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10MAT41

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Engineering Mathematics - IV

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Using Taylor series method, solve $\frac{dy}{dx} = x^2 + y^2, y(0) = 1$ at the point x = 0.2, 0.3 consider up to 4th degree term. **(06 Marks)**

b. Using Runge Kutta method of order 4, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with y(0) = 1 at x = 0.2, 0.4 by taking step length h0.2. **(07 Marks)**

c. Given $\frac{dy}{dx} = \frac{1}{2}xy$, y(0) = 1, y(0.1) =1.0025, y(0.2)=1.0101, y(0.3)=1.0228. Compute y at x = 0.4 by Adams – Bash forth predictor – corrector method use corrector formula twice. **(07 Marks)**

2 a. Evaluate y and z at x = 0.1 from the Picard's second approximation to the solution of the following system of equations given by y = 2 and z = 1 at x = 0 initially $\frac{dy}{dx} = x + z$

$\frac{dz}{dx} = x - y^2$. **(06 Marks)**

b. Given $y'' = x^3(y + y')$ with the initial condition y(0) = 1 y'(0) = 0.5 compute y(0.1) by taking h = 0.1 and using 4th order Runge Kutta method. **(07 Marks)**

c. Applying Milne's method compute y(0.4) Given that y satisfies the equation $\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - 6y = 0$ and y and y' are governed by the following values
y(0) = 1, y(0.1) = 1.03995, y(0.2) = 1.138036
y(0.3) = 1.29865, y'(0) = 0.1, y'(0.1) = 0.6955
y'(0.2) = 1.258, y'(0.3)=1.873. **(07 Marks)**

3 a. Derive Cauchy Riemann Equation in Cartesian form. **(06 Marks)**

b. Prove that for every analytic function f(z) = u + iv the two families of curves $u(x,y) = C_1$ and $v(x,y) = C_2$ form an orthogonal system. **(07 Marks)**

c. If $u - v = (x - y)(x^2 + 4xy + y^2)$ and f(z) = u + iv is analytic function of z = x + iy find f(z) interms of f(z). **(07 Marks)**

4 a. Find the bilinear transformation that maps the points z = 0, i, ∞ onto the points w = 1, −i, −1 respectively, find the invariant points. **(06 Marks)**

b. Discuss the transformation $w = e^z$. **(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)**

PART – B

5 a. Starting from Laplace differential equation. Obtain Bessel's differential equation as $xy'' + xy' + (x^2 - n^2)y = 0$ **(08 Marks)**

b. If $x^3 + 2x^2 - x + 1 = a\,P_0(x) + b\,P_1(x) + c\,P_2(x) + d\,P_3(x)$ find the value of a, b, c, d. **(06 Marks)**

c. Derive Rodrigue's formula $P_n(x) = \frac{1}{2^n n!}\frac{dy}{dx^n}(x^2-1)^n$ **(06 Marks)**

6 a. Define axioms of probability. Prove that,
$P(A \cup B \cup C) = P(A) + P(B) + P(C) + P(A \cap B \cap C) - P(A \cap B) - P(B \cap C) - P(C \cap A)$ **(06 Marks)**

b. A solar water heater manufactured by a company consists of two parts the heating panel and the insulated tank. It is found that 6% of the heaters produced by the company have defective heating panels and 8% have defective tank. Find the percentage of non defective heaters produced by the company. **(07 Marks)**

c. A box contains 500 IC chips of which 100 are manufactured by company X and the rest by company Y. It is estimated that 10% of the chips made by company X and 5% made by company Y are defective. If a randomly selected chip is found to be defective find the probability that it came from company X. **(07 Marks)**

7 a. A random variables X takes the values $-3, -1, 2$ and 5 with respective probabilities $\frac{2k-3}{10}, \frac{k-2}{10}, \frac{k-1}{10}\ \frac{k+1}{10}$. Find the value of k and i) $p(-3 < x < 4)$ ii) $p(x \le 2)$. **(06 Marks)**

b. Find the mean and variance of binomial distribution. **(07 Marks)**

c. In an examination 7% of students scores less than 35% marks and 89% of students score less than 60% marks. Find the mean and standard deviation of the marks are normally distribute, it is given that $P(0 < z < 1.2263) = 0.39$ and $P(0 < z < 1.4757) = 0.43$. **(07 Marks)**

