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06MAT41

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
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. Employ Taylor's series method to find an approximate solution correct to fourth decimal places for the following initial value problem at $x = 0.1$, $dy/dx = x - y^2$, $y(0)=1$. **(06 Marks)**

b. Using modified Euler's method to find $y(0.1)$ given $dy/dx = x^2 + y$, $y(0) = 1$ by taking $h=0.05$. Perform two iterations in each step. **(07 Marks)**

c. If $dy/dx = 2e^x - y$, $y(0) = 2$, $y(0.1) = 2.010$, $y(0.2) = 2.04$ and $y(0.3)=2.09$ find $y(0.4)$ correct to four decimal places. By using Milne's predictor-corrector method (Use corrector formula twice). **(07 Marks)**

2 a. Derive Cauchy-Riemann equations in Cartesian form. **(06 Marks)**

b. Find the analytic function $f(z) = u+iv$ whose real part is $e^{-x}(x\cos y + y\sin y)$. **(07 Marks)**

c. Find the bilinear transformation which maps the points $Z=0, i, \infty$ onto the points $w = 1, -i, -1$ respectively. Find the invariant points. **(07 Marks)**

3 a. State and prove Cauchy's integral formula. **(06 Marks)**

b. Expand $f(z) = \dfrac{1}{(z-1)(z-2)}$ in terms of Laurent's series

valid in the regions i) $|z-1| < 1$ ii) $|z-1| > 1$. **(07 Marks)**

c. Evaluate $\int_c \dfrac{\sin \pi z^2 + \cos \pi z^2}{(z-1)^2(z-2)}$ using Cauchy's Residues theorem where c is the circle $|z| = 3$. **(07 Marks)**

4 a. Solve in series the equation $x\dfrac{d^2y}{dx^2} + \dfrac{dy}{dx} + xy = 0$ **(06 Marks)**

b. Solve Bessel's differential equation leading to $J_n(x)$. **(07 Marks)**

c. Express $x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre's polynomials. **(07 Marks)**

PART – B

5 a. The pressure and volume of a gas are related by the equation $PV^v = K$, where v and K being constants. Fit this equation to the following set of observations. **(06 Marks)**

P (kg/cm^2)	0.5	1.0	1.5	2.0	2.5	3.0
V (litre)	1.62	1.00	0.75	0.62	0.52	0.46

b. Find the correlation coefficient and the regression lines of y on x and x on y for the following data: **(07 Marks)**

x	1	2	3	4	5
y	2	5	3	8	7

c. State and prove Baye's theorem. **(07 Marks)**

6 a. The probability density function of a variate X is

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

Find i) k ii) $P(X \geq 5)$ iii) $P(3 < X \leq 6)$ **(06 Marks)**

b. The number of telephone lines busy at an instant of time is a binomial variate with probability 0.1 that a line is busy. If 10 lines are choosen at random, what is the probability that i) no line is busy ii) at least 5 lines are busy iii) at most 3 lines are busy. **(07 Marks)**

c. Obtain the mean and standard deviation of the normal distribution. **(07 Marks)**

7 a. Explain the following terms:
i) Null hypothesis
ii) Confidence limits
iii) Type I & Type II errors. **(06 Marks)**

b. A die was thrown 9000 times and a throw of 5 or 6 was obtained 3240 times. On the assumption of random throwing, do the data indicate that the die is biased? **(07 Marks)**

c. The nine items of a sample have the following values: 45, 47, 50, 52, 48, 47, 49, 53, 51. Does the mean of these differ significantly from the assumed mean of 47.5? (Given $t_{0.05}$ for 8 df = 2.31). **(07 Marks)**

8 a. The joint probability distribution of two random variables X and Y are given below.

