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10MAT41

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

Note: ***Answer 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. Use Picards method to obtain the solution of $\frac{dy}{dx} = e^x - y$, $y(0) = 1$ and hence find $y(0.2)$ considering upto third approximation. **(06 Marks)**

b. Using 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 $h = 0.2$. **(07 Marks)**

c. Find $y(0.2)$ using modified Euler's method correct to four decimal places for the equation $\frac{dy}{dx} = x - y^2$, $y(0) = 1$, taking $h = 0.1$. **(07 Marks)**

2 a. Solve $\frac{dy}{dx} = 1 + zx$, $\frac{dz}{dx} = -xy$ with $y(0) = 0$, $z(0) = 1$ at $x = 0.3$ by applying Runge-Kutta method of fourth order. **(06 Marks)**

b. Obtain the solution of the equation $2y'' = 4x + y'$ with initial conditions $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.464$, $y(1.3) = 2.7514$ and $y'(1) = 2$, $y'(1.1) = 2.3178$, $y'(1.2) = 2.6725$ and $y'(1.3) = 3.0657$ by computing $y(1.4)$ applying Milne's method. **(07 Marks)**

c. Use Picard's method to obtain the second approximation to the solution of $\frac{d^2y}{dx^2} - x^3\frac{dy}{dx} - x^3y = 0$ given $y(0) = 1$, $y'(0) = \frac{1}{2}$ and hence find $y(0.1)$. **(07 Marks)**

3 a. State and prove Cauchy-Riemann equations in polar form. **(06 Marks)**

b. Find the analytic function $f(z)$ whose imaginary part is $\left(r - \frac{k^2}{r}\right)\sin\theta$, $r \neq 0$ and hence find the real part of $f(z)$. **(07 Marks)**

c. If $f(z)$ is a regular function of z, show that $\left[\frac{\partial}{\partial x}|f(z)|\right]^2 + \left[\frac{\partial}{\partial y}|f(z)|\right]^2 = |f'(z)|^2$. **(07 Marks)**

4 a. Find the image of the triangular region bounded by the lines $x = 1$, $y = 1$, $x + y = 1$ under the transformation $W = Z^2$. **(07 Marks)**

b. If $f(z)$ is analytic within and on C (simple closed curve) and 'a' is a point within 'c' prove that $f(a) = \frac{1}{2\pi i}\int_C \frac{f(z)}{z-a}dz$. **(06 Marks)**

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

SKIT LIBRARY

PART – B

5 a. Obtain the series solution of Bessel's differential equation. **(07 Marks)**

b. Derive the Rodrigues formula. **(06 Marks)**

c. If $x^3 + 2x^2 - x + 1 = aP_0(x) + bP_1(x) + cP_2(x) + dP_3(x)$ using Rodrigue's formula find the values of a, b, c, d. **(07 Marks)**

6 a. If A and B are events with $P(A) = \frac{1}{2}$, $P(A \cup B) = \frac{3}{4}$, $P(\overline{B}) = \frac{5}{8}$ find $P(A \cap B)$, $P(\overline{A} \cap \overline{B})$, $P(\overline{A} \cup \overline{B})$ and $P(\overline{A} \cap B)$. **(06 Marks)**

b. In a college boys and girls are equal in proportion. It was found that 10 out of 100 boys and 25 out of 100 girls were referring same author text book. If a student using that was selected at random, what is the probability of being a boy? **(07 Marks)**

c. A bag contains three coins, one of which is two headed and the other two are normal and fair. A coin is chosen at random from the bag and tossed four times in Succession if head turns up each time, what is the probability that this is the two headed coin. **(07 Marks)**

7 a. Find the value of 'K' such that the following distribution represents a finite probability distribution. Hence find the mean (μ) and standard deviation (σ). Also find $P(X \leq 1)$, $P(X>1)$ and $P(-1 < X \leq 2)$. **(06 Marks)**

X	-3	-2	-1	0	1	2	3
P(X)	k	2k	3k	4k	3k	2k	k

b. If the mean and standard deviation of the number of correctly answered questions in a test given to 4096 students are 2.5 and $\sqrt{1.875}$, find an estimate of the number of candidates answering correctly (i) 8 or more questions (ii) 2 or less (iii) 5 questions. **(07 Marks)**

c. Derive the expressions for the mean and standard deviation of exponential distribution. **(07 Marks)**

8 a. Certain tubes manufactured by a company have mean life time of 800 hours and standard deviation of 60 hours. Find the probability that a random sample of 16 tubes taken from the group will have mean life time, (i) between 790 hours and 810 hours. (ii) less than 785 hours. **(06 Marks)**

b. Two horses A and B were tested according to the time (in seconds) to run a particular race with the following result.