8 a. Explain the following terms :
i) Null hypothesis
ii) Type I and Type II error
iii) Confidence limits. **(06 Marks)**

b. A coin is tossed 1000 times and it turn up head 540 times decide on the hypothesis that the coin is unbiased. **(07 Marks)**

c. A certain stimulus administered to each of the 12 patients resulted is the following change is blood pressure 5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4 can it be calculated that the stimulus will increase the blood pressure ($t_{0.05}$ for 11 df 2.201.) **(07 Marks)**

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10ES42

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019

Microcontroller

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 with a neat block diagram architecture of 8051 microcontroller. **(12 Marks)**

b. Explain Harward and Von-Neumann CPU architectures with necessary diagrams. **(08 Marks)**

2 a. Explain the different addressing modes supported by 8051 μc with an example for each. **(10 Marks)**

b. Correct the following instructions if found to have any wrong syntax. Explain the operation of the corrected instructions:

(i) MOVx R0, @ R1 (ii) MOV A, # B (iii) MOV 77h, A8H

(iv) XCHG A1, R2 (v) ADD A, @B **(10 Marks)**

3 a. Write a program that computes the number of zeros in the following 16-bit stream:
0 1 0 1 1 0 1 0 0 1 0 1 1 0 1 0 **(10 Marks)**

b. Assume Timer 1 is operating in mode 1. It is required to schedule a new task after 0.05 second. If the timer oscillator operates at 10.0 MHz, how should the timer registers be configured for this operation. **(10 Marks)**

4 a. Draw the internal structure of port '0' and explain its operation. **(10 Marks)**

b. Write a 'C' program to monitor the status of a switch 'SW' connected to pin P2.7 and perform the following:
i) If SW = 0, the stepper motor rotates clockwise
ii) If SW = 1, the stepper motor rotates counter clockwise (ACW)
Use the wave drive 4-step sequence. **(10 Marks)**

PART – B

5 a. Explain interrupt vector table. **(10 Marks)**

b. Write the bit pattern of TCON SFR and explain. **(10 Marks)**

6 a. How many types of serial communications are there? Name them and explain each type. **(10 Marks)**

b. Write a program to serially transmit the message 'GOOD' continuously at a baud rate of 9600, 8-bit data and 1 stop bit. **(10 Marks)**

7 a. With a neat block diagram, explain the architecture of MSP 430 μ controller. **(10 Marks)**

b. Explain with an example of MOV instruction the different addressing modes of MSP430. **(10 Marks)**

8 a. Assume that a 60 Hz external clock is being fed into pin T1 (P3.5). Write an 8051 C program for counter 1 in mode 2 to display the seconds and minutes on P1 and P2 respectively. **(10 Marks)**

b. Explain the importance of TI and RI flag used in serial data transfer. **(10 Marks)**

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10ES43

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Control Systems

Time: 3 hrs. Max. Marks:100

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

PART - A

1 a. Define Control System. Give the difference between open loop and closed loop control system, with an example. **(06 Marks)**

b. For the mechanical system shown in fig.Q1(b),
i) Write the nodal circuit ii) Write the performance equation
iii) Write force voltage and force current analogous circuits. **(09 Marks)**

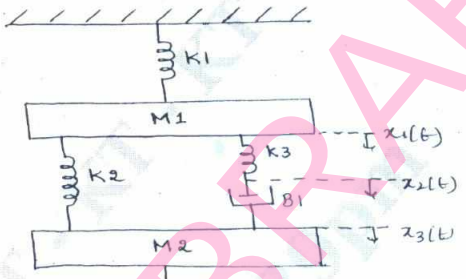

Fig.Q1(b)

c. For the mechanical system shown in fig.Q1(c),
i) Write the nodal circuit ii) Write the performance equations. **(05 Marks)**

