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10MAT41

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Engineering Mathematics - IV

Time: 3 hrs.

Max. Marks: 100

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

PART - A

- 1 a. Using Taylor series method, solve $\frac{dy}{dx} = 2y + 3e^x$, $y(0) = 0$ at $x = 0.2$. (06 Marks)
- b. Using Runge - Kutta method of fourth order solve for $y(0.1)$, $y(0.2)$ given that $\frac{dy}{dx} = y(x + y)$, $y(0) = 1$. (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 Milne's Predictor - Corrector method. (07 Marks)
- 2 a. Approximate y and z at $x = 0.1$, using Picard's method for the solution of the equations $\frac{dy}{dx} = z$, $\frac{dz}{dx} = x^3(y + z)$, given that $y(0) = 1$ and $z(0) = \frac{1}{2}$. (06 Marks)
- b. Using Runge - Kutta fourth order method to solve $y'' = xy' - y$, $y(0) = 3$, $y'(0) = 0$, find y and z at $x = 0.1$. (07 Marks)
- c. Apply Milne's method to compute $y(0.4)$ given that $y'' + xy' + y = 0$ and the values $y(0) = 1$, $y(0.1) = 0.995$, $y(0.2) = 0.9801$, $y(0.3) = 0.956$, $y'(0) = 0$, $y'(0.1) = -0.0995$, $y'(0.2) = -0.196$, $y'(0.3) = -0.2867$. (07 Marks)
- 3 a. Prove that the C - R equations in polar form. (06 Marks)
- b. Show that $f(z) = z^n$, where n is a positive integer is analytic and hence find its derivative. (07 Marks)
- c. If $\phi + i\Psi$ represents the complex potential of an electrostatic field where $\Psi = x^2 - y^2 + \frac{x}{x^2 + y^2}$, find ϕ . (07 Marks)
- 4 a. Find the Bilinear transformation which maps the points $1, i - 1$ into $0, 1, \infty$. (06 Marks)
- b. State and prove the Cauchy's integral formula. (07 Marks)
- c. Evaluate $\int_c \frac{e^{2z}}{(z+1)(z-2)} dz$, where $c: |z| = 3$. (07 Marks)

PART - B

- 5 a. Find the solution of the Laplace's equation in cylindrical system leading to Bessel's differential equation. (06 Marks)
- b. Derive Rodrigue's formula $P_n(x) = \frac{1}{2^n n!} \frac{d^n}{dx^n} (x^2 - 1)^n$. (07 Marks)
- c. Express $f(x) = x^4 + 3x^3 - x^2 + 5x - 2$ in terms Legendre polynomials. (07 Marks)

- 6 a. Define the Empirical and Axiomatic definition of probability and give an example of each. (06 Marks)
- b. Of the cigarette smoking population 70% are men and 30% are women, 10% of these men and 20% of these women smoke wills. What is the probability that person seen smoking a wills will be a man? (07 Marks)
- c. The chance that a doctor will diagnose a disease correctly is 60%. The chance that a patient will die after correct diagnose is 40% and the chance of death by wrong diagnosis is 70%. If a patient dies, what is the chance that his disease was correctly diagnosed? (07 Marks)
- 7 a. Derive the mean and variance of Binomial distribution. (06 Marks)
- b. If x is an exponential distribution with mean 4, evaluate i) $P(0 < x < 1)$ ii) $P(x > 2)$ and iii) $P(-\infty < x < 10)$. (07 Marks)
- c. The marks of 1000 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students whose marks will be i) less than 65 ii) More than 75 and iii) between 65 and 75. (07 Marks)
- 8 a. Define the following terms :
i) Type I – error and Type II – error ii) Level of significance. (06 Marks)
- b. A certain stimulus administered to each of the 12 patients resulted in the following :
Change in blood pressure 5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4, can it be concluded that the stimulus will increase the blood pressure? (t. 05 for 11 d.f = 2.201). (07 Marks)
- c. The theory predicts the proportion of beans in the four groups G_1, G_2, G_3, G_4 should be in the ratio 9:3:3:1. In an experiment with 1600 beans the numbers in the four groups were 882, 313, 287 and 118. Does the experimental result support the theory? (at 5% LOS for 3 d.f = 7.815). (07 Marks)

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Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Microcontrollers

Time: 3 hrs.

