USN | | | | | | | | | | |

10MAT41

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Using Taylor series method, solve the problem $\frac{dy}{dx} = x^2y - 1$, $y(0) = 1$ at the point $x = 0.2$. Consider upto 4^{th} degree terms. **(06 Marks)**

b. Using R.K. method of order 4, solve $\frac{dy}{dx} = 3x + \frac{y}{2}$, $y(0) = 1$ at the points $x = 0.1$ and $x = 0.2$ by taking step length $h = 0.1$. **(07 Marks)**

c. Given that $\frac{dy}{dx} = x - y^2$, $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.0795$, $y(0.6) = 0.1762$. Compute y at $x = 0.8$ by Adams-Bashforth predictor-corrector method. Use the corrector formula twice. **(07 Marks)**

2 a. Evaluate y and z at $x = 0.1$ from the Picards second approximation to the solution of the following system of equations given by $y = 1$ and $z = 0.5$ at $x = 0$ initially.

$$\frac{dy}{dx} = z, \quad \frac{dz}{dx} = x^3(y + z)$$ **(06 Marks)**

b. Given $y'' - xy' - y = 0$ with the initial conditions $y(0) = 1$, $y'(0) = 0$. Compute $y(0.2)$ and $y'(0.2)$ by taking $h = 0.2$ and using fourth order Runge-Kutta method. **(07 Marks)**

c. Applying Milne's method compute $y(0.8)$. Given that y satisfies the equation $y'' = 2yy'$ and y and y' are governed by the following values. $y(0) = 0$, $y(0.2) = 0.2027$, $y(0.4) = 0.4228$, $y(0.6) = 0.6841$, $y'(0) = 1$, $y'(0.2) = 1.041$, $y'(0.4) = 1.179$, $y'(0.6) = 1.468$. (Apply corrector only once). **(07 Marks)**

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

b. Find an analytic function $f(z) = u + iv$. Given $u = x^2 - y^2 + \frac{x}{x^2 + y^2}$. **(07 Marks)**

c. If f(z) is a regular function of z, show that $\left[\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right] |f(z)|^2 = 4\,|f'(z)|^2$ **(07 Marks)**

4 a. Find the bilinear transformation that maps the points $z = -1, i, -1$ onto the points $w = 1, i, -1$ respectively. **(06 Marks)**

b. Find the region in the w-plane bounded by the lines $x = 1$, $y = 1$, $x + y = 1$ under the transformation $w = z^2$. Indicate the region with sketches. **(07 Marks)**

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

PART – B

5 a. Solve the Laplaces equation in cylindrical polar coordinate system leading to Bessel differential equation. **(06 Marks)**

b. If α and β are two distinct roots of $J_n(x) = 0$ then prove that $\int_0^1 x\, J_n(\alpha x)\, J_n(\beta x)\, dx = 0$ if $\alpha \neq \beta$. **(07 Marks)**

c. Express the polynomial, $2x^3 - x^2 - 3x + 2$ interms of Legendre polynomials. **(07 Marks)**

6 a. State and prove addition theorem of probability. **(06 Marks)**

b. Three students A, B, C write an entrance examination. Their chances of passing are ½, ⅓, ¼ respectively. Find the probability that,
i) Atleast one of them passes.
ii) All of them passes.
iii) Atleast two of them passes. **(07 Marks)**

c. Three machines A, B, C produce respectively 60%, 30%, 10% of the total number of items of a factory. The percentages of defective outputs of these three machines are respectively 2%, 3% and 4%. An item is selected at random and is found to be defective. Find the probability that the item was produced by machine C. **(07 Marks)**

7 a. The pdf of a random variable x is given by the following table:

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

Find: i) The value of k ii) $P(x > 1)$ iii) $P(-1 < x \leq 2)$
iv) Mean of x v) Standard deviation of x. **(06 Marks)**

b. In a certain factory turning out razar blades there is a small probability of 1/500 for any blade to be defective. The blades are supplied in packets of 10. Use Poisson distribution to calculate the approximate number of packets containing, i) One defective, ii) Two defective, in a consignment of 10000 packets. **(07 Marks)**

c. In a normal distribution 31% of items are under 45 and 8% of items are over 64. Find the mean and standard deviation of the distribution. **(07 Marks)**