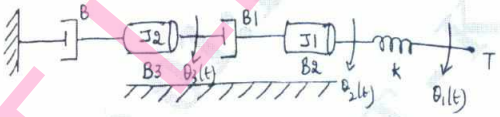

Fig.Q1(c)

2 a. Find the transfer function C(s)/R(s), using block diagram reduction technique for the figure shown in fig. Q2(a). **(10 Marks)**

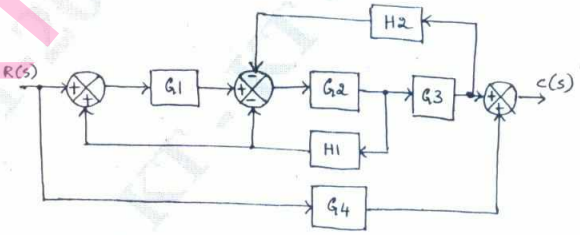

Fig.Q2(a)

b. For the signal flow graph, shown in fig.Q2(b), find the transfer function using Mason's gain formula. **(10 Marks)**

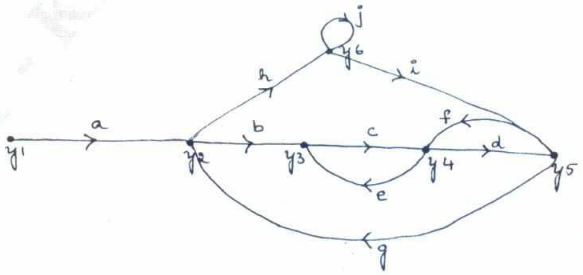

Fig.Q2(b)

3 a. For the unity feedback system having open – loop transfer function

$G(s) = \frac{K(s+2)}{S(s^3+7s^2+12s)}$, find i) Type of the system ii) Error co-efficient iii) Steady state error when the input of the system is $\frac{R}{2}t^2$. **(10 Marks)**

b. A feedback control system shown has a damping factor of 0.8. Determine constant K and all the time domain specifications for the system shown in fig.Q3(b). **(10 Marks)**

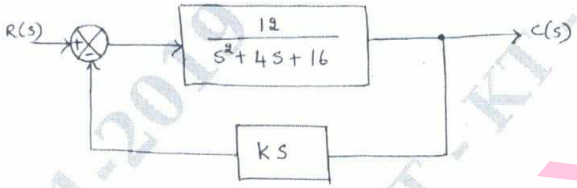

Fig.Q3(b)

4 a. What are the necessary conditions for a system to be stable according to Routh – Hurwitz criteria? **(04 Marks)**

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

$G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$

i) Find the range of K for which the system is stable.

ii) Find K for which system oscillates and what is the corresponding frequency of oscillation. **(10 Marks)**

c. Determine the stability of control system with characteristic equation.

$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$. **(06 Marks)**

PART - B

5 a. The open – loop transfer function of a feedback control system is given by **(12 Marks)**

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

Construct the root locus of the control system and find the range of K for which the closed loop system is stable.

b. Sketch the root locus of the control system with open loop transfer function

$G(s)\,H(s) = \frac{K}{s^2+10s+100}$. Determine the stability of closed loop system. **(08 Marks)**

6 a. A unity feedback control system has **(10 Marks)**

$G(s) = \frac{80}{S(s+2)(s+20)}$. Draw the Bode plot and determine Gain margin , Phase margin , W_{ge} and W_{pc}. Comment on stability.

b. Determine the transfer function from the magnitude plot shown in fig. Q6(b). **(10 Marks)**

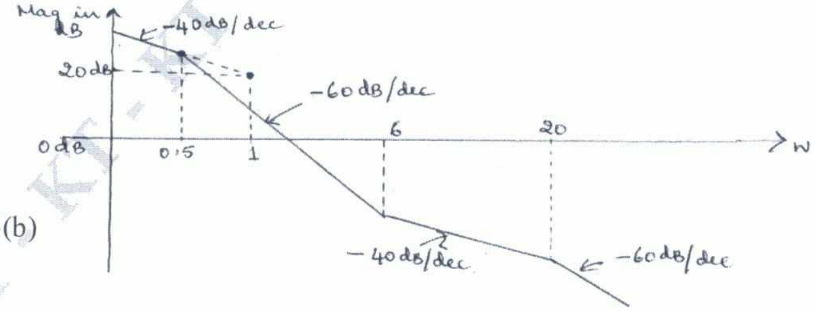

Fig.Q6(b)

