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06MAT41

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Engineering Mathematics - IV

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE full questions choosing atleast two from each part.***

Part A

1 a. Find by Taylor's series method the value of y at $x = 0.1$ and $x = 0.2$ to five places of decimals from $\frac{dy}{dx} = x^2y - 1$, $y(0) = 1$ consider upto 4^{th} degree terms. **(06 Marks)**

b. Apply Runge-Kutta method to find an approximate value of y for $x = 0.2$ in steps of 0.1 of $\frac{dy}{dx} = x + y^2$, given that y = 1, when x = 0. **(07 Marks)**

c. Given $\frac{dy}{dx} = x^2(1+y)$ and y(1)=1, y(1.1)=1.233, y(1.2)=1.548, y(1.3)=1.979, evaluate y(1.4) by Adam's-Bashforth method. **(07 Marks)**

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

b. Determine the analytic function, $f(z) = u + iv$, if

$$u - v = \frac{\cos x + \sin x - e^{-y}}{2(\cos x - \cosh y)}.$$ **(07 Marks)**

c. Discuss the transformation $w = e^z$. **(07 Marks)**

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

b. Find the Taylor's expansion of $f(z) = \frac{2z^3 + 1}{z^2 + z}$ about the point z = i. **(07 Marks)**

c. Evaluate $\int_C \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)^2(z-2)} dz$, where C is the circle $|z| = 3$. **(07 Marks)**

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

b. Reduce the differential equation $x\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + k^2xy = 0$ to Bessel's equation. **(07 Marks)**

c. Derive the Rodrigue's formula, $P_n(x) = \frac{1}{n!2^n}\frac{d^n}{dx^n}(x^2 - 1)^n$. **(07 Marks)**

Part B

5 a. Fit a second degree polynomial to the following data: **(06 Marks)**

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

b. The two regression equations of the variables x and y are
$x = 19.13 - 0.87y$ and $y = 11.64 - 0.50x$
Find i) mean of x's ii) mean of y's and iii) the correlation coefficient of x and y. **(07 Marks)**

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

i) Find k.

ii) Find $P(x<4)$, and $P(3<x\leq 6)$. **(06 Marks)**

b. Derive mean and variance for the Poisson distribution. **(07 Marks)**

c. In a test on 2000 electric bulbs, it was found that the life of a particular make, was normally distributed with an average life of 2040 hours and S.D. if 60 hours. Estimate the number of bulbs likely to burn for

i) More than 2150 hours

ii) Less than 1950 hours and

iii) More than 1920 hours, but less than 2160 hours. **(07 Marks)**

7 a. In a city A, 20% of a random sample of 900 school boys has a certain slight physical defect. In another city B, 18.5% of a random sample of 1600 school boys had the same defect. Is the difference between the proportions significant? **(06 Marks)**

b. A machinist is making engine parts with axle diameter of 0.7 inch. A random sample of 10 parts shows mean diameter 0.742 inch with a S.D. of 0.04 inch. On the basis of this sample, would you say that the axle is inferior? **(07 Marks)**

c. A set of five similar coins is tossed 320 times and the result is:

No. of heads	0	1	2	3	4	5
Frequency	6	27	72	112	71	32

Test the hypothesis that the data follow a binomial distribution. **(07 Marks)**

8 a. The joint distribution of two random variables x and y is given by the following table:

x \ y	2	3	4
1	0.06	0.15	0.09
2	0.14	0.35	0.21

Determine the marginal distribution of x and y. Also verify that x and y are stochastically independent. **(06 Marks)**

b. Find the fixed probability vector of the regular stochastic matrix,

$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$$ **(07 Marks)**

c. Explain i) Transient state ii) Recurrent state iii) absorbing state of Markov chain. **(07 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Advanced Mathematics II

Time: 3 hrs. Max. Marks:100

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

1 a. Show that the lines whose direction cosines are given by the equations $l+m+n=0$, $al^2+bm^2+cn^2=0$ are perpendicular if a+b+c = 0. **(06 Marks)**

b. Show that the angle between any two diagonals of a cube is $\cos^{-1}\left(\frac{1}{3}\right)$. **(07 Marks)**

c. If P, Q, A, B are (1, 2, 3), (-2, 1, 3), (4, 4, 2), (2, 1, -4), find the projection of PQ on AB. **(07 Marks)**