X \ Y	-3	2	4
1	0.1	0.2	0.2
2	0.3	0.1	0.1

Determine i) E(X) and E(Y) ii) E(XY) iii) COU (X,Y) **(06 Marks)**

b. Every year, a man trades his car for a new car. If he has a Maruti, he trades it for an Ambassador. If he has an Ambassador, he trades it for a Santro. However, if he has a Santro, he is just as likely to trade if for a new Santro as to trade if for Maruti or an Ambassador. In 2000, he bought his first car, which was Santro. Find the probability that he has
i) 2002 Santro ii) 2002 Maruti. **(07 Marks)**

c. Define stochastic matrix. Find the unique fixed probability vector for the regular stochastic matrix $A = \begin{bmatrix} 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/4 & 1/4 \end{bmatrix}$ **(07 Marks)**

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06ES42

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
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. What is a microcontroller? With a neat block diagram explain, Harvard architecture. Distinguish between i) microcontroller and microprocessor, and ii) Harvard architecture and Von Neumon's architecture. **(10 Marks)**

b. With a neat block diagram, explain the function of each block of 8051 microcontroller architecture. **(10 Marks)**

2 a. Mention the addressing modes of 8051 microcontroller. Explain each of them with an example for each. **(08 Marks)**

b. Correct the following instructions, if found to have any wrong syntax. Explain the operation of corrected instructions.
i) MOV #C,OA ii) MOV A,RS1 iii) MOV A,@R7 iv) MOV 0346H,@RO
v) XCHG B,@R3. **(05 Marks)**

c. Show the stack contents, SP contents & contents of any register affected after each step of the following sequence of operations.
MOV SP,#70H
MOV R5,#30H
MOV A,#44H
ADD A,R5
MOV R4,A
PUSH 4
PUSH 5
POP 4. **(07 Marks)**

3 a. With the relevant figure, write a sequence of events that occur in 8051 microcontroller when the CALL and RET instructions are executed. **(06 Marks)**

b. Write an ALP in 8051 to find the largest number among the 12, 8 bit numbers stored in the internal RAM. **(07 Marks)**

c. Write an ALP in 8051 to perform the following operation:
Z=(X1+Y1)*(X2+Y2) where, Xl, X2, Y1 and Y2 are the 8 bit hexadecimal numbers stored in the RAM locations. Write a subroutine for the addition and assume that each addition result with 8 bit number. **(07 Marks)**

4 a. Discuss the data types in 8051 C. **(06 Marks)**

b. What are the ways to create time delay? Discuss the factors affecting the accuracy of the time delay. Write a function in C to create a time delay. **(08 Marks)**

c. Write a C program in 8051 to convert packed BCD Ox39 to ASCII and display the bytes on p1 and p2. **(06 Marks)**

PART – B

5 a. What is the difference between timer and counter? Explain the function of each bit in the TMOD. **(04 Marks)**

b. Write an ALP to generate square wave on pin P1.5 of 500 Hz (approximately) with a subroutine to provide a time delay of 30.38μs using timer 0. Assume that crystal frequency of 8051 is 11.0592Hz. **(10 Marks)**

c. In what way timer/counter mode2 programming is different from mode 0 and mode l? **(06 Marks)**

6 a. Explain full duplex, half duplex and simplex serial data transfer. **(06 Marks)**

b. Write the steps required for programming 8051 to transfer data serially. **(08 Marks)**

c. Write a C program for the 8051 to transfer the letter "C" serially at 9600 baud continuously. Use 8 bit data and 1 stop bit. **(06 Marks)**

7 a. What are Interrupts and Interrupt Subroutines? Explain the interrupts that are present in 8051. **(06 Marks)**

b. Discuss what happens if interrupts INTO, INT1 and TF1 are activated at the same time. Assume priority levels set by the power up reset. Program the IP register to assign the highest priority to INT1 and then discuss what happens if INTO, INT1 and TF1 are activated at the same time. Assume that external hardware interrupts are edge triggered. **(06 Marks)**

c. What is a level triggered interrupt? How to get the edge triggered interrupt? Explain the procedure to sample the low level triggered interrupt and edge triggered interrupt. **(08 Marks)**

8 a. Explain, with a block diagram step by step procedure involved to interface 4x4 matrix keyboard with 8051. **(10 Marks)**

b. Discuss interfacing of ADC0804 with 8051 using timing diagram for ADC. **(10 Marks)**

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06ES43

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Control Systems

ime: 3 hrs. Max. Marks:100

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

PART – A

a. For the systems shown in Fig. Q1(i) and Fig. Q1(ii) write the differential equations and obtain the transfer functions. **(04 Marks)**