Horse A:	28	30	32	33	29	34
Horse B:	29	30	30	24	27	29

Test whether you can discriminate between the two horses. Use $t_{0.05} = 2.2$ and $t_{0.02} = 2.72$ **(07 Marks)**

c. A die is thrown 264 times and the number appearing on the face (x) follows the frequency distribution as mentioned below:

x	1	2	3	4	5	6
f	40	32	28	58	54	60

Calculate the value of χ^2. **(07 Marks)**

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Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Microcontrollers

Time: 3 hrs. Max. Marks:100

Note: ***Answer 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.

SKIT LIBRARY

PART – A

1 a. Differentiate between a microprocessor and a microcontroller. **(06 Marks)**
b. With the neat sketch of 8051 architecture, explain the CPU registers. **(08 Marks)**
c. With the help of timing diagram, explain how to interface 8K EPROM and 4K RAM to 8051. **(06 Marks)**

2 a. Write a program to swap the contents of Registers R_7 and R_6 in register block 0, in four different ways. **(06 Marks)**
b. List bit level logical instructions and their operation in 8051. **(08 Marks)**
c. Explain different ranges for Jump instruction available in 8051 microcontroller. **(06 Marks)**

3 a. Write a program to exchange the lower nibble of data present in external memory 6000H and 6001H. **(06 Marks)**
b. An 8-bit code word is stored in location 1000H of external data memory. Code word is valid, if three MSB's are zero and it contains two ones in the remaining five bits. If code word is valid, store FF, else store OO in 1001H. **(08 Marks)**
c. Write a program to blink the LED's alternatively connected to port 0 with a delay of 1 mS. Assume XTAL = 12 MHz. **(06 Marks)**

4 a. Write the circuit diagram for port 0, explain the operations of 8051 using port 0. **(06 Marks)**
b. Show a simple keyboard interface with port of 8051 and explain its operation. **(08 Marks)**
c. Write a program to rotate a stepper motor 64° in the clockwise direction. The motor has a step angle of 2°. **(06 Marks)**

PART – B

5 a. Explain IE and IP registers with its bit pattern. **(06 Marks)**
b. Explain different modes of operation of timer/counter of 8051 with relevant block diagram and steps to program the modes. **(08 Marks)**
c. Write an Assembly (or) C-program to generate a frequency of 100 Hz square wave, using timer 0 in mode-1. Assume crystal frequency = 11.0592 MHz (Assume any pin number). **(06 Marks)**

6 a. Write an 8051 program to send the message of "SAVE POWER" to the serial port continuously. Assume XTAL = 11.0592 MHz, 9600 baud rate, 8-bit data and one stop bit. **(06 Marks)**
b. Explain RS-232 hand shaking signals and specify the purpose of Max – 232 while interfacing. **(08 Marks)**
c. Explain the control word of 8255A. **(06 Marks)**

7 a. Briefly discuss the features of MSP 430 microcontrollers. **(06 Marks)**
b. Explain different addressing modes of MSP 430 with examples. **(08 Marks)**
c. Write a MSP430 assembly program to find the largest in the given array of 'n' bytes. **(06 Marks)**

8 Write short note on with respect to MSP430:
a. Watch dog timer.
b. Real Time Clock (RTC).
c. Significance of Gate in Tmode Register of 8051.
d. Internal RAM structure of 8051. **(20 Marks)**

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10ES43

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Control Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer 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. Define and compare open loop control system with closed loop control system with an example. **(06 Marks)**

b. Obtain the differential equation for the Fig. Q1 (b) shown in Fig. Q1 (b). **(04 Marks)**

