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10MAT41

Fourth Semester B.E. Degree Examination, June/July 2018

Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***
2. ***Use of statistical tables is permitted.***

PART – A

1 a. Using the Taylor's series method, solve the initial value problem $\frac{dy}{dx} = xy + y^2$, $y(0) = 1$ at $x = 0.1$ and $x_2 = 0.2$. **(06 Marks)**

b. Obtain an approximate solution of the equation $\frac{dy}{dx} = x + |\sqrt{y}|$ with initial conditions $y = 1$ at $x = 0$ for the range $0 \le x \le 0.4$ in steps of 0.2, using Euler's modified method. Perform two modifications at each step. **(07 Marks)**

c. If $\frac{dy}{dx} = 2e^x - y$, $y(0) = 2$, $y(0.1) = 2.010$, $y(0.2) = 2.04$ and $y(0.3) = 2.09$, find $y(0.4)$ correct to five decimal places by employing the Milne's predictor-correct method. Use corrector formula twice. **(07 Marks)**

2 a. Find an approximate value of y and z corresponding to $x = 0.1$ given that $y(0) = 2$, $z(0) = 1$ and $\frac{dy}{dx} = x + z$, $\frac{dz}{dx} = x - y^2$. Using Picard's method. **(06 Marks)**

b. Solve, $\frac{d^2y}{dx^2} = x\left(\frac{dy}{dx}\right)^2 - y^2$ for $x = 0.2$, correct to four decimal places, with initial conditions $x = 0$, $y = 1$, $\frac{dy}{dx} = 0$, using Runge-Kutta method. **(07 Marks)**

c. Obtain an approximate solution at the point $x = 0.4$ of the initial value problem, $\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - 6y = 0$, $y(0) = 1$, $y'(0) = 0.1$ using Milner's method. Given $y(0) = 1$, $y(0.1) = 1.03995$, $y(0.2) = 1.138036$, $y(0.3) = 1.29865$, $y'(0) = 0.1$, $y'(0.1) = 0.6955$, $y'(0.2) = 1.258$, $y'(0.3) = 1.873$. **(07 Marks)**

3 a. If $f(z) = u + iv$ is an analytic function, then prove that $\left(\frac{\partial}{\partial x}|f(z)|\right)^2 + \left(\frac{\partial}{\partial y}|f(z)|\right)^2 = |f'(z)|^2$. **(06 Marks)**

b. Find an analytic function $f(z) = u + iv$, given that $u + v = \frac{2\sin 2x}{e^{2y} + e^{-2y} - 2\cos 2x}$. **(07 Marks)**

c. Find an analytic function $f(z) = u + iv$ given the imaginary part $v = r^2\cos 2\theta - r\cos\theta + 2$. **(07 Marks)**

4 a. Find the bilinear transformation that transforms the points $z_1 = i$, $z_2 = 1$, $z_3 = -1$ onto the points $w_1 = 1$, $w_2 = 0$, $w_3 = \infty$ respectively. **(06 Marks)**

b. Evaluate $I = \int_{z=0}^{2+i} (\bar{z})^2 dz$ along the following curves:

i) The straight line $y = \frac{x}{2}$ from the origin θ to the point B(2 + i).

ii) The real axis from 0 to 2 and then vertically to 2 + i. **(07 Marks)**

c. State and prove Cauchy's integral formula. **(07 Marks)**

PART – B

5 a. Obtain the series solution Bessel's differential equation leading to Bessel's function of first kind. **(08 Marks)**

b. If α and β are distinct roots of the equation $J_n(ax) = 0$, then prove that $\int_0^a x J_n(\alpha x).J_n(\beta x)dx = 0$. **(07 Marks)**

c. Evaluate $p_0(x)$, $p_1(x)$, $p_2(x)$, $p_3(x)$ by using the Rodrigue's formula. **(05 Marks)**

