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06MAT41

Fourth Semester B.E. Degree Examination, December 2011
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Given $\frac{dy}{dx} = \frac{1}{1+x^2} - 2y^2$, y(0) = 0. Find y(0.5) in two steps, using the modified Euler's method. **(07 Marks)**

b. Using the Runge-Kutta method of fourth order find y(0.2) for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, y(0) = 1, taking h = 0.1. **(07 Marks)**

c. Given $2dy/dx = (1+x^2)y^2$ and y(0) = 1, y(0.1) = 1.06, y(0.2) = 1.12, y(0.3) = 1.21. Evaluate y(0.4) by Milne's method. **(06 Marks)**

2 a. Obtain the necessary conditions in the Cartesian system, for a function f(z) to be analytic in a region R. **(07 Marks)**

b. Find the analytic function f(z) = u + iv, given $u - v = e^x(\cos y - \sin y)$. **(07 Marks)**

c. Find the bilinear transformation that maps the points 0, -i, -1 of z-plane onto the points i, 1, 0 of w-plane respectively. **(06 Marks)**

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

b. Obtain the power series which represents the function $f(z) = \frac{z^2-1}{z^2+5z+6}$, in the following regions: i) $|z| < 2$ ii) $2 < |z| < 3$ iii) $|z| > 3$ **(07 Marks)**

c. Using the Cauchy's residue theorem, evaluate the integral $\int_C \frac{z^2}{(z-1)^2(z+2)} dz$, where c is the circle $|z| = 5/2$. **(06 Marks)**

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

b. Solve the Bessel's equation of order n given by, $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - n^2)y = 0$ where n is a non-negative real constant. **(07 Marks)**

c. With the usual notations, show that

$$x^4 - 3x^2 + x = \frac{8}{35}P_4(x) - \frac{10}{7}P_2(x) + P_1(x) - \frac{4}{5}P_0(x)$$ **(06 Marks)**

PART – B

5 a. The pressure and volume of a gas are related by the equation $PV^\gamma = k$, γ and k being constants. Fit this equation for the following set of observations:

P(kg/cm²)	0.5	1.0	1.5	2.0	2.5	3.0
V(litres)	1.62	1.00	0.75	0.62	0.52	0.46

(07 Marks)

b. While calculating correlation coefficient between two variables x and y from 25 pairs of observations, the following results were obtained:

$n = 25$, $\Sigma x = 125$, $\Sigma x^2 = 650$, $\Sigma y = 100$, $\Sigma y^2 = 460$, $\Sigma xy = 508$.

Later it was discovered at the time of checking that the pairs of values.

x	y
8	12
6	8

were copied down as

x	y
6	14
8	6

Obtain the correct value of correlation coefficient. **(07 Marks)**

c. A box contains 500 IC chips of which 100 are manufactured by company X and the rest by company Y. It is estimated that 10% of the chips made y company X and 5% made by company Y are defective. If a randomly selected chip is found to be defective, find the probability that it came from company X. **(06 Marks)**

6 a. A die is tossed thrice. A success is getting 1 or 6 on a toss. Find the mean and variance of the number of successes. **(07 Marks)**

b. For the Poisson distribution, prove that, $P(r) = \frac{e^{-m}m^r}{r!}$, where m is the mean of distribution. **(07 Marks)**

c. Fit a normal distribution to the following data:

x :	1	3	5	7	9
y :	2	2	3	2	1

(06 Marks)

7 a. Explain the meanings of i) Null hypothesis type-I and type-II errors ii) Level of significance. **(07 Marks)**

b. Eleven school boys were given a test in drawing. They were given months further tuition and a second test of equal difficulty was held at the end of it. Do the following marks give evidence that the students have benefited by extra coaching? **(07 Marks)**

Boys	1	2	3	4	5	6	7	8	9	10	11
Marks I test	23	20	19	21	18	20	18	17	23	16	19
Marks II test	24	19	22	18	20	22	20	20	23	20	17

c. A survey of 64 families with 3 children each is conducted and the number of male children in each family is noted. The results are tabulated as follows:

Male children	0	1	2	3	Total
Families	6	19	29	10	64

Apply Chi-square test of goodness of fit to test whether male and female children are equiprobable. **(06 Marks)**

8 a. Compute i) $P(x = 1, y = 2)$ ii) $P(x \geq 1, y \leq 2)$ iii) $P(x \leq 1, y \leq 2)$ iv) $P(x + y \geq 2)$, using the following joint probability distribution for x and y. **(07 Marks)**

x \ y	0	1	2	3	Sum
0	0	1/8	1/4	1/8	1/2
1	1/8	1/4	1/8	0	1/2
Sum	1/8	3/8	3/8	1/8	1

b. Discuss : i) Absorbing state ii) Transient state iii) Recurrent state iv) Periodic state. **(07 Marks)**

c. A software engineer goes to his work place every day by motor bike or by car. He never goes by bike on two consecutive days but it he goes by car on a day then he is equally likely to go by car or by bike on the next day. Find the transition matrix for the chain of the mode of transport he uses. If car is used on the first day of week, find the probability that i) bike is used ii) car is used on the fifth day. **(06 Marks)**

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06ES42

Fourth Semester B.E. Degree Examination, December 2011
Microcontrollers

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Compare CISC and RISC CPU architectures. **(04 Marks)**

b. Draw the internal block schematic of 8051 microcontroller. Explain its characteristics. **(10 Marks)**

c. Interface the external ROM and RAM to 8051. Explain how to access them. **(06 Marks)**

2 a. i) What is the necessity of a flag register in a microprocessor/microcontroller?
ii) Which flags of 8051 are affected after the execution of instruction INC A?
iii) For what condition the OV flag of 8051 is set after the addition instruction.
iv) Can the result of logical AND instruction be stored in some destination other than Reg A? If so, indicate such instructions.
v) Give two examples of 9-bit rotate instructions. **(05 Marks)**

b. Explain briefly the addressing modes of 8051, with an example for each. **(06 Marks)**

c. Write a program in 8051 to find the sum of 20 data bytes stored in an array of external RAM starting with address 2000H. Store the 16-bit sum at the end of array. **(09 Marks)**

3 a. Sketch the contents of stack memory indicating the position of SP after the execution of the following :
i) CALL instruction and ii) RET instruction. Assume initially SP = 20H.

```
                                    .
                                    .
                                    .
2000H ACALL FACT                    .
                                    .
                                    .
                                    .

                          2050H FACT:   .
                                        .
                                        .
                                        .
                                        RET
```

(04 Marks)

b. Write a main program in 8051 to find the value of P = N!/R! using a subroutine which finds the value of factorial of a given number. The values of N and R are stored in locations 30H and 31H. Store P in 32H. **(10 Marks)**

c. i) Mention the advantages of using subroutines.
ii) Give the address range of instructions SJMP, AJMP, LJMP.
iii) Mention the differences between RET and RETI instructions. **(06 Marks)**

4 a. Give the bit size and data range details for the widely used seven C data types of 8051 C. **(04 Marks)**

b. Write an 8051 C program to read the content of port P1. If it is greater than 200, wait for 250 msec and send the data to port P2. Otherwise wait for 150 msec and send the data to port Pϕ. **(06 Marks)**

c. Write an 8051 C program to find the checksum byte of data stream 30H, 4AH, 65H and 10H. Convert the binary value of checksum into decimal and display the value of the BCD digits on ports Pϕ, P1 and P2. **(10 Marks)**

PART – B

5 a. What is advantages and disadvantages of Mode-2 operation of 8051 timer when compared Mode-1 operation? **(02 Marks)**

b. Write an 8051 ALP to generate a square wave of 1 kHz on pin P2.1 using Timer-1 in Mode-1 operation. Assume crystal frequency as 12 MHz. Show delay calculation. **(08 Marks)**

c. Write an 8051 C program to generate a rectangular wave of 2 kHz with 60% duty cycle in pin P1.2. Assume crystal frequency as 11.0592 MHz. Use Timer-ϕ in Mode-1 operation. Show delay calculations. **(10 Marks)**