Max. Marks: 100

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

PART – A

- 1
 - a. Distinguish Harvard and Von-Neumann (Princeton) architectures with diagrams. (06 Marks)
 - b. Explain with block diagram the architectural feature of 8051 and list out salient features of 8051 microcontroller. (08 Marks)
 - c. Discuss the need for stack memory in microcontrollers. Explain with examples the PUSH and POP instructions. (06 Marks)

- 2
 - a. What are the addressing modes supported by 8051 μ C? Explain with examples. (08 Marks)
 - b. Explain the different types of conditional and unconditional jump instructions of 8051. Specify the different ranges associated with jump instructions. (08 Marks)
 - c. Differentiate between the following instructions:
i) SWAP and XCH ii) SJMP and LJMP. (04 Marks)

- 3
 - a. Write a ALP to copy the most significant nibble of A in both nibbles of RAM address 3Ch. Also write the algorithm for example if A = 36h, then 3Ch = 33h. (06 Marks)
 - b. Write an ALP to add the unsigned numbers found in internal RAM locations 25h, 26h and 27h together and put the result in RAM locations 31L (MSB) and 30h (LSB). (08 Marks)
 - c. For a machine cycle of 1.085 μ sec find the time delay in the following subroutine:
 DELAY: MOV R2, # 200
 AGAIN: MOV R3, # 250
 HERE: NOP
 NOP
 DJNZ R3, HERE
 DJNZ R2, AGAIN
 RET. (06 Marks)

- 4
 - a. With a relevant figure write a sequence of events that occur in 8051 microcontroller when the CALL and RET instructions are executed. (06 Marks)
 - b. What are the ways to create time delay? Discuss the factors affecting the accuracy of the time delay. (07 Marks)
 - c. What are the differences between timer and counter? Explain with the formats of the SFR. (07 Marks)

PART – B

- 5
 - a. In what way timer/counter mode 2 programming is different from mode 0 and mode 1? (06 Marks)
 - b. Write an ALP to generate square wave on pin 3.4 of ON Time 4 msec and OFF Time 3 msec, using timer 0, mode 0. Assume that crystal frequency of 8051 is 11.0592 Hz. (08 Marks)
 - c. Explain the importance of interrupt priority (IP) SFR and the beginning fixed address of the interrupt handler subroutines. (06 Marks)

- 6 a. Write the steps required for programming 8051 to transfer data serially and what is the role of PCON register in serial communication? (07 Marks)
- b. Write a C program to interface 8051 to LCD. Draw the hardware schematic. (07 Marks)
- c. Write a 'ALP' program to interface stepper motor to 8051, with a neat diagram of 8051 connection to stepper motor. (06 Marks)
- 7 a. Tabulate the different data types in 'C', bits and the data range. (05 Marks)
- b. Write an 8051 C program to send two different strings to the serial port. Assuming that SW is connected to pin P2.0, monitor its status and make a decision as follows:
SW = 0, send your first name
SW = 1, send your last name.
Assume XTAL = 11.0592 MHz, baud rate of 9600, 8 bit data 1 stop bit. (10 Marks)
- c. Write a 'C' program to serially transmit the message "HELLO" continuously at baud rate of 9600, 8-bit data and 1 stop bit. (05 Marks)
- 8 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 MSP 430 assembly program to find the largest in the given array of 'n' bytes. (06 Marks)

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10ES43

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Control Systems

Time: 3 hrs.

Max. Marks:100

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

PART - A

- 1 a. A mechanical system is shown in the Fig.Q.1(a).
 i) Obtain the performance equations.
 ii) Draw the electrical analog based on force-current analogy. (08 Marks)

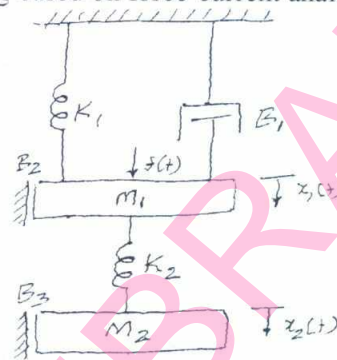


Fig.Q.1(a)

- b. For the mechanical system shown in Fig.Q.1(b), draw the electrical network based on torque current analogy. Write the performance equations. (08 Marks)

