10 of them are found to be very hot. What are the probable limits of the percentage of hot days in the district? **(07 Marks)**

c. A certain stimulus administrated to each of the 12 patients resulted in the following change in blood pressure.
5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4. Can it be concluded that the stimulus will increase the blood pressure? ($t_{0.05}$ for 11 df = 2.201). **(06 Marks)**

8 a. The joint probability distribution of two random variables x and y is as follows :

x \ y	-2	-1	4	6
1	0.1	0.2	0	0.3
2	0.2	0.1	0.1	0

Determine :
i) The marginal distribution of x and y ii) Co variance of x and y iii) Correlation of x and y. **(07 Marks)**

b. Verify that the matrix

$$A = \begin{bmatrix} 0 & 0 & 1 \\ \frac{1}{2} & \frac{1}{4} & \frac{1}{4} \\ 0 & 1 & 0 \end{bmatrix}.$$

is a regular stochastic matrix. **(07 Marks)**

c. Explain:
i) Absorbing state of Markov chain ii) Transient state iii) Recurrent state. **(06 Marks)**

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06ES42

Fourth Semester B.E. Degree Examination, December 2010
Microcontrollers

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer any FIVE full questions, selecting atleast TWO questions from Part – A and Part - B.***
2. ***Missing data may be assumed suitably.***

PART - A

1 a. Bring out the architectural difference between Von – Neumann and Harvard architecture. **(06 Marks)**
b. With a neat diagram, write the programming model of 8051 with addresses of SFRs and ports. Also give the 128 bytes RAM allocation. **(10 Marks)**
c. Explain the oscillator circuit and timing of a 8051 micro controller. **(04 Marks)**

2 a. Write a program to set the carry flag to 1, if the number in reg A is even and reset the carry flag to 0, if the number in reg A is odd. Use the assembly language of 8051. **(04 Marks)**
b. Explain the following instructions of 8051 with examples :
i) XCHD A, @ Ri ii) MOV CA, @ A + PC iii) SWAP A iv) RL A
v) MUL AB vi) DA A. **(09 Marks)**
c. Explain the different addressing modes of 8051. Give an example for each of them and state the advantages and disadvantages of each. **(07 Marks)**

3 a. Explain the different types of conditional and unconditional jump instructions of 8051. Specify the different ranges associated with jump instructions. **(08 Marks)**
b. Find the address of first two internal RAM locations between 20H and 40H, which contains consecutive numbers. If so, set the carry flag to 1, else clear the carry flag. **(06 Marks)**
c. What does the following program do? What is the final result in accumulator? Give the result in terms of functionality.

```
START : MOV A, R3
        RLA
        ANL A, # OAAh
        PUSH ACC
        MOV A, R3
        RRA
        ANL A, # 55h
        MOV R3, A
        POP ACC
        ORL O3h, A
        STMP $
        END
```
(06 Marks)

4 a. Explain C data types for 8051 with their data size in bits and data range. **(06 Marks)**

b. Write a 8051 C – program to read the P1.0 and P1.1 bits of 8051 and issue an ASCII character to port 0 according to the following table. Use case statement only. **(08 Marks)**

P1.1	P1.0	
0	0	Send '0' to PO
0	1	Send '1' to PO
1	0	Send '2' to PO
1	1	Send '3' to PO

c. Write a 8051 C program to convert packed BCD number 0 × 29 to ASCII and display the result on port 1 and port 2. **(06 Marks)**

PART - B

5 a. Explain the different modes of operation of timer / counter of 8051 with relevant block diagram and steps to program the modes. **(07 Marks)**

b. With a neat diagram, explain the TMOD and TCON registers of 8051. **(08 Marks)**

c. Write a 8051 C program to toggle all the bits of port P1 continuously with some delay in between. Use timer 0, 16 bit mode to generate the delay and calculate the delay in msec. **(05 Marks)**

6 a. Explain the serial port of 8051. In detail, explain the SCON register with the diagram. **(08 Marks)**

b. State asynchronous serial communication and data framing. Explain with diagram RS232 pinout. **(08 Marks)**

c. Write a program in assembly language for 8051 to transfer the message "XES" serially at 9600 band, 8 bit data, 1 stop bit. Do this continuously. **(04 Marks)**