6 a. Explain the format of asynchronous serial communication. **(04 Marks)**

b. Explain the function of RS232C pins of DB-9 connector. **(06 Marks)**

c. Write an 8051 ALP to send the message 'CORRECT' or 'FALSE' serially depending on the status of a switch connected to pin P2.2 if it is ON or OFF, respectively. Assume the crystal frequency as 11.0592 MHz. Use 2400 band rate, 8 bit data and one stop bit format. Show delay calculation. **(10 Marks)**

7 a. Explain the different interrupts of 8051 indicating their vector addresses. **(06 Marks)**

b. How to enable/disable the interrupts of 8051 and to set priority for them? Explain. **(04 Marks)**

c. Write an 8051 C program to i) continuously read the status of switch connected to pin P1.2 and send it to pin P2.1 in the main program and ii) generate a square wave of 100 µsec period on P2.3 and send character '*' continuously serially using time and serial interrupt routines, respectively. Use XTAL frequency as 11.0592 MHz and 8 bits data, one stop bit, 4800 band rate format. **(10 Marks)**

8 a. Interface a 2×4 keys keyboard to 8051 and write an ALP to send the keycode to port P1, whenever a key is depressed. **(10 Marks)**

b. Interface a stepper motor to 8051 and write an ALP to rotate the motor in clockwise direction, if the status of a switch connected to port pin P1.2 is ON. Otherwise rotate it in counterclockwise direction. **(10 Marks)**

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06ES43

Fourth Semester B.E. Degree Examination, December 2011
Control 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 open loop and closed loop control system. **(04 Marks)**

b. For the system shown in Fig.Q.1(b), find the transfer function $G(S)=\frac{\theta_2(s)}{T(s)}$. Consider $J_1 = 1\ kgm^2$, $K_1 = 1$ Nm/rad, $K_2 = 1$ Nm/rad. $B_1 = 1$Nm/rad/sec, $B_2 = 1$ Nm/rad/sec. **(06 Marks)**

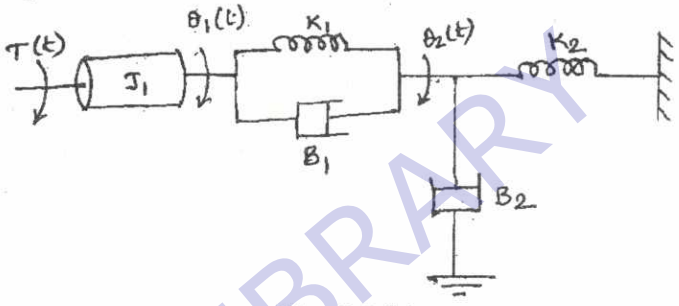

Fig.Q.1(b)

c. Draw the mechanical network for the system shown in Fig.Q.1(c). Write the equations of performance and draw its analogous circuit based on force voltage analogy. **(10 Marks)**

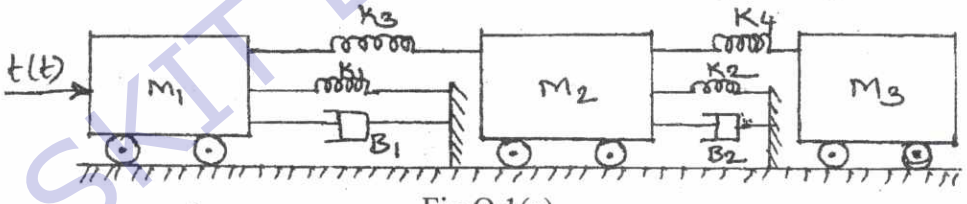

Fig.Q.1(c)

2 a. Derive an expression for the closed loop transfer function of a negative feed back system. **(04 Marks)**

b. Find the overall transfer function $\frac{C(s)}{R(s)}$ using block diagram reduction technique for the system shown in Fig.Q.2(b). **(08 Marks)**