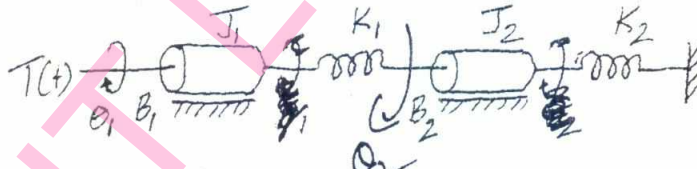


Fig.Q.1(b)

- c. Write an explanatory note on gear trains. (04 Marks)
- 2 a. Define the term transfer function of a linear time invariant system. Derive the expression for the transfer function of a closed loop negative feedback system. (06 Marks)
 b. For the block diagram shown in the Fig.Q.2(b), determine the overall transfer function using block diagram reduction rules. (06 Marks)

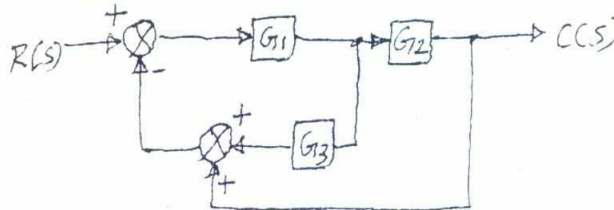


Fig.Q.2(b)

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.

- c. Consider the electrical circuit shown in Fig.Q.2(c). Find $\frac{V_o(s)}{V_i(s)}$ using Mason's gain formula. (08 Marks)

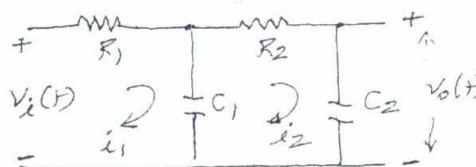


Fig.Q.2(c)

- 3 a. Define the following terms with respect to an underdamped second order system:
i) Peak time; ii) Settling time; iii) Steady state error. (06 Marks)
- b. A unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K , determine settling time, peak overshoot and time to peak overshoot for a unit step input. (08 Marks)
- c. For a unity feedback system whose open loop transfer function is $G(s) = \frac{50}{(1+0.1s)(1+2s)}$. Find the error constants K_p , K_v , K_a . (06 Marks)
- 4 a. State the Routh's stability criterion and mention its limitation. (04 Marks)
- b. Consider the characteristic equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. Using Routh's criterion, determine the stability of the system. (08 Marks)
- c. The closed loop system shown in Fig.Q.4(c) has $G(s) = \frac{K(s+30)}{s(s+5)}$ and $H(s) = \frac{1}{(s+15)}$. Find the range of K for which system is stable. (08 Marks)

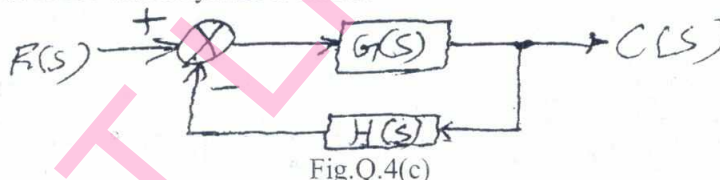
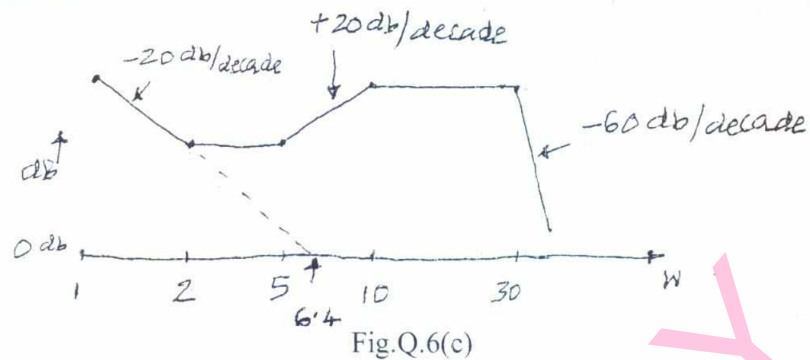


Fig.Q.4(c)