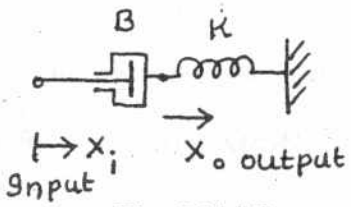

Fig. Q1(a)(i)

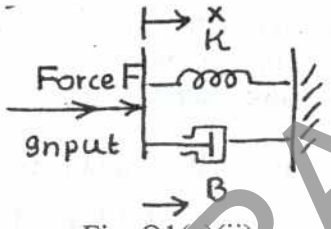

Fig. Q1(a)(ii)

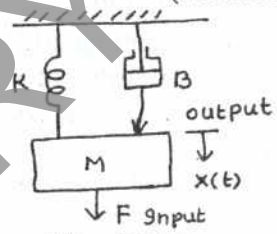

Fig. Q1(b)

b. i) Mass M shown in the mechanical system Fig. Q1(b) is subjected to a force of 1 Newton. Find the final displacement of mass. Take k = 1 N/m, B = 0.2 N-S/m, M = 1kg. **(08 Marks)**
ii) In vertically suspended mechanical system gravitational force 'g' not taken into consideration. Why? **(02 Marks)**

c. Find $G(s) = E_o(s)/T(s)$ for the system shown in Fig. Q1(c).

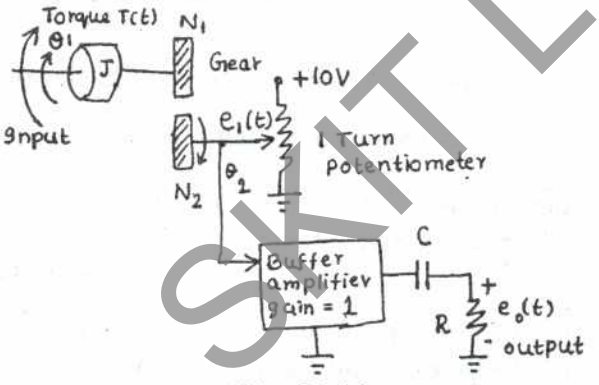

Fig. Q1(c)

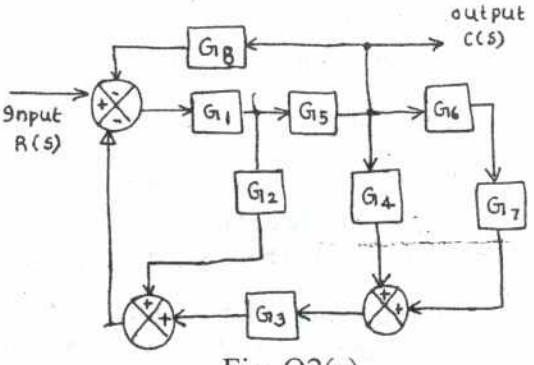

Fig. Q2(a)

(06 Marks)

a. Reduce the block diagram Fig. Q2(a) to a single block T(S) = C(S)/R(S). **(10 Marks)**

b. Using Mason's rule find the transfer function T(s) = C(S)/ R(S) for the system represented in Fig. Q2(b). **(10 Marks)**

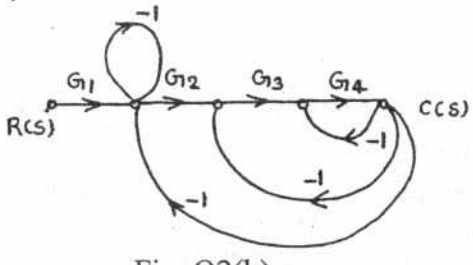

Fig. Q2(b)

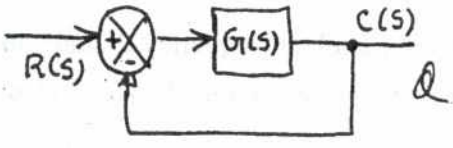

Fig. Q3(c)

3 a. Derive expression for 'peak time' tp for a system executing underdamped motion. **(06 Marks)**

b. The step response of a unity feed back control system is given by $c(t) = 1 - 1.66\, e^{-8t} \sin(6t + 37°)$

i) Find the closed loop transfer function.