7 a. Explain the six interrupts of 8051, with the priority and interrupt vector table. **(07 Marks)**

b. Explain with a diagram, IP and IE registers of 8051. What is their significance? **(08 Marks)**

c. Write an ALP for 8051 to generate a square wave of 50Hz frequency on P1.2, using an interrupt for timer 0. Assume that XTAL = 11.0592 MHz. **(05 Marks)**

8 a. Explain with a diagram, the interfacing of DAC 0808 to 8051 chip. Write the program to generate a sine wave on the CRO. Show the relevant calculation and look up table. **(08 Marks)**

b. Show the interfacing circuit and functional pins of LCD. **(04 Marks)**

c. With a neat diagram, show how a stepper motor is interfaced to 8051. Write a program to rotate it continuously. **(08 Marks)**

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06ES43

Fourth Semester B.E. Degree Examination, December 2010
Control Systems

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. *Standard notations are used.*
3. *Missing data, if any, may be suitably assumed.*

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Define and compare open loop control systems with closed loop control systems, with examples. **(06 Marks)**

b. For the mechanical system shown in Fig.Q1(b), write the differential equation relating to the position y(t) and the force f(t). **(04 Marks)**

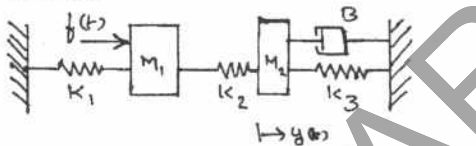

Fig.Q1(b)

c. Derive the electrical analogous quantities for the mechanical quantities using Force-voltage analogg. **(05 Marks)**

d. Derive the mathematical model for an armature controlled DC motor. **(05 Marks)**

2 a. Define the transfer function. Explain Mason's gain formula for determining the transfer function from signal flow graphs. **(06 Marks)**

b. For the block diagram shown in Fig. Q2(b), determine the transfer function $\frac{Q_2(s)}{Q(s)}$ using block diagram reduction algebra. **(08 Marks)**

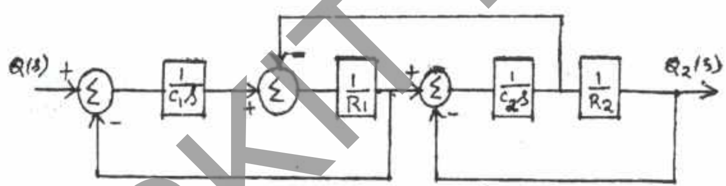

Fig.Q2(b)

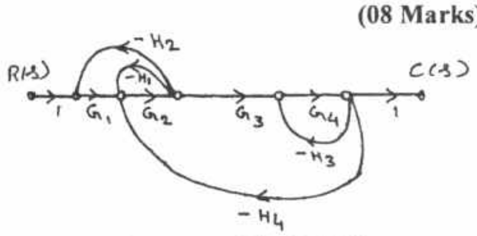

Fig.Q2(c)

c. For the system described by the signal flow graph shown in Fig.Q2(c), obtain the closed loop transfer function $\frac{C(s)}{R(s)}$, using Mason's gain formula. **(06 Marks)**

3 a. Define the following for an underdamped second order system :
i) Rise time ii) Peak overshoot iii) Settling time. **(06 Marks)**

b. Define the steady state error coefficients. Consider a unity feedback control system whose open loop transfer function is $G(s) = \frac{100}{s(0.1s+1)}$. Determine the steady state error, when the input is $r(t) = 1 + t + at^2$; $a \geq 0$. **(06 Marks)**

c. The forward path transfer function of a certain unity negative feedback control system is G(s). The system is subjected to unit step input. From the transient response curves, it is observed that the system peak overshoot is 15% and the time at which it occurs is 1.8 secs. Determine the closed loop transfer function of the system. **(08 Marks)**

4 a. Define absolute stability and marginal stability. **(04 Marks)**

b. The open loop transfer function of a unity negative feedback control system is given by :

$$G(s) = \frac{K(s+2)}{s(s+1)(s+3)(s+5)}.$$

Determine the value of K at which the system is just stable. **(08 Marks)**

c. A unity feedback control system has:

$$G(s) = \frac{20K}{s[(s+1)(s+5)+20]}, \qquad \text{where} \quad r(t) = 2t$$

It is desired that for ramp input $l(t)_{ss} \leq 1.5$. What minimum value must K have for this condition to be satisfied? With this K, is the system stable? **(08 Marks)**