7 a. Construct the Nyquist plot for the control system with **(14 Marks)**

$G(s)\,H(s) = \dfrac{K(s+1)}{S(s-1)}$. From the plot, determine the stability of closed loop system.

b. State Nyquist stability criteria and explain the procedure to find the stability of the system using Nyquist criteria. **(06 Marks)**

8 a. State the advantages of state space approach. **(04 Marks)**

b. Obtain the state model of the given electrical network in standard form shown in fig. Q8(b). Given at $t = t_o$, $i(t) = q(t_o)$ and $V_o(t) = V_o(t_o)$. **(06 Marks)**

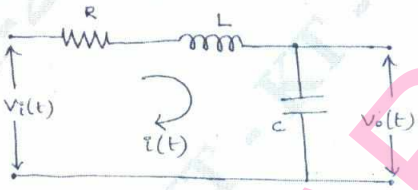

Fig.Q8(b)

c. State and prove the properties of state transition matrix. **(10 Marks)**

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10EC44

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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. Determine whether the following signal is periodic or not. if periodic, find the fundamental period.

i) $x[n] = \cos^2\left[\frac{\pi}{8} n\right]$

ii) $x(t) = \cos\left(\frac{\pi}{3} t\right) + \sin\left(\frac{\pi}{4} t\right)$. **(08 Marks)**

b. State whether the following system represented by

$$y[n] = x[n]\cos\left[\pi \frac{(n+1)}{2}\right].$$

is linear, time-invariant, memoryless, causal, stable and invertible. **(06 Marks)**

c. Draw the waveform of x(–t) and x(2 – t) for the signal x(t) defined by

$$x(t) = \begin{cases} t; & 0 \le t \le 3 \\ 0; & t > 3 \end{cases}.$$ **(06 Marks)**

2 a. State and prove associative and distributive properties of convolution integrals. **(08 Marks)**

b. Evaluate $y(n) = x(n) * h(n)$ for the signal defined by :

$x(n) = \beta^n u(n)\ |\beta| < 1$ and $h(n) = u(n-3)$. **(06 Marks)**

c. Evaluate $y(t) = x(t) * h(t)$ for the signal defined by $x(t) = e^{-3t}\, u(t)$ and $h(t) = u(t+3)$. **(06 Marks)**

3 a. Determine whether the system is stable causal and memory $h(t) = e^{-3t} u(t-1)$. **(04 Marks)**

b. Determine the output of the system described by the difference equation :

$y(n) - \frac{1}{2} y(n-1) = 2x(n)$ with the input $x(n) = (-\frac{1}{2})^n u(n)$ and initial condition $y(-1) = 3$. **(08 Marks)**

c. Convert the following differential equations into integral equation and draw the direct form I and II $d^2/dt^2\, y(t) + 5\, d/dt\, y(t) + 4y(t) = \frac{d}{dt} x(t)$. **(08 Marks)**

4 a. Find the DTFS representation for $x(n) = \cos\left(\frac{6\pi n}{17} + \frac{\pi}{3}\right)$ plot the magnitude and phase of DTFS coefficients. **(10 Marks)**

b. Use the definition of FS to determine the time domain signal represented by following FS coefficients. $X(K) = (-1/3)^{|K|}$ with $W_0 = 1$. **(10 Marks)**

PART – B

5 a. Use the equation describing the DTFT representation to determine the time domain signal corresponding to the DTFT given by :

$$X(e^{j\Omega}) = \sin(\Omega) + \cos\left(\frac{\Omega}{2}\right).$$ **(08 Marks)**

b. Use the defining equation for the FT to evaluate the frequency – domain representations of the signal given by $x(t) = t\,e^{-t}\,u(t)$. **(06 Marks)**

c. Use the properties to find the FT of the signal $x(t) = \sin(2\pi t)\,e^{-t}\,u(t)$. **(06 Marks)**