ii) What is the corresponding open loop transfer function?

iii) Determine the complete output response for a unit step input, when the system is operated on open-loop. **(07 Marks)**

c. The unity feed back system of Fig. Q3(c), where,

$G(s) = \dfrac{k(s+\alpha)}{(s+\beta)^2}$ is to be designed to meet the following specifications. Steady-state error for a unit step input = 0.1; damping ratio = 0.5; natural frequency = $\sqrt{10}$ rad/sec. Find k, α and β. **(07 Marks)**

4 a. Using the Routh-Hurwitz criterion and the unity negative feed back system of Fig. Q3(c).

$G(s)\dfrac{k(s+4)}{s(s+1)(s+2)}$

Find the following :

i) The range of k that keeps the system stable

ii) The value of k that makes the system oscillate

iii) The frequency of oscillation, when k is set to the value that makes the system oscillate. **(10 Marks)**

b. State and prove the theorem on bounded-input pounded-output BIBO stability. **(10 Marks)**

PART – B

5 a. Sketch the general shape of the root locus for each of the open-loop pole-zero plots shown in Figs. Q5(a). **(05 Marks)**

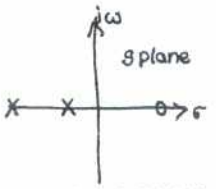

Fig. Q5(a)(i)

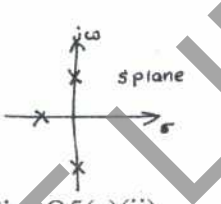

Fig. Q5(a)(ii)

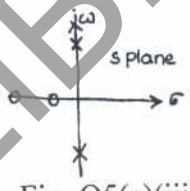

Fig. Q5(a)(iii)

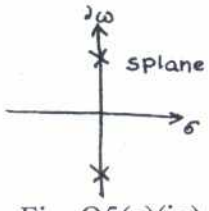

Fig. Q5(a)(iv)

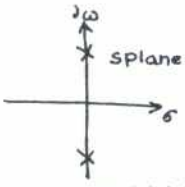

Fig. Q5(a)(v)

b. Given : $G(s) = \dfrac{k(s+1)}{(s+2)(s+3)(s+4)}$ for a negative unity feed back system.

i) Sketch the root locus with necessary calculations. Show at least one TEST POINT on the complex plane on the root locus, where criterion is satisfied.

ii) If k = 10, where are the roots? **(15 Marks)**

6 a. The following polar Nyquist plots are sketches of the map of the positive imaginary axis of the s plane. None of the G(s) H(s) functions have poles in the right half plane. Figs. 6(a)(i) and (ii).

i) Complete each plot-i.e. add the map of the negative imaginary axis and any required closing circular arcs.

ii) Is the system stable?

iii) What is the system type number?

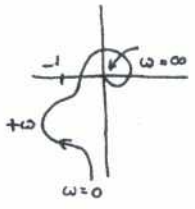

Fig. Q6(a)(i)

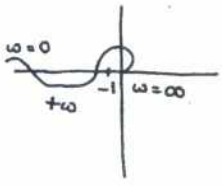

Fig. Q6(a)(ii) **(06 Marks)**

b. Briefly explain frequency domain specifications. **(06 Marks)**

c. A negative feed back system is characterized by: $G(s) = \dfrac{k}{s(s+\alpha)}$, H(s) = 1. Find the values of k and α so that resonant peak $M_r = 1.04$ and resonant frequency $W_r = 11.55$ rad /sec. **(08 Marks)**

7 a. Draw the Bode diagram for the open loop transfer function:

$G(s)\frac{100}{s(0.01s+1)^2}$. i) Is the system stable? ii) Record the gain crossover frequency, phase cross over frequency, gain margin and phase margin. **(12 Marks)**

b. Sketch typical i) Root locus ii) Nyquist and iii) Bode plots, given open loop transfer function, $G(s)\,H(s) = \frac{k}{s}$. Is the system stable? What is gain margin? **(08 Marks)**