PART – B

5 a. Define and explain the significance of angle and magnitude condition, as applied to the root locus method of stability analysis of linear system. **(06 Marks)**

b. Define brake away / in point on a root locus. Explain any one method of determining the same. **(06 Marks)**

c. For the following characteristic polynomial $s^2 + 2s + 2 + K(s+1) = 0$, draw the root locus for $0 \leq K \leq \infty$. **(08 Marks)**

6 a. Explain Nyquist's stability criterion. **(04 Marks)**

b. The open loop transfer function of a unity negative feedback system is given by:

$$G(s) = \frac{K(s+3)}{s(s^2+2s+2)}.$$

Using the Nyquist criteria, find the value of K for which the closed loop system is just stable. **(08 Marks)**

c. Derive an expression for the resonant frequency and resonant peak for a closed loop system having a second order transfer function. **(08 Marks)**

7 a. For the system having open loop transfer function given by :

$$G(s) = \frac{10(1+0.125s)}{s(1+0.5s)(1+0.25s)}$$

Draw the asymptotic Bode magnitude and phase plots. Also determine the phase and gain crossover frequencies and gain and phase margins. Comment on closed loop stability. **(12 Marks)**

b. For the Bode plot shown, evaluate the transfer function. Refer Fig.Q7(b). **(08 Marks)**

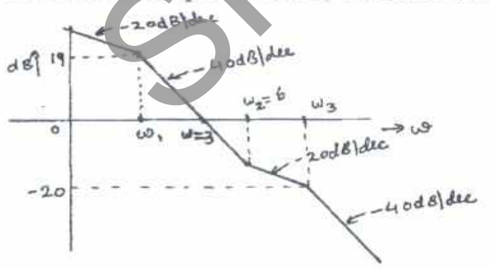

Fig.Q7(b)

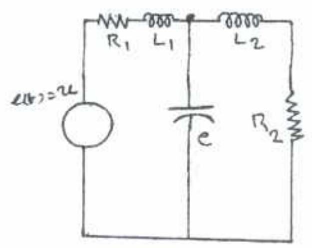

Fig.Q8(a)

8 a. Obtain the state and output equation for the electrical network shown in Fig.Q8(a). **(08 Marks)**

b. The state model of the system is given by :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3 & -4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t), \quad \begin{bmatrix} x_1(0) \\ x_2(2) \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad \text{where} \quad \begin{aligned} u(t) &= 0 \quad \text{for } t < 0 \\ &= e^{-t} \quad \text{for } t \geq 0 \end{aligned}$$

Obtain the response of the system. **(12 Marks)**

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06EC44

Fourth Semester B.E. Degree Examination, December 2010
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Distinguish between : i) Periodic and non-periodic signals and ii) Deterministic and random signals. **(04 Marks)**

b. A signal x(t) is as shown in figure Q1 (b). Find its even and odd parts. **(06 Marks)**

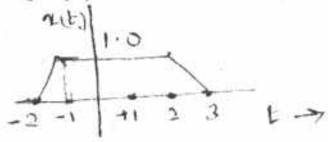

Fig. Q1 (b)

c. Two signals x(t) and g(t) are as shown in figure Q1 (c). Express the signals x(t) in terms of g(t). **(06 Marks)**

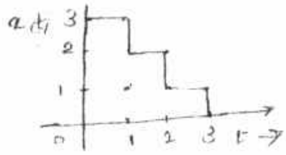

Fig. Q1 (c) – (i)

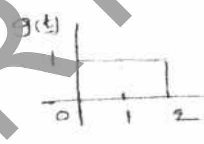

Fig. Q1 (c) – (ii)

d. A system is described by $y(n) = (n+1)x(n)$. Test the system for (i) memory less (ii) Causality (iii) Linearity (iv) Time invariance and (v) Stability. **(04 Marks)**