8 a. A sample of 100 tyres is taken from a lot. The mean life of tyres is found to be 39350 kilometers with a standard deviation of 3260. Can it be considered as a true random sample from a population with mean life of 40000 kilometers? (Use 0.05 level of significance) Establish 99% confidence limits within which the mean life of tyres expected to lie. (Given that $Z_{0.05} = 1.96$, $Z_{0.01} = 2.58$) **(06 Marks)**

b. Ten individuals are chosen at random from a population and their heights in inches are found to be 63, 63, 66, 67, 68, 69, 70, 70, 71, 71. Test the hypothesis that the mean height of the universe is 66 inches. (Given that $t_{0.05} = 2.262$ for 9 d.f.) **(07 Marks)**

c. Fit a Poisson distribution to the following data and test the goodness of fit at 5% level of significance. Given that $\psi^2_{0.05} = 7.815$ for 4 degrees of freedom.

x	0	1	2	3	4
Frequency	122	60	15	2	1

(07 Marks)

* * * * *

USN | | | | | | | | | | |

10ES42

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Microcontrollers

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With neat diagram, with the programming model of 8051 with addresses of SFR's and ports. Also give 128 bytes RAM allocation. **(12 Marks)**

b. Interface 8051 to 8K external RAM and 32K external ROM and explain how 8051 access them? **(08 Marks)**

2 a. Explain difference addressing modes of 8051. Give an example for each of them and mention limitations of each. **(07 Marks)**

b. Explain the following instruction of 8051 with example (values).
i) XCHD A_1 @ Ri ii) MOVC A_1 @ A + PC iii) SWAP A
iv) RL A v) MUL AB vi) DA A **(09 Marks)**

c. Examine the following code and analyse the result with flag register. Content
MOV A_1 # –30d
MOV R_2, # –50d
ADD A, R_2 **(04 Marks)**

3 a. Explain the different types of conditional and unconditional jump instruction of and unconditional jump instruction of 8051. Specify the difference range associated with jump instruction. **(08 Marks)**

b. Classify the CALL instruction in 8051. Explain each one. **(06 Marks)**

c. Write a program to generate and store Fibonacci terms, which are less then FFh. **(06 Marks)**

4 a. What are assembler directives? Explain any four of them. **(05 Marks)**

b. Write a program to find LCM (List Common Multiplier) of two number m_1 and m_2. **(09 Marks)**

c. Explain C data types for 8051 with their data size in bits and data range. **(06 Marks)**

PART – B

5 a. Explain TMOD and TCON register of 8051 timers. **(10 Marks)**

b. For every 50 chocolates, vending machine is getting heated up, it requires minimum of 1sec break after every 50 chocolates. Provide solution for this real time problem. **(10 Marks)**

6 a. What is baud rate? Which timer of the 8051 is used to set the baud rate? **(04 Marks)**

b. Explain SCON register with its bit pattern. **(08 Marks)**

c. Write a 8051 program to send the data message " MICROCONTROLLERS " of the length 17 character at a baud rate 2400, 8bit data, 1stop bit serially. **(08 Marks)**

7 a. Compare polling and Interrupt. Explain the six interrupt of 8051, with primary and interrupt vector table. **(08 Marks)**

b. Write a program to move stepper motor by 20steps is anticlockwise direction interface. **(08 Marks)**

c. Explain the advantages of interfacing 8255 with 8051 µc. **(04 Marks)**

8 a. Explain MSP430 architecture with neat block diagram. **(08 Marks)**

b. Explain memory address space of MSP430 with neat diagram. **(04 Marks)**

c. Write ALP to find larger element in a block of data using MSP430. **(08 Marks)**

* * * * *

(3) (2)

USN | | | | | | | | | | |

10ES43

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016
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. Briefly explain the requirements of a good control system. **(06 Marks)**

b. Show that the two systems shown in Fig.Q1(b)(i) and Fig.Q1(b)(ii) are analogous system by comparing their transfer functions. **(06 Marks)**

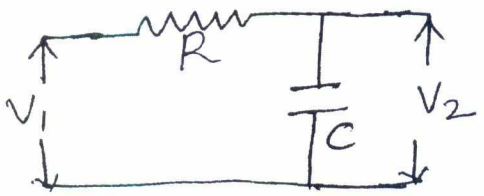

Fig.Q1(b)(i)