PART - B

- 5 a. Discuss the various rules for construction of root loci. (08 Marks)
- b. A negative feedback control system is characterized by $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$. Sketch the root locus plot for values of K ranging from 0 to ∞ , Mark all the salient points on the root locus. (12 Marks)
- 6 a. Discuss the procedure to evaluate Gain margin and phase margin using Bode plots. (06 Marks)
- b. Sketch the Bode plot for the transfer function $G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$. Determine the system gain K for the gain cross over frequency to be 5 rad/sec. (08 Marks)

- c. For the Bode magnitude asymptotic plot of Fig.Q.6(c), determine the transfer function in frequency domain. (06 Marks)



- 7 a. State the Nyquist stability criterion. (06 Marks)
 b. Using the Nyquist stability criterion, investigate the stability of a closed loop system whose open loop transfer function is given by $G(s)H(s) = \frac{K}{(s+1)(s+2)}$. (14 Marks)

- 8 a. State the properties of state transition matrix. (04 Marks)
 b. Represent the electrical circuit shown in Fig.Q.8(b) by a state model. (08 Marks)

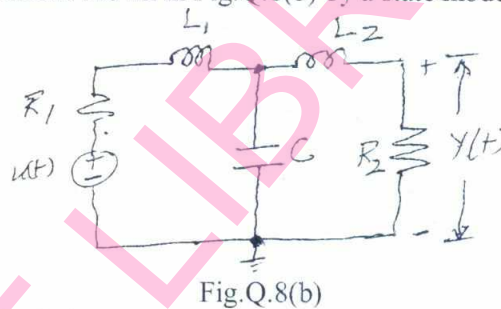


Fig.Q.8(b)

- c. For the signal flow graph of Fig.Q.8(c) write the state and output equations: (08 Marks)

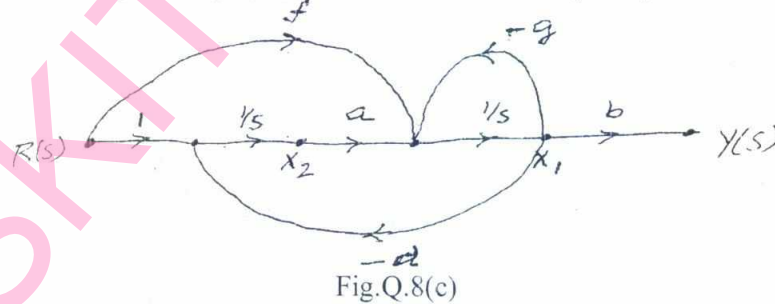


Fig.Q.8(c)

- 4 a. Prove the time shift and frequency shift properties of DTFTs. (06 Marks)
 b. Determine the DTFS of the signal

$$x(n) = \cos\left(\frac{\pi}{3}\right)n.$$
 (06 Marks)
 c. Evaluate the Fourier series representation of the signal $x(t) = \sin 2\pi t + \cos 3\pi t$. Also sketch the magnitude and phase spectra. (08 Marks)

PART – B

- 5 a. Prove the convolution property of DTFT. (05 Marks)
 b. Find the DTFT of unit step sequence. (07 Marks)
 c. Compute the Fourier transform of the signal

$$x(t) = \begin{cases} 1 + \cos \pi t; & |t| \leq 1 \\ 0; & |t| > 1 \end{cases}.$$
 (08 Marks)

- 6 a. The impulse response of a continuous time system is given by

$$h(t) = \frac{1}{RC} e^{-t/RC} u(t).$$

 Find the frequency response and plot the magnitude and phase response. (05 Marks)
 b. Obtain the FT representation for the periodic signal $\sin \omega_0 t$ and draw the spectrum. (07 Marks)
 c. Find the DTFT representation for the periodic signal

$$x(n) = \cos\left(\frac{\pi}{3}\right)n$$

Also draw the spectrum. (05 Marks)

- d. Write a note on sampling theorem and Nyquist rate. (03 Marks)
- 7 a. List the properties of region of convergence. (05 Marks)
 b. Determine the Z-transform, the ROC, and the locations of poles and zeros of $x(z)$ for the following signals: (08 Marks)

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

- c. Find the inverse Z-transform of

$$X(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - z^{-1}\right)}$$

with following ROCs i) $1 < |z| < 2$ ii) $\frac{1}{2} < |z| < 1.$ (07 Marks)