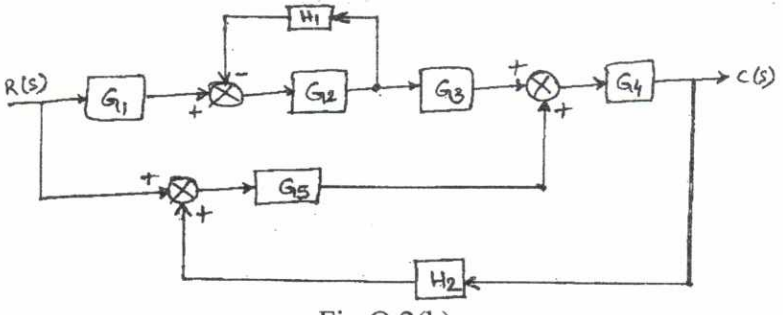

Fig.Q.2(b).

c. Find $\frac{C}{R}$ using Mason's gain formula for the signal flow graph shown in the Fig.Q.2(c).

(08 Marks)

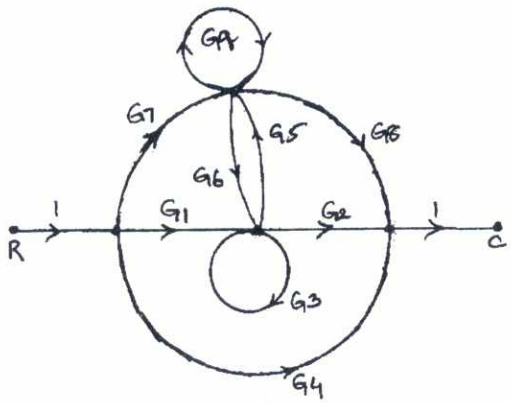

Fig.Q.2(c).

3 a. Considering the response of a second order under damped system to a step input, derive the following : i) Peak time (t_p) ; ii) Rise time (t_r) ; iii) Maximum overshoot (M_p).

(10 Marks)

b. For the negative feed back control system shown in Fig.Q.3(b). Find :

i) Percentage overshoot for the unit step input

ii) Settling time for a unit step input

iii) Steady state error for the input defined by the polynomial $r(t) = 2 + 4t + 6t^2$, $t \geq 0$.

(10 Marks)

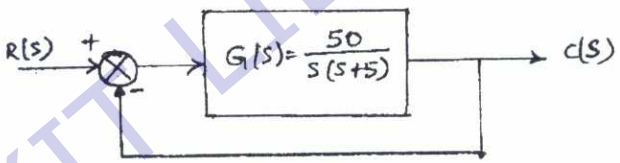

Fig.Q.3(b).

4 a. Explain R-H criterion for determining the stability of a system and mention its limitations.

(06 Marks)

b. A unity feed back control system is descried by the characteristic equation

$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$

Test its stability and find frequency of oscillations. **(06 Marks)**

c. Determine the values of K and b, so that the system shown in Fig.Q.4(c) oscillates with a frequency of 2 rad/sec. **(08 Marks)**

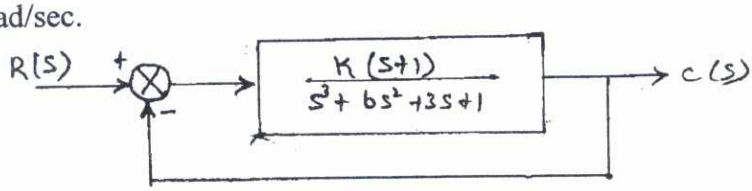

Fig.Q.4(c).

PART – B

5 a. Using angle criterion, prove that the complex part of the root loci for the open loop transfer function given by $G(s)H(s) = \frac{K(s+6)}{(s+2)(s+4)}$ is circular. What is its centre and radius?