6 a. An LTI system has the impulse response $h(t) = 2\,\frac{\sin(2\pi t)}{\pi t}\cos(7\pi t)$. Use the FT to determine the system output if the input is $x(t) = \cos(2\pi t) + \sin(6\pi t)$. **(08 Marks)**

b. The output of a system in response to an input $x(t) = e^{-2t}\,u(t)$ is $y(t) = e^{-t}\,u(t)$. Find the frequency response and the impulse response of this system. **(08 Marks)**

c. Draw the frequency response of following ideal continuous and discrete time filters.
i) Low pass ii) high pass. **(04 Marks)**

7 a. Find the Z – transform of the following signals and draw the pole–zero plot.
i) $h[n] = 2^n u(n) + 3[1/2]^n u(n)$
ii) $y(n) = n(1/2)^n\,u(n-2)$. **(12 Marks)**

b. State the properties of RoC with respect to Z – transform. **(04 Marks)**

c. Find the inverse z – transform of $X(z) = \frac{z}{z^2 - 3z + 1}$ $\quad |z| < 1/2$. **(04 Marks)**

8 a. A causal discrete time LTI system is implemented by using difference equation :
$y(n) = x(n) + x(n-1) + \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2)$
i) What is the transfer function of the system
ii) Sketch the pole-zero diagram of the system
iii) Find the impulse response h(n). **(12 Marks)**

b. The DT signal x(n) is shown in diagram.

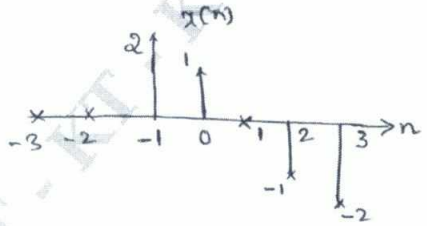

Fig.Q8(b)

i) What is the z –transform x(z) of the signal x(n)
ii) Define $y(z) = z^{-2}x(z)$, sketch the signal y(n)
iii) Define $G(z) = x(-z)$, sketch g(n)
iv) Define $F(z) = x(1/z)$, sketch f(n). **(08 Marks)**

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10EC45

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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. If A and B are two unsigned variables, with A = 1100 and B = 1001, find the value of following expressions:
(i) A and B (ii) A ∧ B (iii) A && B
(iv) A >> 1 (v) ~| A (vi) B ror 2 **(06 Marks)**

b. Explain verilog data types. **(08 Marks)**

c. Explain std_logic and bit_vector data types in VHDL. **(06 Marks)**

2 a. Write the gate level diagram and VHDL code of 2×2 bit combinational array multiplier in Data flow description style. Draw the simulation waveforms. **(10 Marks)**

b. Write the verilog code of 3 bit ripple carry adder in data flow description style. Assume 4 ns propagation delay for all gates. Draw the simulation waveform. **(10 Marks)**

3 a. Explain verilog repeat and forever statements with example. **(04 Marks)**

b. Write verilog code for positive edge triggered JK flip-flop in behavioral description style. **(06 Marks)**

c. Write the flow chart and VHDL code of Booth algorithm of multiplication. **(10 Marks)**

4 a. Write the structural description of 3-bit magnitude comparator using 3-bit adder in VHDL. **(10 Marks)**

b. Write the verilog description for 3-bit asynchronous down counter using generate. **(10 Marks)**

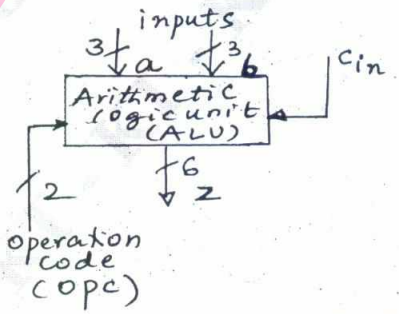
PART – B

5 a. Write VHDL code for converting a signed binary to integer using procedure. **(08 Marks)**

b. Write VHDL code for writing integers to a file. **(08 Marks)**

c. Write verilog function to find the greater of two signed numbers. **(04 Marks)**