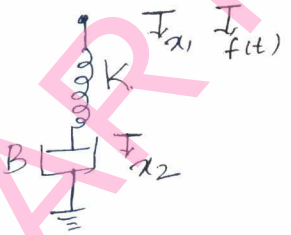

Fig.Q1(b)(ii)

c. For the mechanical system shown in Fig.Q1(c), i) Draw the mechanical network ii) write the differential equations iii) draw force – voltage analogous electric network. **(08 Marks)**

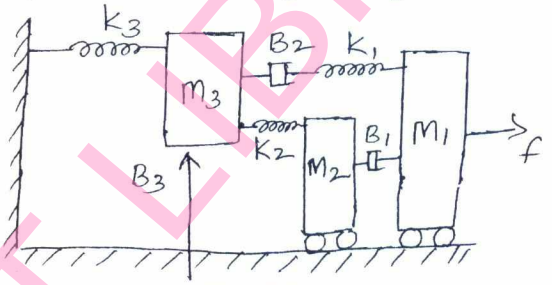

Fig.Q1(c)

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

b. What is signal-flow graph representation? Briefly explain the properties of signal flow graph. **(06 Marks)**

c. Draw a block diagram for the electric circuit shown in Fig.Q2(c) and obtain the transfer function $\frac{E_0(s)}{E_i(s)}$. **(08 Marks)**

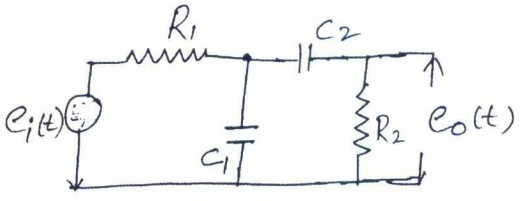

Fig.Q2(c)

3 a. Show that the steady state error $e_{ss} = \lim_{s\to 0} \frac{SR(s)}{1+G(s)H(s)}$ using simple closed loop system with –ve feedback. **(06 Marks)**

b. The block diagram of a simple servo system is shown in Fig. Q3(b). Compute the values of K and T to give overshoot of 20% and peak time of 2 sec. **(06 Marks)**

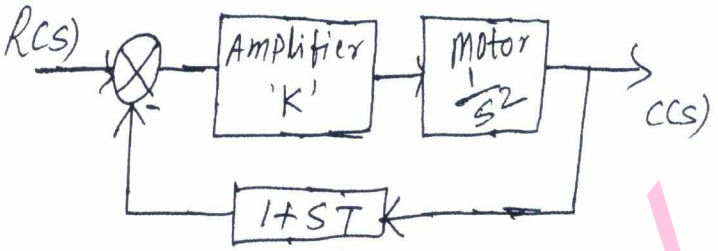

Fig.Q3(b)

c. Referring to Fig.Q3(c), find the following : i) transfer function : $\frac{X(s)}{F(s)}$ ii) ξ, W_n iii) % M_p, T_s and T_p. where K = 33 N/m, B = 15 N – s/m, M = 3 kg. **(08 Marks)**

Fig.Q3(c)

4 a. What is stable and unstable systems? What is the difference between absolute and relative stable systems? **(06 Marks)**

b. A unity feedback control system has $G(S) = \frac{K(s+13)}{s(s+3)(s+7)}$, using Routh's criterion calculate the range of K for which the system has its closed loop poles more negative than –1. **(06 Marks)**

c. The open loop transfer function of a unity feedback, open loop control system is given by $G(s) = \frac{K(s+10)}{s^2(s^2+2s+10)}$, i) find the value of K so that the steady state error for a unity parabolic input is ≤ 0.1 ii) for the value of K found in part i) verify the closed loop system is stable or not. **(08 Marks)**

PART – B

5 a. Consider the system with $G(s)H(s) = \frac{K}{s(s+2)(s+4)}$, find whether s = – 0.75 and s = –1 + j4 is on the root locus using angle condition. **(04 Marks)**

b. For a system having $G(s)H(s) = \frac{K}{s(s+3)(s^2+3s+11.25)}$. Find the valid break away points and angle of departure. **(06 Marks)**

c. Show that the part of the root locus of a system with $G(s)H(s) = \frac{K(s+3)}{s(s+2)}$ is a circle having center (–3, 0) and radius at $\sqrt{3}$.(Using both graphical and analytical method). **(10 Marks)**