(08 Marks)

b. Sketch the root locus plot for a negative feed back control system whose open loop transfer function is given by $G(s)H(s)=\frac{k}{s(s+1)(s+2)(s+3)}$ for all values of K ranging from 0 to ∞. Find the value of K for closed loop stability. **(12 Marks)**

6 a. Find the gain margin and phase margin for the negative feedback control system having open loop TF $G(s)H(s)=\frac{6}{(s^2+2s+2)(s+2)}$. **(08 Marks)**

b. Using Nyquist stability criterion, investigate the stability of a negative feedback control system whose openloop TF is given by $G(s)H(s)=\frac{100}{(s+1)(s+2)(s+3)}$. Assume wg = 1.253 rad/sec wg = gain cross over frequency. **(12 Marks)**

7 a. Sketch the Bode – plot for the openloop TF $G(s)H(s)=\frac{k(1+0.2s)(1+0.025s)}{s^3(1+0.001s)(1+0.005s)}$. Find the range of K for closed loop stability. **(14 Marks)**

b. For the plot of the asymptotic magnitude (in db) versus frequency (log scale) shown in Fig.Q.7(b), find the associated transfer function. **(06 Marks)**

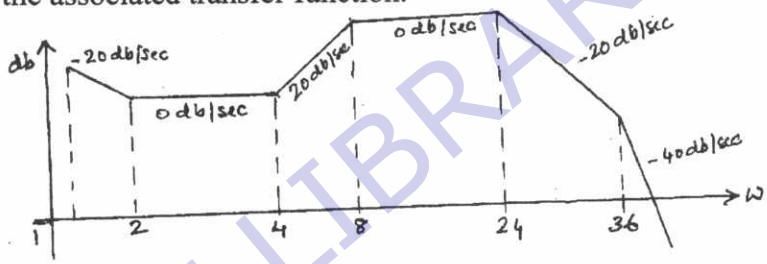

Fig.Q.7(b)

8 a. Define : i) State ; ii) State space and iii) State variables. **(06 Marks)**

b. Obtain the appropriate state model for a system represented by an electric circuit in Fig.Q.8(b). **(08 Marks)**

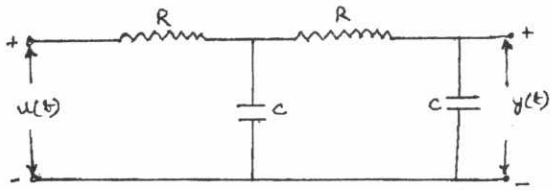

Fig.Q.8(b)

c. Represent the mechanical system shown in Fig.Q.8(c) by state space with X_2 as output. **(06 Marks)**

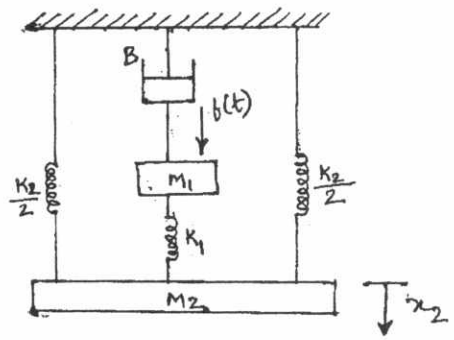

Fig.Q.8(c)

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06EC44

Fourth Semester B.E. Degree Examination, December 2011

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. A continuous-time signal x(t) is shown in Fig.Q1(a). Sketch and label each of the following :

i) $x(t)u(1-t)$ ii) $x(t)[u(t)-u(t-1)]$ iii) $x(t)\,\delta\left(t-\frac{3}{2}\right)$

iv) $x(t)\,[u(t+1)-4(t)]$ v) $x(t)\,u(t-1)$ **(10 Marks)**

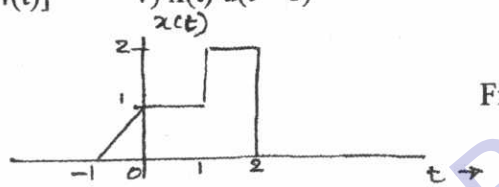

Fig.Q1(a)

b. Consider the following sinusoidal signal. Determine whether each x(n) is periodic and if it is find its fundamental period.