2 a. Find the equation of the plane in the intercept form. **(06 Marks)**

b. Find the equation of the plane which passes through (3, -3, 1) and is perpendicular to the planes $7x+y+2z=6$ and $3x+5y-6z=8$. **(07 Marks)**

c. Show that the lines $\frac{x-5}{4}=\frac{y-7}{4}=\frac{z+3}{-5}$, $\frac{x-8}{7}=\frac{y-4}{1}=\frac{z-5}{3}$ are coplanar. Find their common point. **(07 Marks)**

3 a. Show that the four points whose position vectors are $3i-2j+4k$, $6i+3j+k$, $5i+7j+3k$ and $2i+2j+6k$ are coplanar. **(06 Marks)**

b. A particle moves along the curve $x=t^3+1$, $y=t^2$, $z=2t+5$ where t is the time. Find the components of its velocity and acceleration at t = 1 in the direction $2i+3j+6k$. **(07 Marks)**

c. If $\vec{A}=4i+3j+k$, $\vec{B}=2i-j+2k$ find a unit vector N perpendicular to vectors A and B. Such that A, B, N form a right-handed system. **(07 Marks)**

4 a. Find the angle between the tangents to the curve $\vec{r}=t^2i+2tj-t^3k$ at the point $t=\pm1$. **(06 Marks)**

b. Let $\vec{a}=i+j-k$, . $\vec{b}=i-j+k$, $\vec{c}=i-j-k$. Find the vector $\vec{a}\times\left(\vec{b}\times\vec{c}\right)$. **(07 Marks)**

c. Find a unit vector normal to the surface $x^2+3y^2+2z^2=6$ at (2, 0, 1). **(07 Marks)**

5 a. Find the directional derivative of $f(x,y,z)=xy^2+yz^3$ at the point (2, -1, 1) in the direction of i+2j+2k. **(06 Marks)**

b. Find i) $\operatorname{div}\left(3x^2i+5xy^2j+xyz^3k\right)$ at (1, 2, 3).

ii) $\operatorname{curl}\left[xyzi+3x^2yj+\left(xz^2-y^2z\right)k\right]$ **(07 Marks)**

c. Find the values of the constants a, b, c for which the vector $v=(x+y+az)i+(bx+3y-z)j+(3x+cy+z)k$ is irrotational. **(07 Marks)**

6 a. Find the Laplace transform of

$$f(t)=\begin{cases}e^t;0<t<1\\0;\ t>1\end{cases}.$$ **(05 Marks)**

b. Find $L\left\{e^{-3t}(2\cos5t-3\sin5t)\right\}$. **(05 Marks)**

c. Evaluate $L\left\{t\sin^2t\right\}$. **(05 Marks)**

d. Find $L\left\{\frac{1-e^t}{t}\right\}$. **(05 Marks)**

7 Find the inverse Laplace transform for the following:

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

b. $\frac{s+2}{s^2-4s+13}$. **(05 Marks)**

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

d. $\log\left(\frac{s+a}{s+b}\right)$. **(05 Marks)**

8 a. Use Laplace transform method to solve,

$\frac{d^2x}{dt^2}-2\frac{dx}{dt}+x=e^t$ with $x=2$, $\frac{dx}{dt}=-1$ at $t=0$. **(10 Marks)**

b. Solve the following simultaneous equations using Laplace transform method,

$\frac{dx}{dt}-y=e^t$; $\frac{dy}{dt}+x=\sin t$; given $x(0)=1$, $y(0)=0$. **(10 Marks)**

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06ES42

Fourth Semester B.E. Degree Examination, Dec 08 / Jan 09
Microcontrollers

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE full questions, selecting atleast TWO questions from each part.***

PART - A

1 a. Differentiate between a microprocessor and a microcontroller. **(06 Marks)**
b. List the salient features of 8051 microcontroller. **(06 Marks)**
c. Explain the memory organization in 8051 controller. **(08 Marks)**

2 a. Explain the following instructions with suitable examples.
i) SWAP ii) MOVX iii) XCHD iv) DA A. **(06 Marks)**
b. Write an assembly language programme using 8051 mnemonics to convert 2 digit BCD to binary. **(06 Marks)**
c. What is a stack? Explain with examples the PUSH and POP instructions. **(08 Marks)**