2 a. An LTI system has impulse response $h(n) = [U(n) - U(n-4)]$. Find the output of the system if the input $x(n) = [U(n+10) - 2U(n+5) + U(n-6)]$. Sketch the output. **(08 Marks)**

b. Show that an arbitrary signal x(n) can be expressed as a sum of weighted and time shifted impulses, $x(n) = \sum_{K=-\infty}^{\infty} x(k)\delta(n-k)$. **(04 Marks)**

c. An LTI system is described by an impulse response $h(t) = [U(t-1) - U(t-2)]$. Find the output of the system if the input x(t) is as shown in figure Q2 (c). Sketch the output. **(08 Marks)**

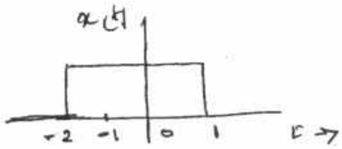

Fig. Q2 (c)

3 a. Two LTI systems with impulse responses $h_1(n)$ and $h_2(n)$ are connected in cascade. Derive the expression for the impulse response if the two systems are replaced by a single system. **(04 Marks)**

b. An LTI system has its impulse response, $h(n) = 4^{-n} U(2-n)$. Determine whether the system is memory less, stable and causal. **(04 Marks)**

c. A system is described by a differential equation,

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t) + \frac{dx(t)}{dt}.$$ Determine its forced response if the input $x(t) = [\cos t + \sin t]U(t)$ **(06 Marks)**

3 d. Draw the direct form I and direct form II implementations for the following difference equation, $y(n)+\frac{1}{2}y(n-1)-y(n-3)=3x(n-1)+2x(n-2)$. **(06 Marks)**

4 a. State and prove convolution property of continuous time Fourier series. **(06 Marks)**

b. Find the DTFS co-efficients of the signal shown in figure Q4 (b), **(08 Marks)**

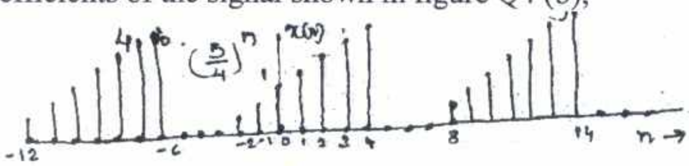

Fig. Q4 (b)

c. Determine the time domain signal x(t), whose Fourier co-efficient are,

$X(K)=\frac{3}{2}e^{-J\frac{\pi}{4}}, K=-1$; $X(K)=\frac{3}{2}e^{J\frac{\pi}{4}}, K=1$; $X(K)=0$ otherwise. **(06 Marks)**

PART - B

5 a. State and prove the following properties of Fourier transform:

i) Frequency shifting property ii) Time differentiation property **(06 Marks)**

b. Show that the Fourier transform of a train of impulses of unit height separated by T secs is also a train of impulses of height $\omega_0=\frac{2\pi}{T}$ separated by $\omega_0=\frac{2\pi}{T}$ sec. **(08 Marks)**

c. Find the DTFT of following signals and draw its magnitude spectrum:

i) $x(n)=a^n U(n)$; $|a|<1$ ii) $x(n)=\delta(n)$ unit impulse. **(06 Marks)**

6 a. The system produces an output $y(t)=e^{-t}u(t)$ for an input of $x(t)=e^{-2t}u(t)$. Determine the frequency response and impulse response of the system. **(08 Marks)**

b. State and prove sampling theorem for low pass signals. **(07 Marks)**

c. Find the Nyquist rate for the following signals:

i) $x(t)=25e^{J500\pi t}$ ii) $[x(t)]=[1+0.1\sin(200\pi t)]\cos(2000\pi t)$ **(05 Marks)**

7 a. State and prove time reversal and differentiation in Z-domain properties of Z-transforms. **(06 Marks)**

b. Find the Z-transforms of following sequences including R.O.C.: i) $x(n)=-\left(\frac{1}{2}\right)^n u(-n-1)$

ii) $x(n)=\alpha^{|n|}$ $|\alpha|<1$ **(06 Marks)**

c. The Z-transform of sequence x(n) is given by, $X(z)=\frac{z(z^2-4z+5)}{(z-3)(z-2)(z-1)}$