6 a. Write the mixed type description of ALU in Fig.Q6(a) using verilog code. Addition is to be implemented by carry look ahead adder in data flow style. Multiplication and division by behavioral style. **(10 Marks)**



operation code (opc)	Operation
00	Addition
01	Multiplication
10	Integer division
11	No operation

Fig.Q6(a)

b. Write VHDL code for 16×8 SRAM (Static memory) with block diagram and function table. Use package. **(10 Marks)**

7 a. Write mixed language description of a master slave D flip-flop invoking a VHDL entity for D latch from a verilog module. **(08 Marks)**

b. Write a mixed language description of an AND gate invoking a verilog module from a VHDL module. **(08 Marks)**

c. Discuss the limitations of mixed language description. **(04 Marks)**

8 a. Define synthesis. With flow chart, explain the steps involved in synthesis process. **(08 Marks)**

b. Write verilog code for signal assignment statement y = 2 * x + 3. Show the synthesized logic symbol and gate level diagram. Write structural code in verilog using gate level diagram. **(08 Marks)**

c. For the listing given draw the gate level diagram.

```
always @(a, x, x1)
  begin
    if (a = = 1'b1)
      y = x;
    else
      y = x1;
    end
```

(04 Marks)

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10EC46

Fourth Semester B.E. Degree Examination, Dec.2018/Jan. 2019
Linear IC's and Applications

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the operation of a basic op-amp, circuit. **(08 Marks)**

b. Define the following op-amp parameters and mention their typical values for op-amp 741 : i) CMRR ii) slew rate. **(04 Marks)**

c. Using a 741 op-amp, design a non-inverting amplifier to have a voltage gain of approximately 66. The input signal amplitude is 15mV. **(04 Marks)**

d. The difference of 2 input signals is to be amplified by a factor of 37. Each input has an amplitude of 50mV. Using Lf 353 Op-amp design a suitable circuit. **(04 Marks)**

2 a. Sketch the circuit of a high Zin capacitor coupled voltage follower. Briefly explain its operation and also show that the input impedance is very high compared to the capacitor coupled voltage follower. **(06 Marks)**

b. A capacitor coupled non-inverting amplifier using op-amp 741 is to have a gain of 100 and $V_0 = 5V$. The load resistance is 10kΩ and the lower cutoff frequency is to be 100Hz. Design a suitable circuit. **(06 Marks)**

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

3 a. Explain the phase–lag and phase–lead frequency compensation methods briefly. **(08 Marks)**

b. With the help of neat circuit diagram explain the Zin MOD method of frequency compensation. **(06 Marks)**

c. Determine the upper cut-off frequency and maximum distortion free output amplitude for a voltage follower when :
   i) A 741 op-amp is used (f_2 = 800 KHz and S = 0.5V/μs)
   ii) LF 353 op-amp is used (f_2 = 5MHz, S = 13V/μs). **(06 Marks)**

4 a. With a neat sketch, explain the working of a precision voltage source using op-amp with Zener diode. Derive an expression relating V_0 and V_Z. **(07 Marks)**

b. Draw the circuit of an instrumentation amplifier. Explain its characteristics show how it voltage gain can be varied. **(07 Marks)**

c. Using bipolar op-amps with $V_{CC} = \pm 15V$, design the high input impedance precision full – wave rectifier circuit. The input peak voltage is to be 1V and no amplification is to occur. Assume adequate diode current as 500μA. **(06 Marks)**

PART – B

5 a. Briefly explain the operation of the following op-amp based applications with neat diagrams:
Sample and hold circuit
Logarithm amplifier. **(08 Marks)**

b. Using 741 op-amp with a supply of ±15V, design a phase shift oscillator to have an output frequency of 5KHz. Assume c = 0.01μF. **(04 Marks)**

c. With a neat circuit diagrams and waveforms briefly explain the operation of a triangular/rectangular wave generator. **(08 Marks)**