- 8 a. Find the transfer function and impulse response of a causal LTI system if the input to the system is $x(n) = (-1/3)^n u(n)$ and the output is $y(n) = 3(-1)^n u(n) + (1/3)^n u(n).$ (08 Marks)
 b. Determine the transfer function and difference equation representation of an LTI system described by the impulse response $h(n) = (1/3)^n u(n) + (1/2)^{n-2} u(n-1).$ (04 Marks)
 c. Determine the forced response, natural response and output of the system described by the difference equation $y(n) + 3y(n-1) = x(n) + x(n-1)$, if the input is $x(n) = \left(\frac{1}{2}\right)^n u(n)$ and $y(-1) = 2$ is the initial condition. (08 Marks)

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Fundamentals of HDL

Time: 3 hrs.

Max. Marks: 100

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

PART – A

- 1 a. Explain composite VHDL and verilog data types. (08 Marks)
 b. If A, B and C are the unsigned variables with A = "110011", B = "010100", C = "101". Find the values of
 (i) $Y = \&A$ (ii) $Y = A \&\& B$ (iii) $Y = A \text{ sra } 2$
 (iv) $Y = B \text{ rol } 2$ (v) $Y = A \ll 2$ (vi) $Y = A \text{ and not } B \text{ xor } 2 \text{ nand } C$ (07 Marks)
 c. Write the major differences between VHDL and verilog. (05 Marks)

- 2 a. Write a VHDL program in data flow style using signal assignment statements to implement a 2 to 1 multiplexer with active low enable signal (Ebar). If the propagation delay of each gate is 9 ns, calculate at what time the output is available when the input signals (A, B, select, Ebar) are changed at T_0 , T_1 and T_2 as shown in Fig.Q2(a). (07 Marks)

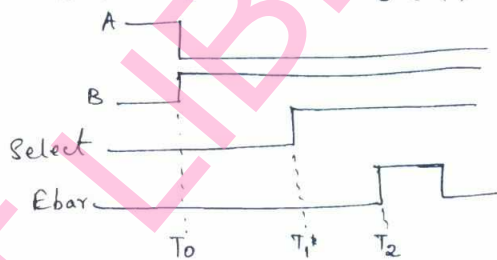


Fig.Q2(a)

- b. Write a VHDL program to realize a D-latch in Data flow style, Consider enable signal as active low. (06 Marks)
 c. Write a verilog program to implement a 3-bit carry-look ahead adder in data flow style. (07 Marks)
- 3 a. Compare signal and variable assignment statement. (05 Marks)
 b. Write a verilog code to implement a positive edge triggered JK flip flop shown in Fig.Q3(b) in behavioural style using (i) else if and (ii) case statement. (08 Marks)

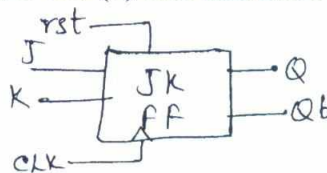


Fig.Q3(b)

- c. Write the flow chart of Booth multiplication algorithm. Show the steps to find the product of two signed 5-bit numbers -5 and 9. (07 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.

- 4 a. Write a VHDL program to realize the block diagram shown in Fig.Q4(a) in structural style (No need to show the implementation of components). (07 Marks)

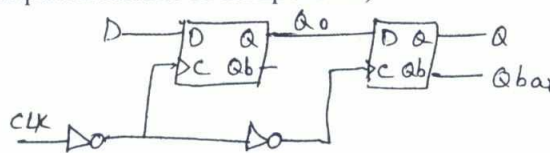


Fig.Q4(a)

- b. Write a verilog program to implement a 4-bit magnitude comparator using 4-bit adders in structural style. (07 Marks)
- c. Explain the following keywords (i) Generate (ii) Generic and (iii) Parameter. (06 Marks)

PART – B

- 5 a. Explain procedure with syntax and example in VHDL. (06 Marks)
- b. Write a verilog program to convert an unsigned binary to an integer using task. (08 Marks)
- c. Write a VHDL function to find the greater of two signed numbers. (06 Marks)
- 6 a. When mixed type description is preferred? Give example. (06 Marks)
- b. Explain different VHDL user defined types. (06 Marks)
- c. Write a verilog description of a 32×8 SRAM to implement the function table shown in Table 6(c).