6 a. A husband and wife appear for two vacancies of a post. The probability of husband's selection is 1/7 and that of wife's selection is 1/5. What is the probability that (i) both of them will be selected? (ii)Only one of them is selected? (iii) Neither is selected? **(06 Marks)**

b. What are independent events? If A and B are independent prove that (i) A and $\bar{B}$ are independent, (ii) $\bar{A}$ and B are independent and (iii) $\bar{A}$ and $\bar{B}$ are independent. **(07 Marks)**

c. An author has four typists typing the manuscript of his latest book. Typist A does 30% of the typing; typist B 25%; typist C 20% and typist D, 25%. Errors occur on 5% of the pages typed by A, on 4% types by B, on 3% typed by C and on 2% typed by D. If a page is chosen at random what is the probability that it contains errors? If a page chosen contains errors, what is the probability that it was typed by typist A or typist B? **(07 Marks)**

7 a. A random variable x has the density function

$$f(x) = \begin{cases} kx^2, & -3 \le x \le 3 \\ 0, & \text{elsewhere} \end{cases}$$

Evaluate K, and find (i) $p(1 \le x \le 2)$ ii) $p(x \le 2)$ iii) $p(2 < x \le 3)$ and iv) $p(x > 1)$. **(06 Marks)**

b. Find the mean, variance and standard deviation for the binomial distribution. **(07 Marks)**

c. The life of a certain type of electrical lamps is normally distributed with mean of 2040 hrs and standard deviation 60 hours. In a consignment of 2000 lamps, find how many would be expected to burn for (i) more than 2150 hours (ii) less than 1950 hours, and (iii) between 1920 hours and 2160 hours given that A(1.5) = 0.4332, A(1.83) = 0.4664 and A(2) = 0.4772. **(07 Marks)**

8 a. The mean and standard deviation of marks scored by a sample of 100 students are 67.45 and 2.92. Find (i) 95% and (ii) 99% confidence intervals for estimating the mean marks of the student population. **(06 Marks)**

b. Consider the sample consisting of nine numbers 45, 47, 50, 52, 48, 47, 49, 53 and 51. The sample is drawn from a population whose mean is 47.5. Find whether the sample mean differs significantly from the population mean at 5% level of significance. **(07 Marks)**

c. Fit a binomial distribution to the following data:

x_i	0	1	2	3	4	5
f_i	2	14	20	34	22	8

Test the goodness of this fit at 5% level of significance. **(07 Marks)**

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10ES42

Fourth Semester B.E. Degree Examination, June/July 2018
Microcontrollers

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Standard notations are used.***
3. ***Missing data may be suitably assumed.***

PART – A

1 a. What are the differences between microprocessor and microcontroller? **(04 Marks)**
b. Explain in brief Harvard and Von-Neumann CPU architecture. **(06 Marks)**
c. With neat block diagram, explain the architecture of 8051. **(10 Marks)**

2 a. Identify the addressing modes used in the following instruction:
(i) MOV A, @ R1 (ii) MOV A, #52h (iii) MOV A, 50h (iv) SJMP NEXT
(v) LJMP 1C00h. **(05 Marks)**
b. With an example write the classification of instructions in 8051. **(10 Marks)**
c. Explain the different types of Jump instruction in 8051. **(05 Marks)**

3 a. What are assembler directives? Explain any four assembler directives. **(08 Marks)**
b. Write a program to subtract two 16-bit numbers in assembly language. **(06 Marks)**
c. Find the delay produced by the following program, and assume that clock frequency is 11.0592 MHz.

```
Delay : MOV R2, #30
HERE : DJNZ R2, HERE
       NOP
       NOP
       RET
```

(06 Marks)

4 a. Describe with functional block diagram 'Port 0' and 'Port 1' of 8051. **(10 Marks)**
b. Write an 8051 C program to turn port line $P_{0.5}$ on and off 500 times, with a suitable delay. **(05 Marks)**
c. Explain the technique of debouncing a key using a circuit diagram. **(05 Marks)**

PART – B

5 a. With a neat diagram, describe the interrupt structure of 8051 and also explain the interrupt control register. **(12 Marks)**
b. Describe the mode 1 operation of Timer 0 with timer control logic diagram. **(08 Marks)**

6 a. Explain the function of each bit of SCON register in 8051. **(06 Marks)**
b. Write the sequence of actions to be performed for serial data transmission. **(06 Marks)**
c. Write the assembly language program to transfer letter C serially at 9600 baud rate continuously. Assume clock frequency of 11.0592 MHz. **(08 Marks)**