3 a. Differentiate between a counter and timer. Explain the timer modes of operation in 8051. **(06 Marks)**
b. Name and explain the significance of interrupt of 8051 controllers. **(06 Marks)**
c. Write a 8051 C program to toggle all bits of port Po continuously. Use timer 0 to generate the delay of 1 sec between each toggle. **(08 Marks)**

4 a. Differentiate between JMP and call instruction. Explain with suitable examples the different ranges associated with call instructions. **(06 Marks)**
b. Explain with suitable examples Lcall and Scall instruction in 8051. **(06 Marks)**
c. Write an assembly language program to realize an exclusive OR gate. Assume P1.0 and P1.1 as inputs and P2.0 as output bit. **(08 Marks)**

PART - B

5 a. Write an 8051C program to transfer the message "Good morning" serially at 9600 baud, 8 bit data, 1 slip bit. **(06 Marks)**
b. Explain serial port of 8051. Explain the significance of SCOW register in detail. **(06 Marks)**
c. What is the use of MODEM in serial communication? Describe different types of modulation techniques used in MODEM. **(08 Marks)**

6 a. What is key bouncing? How it is eliminated? **(04 Marks)**
b. Show a simple keyboard interface with a port of 8051 and explain its operation. **(06 Marks)**
c. With suitable hardware and software features, explain an interface of 7 segment display in multiplexed connection. **(10 Marks)**

7 a. Explain the salient features of an ADC. What are the signals of importance while interfacing such an ADC to a 8051 controller? **(10 Marks)**
b. Show a scheme of interfacing an 8-bit ADC to a 8051 controller. Write the software required to obtain the output from such an interface. Discuss practical application. **(10 Marks)**

8 a. Show an interface of 8051 controller with a stepper motor drive circuit and explain its principles of operation. **(10 Marks)**

b. Write an 8051 assembly language program to (step) control stepper motor using connections given in fig. 8(b) below.

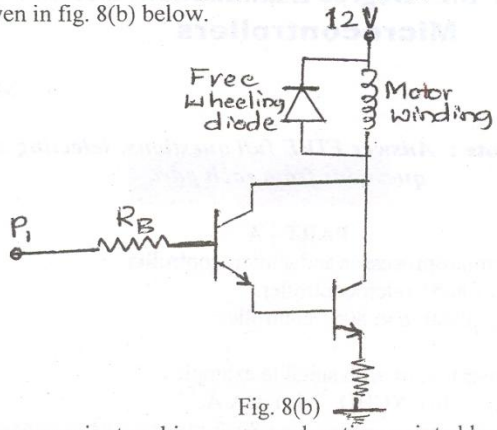

Fig. 8(b)

Assume code sequence is stored in a memory location pointed by DPTR code. Use suitable delay routine, comment on each of instruction used. **(10 Marks)**

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06ES43

Fourth Semester B.E. Degree Examination, Dec 08 / Jan 09
Control Systems

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE full questions, selecting atleast TWO questions from each part.***

PART - A

1 a. Distinguish between open loop and closed loop control system. Describe two examples for each. **(10 Marks)**

b. Write the differential equations for the mechanical system shown in fig. 1(b) and obtain f – v and f – I analogous electrical circuits. **(10 Marks)**

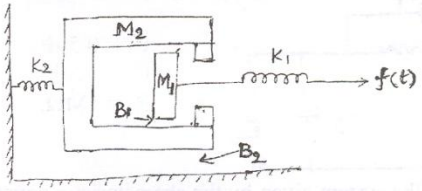


Fig. 1(b)

2 a. Draw a block diagram for the bridge circuit shown in fig.2(a), where vi and io are the input and output variables respectively. Also determine $\frac{I_o(s)}{V_i(s)}$ by block diagram reduction technique. **(12 Marks)**

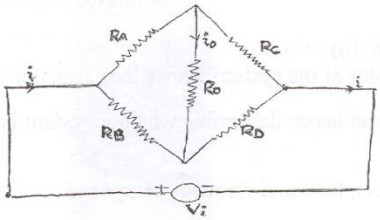


Fig. 2(a)

b. For the system represented by the following equation, find the transfer function $\frac{X(S)}{U(S)}$ by signal flow graph.