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

Table 6(c)

- 7 a. Explain how to invoke a VHDL entity from a verilog module. (08 Marks)
- b. Write the block diagram of a 9-bit adder and implement it by mixed language description. (12 Marks)
- 8 a. What is synthesis? With a neat flow chart explain the steps involved in a synthesis process. (10 Marks)
- b. Find the gate-level mapping for the verilog code given below:

```

module if_st(a, y)
input[2:0] a;
output y;
reg y;
always (a)
begin
    if (a < 3' b 1 0 1)
        y = 1' b 1;
    else
        y = 1' b 0;
    end
end module

```

(10 Marks)

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Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
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. Use of standard resistor value and standard capacitor value table is allowed.

PART – A

- 1
 - a. Define the following terms with respect to opamp and specify their typical values for a 741 opamp:
 - i) CMRR
 - ii) PSRR
 - iii) Slew Rate. (06 Marks)
 - b. Derive an expression for the output voltage of non-inverting summing circuit. (07 Marks)
 - c. The difference of two input signals is to be amplified by a factor of 37. Each input has an amplitude of approximately 50 mV. Using LF353 opamp, design a difference amplifier to obtain approximately equal input resistance at the two input terminals and also provide common mode nulling. (07 Marks)
- 2
 - a. Using a BIFET opamp, design a capacitor coupled inverting amplifier with an input signal of 30 mV, a load resistance of 2.2 k Ω , $A_v = 150$ and $f_1 = 80$ Hz. (05 Marks)
 - b. A high input impedance capacitor coupled non-inverting amplifier is to be designed using 741 opamp with $A_v = 120$, $f_1 = 100$ Hz, input signal of 50 mV, and the load resistance ranging from 2.7 k Ω to 27 k Ω . (09 Marks)
 - c. Using 741 opamp with maximum input bias current of 500 nA, design a capacitor coupled voltage follower with a lower cutoff frequency of 120 Hz, and load resistance of 8.2 k Ω using +30V power supply. (06 Marks)
- 3
 - a. Discuss about the conditions that have to be fulfilled for an opamp circuit to oscillate. (05 Marks)
 - b. With the help of circuit schematic and frequency response, explain how phase lag compensation can be used to stabilize opamp circuit. (05 Marks)
 - c. Mention the need for Z_{in} MOD compensation. Discuss the role of compensating components in Z_{in} MOD compensation for an inverting amplifier. (05 Marks)
 - d. List the precautions to be observed for opamp circuit stability. (05 Marks)
- 4
 - a. Design a low resistance voltage source (with reference voltage derived from potential divider) to provide an output voltage of 8V. A 741 opamp with a $\pm 15V$ supply is to be used, and the maximum output current is to be 60 mA. (08 Marks)
 - b. Determine the range of resistance of externally connected resistor R_G for a LH0036 IC instrumentation amplifier to give a voltage gain adjustable from 30 to 300. (03 Marks)
 - c. Design a precision full wave rectifier consisting of a summing circuit and a precision half wave rectifier to produce a 2V peak output from a sine wave input with peak value of 0.5 V and frequency of 1 MHz. Use bipolar opamps with a supply voltage of $\pm 15V$. (09 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.

PART – B

- 5 a. A $\pm 5V$, 10 kHz square wave from a signal source with a resistance of 100Ω is to have its positive peak clamped precisely at ground level. Tilt on the output is not to exceed 1% of the peak amplitude of the wave. Design the precision clamping circuit using a supply of $\pm 12V$. (08 Marks)
- b. Draw the fundamental circuit of logarithmic amplifier and derive an expression for output voltage. (06 Marks)
- c. Design a wein bridge oscillator to have an output frequency of 15 kHz using a BIFET opamp with a supply voltage of $\pm 12V$. (06 Marks)
- 6 a. With a neat circuit diagram and associated waveforms explain the working principle of inverting Schmitt trigger circuit. (05 Marks)
- b. Explain the working principle of astable multivibrator with a neat circuit schematic and waveforms. Specify the design procedure for this circuit. (09 Marks)
- c. Using a 741 opamp, design a second order low pass filter with a cutoff frequency of 1 kHz. (06 Marks)
- 7 a. Discuss about the important characteristics of three terminal IC regulator. (04 Marks)
- b. Draw the functional block diagram of IC723 voltage regulator and explain. (06 Marks)
- c. With the help of circuit schematic explain the principle of operation of switched mode power supply. Mention its advantages. (10 Marks)
- 8 a. Draw the circuit diagram of monostable multivibrator using IC 555 and derive the expression for output pulse width. (05 Marks)
- b. Give the basic block schematic of PLL and explain the function of each block. (06 Marks)
- c. Draw the functional diagram of dual slope ADC and explain its working principle. Mention its advantages and limitations. (09 Marks)

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Advanced Mathematics – II

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions.