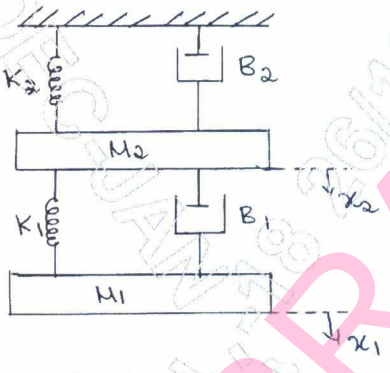

Fig. Q1 (b)

c. Obtain the differential equation describing the system shown in the Fig. Q1 (c) and also sketch the electrical circuit based on, (i) Torque voltage analogy (ii) Torque current analogy. **(10 Marks)**

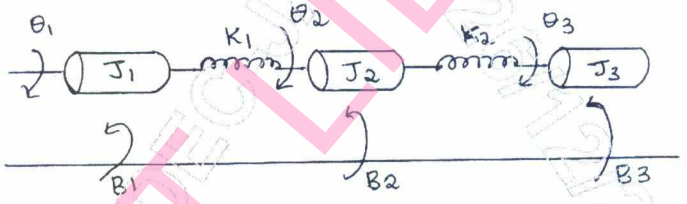

Fig. Q1 (c)

2 a. Define the following terms:
(i) Self loop (ii) Node (iii) Branch (iv) Feedback loop. **(04 Marks)**

b. Simplify the block diagram shown in the Fig. Q2 (b) below, also obtain he closed loop transfer function $C(s)/R(s)$. **(08 Marks)**

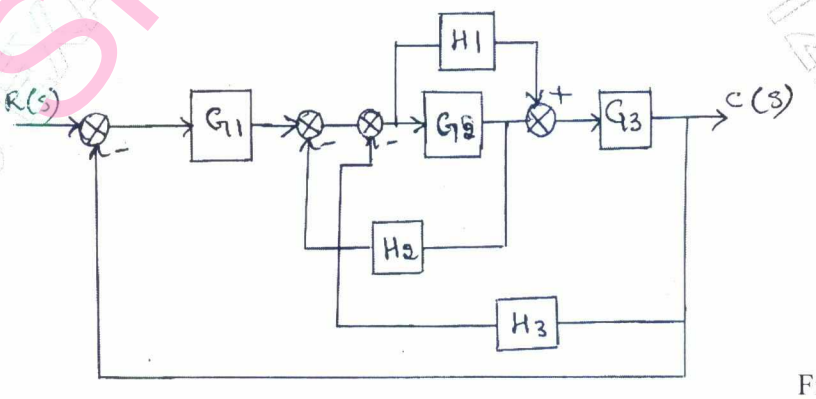

Fig. Q2 (b)

c. Find the overall transfer function by using Mason's gain formula for Fig. Q2 (c) shown below. **(08 Marks)**

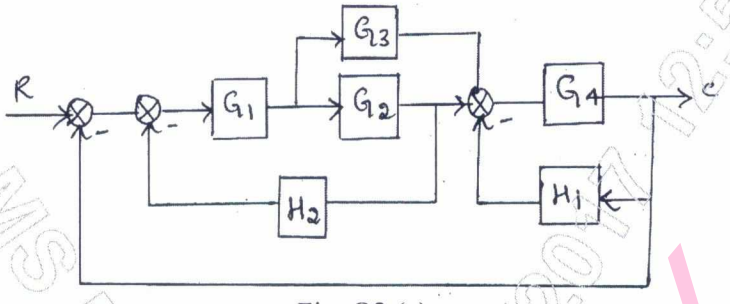

Fig. Q2 (c)

3 a. Explain the following time domain specification of a 2nd order system,
(i) Rise time (ii) Delay time (iii) Peak time (iv) Peak overshoot. **(06 Marks)**

b. For a system shown in Fig. Q3 (b), find the value of 'A' such that damping ratio is 0.5, determine the values of Tr, T_P, M_P and T_S in the unit step response. **(08 Marks)**