8 a. Distinguish modern control theory from classical control theory. **(08 Marks)**

b. Define :i) State ii) State space iii) State variables. **(06 Marks)**

c. The following equation defines a separately excited DC motor in the form of differential equation:

$$w + \left(\frac{B}{J}\right)\frac{dw}{dt} + \left(\frac{k^2}{LJ}\right)w = \left(\frac{k}{LJ}\right)V$$

The above equation in state space form is as follows :

$$\begin{bmatrix} \ddot{w} \\ w \end{bmatrix} = p\begin{bmatrix} \dot{w} \\ w \end{bmatrix} + Q\ V$$

Find p matrix, if V is voltage input and w is angular velocity. **(06 Marks)**

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06EC44

Fourth Semester BE Degree Examination, Dec.09-Jan.10
Signals and 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 be suitably assumed.

PART – A

1 a. Sketch :
i) $y(t) = r(t+1) - r(t) + r(t-2)$
ii) $z(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$. **(04 Marks)**

b. i) Is the signal $y(t) = \cos(20\pi t) + \sin(50\pi t)$ periodic? What is the period of y (t)?
ii) What is the power and energy of the signal, $x(t) = A\cos(\omega t + \theta)$? **(04 Marks)**

c. Determine the properties of the capacitive system, if the voltage across it $v_c(t) = \frac{1}{c}\int_{-\infty}^{t} i(z)\,dz$, considering i(t) as the input and $v_c(t)$ as output. **(06 Marks)**

d. A discrete time system is given by $y[n] = x[n]\,x[n-1]$. Determine its properties. **(06 Marks)**

2 a. The impulse response is given by $h(t) = u(t)$. Determine the output of the system, if $x(t) = e^{-\alpha t}u(t)$. State any assumptions made. **(06 Marks)**

b. Determine the natural response and forced response of a system described by the relationship: $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt}$

$y(0) = 0$, $\frac{dy(t)}{dt}(0) = 1$; $x(t) = e^{-2t}u(t)$. **(08 Marks)**

c. Obtain the direct form I and II block representation of a system described by the input-output relationship, $\frac{d^2y(t)}{dt^2} + y(t) = 3\frac{dx(t)}{dt}$. **(06 Marks)**

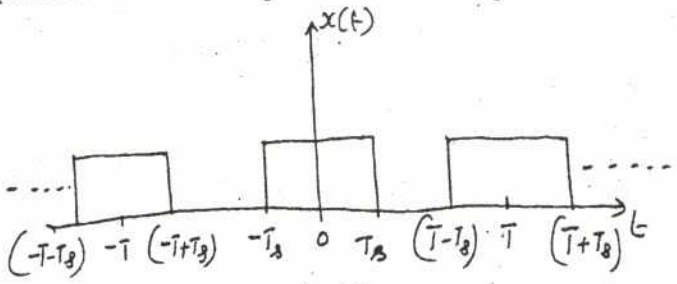
3 a. The impulse response of an LTI system is given by $h[n] = u[n]$. Determine the output if $x[n] = 3^n u[-n]$. **(08 Marks)**

b. If the output of an LTI system is given by: $y[n] = x[n+1] + 2x[n] - x[n-1]$, determine impulse response and comment on the system causality and stability. **(06 Marks)**

c. Determine the step response of a relaxed system whose input output relationship is given by: $\downarrow y[n] + 4y[n-1] + 4y[n-2] = x[n]$. **(06 Marks)**

4 a. Determine the FS representation of the square wave shown in Fig.4(a). **(07 Marks)**

Fig.4(a)



b. If the FS representation of a signal x (t) is x [k], derive the FS of a signal x (t – to) [time shift property of FS]. **(06 Marks)**

c. Determine the DTFS for the sequence $x[n] = \cos^2\left[\frac{\pi}{4}n\right]$. **(07 Marks)**

PART – B

5 a. Show that the Fourier Transform of a rectangular pulse described by:

$x(t) = 1 \;;\; -T \le t \le T$

$= 0 \;;\; |t| > T$

is a sinc function. Plot the magnitude and phase spectrum. **(07 Marks)**

b. If $y(t) = \frac{dx(t)}{dt}$, where x (t) is a non-periodic sigal, find the Fourier Transform of y (t) in terms of x (jw). **(06 Marks)**

c. Determine the PTFT of the signal, $x[n] = \{1, 1, \underset{\uparrow}{1}, 1, 1\}$ and sketch the spectrum $x(e^{j\Omega})$ over the frequency range $-\pi \le \Omega \le \pi$. **(07 Marks)**

6 a. The input $x(t) = e^{-3t}u(t)$ when applied to a system, results in an output $y(t) = e^{-t}u(t)$. Find the frequency response and impulse response of the system. **(07 Marks)**

b. Find the FT of a train of unit impulses as shown in Fig.6(b). **(07 Marks)**

Fig.6(b)

c. Find the FT pair corresponding to the discrete time periodic signal: $x[n] = \cos\left[\frac{2\pi}{N}n\right]$. **(06 Marks)**

7 a. Find the z - transform and RoC of $x[n] = \alpha^{|n|}$. What is the constraint on α? **(06 Marks)**

b. Using properties of z – transform, find convolution of $x[n] = \left[\underset{\uparrow}{1}, 2, -1, 0, 3\right]$ and $y[n] = \left[\underset{\uparrow}{1}, 2, -1\right]$. **(06 Marks)**

c. Determine x [n] if $x(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - z^{-1}\right)}$ for i) RoC of $|z| < \frac{1}{2}$ and ii) RoC of $1 < |z| < 2$. **(08 Marks)**

8 a. Find x [n] if $x(z) = \frac{16z^2 - 4z + 1}{8z^2 + 2z - 1}$; RoC : $|z| > 1/2$. **(06 Marks)**

b. Prove the time shift property of unilateral z-transform. **(06 Marks)**

c. Determine the transfer function and difference equation if the impulse response is $h[n] = \left[\frac{1}{3}\right]^n u[n] + \left[\frac{1}{2}\right]^{n-2} u[n-1]$. **(08 Marks)**

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06EC45

Fourth Semester B.E. Degree Examination, Dec.09-Jan.10
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 structure of VHDL module and Verilog module. **(05 Marks)**

b. Given A = 1000 and B = 0011, perform the following operations :
   i) AXNOR B
   ii) Shift B two position left logical
   iii) Reduction NAND
   iv) Verilog concatenation {A, B}
   v) Verilog modulus A % B. **(05 Marks)**

c. Explain the Verilog data types. **(04 Marks)**

d. List the types of descriptions. Write VHDL code to describe one bit full adder using mixed style description. **(06 Marks)**

2 a. What are the facts of data flow description? Explain with an example the execution of signal assignment statement in HDL. **(06 Marks)**

b. Derive a minimized Boolean function of the system that has three 1 bit input 'a' and 1 bit output 'b'. The output 'b' is '1' when input 'a' is 1, 3, 6, 7, otherwise 'b' is 'O'. Write a dataflow description in VHDL. What is the function of this system? **(04 Marks)**

c. Write the block diagram of a 4 bit ripple carry adder and its Boolean functions. Write a dataflow description in verilog. Assume 3 ns propagation delay for all two input gates. Draw the simulation waveform. **(10 Marks)**

3 a. Explain the execution of process statement. **(02 Marks)**

b. Distinguish between :
   i) VHDL IF and VHDL case
   ii) VHDL Next and Exit
   iii) Verilog repeat and Verilog forever
   iv) Always and initial. **(08 Marks)**

c. Using Booth algorithm, find the product of two 4 bit numbers -3 and 8. Write a Verilog code using behavioral style of description. **(10 Marks)**

4 a. Explain how binding is achieved in VHDL between :
   i) Entity and component
   ii) Library and module **(04 Marks)**

b. Write a VHDL structural description of a full adder using two half adder and an OR gate. Write the simulation waveform. **(08 Marks)**

c. Write a Verilog structural description of a N = 3 bit magnitude comparator using generate statement. **(08 Marks)**

PART – B

5 a. What are the significance of procedure, tasks and functions? Differentiate between procedure/task and function. **(04 Marks)**

b. Write a code to convert the unsigned integer to (N = 4) binary using procedure. **(08 Marks)**

c. Write a VHDL code for finding the word with the lowest ASCII value using file operations. **(08 Marks)**