Find x(n) for the following ROC's:

i) $2<|z|<3$ ii) $|z|>3$ iii) $|z|<1$. **(08 Marks)**

8 a. Solve the following linear constant co-efficient difference equation using z-transform method: $y(n)-\frac{3}{2}y(n-1)+\frac{1}{2}y(n-2)=\left(\frac{1}{4}\right)^n u(n)$ with initial conditions, $y(-1)=4$, $y(-2)=10$. **(10 Marks)**

b. A causal system has input x(n) and output y(n). Find the impulse response of the system if,

$x(n)=\delta(n)+\frac{1}{4}\delta(n-1)-\frac{1}{8}\delta(n-2)$; $y(n)=\delta(n)-\frac{3}{4}\delta(n-1)$

Find the output of the system if the input is $\left(\frac{1}{2}\right)^n u(n)$. **(10 Marks)**

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06EC45

Fourth Semester B.E. Degree Examination, December 2010
Fundamentals of HDL

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. *Missing data may be suitably assumed.*

PART – A

1 a. Discuss the needs of HDL. **(06 Marks)**
b. With general syntax and suitable examples, explain the shift operators available in VHDL and verilog. **(12 Marks)**
c. Differentiate between an entity and a symbol. **(02 Marks)**

2 a. What do you mean by the data flow style of description? Explain its features with a suitable example. **(05 Marks)**
b. Write a data flow description VHDL for a system that has three 1-bit inputs a(1), a(2) and a(3); and one 1-bit output b. The least significant bit is a(1); and b is 1, only when (a(1)a(2)a(3)) = 1, 3, 6 or 7 (all in decimal). Otherwise b is 0. Derive a minimized Boolean function of the system and write the data flow description. **(10 Marks)**
c. With a suitable example, explain the concept of signal declaration. **(05 Marks)**

3 a. With syntax of CASE statement in VHDL and verilog, discuss its facts. **(10 Marks)**
b. Write a behavioral description of a 4-bit binary counter, in verilog. **(10 Marks)**

4 a. Write a VHDL structural description for full adder, using two half adders. **(06 Marks)**
b. What is the advantage of structural coding in verilog, compared to structural coding in VHDL? **(02 Marks)**
c. Define state machine. Using the state machine concept, showing all the details, design a counter, which counts → 0, 2, 3, 5, 7 . Write the VHDL code for the same. (Use JK flip-flop). **(12 Marks)**

PART – B

5 a. With declaration syntax of procedure, explain its facts. **(08 Marks)**
b. Write a verilog function to find the largest of the two signed numbers. **(08 Marks)**
c. Bring out the differences between functions and procedures. **(04 Marks)**

6 a. What do you understand by a file in HDL? List out the VHDL procedures for file processing. **(04 Marks)**
b. With syntax, explain the package and the package body. **(06 Marks)**
c. Write VHDL code for the state diagram shown in figure Q6 (c). **(10 Marks)**

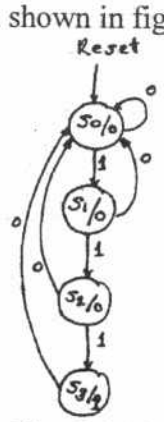

Fig. Q6 (c)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

7 a. Discuss the facts and limitations of mixed language description. **(08 Marks)**
b. With mixed language description of full adder, explain the invoking of VHDL entity from a verilog module. **(12 Marks)**

8 a. Define synthesis. **(02 Marks)**
b. With a neat flow chart, explain the steps involved in a synthesis process. **(08 Marks)**
c. Draw the gate level synthesis information, extracted from the following verilog code.

```
always @ (s, a, b)
begin
    if (s = = 1'b1)
      Y = b;
    else
      Y = a;
end
```

(05 Marks)
d. Explain the mapping of the signal assignment statement, $y \Leftarrow x$; to gate level, with a suitable example. **(05 Marks)**

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Fourth Semester B.E. Degree Examination, December 2010
Linear ICs and Applications