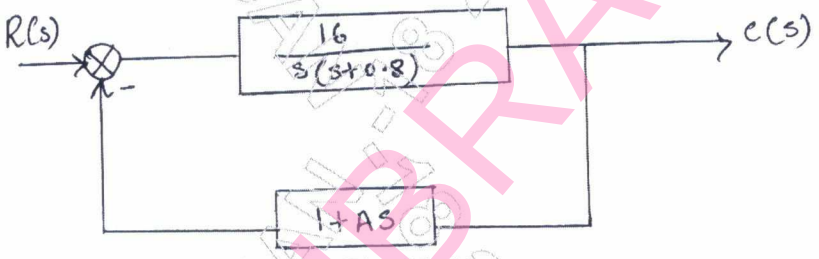

Fig. Q3 (b)

c. For a system shown in the Fig. Q3 (c) below determine steady state error for a unit step input given to the system. **(06 Marks)**

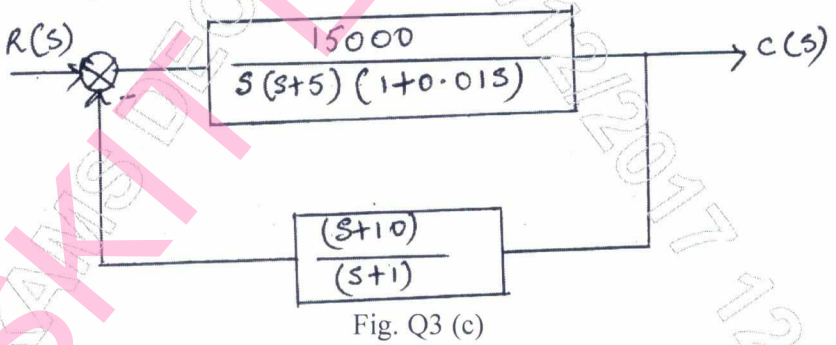

Fig. Q3 (c)

4 a. What are the necessary conditions and limitations for the system to be stable in case of Routh Hurwitz criterion? **(06 Marks)**

b. Examine the stability of Routh criterion $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$. **(06 Marks)**

c. The open loop transfer function of a unity feedback control system is given by,

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

Determine the values of 'K'.

(i) For which the system is stable.

(ii) Which will cause the sustained oscillation in closed loop system and frequency of sustained oscillations? **(08 Marks)**

PART – B

5 a. What is Root locus? State the different rules for construction of root loci? **(08 Marks)**

b. For a unity feedback system $G(s) = \frac{K}{s(s+4)(s+2)}$. Sketch the root locus showing all the details on it. **(12 Marks)**

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

b. Sketch the Nyquist plot and comment on closed loop stability of a system whose open loop transfer function is,

$$G(s)H(s) = \frac{10}{s(s+2)(s+1)}$$ **(12 Marks)**

7 a. Define the following terms:

(i) Gain cross over frequency (ii) Gain margin

(iii) Phase cross over frequency (iv) Phase margin **(08 Marks)**

b. A unity feedback control system has $G(s) = \frac{80}{s(s+2)(s+20)}$. Draw the Bode plot. Determine GM, PM, ω_{gc} and ω_{pc}. Comment on the stability. **(12 Marks)**

8 a. Define the following terms:

(i) State

(ii) State variable

(iii) State space **(06 Marks)**

b. Obtain the state space representation of the following system given by,

$$\frac{Y(s)}{U(s)} = \frac{2(s+3)}{(s+1)(s+2)}$$

Find the partial fraction of it. **(07 Marks)**

c. Obtain phase variable representation for a system whose transfer function is given by,

$$\frac{Y(s)}{u(s)} = \frac{6s^3 + 4s^2 + 3s + 10}{s^3 + 8s^2 + 4s + 20}$$ **(07 Marks)**

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10EC44

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Categorize the following signal as energy or power signal, and find the corresponding energy or power of the signal. $x(t) = \cos(\pi t) + \sin(5\pi t)$. **(06 Marks)**

b. For x(n) and y(n) shown in Fig.Q1(b), draw $x(n+1)\cdot y(-2-n)$. **(06 Marks)**