6 a. Explain the implementation of single dimensional and two dimensional arrays in VHDL. **(04 Marks)**

b. Write a block diagram and function table of 128 x 16 static memory. Write a Verilog code. Verify the code by simulation waveform by writing data in memory locations 8, 18, 46, 126 and read the contents of two memory locations 18 and 46. **(08 Marks)**

c. Explain the fetch and execute cycles of basic computer for the following operations :
Halt, Add, Mult, NAND. **(08 Marks)**

7 a. Write mixed-language description of a master slave D flip flop invoking a VHDL entity from a Verilog module. **(10 Marks)**

b. Write a mixed-language description of an AND gate invoking a Verilog module from a VHDL module. **(06 Marks)**

c. What are the limitations of mixed-language descriptions? **(04 Marks)**

8 a. What is synthesis? List the general steps involved in synthesis. **(08 Marks)**

b. Give synthesis information extracted, when the input and output are defined as :
i) bit ii) Std – logic – vector. **(04 Marks)**

c. Write a behavioral code in VHDL and Verilog for the signal assignment statement Y = X. Explain the mapping to gate level logic diagram. **(08 Marks)**

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06EC46

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Linear ICs and Applications

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following terms as applied to an operational amplifier and mention their typical values for IC 741:
   i) CMRR
   ii) PSRR
   iii) Slew rate
   iv) Output impedance. **(08 Marks)**

   b. Explain the block diagram of an operational amplifier with the help of a diagram indicating the various building blocks. **(08 Marks)**

   c. Sketch and explain a typical gain versus frequency graph for an operational amplifier. **(04 Marks)**

2 a. Design a capacitor-coupled voltage follower using IC741 operational amplifier. The lower cutoff frequency for the circuit is to be 100Hz and the load resistance is 4.7 kΩ. Draw the circuit and explain the operation. **(12 Marks)**

   b. Sketch the circuit of a capacitor-coupled inverting amplifier using a single polarity supply. Briefly explain the operation. **(08 Marks)**

3 a. Discuss the operational amplifier circuit stability and show how feedback in an inverting amplifier can produce instability. Explain the conditions necessary for oscillations to occur in an operational amplifier circuit. **(08 Marks)**

   b. Sketch and explain a circuit to show the Z_{in} mod method of frequency compensation. State the application of the circuit. **(08 Marks)**

   c. List the precautions that should be observed for operational amplifier circuit stability. **(04 Marks)**

4 a. Draw the circuit of an instrumentation amplifier. Discuss the characteristics of the circuit and show how the voltage gain can be varied. Also show the method of nulling common mode outputs and how the dc output voltage can be level shifted. **(12 Marks)**

   b. A voltage source is to be designed to provide a constant output voltage of approximately 6V. The load resistance has a minimum value of 150Ω and the available supply voltage is ±12V. Design a suitable circuit using IC 741 and a zener diode with V_z of 6.3V. **(08 Marks)**

PART – B

5 a. A voltage follower type peak detector is to be designed. The pulse type signal voltage has a peak value of approximately 2.5V with a rise time of 5 μs and the output voltage is to be held at 2.5V for a time of 100 μs. The maximum output error is to be approximately 1%. Calculate the required component values and specify the output current and slew rate of the op-amps. **(12 Marks)**

   b. Draw the circuit of a phase shift oscillator using an operational amplifier. Sketch the output and feedback voltage waveforms and explain the circuit operation. **(08 Marks)**

6 a. Explain the operation of an inverting Schmitt trigger circuit with different UTP and LTP voltages, with the help of a suitable circuit. Discuss the design procedure for components used. Also indicate the input/output characteristics for the inverting Schmitt trigger circuit. **(10 Marks)**

b. Design a second order low pass filter circuit to have a cutoff frequency of 2 kHz. Draw the circuit and indicate the frequency response of the filter. **(10 Marks)**