$x = x_1 + \alpha_3 U$; $\dot{x}_1 = -\beta_1 x_1 + x_2 + \alpha_2 U$; $\dot{x}_2 = -\beta_2 x_1 + \alpha_1 U$ **(08 Marks)**

3 a. Considering the response of a second order system to a unit step input, derive the following : i) Peak time (t_p) ii) Rise time (t_r) iii) Maximum overshoot (M_p). **(08 Marks)**

b. Assuming the time constant T of the controller to be 3 sec and the ratio of the torque to inertia K/J to be 3 rad^2/sec^2, find the damping ratio, rise time, peak time and maximum overshoot (M_p) of the system shown in fig 3(b). **(06 Marks)**

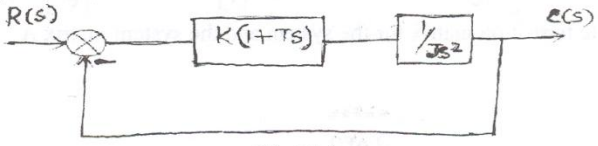


Fig.3(b)

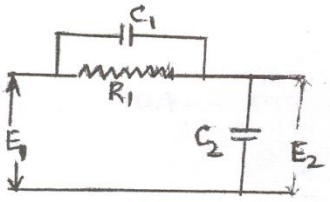
c. For a unity feedback system given by $G(s) = \frac{20(S+2)}{S(S+3)(S+4)}$

i) Find the static error constant

ii) Find the steady state error for $r(t) = 3\,u(t) + 5(t)\,u(t)$. **(06 Marks)**

4 a. What are the difficulties encountered while assessing the R-H criteria and how do you eliminate these difficulties, explain with examples. **(06 Marks)**

b. The open loop transfer function of a unity feedback control system is given by $G(S) = \frac{50}{S(1+0.05S)(1+0.2S)}$. Apply R-H criteria. Show that the system is unstable. Confirm that the introduction of the two terminal pair network connected in cascade with G(S) makes the system stable. **(08 Marks)**



$C_1 = 0.5\mu F$
$C_2 = 10\mu F$
$R_1 = 1M\Omega$.

c. Ascertain the stability of the system given by the characteristic equation $S^6 + 3S^5 + 5S^4 + 9S^3 + 8S^2 + 6S + 4 = 0$. **(06 Marks)**

PART - B

5 a. State the different rules for the construction of root locus. **(08 Marks)**

b. Sketch the root locus for the system $G(S)\,H(S) = \frac{K}{S(S+1)(S+2)(S+3)}$ **(12 Marks)**

6 a. State and explain Nyquist stability criterion. **(08 Marks)**

b. Draw the complete Nyquist plot of the system whose loop transfer function is given by $G(S) = \frac{50}{S(1+0.1S)(1+0.2S)}$ and hence determine whether system is stable or not. **(12 Marks)**

7 a. Explain the correlation between time and frequency response. **(08 Marks)**

b. The open loop transfer function of a unity feedback system is $G(S) = \frac{1}{S(1+0.5S)(1+0.1S)}$.

Find gain and phase margin. If a phase-lag element with transfer function of $\left(\frac{1+2S}{1+5S}\right)$ is added in the forward path find by how much the gain must be changed to keep the margin same. **(12 Marks)**

8 a. Define state transition matrix and list the properties of the state transition matrix. **(08 Marks)**

b. The state equation of a certain system is $\dot{x} = Ax$, where A is a 2×2 constant matrix.

If $x(0) = \begin{bmatrix} 1 \\ -3 \end{bmatrix}$ then $\bar{x}(t) = \begin{bmatrix} e^{-3t} \\ -3e^{-3t} \end{bmatrix}$ and if $\bar{x}(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ then $\bar{x}(t) = \begin{bmatrix} e^{t} \\ e^{t} \end{bmatrix}$

Determine the state transition matrix for the system and the system matrix A. **(12 Marks)**

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06EC44

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE full questions choosing at least two full questions from each part.***

Part A

1 a. Determine even and odd component of following signals,

i) $x(t) = 1 + t\tan t + t^2 \tan^2 t$ ii) $x(n) = n^2\left(\frac{1}{2}\right)^{n-2}$ **(06 Marks)**

b. Determine energy in the signal $x\left(-\frac{1}{2}t+3\right)$ given the signal x(t) as below, **(08 Marks)**