6 a. Explain the operation of an op-amp based monostable multivibrator using relevant waveforms. **(08 Marks)**

b. Using a 741 op-amp with a supply of ±12V, design an inverting schemitt trigger circuit to have trigger points at ±3V. **(06 Marks)**

c. Design a 2nd order law-pass filter circuit to have a cutoff frequency of 1KHz. **(06 Marks)**

7 a. With a neat functional diagram explain the operation of a low voltage regulator using IC723. **(06 Marks)**

b. Discuss the performance parameters of a voltage regulator. **(06 Marks)**

c. What is the principle of operation of a switched mode power supply? Discuss their advantages and disadvantages. **(08 Marks)**

8 a. With a neat circuit diagram explain the operation of a 3 bit R-2R ladder DAC. Also derive the expression for its output voltage. **(06 Marks)**

b. Explain the operation of an astable multiivbrator using 555 timer with a neat functional diagram and waveforms. Derive the expression for its frequency a duty cycle. Given $R_A = 2.2K\Omega$ and $R_B = 6.8k\Omega$ and $C = 0.01\mu F$. Calculate T_{high}, T_{low}, duty cycle and f_0. **(10 Marks)**

c. Mention the applications of PLL. **(04 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. Prove that the angle between two lines whose direction cosines are (l_1, m_1, n_1) and (l_2, m_2, n_2) is $\cos\theta = l_1l_2 + m_1m_2 + n_1n_2$ **(07 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) **(06 Marks)**

2 a. Derive the equation of the plane in the intercept form $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$. **(07 Marks)**

b. Find the image of the point (2, −1, 3) in the plane $2x+4y+z-24=0$. **(07 Marks)**

c. Find the equation of the plane containing the line $\frac{x+1}{2}=\frac{y+2}{3}=\frac{z+3}{4}$ and is perpendicular to the line $x-2y+3z=4$. **(06 Marks)**

3 a. Show that the position vectors of the vertices of a triangle $2i-j+k$, $i-3j-5k$ and $3i-4j-4k$ form a right angled triangle. **(07 Marks)**

b. Find the cosine and sine of the angle between the vectors $2i-j+3k$ and $i-2j+2k$. **(07 Marks)**

c. Find the value of λ such that the vectors $\vec{a}=\lambda i-5j-2k$, $\vec{b}=-7i+14j-3k$ and $\vec{c}=11i+4j+k$ are coplanar. **(06 Marks)**

4 a. A particle moves along a curve $x=t^3-4t$, $y=t^2+4t$, $z=8t^2-3t^3$. Determine its velocity and acceleration and also the magnitude of velocity and acceleration at t = 2. **(07 Marks)**

b. 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)**

c. Find the directional derivative of the function $\phi = xyz$ along the direction of the normal to the surface $xy^2+yz^2+zx^2=3$ at the point (1, 1, 1) **(06 Marks)**

5 a. If $\vec{F}=\nabla(x^3+y^3+z^3-3xyz)$ find div $\vec{F}$ and curl $\vec{F}$. **(07 Marks)**

b. Show that curl(gradϕ) = 0. **(06 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 t^n, where n is a positive integer. **(05 Marks)**

b. Find $L(\sin 5t \cos 2t)$. **(05 Marks)**

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

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

7 a. Find $L^{-1}\left[\frac{s+5}{s^2 - 6s + 13}\right]$. **(07 Marks)**

b. Find $L^{-1}\left[\frac{1}{s(s+1)(s+2)(s+3)}\right]$. **(07 Marks)**

c. Find $L^{-1}\left[\log\left(\frac{s+a}{s+b}\right)\right]$. **(06 Marks)**

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

b. Using Laplace transform solve $\frac{dx}{dt} + y = \sin t$, $\frac{dy}{dt} + x = \cos t$ given $x(0) = 1$, $y(0) = 0$ **(10 Marks)**

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