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. What is an op-amp? Explain the working of its basic circuit. **(04 Marks)**

b. Define CMRR of an op-amp. If a non-inverting amplifier is designed for a gain of 100, using an op-amp with 95 dB CMRR, calculate the common mode output (V_{OCm}) for a common mode input (V_{icm}) of 2 V. **(06 Marks)**

c. Design a non-inverting amplifier to provide a gain of 50 for an input of 100 mV. Compute its input and output impedances. Given, R_i = 2 MΩ, R_o = 75 Ω, I_{Bmax} = 500 nA, and M = 200,000 for the op-amp (741). **(08 Marks)**

d. How do you provide compensation for the bias current for the amplifier of Q1 (c) above? **(02 Marks)**

2 a. Explain the operation of a high Z_{in} voltage follower based AC amplifier. Prove that its Z_{in} is very large, ideally. **(08 Marks)**

b. Design a C-coupled inverting amplifier for a pass-band gain of 100, $f_1 = 120$ Hz and $f_2 = 5$ kHz. Assume $R_L = 2$ kΩ and use the LF353BIFET op-amp. **(08 Marks)**

c. Explain how exactly the circuit of a non-inverting ac amplifier is modified to be used with single-supply op-amps. **(04 Marks)**

3 a. With the help of frequency and phase response curves of a typical op-amp, discuss the concept of circuit stability for high gain and low gain amplifiers. **(12 Marks)**

b. Explain the frequency compensation technique, using a phase-lead network. **(04 Marks)**

c. Define the slew rate and determine the slew rate limited cut-off frequency for a 741 based voltage follower. The peak sine wave output should be 10 V. Given ; slew rate of 741 is 0.5 V/μsec. **(04 Marks)**

4 a. Explain the operation of a low resistance voltage source and design the same to provide a constant Vout of 10 V. The load varies from 100 Ω to 1 KΩ and the available supply is ± 15 V. Use 1N758 zener of $V_z = 10V$ and design the various circuit elements. **(08 Marks)**

b. Draw the circuit of an instrumentation amplifier and derive and expression for the gain. **(06 Marks)**

c. With a circuit diagram and waveforms, explain the operation of a non-saturating precision half-wave rectifier. **(06 Marks)**

PART – B

5 a. Design a V/I converter to drive a floating load of 1 KΩ ± 10% with a constant current of 2 mA. **(04 Marks)**

b. Explain how sustained oscillations are obtained in a Weinbridge oscillator. Draw the circuit diagram. **(06 Marks)**

c. Design a RC phase-shift oscillator for a output frequency of 5 kHz. Use LM741 with ± 15V power supply. **(06 Marks)**

d. With a suitable derivation, explain a logarithmic amplifier. **(04 Marks)**

6 a. Explain the operation of an op-amp based astable multivibrator. Use relevant waveforms. **(06 Marks)**

b. With waveforms, explain the working of : i) Zero-crossing detector, and
ii) Voltage-level detector. **(06 Marks)**

c. Design a 2^{nd} order LPF using 741 for a cut-off frequency of 5 kHz. Draw its frequency response and comment on the same. **(08 Marks)**

7 a. Explain the working of a series voltage regulator, with current limit protection. **(08 Marks)**

b. Design a 723 based voltage regulator to provide constant $V_0 = 20$ V and $I_{o\max} = 250$ mA. Given $V_{in-unreg} = 30V \pm 10\%$. **(06 Marks)**

c. Briefly explain the standard representation / configuration of 78XX type regulators. **(06 Marks)**

8 a. Design a monostable multivibrator using 555 timer to obtain a pulse of width 10 msec. **(06 Marks)**

b. Briefly explain the working of a 4-bit binary weighted resistor DAC. **(06 Marks)**

c. Explain the operation of a successive approximation ADC using a simplified block-diagram. **(06 Marks)**

d. Define lock-in range and capture range with reference to PLLS. **(02 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, December 2010

Advanced Mathematics - II

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Find the ratio in which the line joining (2, 4, 16) and (3, 5, –4) is divided by the plane $2x-3y+z+6=0$. **(06 Marks)**

b. Find the angle between the lines whose direction cosines are given by $3l+3+5n=0$ and $6mn-2ln+5lm=0$. **(07 Marks)**

c. Derive the equation of the plane in the form $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$. **(07 Marks)**