7 Write short notes on:
(i) Clock system of MSP 430 (ii) Real time clock.
(iii) 8255 PPI. (iv) Features of MSP430. **(20 Marks)**

8 a. Explain the bits of TCON register. Write an 8051 C program to toggle only bit P1.5 continuously every 50 msec. Use timer1 to generate the delay.
Assume XTAL = 11.0592 MHz. **(10 Marks)**
b. Give the control word format of 8255. Write an ALP (Assembly program) to send data 55H and AAH to port B continuously. Assume base address for 8255 as 4500H. **(10 Marks)**

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10ES43

Fourth Semester B.E. Degree Examination, June/July 2018
Control Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define control system. Explain linear and nonlinear control system. **(06 Marks)**

b. Derive transfer function for a lag-lead network, shown in Fig.Q.1(b). **(06 Marks)**

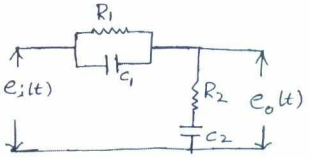


Fig.Q.1(b)

c. For the mechanical system shown in Fig.Q.1(c) i) Draw the mechanical network; ii) Write differential equations; iii) Draw force-to-voltage [F-V] analogous electric network.

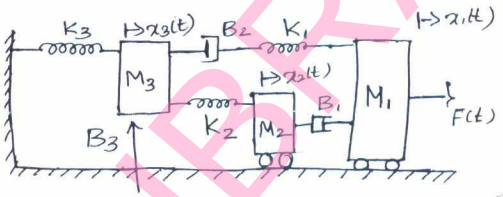


Fig.Q.1(c) **(08 Marks)**

2 a. Illustrate how to perform the following in connection with block diagram reduction techniques:
i) Moving a summing point before the block.
ii) Removing minor feedback loop.
iii) Shifting take off point after summing point. **(06 Marks)**

b. Obtain $\frac{C_1(S)}{R_2(S)}$ and $\frac{C_2(S)}{R_1(S)}$ for the given multiple input and multiple output system shown in Fig.Q.2(b). **(06 Marks)**

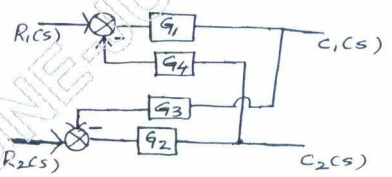


Fig.Q.2(b)

c. Draw the signal flow graph and determine the overall transfer function of the block diagram shown in Fig.Q.2(c) using Mason's gain formula. **(08 Marks)**

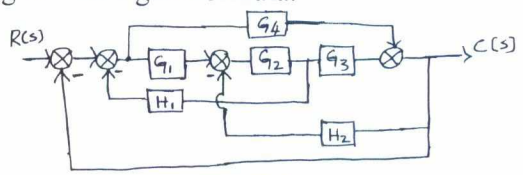


Fig.Q.2(c)

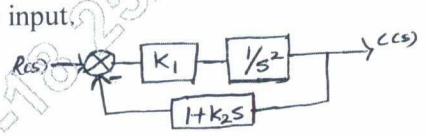
3 a. State various standard test signals commonly used in control system. Sketch their typical plots and obtain their Laplace transform. **(06 Marks)**

b. A unity feedback system has $G(S) = \frac{10(S+2)(S+3)}{S(S+1)(S+5)(S+4)}$. Determine:

i) Type of the system
ii) All error coefficients and
iii) Steady state error where input is $r(t) = 3 + t + t^2$. **(06 Marks)**

c. For control system shown in Fig.Q.3(c) find the values of K_1 and K_2 so that $M_P = 25\%$ and $T_P = 4$ sec. Assume unit step input. **(08 Marks)**

Fig.Q.3(c)



4 a. Define the following terms related to a control system:
i) Stable system ii) Marginally stable system iii) Relatively more stable system. **(06 Marks)**

b. For unity feedback system, $G(S) = \frac{K}{S(1+0.4S)(1+0.25S)}$, find range of values of K, marginal value of K and frequency of sustained oscillations. **(06 Marks)**

c. Using RH criterion determine the stability of the system having the characteristic equation $S^6 + 2S^5 + 5S^4 + 8S^3 + 8S^2 + 8S + 4 = 0$. Examine the stability. **(08 Marks)**