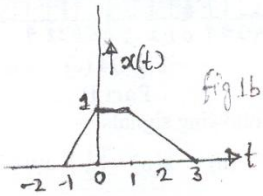

Fig. Q1 (b)

c. Verify the following system for i) Linerity ii) Time-invariance iii) Causal iv) Memory less.

$$y(n) = x(n) + \sum_{K=-\infty}^{n-1} x(k)$$ **(06 Marks)**

2 a. A LTI system has an impulse response $h(t) = e^{-|t-2|}$. Find the output of the system for the input $x(t) = e^{-3t}u(t)$. **(10 Marks)**

b. A discrete time system which is linear and time-invariant has impulse response $h(n) = \left(\frac{1}{2}\right)^n (u(n) - u(n-7))$. If the impulse is $x(t) = \left(\frac{1}{3}\right)^n \quad 0 \geq n \geq 9$ $= 0 \quad$ otherwise

Determine the output and obtain closed form expression in each region. **(10 Marks)**

3 a. A system is described by $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = \frac{dx(t)}{dt}$.

With initial conditions $y(0) = -1$ $\left.\frac{dy(t)}{dt}\right|_{t=0} = 2$

If the input is $x(t) = 2e^{-2t}u(t)$, determine the output (do not use any transforms). **(10 Marks)**

b. Determine the step response of the LTI system whose impulse response is given by $h(n) = \left(-\frac{3}{4}\right)^n u(n)$. **(04 Marks)**

c. Draw the direct form – I and direct form – II implementation of the system given by, $y(n) - \frac{1}{2}y(n-1) + \frac{1}{3}y(n-3) = x(n) + 3x(n-1)$. **(06 Marks)**

4 a. State and prove Parseval's theorem for continuous time periodic signals x(t). Using the same evaluate the following :

$$\sum_{k=-\infty}^{\infty} \frac{\sin^2\left(\frac{k\pi}{4}\right)}{k^2}.$$ **(10 Marks)**

4 b. Determine the time-domain signal given the DTFS coefficients,
$x(k)=\cos\left(\frac{10\pi}{21}k\right)+j\sin\left(\frac{4\pi}{21}k\right)$. **(04 Marks)**

c. Determine Fourier series representation of the signal x(n) shown below, and sketch its magnitude spectra. **(06 Marks)**

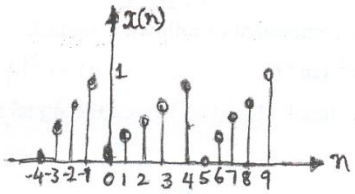

Fig Q4 (c)

Part B

5 a. Determine the DTFT of the following signals,

i) $x(n)=a^{|n-2|}$, $|a|<1$ ii) $x(n)=\left(\frac{1}{2}\right)^n u(n-2)$ iii) $x(n)=2^n[u(n)-u(n-6)]$. **(10 Marks)**

b. Determine the time-domain signal given its FT as follows:

i) $x(j\omega)=\dfrac{-j\omega}{(j\omega)^2+3j\omega+2}$. ii) $x(j\omega)=\begin{cases}1 & -\pi/2\le\omega\le\pi/2\\ 0 & |\omega|>\pi/2\end{cases}$

iii) $x(j\omega)=\begin{cases}2\cos\omega & |\omega|\le\pi\\ 0 & |\omega|>\pi\end{cases}$ **(10 Marks)**

6 a. Determine the frequency response and impulse response of a system described by $\dfrac{d^2y(t)}{dt^2}+5\dfrac{dy(t)}{dt}+6y(t)=-\dfrac{dx(t)}{dt}$. **(07 Marks)**

b. Explain the process of sampling and concept of aliasing as applicable to continuous time signals. **(06 Marks)**

c. Determine the frequency response $H(j\omega)$ of a system which has impulse response of $h(t)=\dfrac{\sin(\pi t)}{\pi t}\cos(3\pi t)$ using the modulation property. Plot the magnitude and phase response of $H(j\omega)$. **(07 Marks)**

7 a. Determine the z-transform of the following sequences along with their ROC. Plot the poles and zeros:

i) $x(n)=\left(\frac{3}{4}\right)^n u(n)+(2)^n u(-n-1)$. ii) $x(n)=(n-3)^2\left(\frac{1}{3}\right)^{n-3}u(n-3)$. **(10 Marks)**

b. Determine output of the LTI system where $h(n)=\left(\frac{1}{2}\right)^n u(n)$ and $x(n)=n\left(-\frac{1}{2}\right)^n u(n)$ using z-transform techniques. **(10 Marks)**