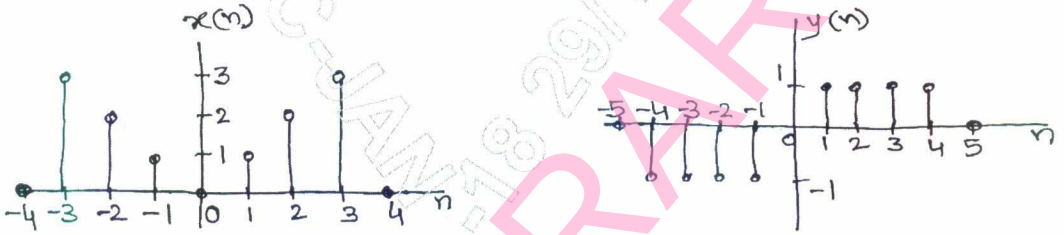

Fig.Q1(b)

c. Determine whether the following signal is periodic or not. If periodic, find its fundamental period. $x(n) = \cos\left(\frac{\pi n}{3}\right)\cdot\sin\left(\frac{\pi n}{5}\right)$. **(04 Marks)**

d. Determine whether the system described by the following input output relation is time – invariant or not $y(t) = \frac{1}{L}\int_{-\infty}^{t} x(\tau)d\tau$. **(04 Marks)**

2 a. The impulse response of a discrete time LTI system is given by $h(n) = a^n[u(n) - u(n-5)]$. Determine the output of the system for the input $x(n) = b^n u(n)$, using convolution sum. **(06 Marks)**

b. Evaluate the continuous time Convolution of the two signals given in Fig.Q2(b). **(06 Marks)**

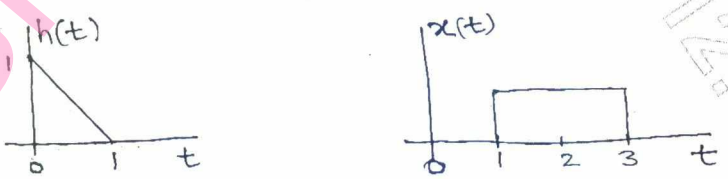

Fig. Q2(b)

c. Compute the discrete time convolution sum of the following two sequences using any method $x_1(n) = \{1, \underset{\uparrow}{2}, 3, 4\}, x_2(n) = \{1, 1, \underset{\uparrow}{3}, 2\}$. **(04 Marks)**

d. The impulse response of a continuous time LTI system is given by $h(t) = e^{2t}u(t-1)$. Is the system causal and stable? Give reason for your answer. **(04 Marks)**

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3 a. Find the forced response of the system shown in Fig.Q3(a), where x(t) = cos (t). **(06 Marks)**

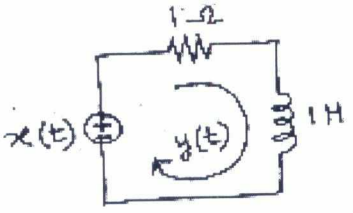

Fig.Q3(a)

b. Draw the direct form I and direct form II implementations of the system described by the following differential equation : $\frac{d^3}{dt^3}y(t)+2\frac{d}{dt}y(t)+3y(t)=x(t)+3\frac{d}{dt}x(t)$. **(06 Marks)**

c. What is the natural response of the system described by the given difference equation? $y(n)-\frac{1}{16}y(n-1)=x(n-1)$, with $y(-1)=1$. **(04 Marks)**

d. For the interconnections of the system shown in Fig.Q3(d), obtain the overall impulse response in terms of the individual impulse responses. **(04 Marks)**

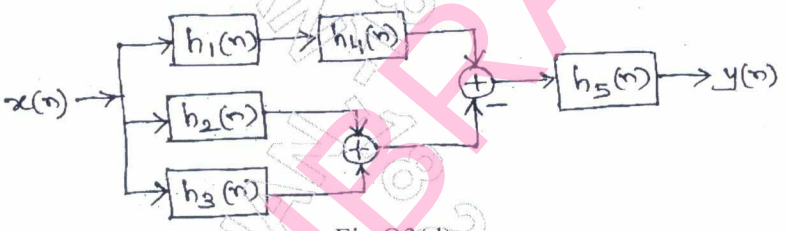

Fig.Q3(d)