PART – B

5 a. Find valid break away points and inter section of root locus with imaginary axis for $G(S)H(S) = \frac{K(S+1)}{S(S-1)(S^2+5S+20)}$. **(08 Marks)**

b. Sketch the rough nature of the root locus of a certain control system whose characteristic equation is given as $S^3 + 9S^2 + KS + K = 0$. Comment on stability. **(12 Marks)**

6 a. Explain the correlation between time domain and frequency domain systems. **(06 Marks)**

b. For a unity feedback system $G(S) = \frac{242(S+5)}{S(S+1)(S^2+5S+121)}$. Sketch the bode plot, find W_{gc}, W_{pc}, GM and PM. Comment on stability. **(14 Marks)**

7 a. Draw a polar plot for a –VC feedback control system having an open loop transfer function.

$G(S)H(S) = \frac{100}{(S+2)(S+4)(S+8)}$. **(06 Marks)**

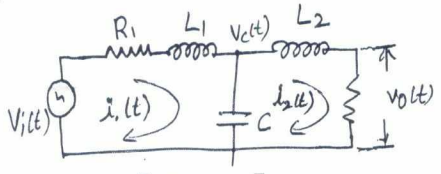
b. List the advantages of Nyquist plot. **(04 Marks)**

c. Investigate the stability of a negative feedback control system whose open loop transfer function is given by $G(S)H(S) = \frac{100}{(S+1)(S+2)(S+3)}$, using Nyquist stability criterion. **(10 Marks)**

8 a. Define state variables. List the properties of state transition matrix. **(06 Marks)**

b. Obtain the state and output equation for the electrical network shown in Fig.Q.8(b). **(06 Marks)**

Fig.Q.8(b)



c. Find the state transition matrix for $A = \begin{bmatrix} 0 & -1 \\ +2 & -3 \end{bmatrix}$. **(08 Marks)**

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10EC44

Fourth Semester B.E. Degree Examination, June/July 2018
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the following continuous time signals with examples: (i) Even and Odd (ii) Periodic and Non periodic (iii) Energy and power. **(06 Marks)**

b. Test $y(t) = x(t)g(t)$ whether the system is,
(i) Linear (ii) Time variant (iii) Stable. **(06 Marks)**

c. Perform the following operation on the signal shown in Fig. Q1 (c).

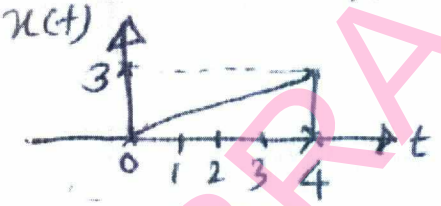

Fig. Q1 (c)

(i) $x(3t+2)$; (ii) $x(2(t+2))$; (iii) $x(-2t-1)$ (iv) $x(-2t+3)$ **(08 Marks)**

2 a. Prove the following properties of convolution sum:
(i) $x(n)*h(n) = h(n)*x(n)$.
(ii) $\{x(n)*h_1(n)\}*h_2(n) = x(n)*\{h_1(n)*h_2(n)\}$ **(06 Marks)**

b. Evaluate the following convolution integral: $y(t) = u(t+1)*u(t-2)$. **(06 Marks)**

c. Find the convolution of,
$x(n) = \{1 \underset{\uparrow}{2} 3 4\}$ and $h(n) = \{5 \underset{\uparrow}{4} 3 2 1\}$ **(08 Marks)**

3 a. Determine LTI systems characterized by impulse response,
(i) $h(n) = \left(\frac{1}{2}\right)^n u(n)$
(ii) $h(t) = e^{-4|t|}$ are stable and causal. **(06 Marks)**

b. Find the natural response of the system,
$$y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$$
with $y(-1) = 0$ and $y(-2) = 1$. **(06 Marks)**

c. Sketch direct form I and direct form II implementations for,
(i) $y(n) + \frac{1}{2}y(n-1) - 2y(n-3) = 3x(n-1) + 2x(n-2)$
(ii) $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = 2\frac{dx(t)}{dt}$. **(08 Marks)**