i) $x(n) = 10\sin(2n)$ ii) $x(n) = 15\cos(0.2\pi n)$ iii) $x(n) = 5\sin[6\pi n/35]$ **(06 Marks)**

c. If $x(n) = \{1\ 2\ 3\ \underset{\uparrow}{4}\ 5\ 6\ 7\}$, find : i) $y(n) = x(2n-3)$, ii) $y(n) = x(-2n+1)$ **(04 Marks)**

2 a. Find the convolution of x(t) with h(t), where

$x(t) = A[u(t)+u(t-T)]$ and $h(t) = A[u(t)-u(t-2T)]$ **(10 Marks)**

b. A discrete system has impulse response $h(n) = a^n u(n+3)$. Is this system BIBO stable, causal and memory less? **(03 Marks)**

c. The impulse response of the system is given by $h(t) = e^{-2|t|}$, find the step response of the system. **(07 Marks)**

3 a. Determine the condition of the impulse response of the system if system is :

i) memory less ii) causal iii) stable iv) invertible. **(10 Marks)**

b. Solve the differential equation : $\frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t)=2x(t)$, with initial conditions $y(0)=0$, $y'(0)=1$ for the input $x(t) = \text{cost}\,u(t)$. **(10 Marks)**

4 a. Determine the Fourier series representation of the following signals :

i) $x(t)=3\cos\left[\frac{\pi}{2}t+\frac{\pi}{4}\right]$ ii) $x(t)=2\sin(2\pi t-3)+\sin 6\pi t$ **(10 Marks)**

b. Determine the Fourier series representation for the square wave shown in Fig.Q4(b).

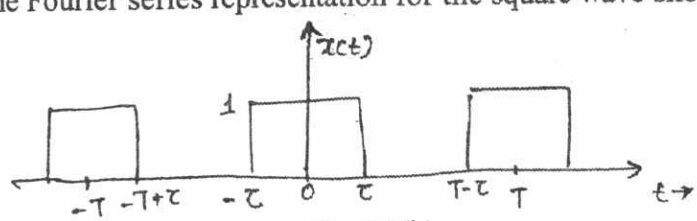

Fig.Q4(b)

(10 Marks)

PART – B

5 a. Use the differentiation in time and differentiation in frequency properties to determine the FT of Gaussian pulse defined by $g(t) = \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}}$. **(10 Marks)**

b. Find the FT of $x(t) = \frac{1}{1+jt}$. **(05 Marks)**

c. Find the inverse FT of $x(j\omega) = \frac{(1-j\omega)}{6+j\omega+\omega^2}$. **(05 Marks)**

6 a. State and prove Rayleigh's energy theorem. **(08 Marks)**

b. Find the frequency response and impulse response of the system with input x(t) and output y(t) is given by :
i) $x(t) = e^{-2t}u(t)$ and $y(t) = e^{-3t}u(t)$ ii) $x(t) = e^{-2t}u(t)$ and $y(t) = 2te^{-2t}u(t)$ **(08 Marks)**

c. Determine the difference equation description for the system with impulse response.

$$h(n) = 3\delta(n) + 2\left(\frac{1}{2}\right)^n u(n) + \left(-\frac{1}{2}\right)^n u(n)$$ **(04 Marks)**

7 a. Determine the ZT of the following sequence :
i) $x(n) = \alpha^{|n|}$ for $|\alpha| < 1$ ii) $x(n) = n^2u(n)$. **(10 Marks)**

b. Find the inverse ZT of :
i) $x(z) = \frac{16z^2 - 4z + 1}{8z^2 + 2z - 1}$ for $|z| > \frac{1}{2}$ ii) $x(z) = e^{z^2}$ for all z $|z| \neq \infty$. **(10 Marks)**

8 a. A system has the transfer function,

$$H(z) = \frac{2}{1 - 0.9e^{j\frac{\pi}{4}}z^{-1}} + \frac{2}{1 - 0.9e^{j\frac{\pi}{4}}z^{-1}} + \frac{3}{1+2z^{-1}}.$$