4 a. A periodic signal with period 4 sec is described over one fundamental period as x(t) = 3 – t, 0 < t < 4. Find the exponential Fourier series and plot its magnitude spectrum. **(06 Marks)**

b. Determine the discrete time Fourier series representation of the given signal. Draw its magnitude and phase spectra. $x(n)=\cos\left(\frac{6\pi n}{13}+\frac{\pi}{6}\right)$ **(06 Marks)**

c. State and prove frequency shift property with reference to Fourier series of continuous time signals. **(04 Marks)**

d. State and prove Parseval's theorem with reference to DTFS. **(04 Marks)**

PART – B

5 a. Find the inverse Fourier transform and draw the time domain signal for the rectangular spectrum given by $X(j\omega)=\begin{cases}1, & \frac{-W}{2}<\omega<\frac{W}{2}\\ 0, & |W|>\frac{W}{2}\end{cases}$. **(08 Marks)**

b. A discrete time rectangular pulse is defined as $x(n)=\begin{cases}1, & |n|\le M\\ 0, & |n|>M\end{cases}$.

Find and plot the DTFT of the signal. **(08 Marks)**

c. Using suitable properties find the inverse DTFT of :

$X(j\Omega)=\frac{1}{1-ae^{-j(\Omega+\pi/4)}}$, $|a|<1$. **(04 Marks)**

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6 a. A continuous time LTI system produces an output $y(t) = e^{-t}u(t)$ when excited by the input $x(t) = e^{-2t}u(t)$. Evaluate the frequency response and impulse response of the system. **(08 Marks)**

b. Find the impulse response and step response of the LTI system shown in Fig.Q6(b) using Fourier analysis techniques. **(08 Marks)**

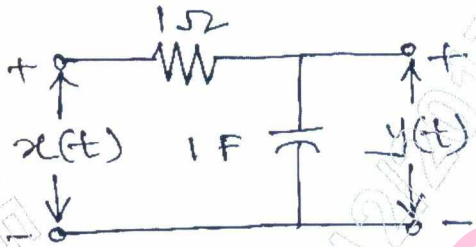

Fig.Q6(b)

c. A continuous time signal is given by $x(t) = 4\cos(100\pi t)$. What is the minimum sampling rate required to avoid aliasing? If the signal is sampled at 200 Hz, then give the expression for the discrete time signal after sampling. **(04 Marks)**

7 a. Using the Z – transform properties, find the Z – transform and RoC of the following signal : $x(n) = n(\frac{1}{2})^n u(n) * (\frac{1}{4})^{-n}u(-n)$. **(08 Marks)**

b. Find the time domain signal corresponding to the given z – transform, using partial fraction expansion approach. $X(z) = \dfrac{z^3 - 10z^2 - 4z + 4}{2z^2 - 2z - 4}$, RoC : $|z| < 1$. **(08 Marks)**

c. Derive the relation between z – transform and discrete time Fourier transform. **(04 Marks)**

8 a. Consider a system described by the difference equation $y(n) - 0.9\,y(n-1) = x(n)$, with initial condition $y(-1) = 2$. Find the step response of the system using unilateral z – transform. **(08 Marks)**

b. The difference equation of a causal and stable system is given by :

$$y(n) - \frac{5}{6}y(n-1) + \frac{1}{6}y(n-2) = x(n) - 2x(n-1)$$

Determine the impulse response of the system. Also find the output if the input is $x(n) = 2^n u(n)$. **(08 Marks)**

c. Determine the transfer function of the inverse of the system, whose difference equation is given by : $y(n) - \frac{1}{4}y(n-2) = 6x(n) - 7x(n-1) + 3x(n-2)$. **(04 Marks)**

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Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Fundamentals of HDL

Time: 3 hrs. Max. Marks:100

Note: ***Answer 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. List different types of description in HDL. Explain structural and behavioral description with example. **(10 Marks)**

b. Given unsigned variables A, B, C with A = 11001011 B = 10110110, C = 00011011 find the value of
i) A ror 1 ii) A NAND C iii) B Sra 1 iv) ~ 1 C **(04 Marks)**

c. Explain scalar data types with syntax. **(06 Marks)**

2 a. Write a Verilog code for 2×2 unsigned combinational array multiplier with diagram. **(08 Marks)**

b. Write a VHDL code in data flow description for two bit magnitude comparator with simplified boolean expression. **(12 Marks)**