4 a. State and prove (i) Time-shift and (ii) Frequency shift properties of Fourier series. **(06 Marks)**

b. Determine the DTFS of the signal, $x(n) = \cos\left(\frac{\pi}{3}n\right)$ and draw the spectrum. **(06 Marks)**

c. Evaluate the FS representation for the signal, $x(t) = \sin(2\pi t) + \cos(3\pi t)$. Sketch the magnitude and phase spectra. **(08 Marks)**

PART – B

5 a. State and prove the following properties of DTFT:(i)Frequency differentiation (ii)Linearity. **(06 Marks)**

b. Find the inverse Fourier transform of,

$$X(j\omega) = \frac{-j\omega}{(j\omega)^2 + 3j\omega + 2}.$$ **(06 Marks)**

c. Find the DTFT of the signals:

(i) $x(n) = 2^n u(-n)$ (ii) $x(n) = \left(\frac{1}{4}\right)^n u(n+4)$. **(08 Marks)**

6 a. The system produces the output of $y(t) = e^{-t}u(t)$ for an input of $x(t) = e^{-2t}u(t)$. Determine the frequency response and impulse response of the system. **(06 Marks)**

b. State and prove sampling theorem for low pass signal. **(08 Marks)**

c. Find the Nyquist rate and Nyquist interval for the following signals:

(i) $m(t) = \frac{1}{2\pi}\cos(4000\pi t)\cos(1000\pi t)$

(ii) $m(t) = \frac{\sin 500\pi t}{\pi t}$. **(06 Marks)**

7 a. Write any six properties of ROC's. **(06 Marks)**

b. Determine the z-transform of,

(i) $x(n) = -a^n u(-n-1)$.

(ii) $x(n) = a^n \cos(\Omega_0 n)u(n)$ **(06 Marks)**

c. Determine the inverse z-transform of the following:

(i) $x(z) = \frac{1}{1-az^{-1}}$, ROC : $|z| > |a|$

(ii) $x(z) = \frac{1}{1-az^{-1}}$, ROC : $|z| < |a|$ **(08 Marks)**

8 a. Find the unilateral z-transform of the following x(n):

(i) $x(n) = a^n u(n)$.

(ii) $x(n) = a^{n+1}u(n+1)$ **(06 Marks)**

b. Determine the system function and unit sample response of the system described by the difference equation, $y(n) - \frac{1}{2}y(n-1) = 2x(n)$, $y(-1) = 0$. **(06 Marks)**

c. Solve the difference equation,
$y(n) - 3y(n-1) - 4y(n-2) = 0$, $n \geq 0$
If $y(-1) = 5$ and $y(-2) = 0$. **(08 Marks)**

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10EC45

Fourth Semester B.E. Degree Examination, June/July 2018
Fundamentals of HDL

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain VHDL and verilog ports. **(07 Marks)**
b. Discuss scalar data types in aVHDL. **(08 Marks)**
c. Compare VHDL and verilog. **(05 Marks)**

2 a. List five major differences between signal assignment and variable assignment statements. **(05 Marks)**
b. Draw the logic symbol and excitation table of a D-latch. Derive the next state equation and draw the logic diagram. Write verilog code in dataflow description. **(10 Marks)**
c. Explain, with example, how to assign delay time to signal assignment statements in VHDL and verilog. **(05 Marks)**

3 a. Explain process statement in VHDL and always statement in verilog. **(08 Marks)**
b. Write behavioral verilog code for a 8:3 priority encoder. **(06 Marks)**
c. Multiply +7 and -5 using Booth's algorithm. **(06 Marks)**

4 a. Explain with example, i) Binding between library and component in VHDL and ii) Binding between two modules in verilog. **(10 Marks)**
b. Write VHDL structural description of a N-bit magnitude comparator using generate statement (Assume all component descriptions available in work library). **(10 Marks)**

PART – B

5 a. Explain procedures in VHDL and tasks in verilog. **(06 Marks)**
b. Write verilog code to convert an unsigned integer to binary using task. **(06 Marks)**
c. Write VHDL description using function to compute the factorial of a positive integer. **(08 Marks)**