8 a. A stable system is described by the difference equation,
$y(n)-y(n-1)+\frac{1}{4}y(n-2)=x(n)+\frac{1}{4}x(n-1)-\frac{1}{8}x(n-2)$. Determine its impulse response.
If $x(n)=\left(\left(\frac{1}{4}\right)^n+\left(-\frac{1}{2}\right)^n\right)u(n)$ determine the output. **(10 Marks)**

b. Determine forced response, the natural response and comlete response of the system described by,
$y(n)-\frac{3}{4}y(n-1)+\frac{1}{8}y(n-2)=2x(n)$
$y(-1)=1$, $y(-2)=-1$, $x(n)=u(n)$
using unilateral z-transform. **(10 Marks)**

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06EC45

Fourth Semester B.E. Degree Examination, Dec 08 / Jan 09
Fundamentals of HDL

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE full questions, selecting atleast TWO questions from each part.***

PART - A

1 a. Mention the types of HDL descriptions. Explain dataflow and behavioral descriptions. **(07 Marks)**

b. Discuss different logical operators used in HDLS. **(08 Marks)**

c. Compare VHDL and Verilog. **(05 Marks)**

2 a. Explain signal declaration and signal assignment statements with relevant examples. **(06 Marks)**

b. Write a data – flow description (in both VHDL and Verilog) for a full adder with active high enable. **(08 Marks)**

c. Write HDL codes for 2× 2-bit combinational array multiplier. **(06 Marks)**

3 a. Explain IF and CASE statements with examples. **(08 Marks)**

b. Explain Booth algorithm with a flow chart. Write VHDL or Verilog description for 4× 4-bit Booth algorithm. **(12 Marks)**

4 a. What is Binding? Discuss the binding between library and components. **(08 Marks)**

b. Write the HDL description of 2:1 multiplexer with active low enable in VHDL/Verilog, using structural style. **(12 Marks)**

PART - B

5 a. Explain the following with syntax (i) Procedures in VHDL (ii) Tasks in Verilog. **(06 Marks)**

b. Write VHDL/Verilog code to convert a fractional Binary to Real number using Procedures/Tasks. **(08 Marks)**

c. Describe all file processing tasks in Verilog. **(06 Marks)**

6 a. What is the necessity of Mixed-type description? **(04 Marks)**

b. Describe the development of HDL code for an Arithmetic Logic Unit and write VHDL/Verilog code for an ALU, shown in fig.6(b). **(16 Marks)**

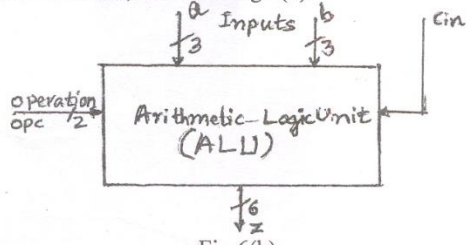

Fig.6(b)

Assume the following operations : - Addition, Multiplication, Division, No Operation.

7 a. How to invoke a VHDL entity from a Verilog module. **(08 Marks)**

b. Explain mixed language description of a JK Flip – Flop with a clear pin and write the simulation waveform. **(12 Marks)**

8 a. Describe synthesis information extraction from entity and module with examples. **(10 Marks)**

b. Explain mapping the signal – assignment and variable assignment statements to Gate-level with suitable examples. **(10 Marks)**

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06EC46

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Linear ICs and Applications

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE full questions choosing at least two full questions from each part.***

Part A

1 a. What is meant by offset in an op-amp, how does it effect the performance of the op-amp? If an op-amp has an bias current of 200nA and two equal resistances of 20kΩ are connected between inverting terminal and ground, as well as non-inverting terminal and ground respectively, what will be the input offset voltage for a tolerance of ±20% in resistor values? What will be output voltage under open loop gain of 10^5? **(08 Marks)**

b. Prove that the open loop input and output impedances of an op-amp under closed loop condition change due to feedback. Determine these impedances for an non-inverting amplifier with a closed loop gain of 200. The op-amp has differential input impedance of $2\times10^6\,\Omega$ and output impedance 50Ω. The open loop gain of op-amp $Av_0 = 10^6$. **(04 Marks)**

c. Explain with circuit diagram how a dual supply op-amp can be configured to operate with single supply. **(08 Marks)**