Find the impulse response assuming the system is (i) stable and (ii) causal. **(10 Marks)**

b. A system is described by the difference equation :

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

Find the transfer function of the system. **(05 Marks)**

c. State and prove final value theorem in ZT. **(05 Marks)**

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06EC45

Fourth Semester B.E. Degree Examination, December 2011
Fundamentals of HDL

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the VHDL scalar data types. Compare the VHDL data types with verilog data types. **(08 Marks)**

b. If A, B and C are three unsigned variables with A = 11110000, B = 01011101, C = 00000000, find the value of
i) A NAND B ii) A && C iii) ~ | B iv) A ror 2 v) ! B vi) B << 1. **(06 Marks)**

c. Mention the different styles of writing the description using HDL. Explain the switch level and mixed type description by taking example. **(06 Marks)**

2 a. Explain with an example how the execution of the signal assignment statement takes place in HDL. **(04 Marks)**

b. Write the truth table and derive the Boolean functions after minimization for a full adder with active low enable i.e., if enable is low the sum and carry are the usual outputs of the adder. Then write a dataflow description using VHDL and include a delay of 2 ns for any gate including XOR. **(06 Marks)**

c. Obtain the Boolean expressions for a 2-bit comparator. Write the dataflow description in VHDL and verilog. **(10 Marks)**

3 a. Write a VHDL code for D-latch using i) signal assignment statements ii) variable assignment statements. Distinguish between these two types of statements with the help of simulation waveforms. **(08 Marks)**

b. Explain the general format of various loop statements in HDL, with examples. **(08 Marks)**

c. Write a verilog code to implement a 3-bit binary counter, with active high synchronous clear using case statement. **(04 Marks)**

4 a. Explain with suitable examples, how binding is achieved in the VHDL between
i) Entity and Architecture ii) Entity and Component iii) Library and Module. **(06 Marks)**

b. Write a structural description using VHDL to implement a 2:1 multiplexer, with active low enable. **(10 Marks)**

c. Explain the use of i) Generic statement ii) Parameter iii) Generate statement. **(04 Marks)**

PART – B

5 a. Give the significance of procedure, task and function. Compare them. **(05 Marks)**

b. Write a task to multiply two signed numbers, using the Booth algorithm. Use this task to perform signed vector multiplication, d = a * b , where a is a row vector with three elements and b is a column vector with three elements. **(10 Marks)**

c. Write a VHDL code to read a file consisting of four ASCII characters. **(05 Marks)**

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.

6 a. Write a VHDL code for finding the greatest element of an array. Build a package for an array and use it in the code. **(08 Marks)**

b. Explain the implementation of arrays in VHDL and verilog. **(06 Marks)**

c. Write a verilog description of a 32×8 SRAM with the function table as shown in the Table Q.6(c). **(06 Marks)**

CS	R/$\overline{WR}$	Memory function
0	X	Deselected
1	1	Read cycle
1	0	Write cycle

Table Q.6(c)

7 a. How do you invoke a verilog module from a VHDL module? Explain by considering the mixed language description of a full subtractor using two half subtractors. **(08 Marks)**

b. Write a VHDL code for a 1-bit full adder, using the structural description. Invoke this VHDL code in a verilog module to implement a 3-bit adder with zero flag. The zero flag is set if output of adder is zero otherwise it is set to 1. **(12 Marks)**

8 a. What is synthesis? Discuss some important facts related to synthesis. **(06 Marks)**

b. Explain the VHDL synthesis information extraction from entity when the input and outputs are declared as i) Bit ii) Std_logic_vector iii) Unsigned iv) User defined type. **(08 Marks)**

c. Write a behavioral code in VHDL/verilog for a 2 to 4 decoder with active low output. Show the gate level synthesis of the code. **(06 Marks)**

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06EC46

Fourth Semester B.E. Degree Examination, December 2011

Linear ICs and Applications

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. Justify any assumptions made.