6 a. Describe packages in VHDL with example. **(06 Marks)**
b. Draw the block diagram and write verilog description for a 16 × 8 SRAM. **(10 Marks)**
c. List various built-in procedures and built-in tasks for file-handling. **(04 Marks)**

7 a. Develop a block diagram of a 9-bit adder using three 3-bit carry look-ahead adder slices. Describe 3-bit look-ahead adder slice using VHDL and invoke this in verilog module. **(10 Marks)**
b. Show through an example of 8:3 priority encoder how to instantiate CASEX in VHDL. **(10 Marks)**

8 a. What is synthesis? Discuss important facts associated with synthesis. **(08 Marks)**
b. Generate the gate-level synthesis for a signal assignment statement y = 2 * x + 3 and write its structural code in verilog. **(12 Marks)**

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10EC46

Fourth Semester B.E. Degree Examination, June/July 2018
Linear IC's 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 resistance (10% tolerance) and capacitance values.***

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. With circuit diagram, explain the working of basic circuit of operational amplifier. **(07 Marks)**

b. A direct coupled noninverting amplifier is to amplify a 100 mV signal to a level of 3 V. Using IC741, design a suitable circuit. Assume $I_{B(max)} = 500$ nA. **(07 Marks)**

c. Write the circuit diagram of 3 input non inverting summing circuit and prove that $V_0 = V_1 + V_2 + V_3$. **(06 Marks)**

2 a. Explain the design steps to build a high input impedance capacitor coupled non-inverting voltage follower. **(06 Marks)**

b. Design a capacitor coupled inverting amplifier using IC741 to have a voltage gain of 85, output voltage amplitude of 3 V and signal frequency range from 30 Hz to 14 kHz. Assume load resistance is 1 kΩ and $I_{B(max)} = 500$ nA. **(07 Marks)**

c. Design a capacitor coupled non-inverting a amplifier using single polarity power supply is to have a 22 V supply, voltage gain of 95 V, lower cutoff frequency of 150 Hz, minimum load resistance of 7 kΩ and $I_{B(max)} = 520$ nA and output amplitude of 4.5 V. **(07 Marks)**

3 a. How upper cutoff frequency of IC741 is determined? **(07 Marks)**

b. For a voltage follower circuit using a 741 opamp, calculate the following. Assume slew rate = 0.5 V/μsec.

(i) Slew rate limited cutoff frequency if the peak of the sine wave output is 5 V.

(ii) Maximum value of the sinusoidal output voltage that will allow the circuit to operate at the 800 kHz unity-gain cutoff frequency.

(iii) Cutoff frequency limited rise time at 800 kHz unity gain cut off frequency and slew rate limited rise time if the output amplitude is 5V. **(06 Marks)**

c. Design an inverting amplifier to have a gain of 100. Input signal amplitude is 50 mV. Calculate the capacitance and resistance values to be added using Zin mod compensation method to reduce the gain to 60 dB. Assume $I_{B(max)} = 200$ nA, new cutoff frequency = 2 MHz. **(07 Marks)**

4 a. Design an instrumentation amplifier to have an overall gain of 800. The input signal amplitude is 25 mV and the supply is ±15 V. Assume $I_{B(max)} = 500$ nA and opamp 741 is used. **(10 Marks)**

b. Write the circuit diagram of precision full wave rectifier and obtain the expression for the output voltage during the positive and negative half cycle of the input. **(10 Marks)**

PART – B

5 a. Explain voltage follower peak detector. **(06 Marks)**

b. With circuit diagram, explain the circuit to generate triangular / rectangular waveform. **(07 Marks)**

c. Using 741 opamp with a supply of ±12 V, design a phase shift oscillator to have an output frequency of 3.5 kHz. Assume $I_{B(max)} = 500$ nA. **(07 Marks)**

6 a. Using a bipolar opamp with ±18V supply, design an inverting Schmitt trigger circuit to have UTP = 1.5 V and LTP = −3V. Assume diode current = 500 μA, $V_F = 0.7$ V. **(10 Marks)**

b. Build a circuit to have one stable output stage using opamp and write the necessary equations to design the circuit. **(10 Marks)**