2 a. A capacitor coupled non-inverting amplifier is to be designed to have high input impedance with a gain of 40 dB. If the open loop gain of op-amp is 2×10^5 and input impedance 1.5×10^6 Ω, calculate the various circuit elements. The required cutoff frequency is 100 Hz. The load resistance is 2.2 kΩ and input parasitic capacitance 15 pf. Also calculate the input impedance. **(08 Marks)**

b. Derive the condition under which an non-inverting amplifier can be used as a voltage follower. What will be the input impedance? **(06 Marks)**

c. How upper cutoff frequency is decided in an op-amp and when is it necessary? **(06 Marks)**

3 a. What is the need of stability check in an op-amp? From the frequency response show how stability of an op-amp can be analyzed. When do you say an op-amp is stable? **(08 Marks)**

b. An operational amplifier has a unity cross-over frequency of 1 MHz. Calculate the upper cutoff frequency in the following cases:

i) Inverting amplifier with $A_{vc} = 100$ dB.

ii) Non inverting amplifier with $A_{vc} = 50$ dB.

iii) Voltage follower:

Show these on the frequency response plot if $A_{vo} = 120$ dB. **(04 Marks)**

c. Explain how bandwidth increases by using Z_{in} mod compensation. **(08 Marks)**

4 a. What is the concept of current source and current sink? Design a current sink to provide 100 mA through a load of 30Ω. The op-amp supply voltage is ±12V. A zener of 4.7 V is used at input $I_{ZOP} = 5$mA. An n-channel power MOSFET is used with $V_{DS(max)}$ = 60 V, I_{Dmax}=150 mA and R_{Don}=7.5Ω. **(08 Marks)**

b. Draw the circuit of a double ended peak clipper and explain the clipping action. Design a clipper to limit the output between +5.4 V and –4.6 V. The input peak voltage is 1 volt sinewave. Draw the input and output waveforms. **(08 Marks)**

c. What is a dead zone circuit? Explain. **(04 Marks)**

Part B

5 a. Explain the importance and working of ,
   i) Voltage follower peak detector.
   ii) Sample and hold. **(08 Marks)**

b. Define the following terms clearly i) Pulse width ii) Duty cycle iii) Frequency. How these are generated in a triangular / rectangular wave generator? Draw the waveforms at different points. **(08 Marks)**

c. Design an R-C phase shift oscillator to give an sinusoidal frequency of 5 kHz. Assume appropriate supply voltage required if 741 CT op-amp is used. **(04 Marks)**

6 a. How can op-amp be used as reference detector under open loop, what are its limitations? How this can be overcome using Schmitt trigger? **(08 Marks)**

b. Design an Astable multivibrator that can produce an output with $t_{on} = t_{off}$ of 1 m sec. The operational amplifier is driven with a ± 15 volts supply. Draw waveforms across capacitor, feedback and output. The hysterisis should not exceed 0.1 volt. **(06 Marks)**

c. Distinguish between first order and second order filter. Why in a third order filter additional op-amp is required? Draw the circuit and plot of third order filter. **(06 Marks)**

7 a. Define and explain the following terms, used in a voltage regulator - i) Line regulation ii) Load regulation. **(04 Marks)**

b. Design a series pass regulator to give an output of 9 volts to a minimum and load resistance of 36Ω for a two-in-one radio. The input DC coming from a rectifier filter varies between 9 volts and 15 volts. The op-amp available has a bias current of 12 nA and requires $V_{s\min} = \pm 7$ V and $V_{s\max} = \pm 18$V . The available zener diode is of 4.7 volts with $I_{z\max} = 20$mA . Specify the ratings required of series pass element and constant current short circuit protection transistor. **(08 Marks)**

c. What are the salient features of 723 regulator? Explain by drawing a schematic. **(08 Marks)**

8 Draw the schematic of the following and explain their working, draw the waveforms at various points to support your discription,

a. 555 timer as monostable.

b. Phase locked loop as atomatic, frequency controller.

c. 4 bit ADC with $V_{in\,max} = 2$ volts

d. 8 bit DAC with $V_{out\,max} = 5$ volts. **(20 Marks)**

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