2 a. Find the reflection of the point (1, 3, 4) in the plane $2x-y+z+3=0$. **(07 Marks)**

b. Find the equation of the line through (1, 2, -1) and perpendicular to each of the lines $\frac{x}{1}=\frac{y}{0}=\frac{z}{-1}$ and $\frac{x}{3}=\frac{y}{4}=\frac{z}{5}$. **(06 Marks)**

c. Prove that the lines $\frac{x-4}{1}=\frac{y+3}{-4}=\frac{1+z}{7}$ and $\frac{x-1}{2}=\frac{y+1}{-3}=\frac{z+10}{8}$ intersect and find the coordinates of their point of intersection. **(07 Marks)**

3 a. If $\vec{A}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{B}=3\hat{i}-\hat{j}+2\hat{k}$ then :

i) Show that $\vec{A}+\vec{B}$ and $\vec{A}-\vec{B}$ are orthogonal and

ii) Find the angle between $2\vec{A}+\vec{B}$ and $\vec{A}+2\vec{B}$. **(07 Marks)**

b. Prove that $[\vec{A}+\vec{B}, \vec{B}+\vec{C}, \vec{C}+\vec{A}]=2[\vec{A}\vec{B}\vec{C}]$. **(06 Marks)**

c. If $\vec{A}=2\hat{i}-\hat{j}+3\hat{k}$, $\vec{B}=-\hat{i}+3\hat{j}+3\hat{k}$ and $\vec{C}=\hat{i}+\hat{j}-2\hat{k}$, find the reciprocal triad $(\vec{A}'\vec{B}'\vec{C}')$. **(07 Marks)**

4 a. For the curve $\vec{R}=a(\cos t\,\hat{i}+\sin t\,\hat{j}+t\tan\alpha\,\hat{k})$ where a and α are constants, evaluate $\left|\frac{d\vec{R}}{dt}\times\frac{d^2\vec{R}}{dt^2}\right|$. **(06 Marks)**

b. The position vector of a moving particle at time t is $\vec{R}=t^2\hat{i}-t^3\hat{j}+t^4\hat{k})$. Find the tangential and normal components of its acceleration at t = 1. **(07 Marks)**

c. Find the directional derivative ϕ = xyz along the direction of the normal to the surface $x^2z+y^2x+z^2y=3$ at the point (1, 1, 1). **(07 Marks)**

5 a. Show that $\nabla^2(r^n) = n(n+1)r^{n-2}$ where $r^2 = x^2 + y^2 + z^2$. **(07 Marks)**

b. If $\vec{F} = e^{xyz}(\hat{i}+\hat{j}+\hat{k})$ find $\operatorname{div}\vec{F}$ and $\operatorname{curl}\vec{F}$. **(06 Marks)**

c. Prove that $\nabla \times \nabla \times \vec{F} = \nabla(\nabla.\vec{F}) - \nabla^2\vec{F}$. **(07 Marks)**

6 a. Prove that $L\{\cos at\} = \dfrac{s}{s^2+a^2}$ $s > 0$ **(05 Marks)**

b. Find : i) $L\{e^{-t}\sin^2 t\}$ ii) $L\{te^{-t}\sin 3t\}$ iii) $L\left\{\dfrac{\cos 2t - \cos 3t}{t}\right\}$ **(15 Marks)**

7 a. IF $f(t) = \begin{cases} t^2, & 0 < t < 2 \\ t-1, & 2 < t < 3 \\ 7, & t > 3 \end{cases}$, find $L\{f(t)\}$. **(07 Marks)**

b. Find $L^{-1}\left\{\dfrac{4s+5}{(s-1)^2(s+2)}\right\}$. **(06 Marks)**

c. Apply convolution theorem to evaluate $L^{-1}\left\{\dfrac{s}{(s^2+a^2)^2}\right\}$. **(07 Marks)**

8 a. If $f'(t)$ is a continuous function and $L\{f(t)\}=F(s)$ then prove that $L\{f'(t)\} = sF(s) - f(0)$. **(04 Marks)**

b. Solve the following using Laplace transform :
$y'' + 2y' - 3y = \sin t$, when $y(0) = 0 = y'(0)$. **(06 Marks)**

c. Using Laplace transform method, solve the simultaneous equations:
$\dfrac{dx}{dt} + 5x - 2y = t$; $\dfrac{dy}{dt} + 2x + y = 0$, given $x = y = 0$, when $t = 0$. **(10 Marks)**

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