7 a. List and explain the characteristics of three terminal IC regulators. **(04 Marks)**

b. Explain the principle of operation of a switching regulator. Discuss its advantages and disadvantages. **(08 Marks)**

c. Design a voltage regulator using IC 723 to get a voltage output of 5V. **(08 Marks)**

8 a. Explain the functional diagram of IC 555 with a neat sketch. **(10 Marks)**

b. Write explanatory notes on:
   i) PLL
   ii) A/D converters. **(10 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.09/Jan.10
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. If (l, m, n) be the direction cosines of a line then prove that $l^2 + m^2 + n^2 = 1$. **(06 Marks)**

b. Find the value of K if the angle between the lines with direction ratios -2, 1, -1 and 1, -K, -1 is $\frac{2\pi}{3}$. **(07 Marks)**

c. Find the projection of the line segment AB on CD, where A = (3, 4, 5), B = (4, 6, 3), C = (-1, 2, 4), D = (1, 0, 5) **(07 Marks)**

2 a. Find the angle between the planes x-y+2z = 9 and 2x+y+z = 7. **(06 Marks)**

b. Find the equation of the plane passing through the line of intersection of the planes $x + 2y - 3z - 1 = 0$ and $3x - y + 4z - 5 = 0$ and perpendicular to the plane $3x - y - 3z + 4 = 0$. **(07 Marks)**

c. Find the point of intersection of the lines, $\frac{x-4}{1} = \frac{y+3}{-4} = \frac{z+1}{7}$ and $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8}$. **(07 Marks)**

3 a. If $\vec{A} = 2i - 3j - k$ and $\vec{B} = i + 4j - 2k$, find $(\vec{A}+\vec{B}) \times (\vec{A}-\vec{B})$. **(06 Marks)**

b. For any three vectors $\vec{a}$, $\vec{b}$, $\vec{c}$, prove that $\left(\vec{a}\times\vec{b}\right)\times\vec{c} = \left(\vec{a}\cdot\vec{c}\right)\vec{b} - \left(\vec{b}\cdot\vec{c}\right)\vec{a}$ **(07 Marks)**

c. Prove that the four points $4i + 5j + k$, $-(j+k)$, $(3i+9j+4k)$ and $4(-i+j+k)$ are coplanar. **(07 Marks)**

4 a. A particle moves along the curve $x = 1 - t^3$, $y = 1 + t^2$ and $z = 2t - 5$ where t is the time. Find the velocity and acceleration at t = 1. **(06 Marks)**

b. Find the unit vector normal to the surface $x^2y - 2xz + 2y^2z^4 = 10$ at (2, 1, -1). **(07 Marks)**

c. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point (2, -1, 2). **(07 Marks)**

5 a. If $\vec{F} = (3x^2y - z)i + (xz^3 + y^4)j - 2x^3z^2k$ find grad(div $\vec{F}$) at (2, -1, 0). **(06 Marks)**

b. Find curl(curl $\vec{A}$) given that $\vec{A} = xyi + y^2zj + z^2yk$. **(07 Marks)**

c. Show that $\vec{F} = \frac{xi + yj}{x^2 + y^2}$ is both solenoidal and irrotational. **(07 Marks)**

6 a. Find the Laplace transform of $f(t) = \begin{cases} t, & 0 < t < 4 \\ 5, & t > 4 \end{cases}$. **(05 Marks)**

b. Find $L(t^n)$ where n is a positive integer. **(05 Marks)**

c. Find $L[t\cos at]$. **(05 Marks)**

d. Find $L\left[\frac{\cos at - \cos bt}{t}\right]$. **(05 Marks)**

7 Find the inverse Laplace transform for the following:

a. $\frac{(s+2)^3}{s^6}$ **(05 Marks)**

b. $\frac{2s-1}{s^2+4s+29}$ **(05 Marks)**

c. $\frac{2s^2+5s-4}{s^3+s^2-2s}$ **(05 Marks)**

d. $\log\left(1-\frac{a^2}{s^2}\right)$ **(05 Marks)**

8 a. Use Laplace transform method to solve, $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=e^{-t}$; $y(0)=0$, $y'(0)=0$ **(10 Marks)**

b. Find the inverse Laplace transformation of $\frac{s^2}{(s-2)^3}$ **(10 Marks)**

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