3 a. Write a VHDL code for D – Latch using signal and variable assignment statement. With simulation waveforms clearly distinguish between them. **(10 Marks)**

b. Explain for loop, while loop, Next and Exit in VHDL. **(04 Marks)**

c. Write a verilog code for 2×1 multiplexer with tristate output using IF-else statement. **(06 Marks)**

4 a. Write a structural description in VHDL for full adder with simulation waveform. **(08 Marks)**

b. Explain binding between :
i) Entity and Architecture
ii) Entity and component
iii) Library and module. **(06 Marks)**

c. Write a Verilog code for N-bit asynchronous down counter using generate statement. **(06 Marks)**

PART – B

5 a. Write a VHDL code to perform signed vector multiplication using procedure. **(10 Marks)**

b. Write a Verilog function to find greater of two signed number. **(05 Marks)**

c. Write a note on Verilog file processing. **(05 Marks)**

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

b. Write a VHDL code for addition of two 3×3 matrices. **(06 Marks)**

c. With a block diagram and function table write a VHDL code for 16×8 SRAM. **(10 Marks)**

7 a. Explain how to invoke Verilog module from a VHDL module. **(08 Marks)**

b. Write mixed language description of a 3-bit adder with zero flag. **(12 Marks)**

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

b. With an example; explain synthesis of loop statement and show RTL synthesis. **(10 Marks)**

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10EC46

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Linear Integrated Circuits 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. Explain the basic circuit of operational amplifier. **(08 Marks)**

b. Draw neat circuit diagram of a direct coupled non-inverting op-Amp and explain the design steps. **(06 Marks)**

c. Design an inverting amplifier using 741 op-Amp for the voltage gain to be 50 and the output voltage amplitude to be 2.5 volts. **(06 Marks)**

2 a. Draw neat circuit diagram of a capacitor coupled voltage follower and give its design steps. **(07 Marks)**

b. With neat circuit diagram, explain the high input impedance capacitor coupled non-inverting amplifier. **(07 Marks)**

c. Using a LF353BIFET op-Amp design a high Z_{in} capacitor coupled non-inverting amplifier to have a low cut off frequency of 200 Hz. The input and output voltages are to be 15 mV and 3V respectively and the minimum load resistance is 12 KΩ. **(06 Marks)**

3 a. Sketch the circuit of a lag and lead compensation network. Explain its operation and show how it affects the frequency response of op-Amp. **(08 Marks)**

b. Write a note on Z_{in} mod compensation. **(06 Marks)**

c. Determine the upper cutoff frequency for a: (i) voltage follower (ii) unity gain inverting amplifier, using a 741 op-Amp, given that UGB of 741 is 800 kHz. **(06 Marks)**

4 a. What are the advantages of Precision Rectifier over Ordinary Rectifier? Explain the working of a precision half wave rectifier. **(06 Marks)**

b. Draw the circuit diagram of instrumentation amplifier using op-Amp. Explain its working and derive the expression of output. **(08 Marks)**

c. With neat circuit diagram explain the working of op-Amp Limiting Circuit. **(06 Marks)**

PART – B

5 a. Draw the op-Amp sample and hold circuit and explain its operation. **(08 Marks)**

b. Explain the working of phase shift oscillator using op-Amp. **(06 Marks)**

c. With a neat circuit diagram, explain the Wein-Bridge oscillator using op-amp. **(06 Marks)**

6 a. Explain the working of inverting Schmitt trigger with the help of circuit diagram and waveform. **(07 Marks)**

b. Draw the circuit and explain op-Amp astable multivibrator. **(06 Marks)**

c. With the help of circuit diagram and frequency response, explain the working of second order lowpass filter. **(07 Marks)**

7 a. Mention the advantages of IC voltage regulator. Draw the series op-Amp regulator and explain its working. **(10 Marks)**

b. Draw the internal schematic diagram of IC 723 regulator and explain its working. **(10 Marks)**