1.
 - a. Find the angle between any two diagonals of a cube. (06 Marks)
 - b. The direction cosines of three mutually perpendicular lines are l_1, m_1, n_1 , l_2, m_2, n_2 and l_3, m_3, n_3 . Show that the line with direction cosines $l_1 + l_2 + l_3$, $m_1 + m_2 + m_3$, $n_1 + n_2 + n_3$ is equally inclined to the above lines. (07 Marks)
 - c. Find the equations of the plane passing through the points (1, 2, 3) (0, 1, 4) and (0, 0, 1). (07 Marks)

2.
 - a. Derive the equation to the plane in the intercept form $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$. (06 Marks)
 - b. Find the angle between the lines $\frac{x-1}{1} = \frac{y-5}{0} = \frac{z+1}{2}$ and $\frac{x+3}{3} = \frac{y}{5} = \frac{z-5}{2}$. (07 Marks)
 - c. Find the image of the point (1, 2, 3) in the line $\frac{x+1}{2} = \frac{y-3}{3} = -z$. (07 Marks)

3.
 - a. Show that the position vectors of the vertices of a triangle $2i - j + k$, $i - 3j - 5k$, $3i - 4j - 4k$ form a right angled triangle. (06 Marks)
 - b. Find a vector of magnitude 12 units which is perpendicular to the vectors $\vec{a} = 4i - j + 3k$ and $\vec{b} = -2i + j - 2k$. (07 Marks)
 - c. Find λ so that the points A(-1, 4, -3), B(3, 2, -5), C(-3, 8, -5) and D(-3, λ , 1) are coplanar. (07 Marks)

4.
 - a. Find the unit tangent vector of the space curve $x = 1 + t^3$, $y = 2t^3$, $z = 2 - t^3$ at $t = 1$. (06 Marks)
 - b. Find the angle between the tangents to the curve $\vec{r} = \left(t - \frac{t^2}{2}\right)i + t^2j + \left(t + \frac{t^2}{2}\right)k$ at $t = \pm 1$. (07 Marks)
 - c. A particle moves along the curve whose parametric equations are $x = t - \frac{t^3}{3}$, $y = t^2$ and $z = t + \frac{t^3}{3}$, where 't' is the time. Find the velocity and acceleration at any time 't'. Also find their magnitudes at $t = 3$. (07 Marks)

5.
 - a. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $x = z^2 + y^2 - 3$ at (2, -1, 2). (06 Marks)
 - b. Find the constants a, b, c such that the vector, $\vec{F} = (x + y + az)i + (bx + 2y - z)j + (x + cy + 2z)k$ is irrotational. (07 Marks)
 - c. If $\vec{A} = \text{grad}(x^3 + y^3 + z^3 - 3xyz)$ then find $\text{div } \vec{A}$ and $\text{curl } \vec{A}$. (07 Marks)

- 6 a. Find the expression for $L[\sin at]$. (05 Marks)
 b. Find $L[t \sin at]$. (05 Marks)
 c. Find $L\left[\frac{1-e^{at}}{t}\right]$. (05 Marks)
 d. Find $L[e^t \cos^2 2t]$. (05 Marks)
- 7 a. Find $L^{-1}\left[\frac{s}{(s+2)(s^2+1)}\right]$. (06 Marks)
 b. Find $L^{-1}\left[\frac{s+2}{s^2+2s+2}\right]$. (07 Marks)
 c. Find $L^{-1}\left[\log\left[\frac{s^2+1}{s(s-1)}\right]\right]$. (07 Marks)
- 8 a. Using Laplace transform solve:
 $y'' - 2y' + y = e^{2t}$ with $y(0) = 0$ and $y'(0) = 1$. (10 Marks)
 b. Solve using Laplace transformation, method $y'' + 2y' - 3y = \sin t$, $y(0) = y'(0) = 0$. (10 Marks)