PART – A

1 a. Explain input offset current and state a typical input offset current level for an operational amplifier. Discuss offset nulling. **(07 Marks)**

b. Sketch the complete circuit of an op-amp non-inverting amplifier. Write equations for determining suitable values for each resistor :
i) using a bipolar op-amp and ii) using a BIFET op-amp. **(07 Marks)**

c. Design a differential amplifier for a gain of 100. If the input voltage, V_1 = 10V and V_2 = 10.01 to 10.1V. Calculate impedances at V_1, V_2, common mode and differential. Use 741 op-amp. **(06 Marks)**

2 a. Explain how to determine the capacitor values for a high input impedance capacitor coupled inverting amplifier. **(06 Marks)**

b. Explain how exactly the circuit of a non-inverting ac amplifier is modified to be used with single supply op-amps. **(06 Marks)**

c. Design a capacitor-coupled inverting amplifier to operate with a +20V supply. The minimum input signal level is 50 mV, the voltage gain is to be 68, the load resistance is 500Ω, and the lower cut-off frequency is to be 200 Hz, using 741 op-amp. **(08 Marks)**

3 a. With a neat sketch, explain Z_{in} MOD method of frequency compensation. Write the equation for the feedback factor. **(09 Marks)**

b. Define gain bandwidth product of an op-amp and explain its significance. **(05 Marks)**

c. i) Calculate the cut-off frequency limited rise time for a voltage follower circuit using 741 op-amp. Also determine the slew-rate limited rise time if the output amplitude is to be 5V, and cut-off frequency is equal to 800 KΩ.
ii) Determine the maximum undistorted pulse output amplitude for the 741 voltage follower if the output rise time is not to exceed 1 μs. **(06 Marks)**

4 a. Draw the circuit of a current source using an op-amp and a power MOSFET. Indicate typical voltage levels throughout the circuit and explain its operation. **(06 Marks)**

b. Sketch the circuit of a two output half wave precision rectifier. Draw the input and output waveforms and explain the circuit operation. **(06 Marks)**

c. Design a voltage source to provide a constant output voltage of 6V using Zener diode V_Z = 6.3V. The load resistance has a minimum value of 150Ω and the available supply voltage is ±12V. Assume I_z = 20 mA, $h_{fe(min)}$ = 20, $I_{c(max)}$ > 42 mA and $V_{cc(max)}$ > V_{cc}. Draw the circuit diagram and insert the designed values. **(08 Marks)**

PART – B

5 a. Sketch a precision rectifier peak detector circuit, draw the input and output waveforms and explain the circuit operation. Write the equation for calculating the capacitor value for a peak detector circuit. **(06 Marks)**

b. With a neat circuit diagram and waveforms, explain the operation of triangular/rectangular wave generator. **(08 Marks)**

c. Using a 741 op-amp with a supply of ±12V, design a phase-shift oscillator to have an output frequency of 3.5 kHz. **(06 Marks)**

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

b. With a neat circuit diagram and waveforms, explain the operation of inverting Schmitt trigger. **(06 Marks)**

c. Design a 2^{nd} order high pass active filter to have a cutoff frequency of 12 kHz. Use a 715 op-amp and estimate the highest signal frequency that will be passed. **(08 Marks)**

7 a. What is the principle of switch-mode power supplies? Discuss their advantages and disadvantages. **(06 Marks)**

b. Explain the functional block-diagram of IC 723 regulator. **(06 Marks)**

c. Design a voltage regulator using IC 723 to meet the following specifications :
$V_o = 5V$, $I_o = 100$ mA, $V_{in} = 15 \pm 20\%$, $I_{sc} = 150$ mA, $V_{sense} = 0.7V$. **(08 Marks)**

8 Explain the following with neat diagrams and waveforms :

a. 555 timer as astable multivibrator **(07 Marks)**

b. 566 voltage controlled oscillator **(07 Marks)**

c. Successive approximation ADC **(06 Marks)**

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