8 a. Draw the internal schematic diagram of 555 IC configuring it for monostable operation. Explain its working. **(08 Marks)**

b. With the help of basic block diagram, explain PLL. **(06 Marks)**

c. Explain the working of D to A converter using R-2R network. **(06 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions selecting atleast 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. Find the direction cosines ℓ, m, n of the line :
$x + y + z + 1 = 0$
$4x + y - 2z + 2 = 0$. **(06 Marks)**

b. Show that the lines $\frac{x+4}{3} = \frac{y+6}{5} = \frac{z-1}{-2}$ and $3x - 2y + z + 5 = 0 = 2x + 3y + 4z - 4$ are coplanar. **(07 Marks)**

c. Find the angle between the line $\frac{x+4}{4} + \frac{y-3}{-3} = \frac{z+2}{1}$ and the plane $2x + 2y - z + 15 = 0$. **(07 Marks)**

2 a. Find the equation of the plane which passes through the points A(0, 1, 1), B(1, 1, 2), C(–1, 2, –2). **(06 Marks)**

b. Find the equation of the plane which passes through the point(3, –3, 1) and normal to the line joining the points (3, 2, –1) and (2, –1, 5). **(07 Marks)**

c. Find the equations to the two planes which bisects the angle between the planes :
$3x - 4y + 5z = 3$
$5x + 3y - 4z = 9$. **(07 Marks)**

3 a. Find the sides and the angle A of the triangle whose vertices are $\overline{OA} = I - 2J + 2K$, $\overline{OB} = 2I + J - K$, $\overline{OC} = 3I - J + 2K$. **(06 Marks)**

b. Show that the points $-6I + 3J + 2K$, $3I - 2J + 4K$, $5I + 7J + 3K$ and $-13I + 17J - k$ are coplanar. **(07 Marks)**

c. Prove that : $\left[\bar{B} \times \bar{C}, \bar{C} \times \bar{A}, \bar{A} \times \bar{B}\right] = \left[\bar{A}\,\bar{B}\,\bar{C}\right]^2$. **(07 Marks)**

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

b. If $\bar{A} = (\cos t)I + (\sin t)J + (4t)K$ and $\bar{B} = (t^3 + 1)I + J + (8t^2 - 3t^3)K$ then find :
i) $\frac{d}{dt}(\bar{A} + \bar{B})$ ii) $\frac{d}{dt}(\bar{A} \cdot \bar{B})$. **(07 Marks)**

c. If $\phi = 3x^2y - y^3z^2$, find grad ϕ at (1, –2, 1). Also find a unit normal vector to the surface $3x^2y - y^3z^2 = 6$ at (1, –2, 1). **(07 Marks)**

PART – B

5 a. If $\bar{A} = xyz\,I + 3x^2y\,J + (xz^2 - y^2z)K$ then find curl $\bar{A}$ at (1, 2, 3). **(06 Marks)**

b. Find the directional derivative of the scalar function $f(x, y, z) = x^2 + xy + z^2$ at the point A(1, –1, –1) in the direction of $2\hat{i} + 3\hat{j} + 2\hat{k}$. **(07 Marks)**

c. If $u = x^2 + y^2 + z^2$ and $\bar{r} = xI + yJ + zK$ then find div $(u\bar{r})$ in terms of u. if $\vec{f} = \nabla(x^3 + y^3 + 2^3 - 3xyz)$ find $\nabla \cdot \vec{f}$ and $\nabla \times \vec{f}$. **(07 Marks)**

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6 a. Find the Laplace transform of f(t) defined as :

$$f(t) = \begin{cases} \frac{t}{6}, & \text{when } 0 < t < 6 \\ 1, & \text{when } t < 6 \end{cases}.$$ **(05 Marks)**

b. Find : i) $L(\cos t^2 t)$ ii) $L(t \sin h\, at)$ iii) $L\left(\frac{1}{t}\sin 2t\right)$. **(15 Marks)**

7 a. Find : $L(e^{2t} \cos 3t)$. **(06 Marks)**

b. Find : $L^{-1}\left(\frac{2h-5}{9s^2-25}\right)$. **(07 Marks)**

c. Find : $L^{-1}\left(\frac{s^2+4}{x^2+9}\right)$. **(07 Marks)**

8 a. Using Laplace transforms, find the solution of the initial value problem $y''-4y'+4y=64 \sin 2t$, $y(0) = 0$, $y'(0) = 1$. **(10 Marks)**

b. Using Laplace transforms, solve $y'' + 9y = \cos 2t$, $y(0) = 1$, $y'(0) = \frac{12}{5}$. **(10 Marks)**

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