7 a. The designed dc voltage regulator has $V_S = V_{CC} = 12V$, $V_0 = 6.3V$, $R_1 = 270\Omega$. If the supply resistance is 25Ω, determine the line regulation, load regulation and ripple rejection for the circuit. IN 753 zener diode is used in the circuit. Assume $Z_Z = 7\ \Omega$, $I_{L(max)} = 42$ mA and 10% change in V_S is allowed. **(08 Marks)**

b. With circuit diagram, explain 3 terminal positive monolithic regulator and high voltage 723 regulator. **(12 Marks)**

8 a. Explain Astable multivibrator circuit using 555 timer, using the functional diagram (equations are not needed). **(10 Marks)**

b. Explain the block diagram of voltage controlled oscillator IC and obtain the expression for f_0. **(10 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, June/July 2018

Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. Find the ratio in which the point C, (9, 8, -10) divides the line segment joining the points A(5, 4, -6) and B(3, 2, -4). **(06 Marks)**

b. If $\cos\alpha$, $\cos\beta$, $\cos\gamma$ are the direction cosines of a straight line, prove that (i) $\sin^2\alpha+\sin^2\beta+\sin^2\gamma=2$ (ii) $\cos2\alpha+\cos2\beta+\cos2\gamma=-1$. **(07 Marks)**

c. Find the constant K such that the angle between the lines with direction ratios (-2, 1, -1) and (1, -K, 1) is 90°. **(07 Marks)**

2 a. Show that the angles between the diagonals of a cube is $\theta=\cos^{-1}(1/3)$. **(06 Marks)**

b. Find the equation of the plane through the points (1, 0, -1) and (3, 2, 2) and parallel to the line $\frac{x-1}{1}=\frac{1-y}{2}=\frac{z-2}{3}$. **(07 Marks)**

c. Show that the points A(-6, 3, 2), B(3, -2, 4), C(5, 7, 3) and D(-13, 17, -1) are coplanar. Also find the equation of the plane containing them. **(07 Marks)**

3 a. Find the angle between the vectors $\vec{a}=2i+6j+3k$, $\vec{b}=12i-4j+3k$. **(06 Marks)**

b. Find the area of a parallelogram whose adjacent sides are $i-2j+3k$ and $2i+j-4k$. **(07 Marks)**

c. Find a unit vector perpendicular to both vectors $\vec{a}=2i-3j+k$, $\vec{b}=7i-5j+k$. **(07 Marks)**

4 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 $x=t^3+1$, $y=t^2$, $z=2t+3$ where t is the time. Find the components of velocity and acceleration at $t=1$ in the direction of $i+j+3k$. **(07 Marks)**

c. Find the directional derivative of $f(x,y,z)=xy^2+yz^3$ at the point (2, -1, 1) in the direction of vector $i+2j+2k$. **(07 Marks)**

5 a. Find div F and curl F where $F=\text{grad}(x^3+y^3+z^3-3xyz)$. **(06 Marks)**

b. Show that $F=x(y-z)i+y(z-x)j+z(x-y)k$ is solenoidal. **(07 Marks)**

c. Find the constants a and b so that the vector $\vec{F}=(axy+z^3)\hat{i}+(3x^2-z)\hat{j}+(bxz^2-y)\hat{k}$ is irrotational. **(07 Marks)**

6 a. Find the Laplace transforms of $1+2t^3-4e^{3t}+5e^{-t}$. **(07 Marks)**

b. Find the Laplace transform of $t^2\sin^2 t$. **(07 Marks)**

c. Find the Laplace transform of $\frac{\sin at}{t}$. **(06 Marks)**

7 a. Find the inverse Laplace transform of $\frac{3s-4}{16-s^2}$. **(06 Marks)**

b. Find the inverse Laplace transform of $\frac{1}{s^2+4s+9}$. **(07 Marks)**

c. Evaluate $L^{-1}\left\{\frac{1}{(s+1)(s+2)}\right\}$. **(07 Marks)**

8 a. Obtain the Laplace transforms of $f'(t)$, $f''(t)$. **(08 Marks)**

b. Solve the differential equation using Laplace transforms $y''-3y'+2y=1-e^{2t}$ under the conditions $y(0) = 1$, $y'(0) = 0$. **(12 Marks)**

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