6 a. List the advantages and limitations of frequency domain approach. **(04 Marks)**

b. What is lead and lag network? List the effects of lead and lag compensator. **(06 Marks)**

c. For a control system having $G(s) = \frac{k(1+0.5s)}{s(1+2s)(1+0.05s+0.125s^2)}$, draw bode plot, with K = 4 and find gain margin and phase margin. **(10 Marks)**

7 a. Draw polar plot of :

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

b. State and explain Nyquist stability criterion. **(04 Marks)**

c. For the given system $G(s) = \frac{10}{s^2(1+0.25s)(1+0.5s)}$ sketch the Nyquist plot and determine whether the system is stable or not. **(10 Marks)**

8 a. Construct the state model using phase variables if the system is described by the differential equation : $\frac{d^3y(t)}{dt^3} + \frac{4d^2y(t)}{dt^2} + \frac{7dy(t)}{dt} + 2y(t) = 5u(t)$. Draw the state diagram. **(06 Marks)**

b. List the properties of the state transition matrix. **(06 Marks)**

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

* * * * *

(5) (A)

USN | | | | | | | | | | |

10EC44

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Signals & Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Sketch EVEN and ODD components of the signal x(t) shown in Fig. Q1 (a). **(04 Marks)**

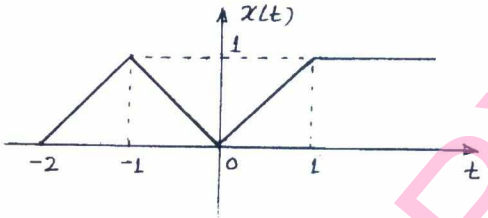

Fig. Q1 (a)

b. Determine whether the following signal x(n) is ENERGY or POWER signal:

$x(n) = n; \quad 0 \le n \le 5$

$= 10 - n; \quad 5 \le n \le 10$

$= 0$; ew (elsewhere / otherwise) **(04 Marks)**

c. Determine whether the following signals are periodic or not. If periodic find the fundamental period:

i) $x(n) = \cos\left(\frac{\pi n}{8}\right)\sin\left(\frac{\pi n}{4}\right)$

ii) $x(t) = x_1(t) + x_2(t) + x_3(t)$ with fundamental periods of 3.2, 9.6 and 12.8 secs for x_1, x_2 and x_3 respectively. **(06 Marks)**

d. A continuous time signal x(t) is shown in Fig. Q1 (d). Sketch

i) $x(t)u(1-t)$

ii) $x(t)[u(t) - u(t-1)]$

iii) $x(t)[u(t+1) - u(t)]$ **(06 Marks)**

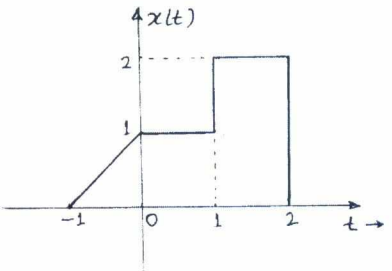

Fig. Q1 (d)

2 a. Determine and sketch the convolved output of the system whose input x(t) and impulse response h(t) are given as follows:

$x(t) = e^{-3t}\{u(t) - u(t-2)\}; \qquad h(t) = e^{-t}u(t)$ **(10 Marks)**

b. State and prove the Associative property of convolution sum. **(04 Marks)**

c. Find the unit step response of the following systems given by their impulse responses:

i) $h(t) = e^{-|t|}$ ii) $h(n) = \left(\frac{1}{2}\right)^n u(n)$ **(06 Marks)**

3 a. Determine whether the following systems defined by their impulse responses are causal and stable

i) $h(t) = e^{-3t}u(t-1)$

ii) $h(n) = 4^{-n}u(2-n)$ **(06 Marks)**

b. Find the total response of the system given by differential equation,
$y''(t) + 3y'(t) + 2y(t) = 2x(t)$ with $y(0) = -1$, $y'(0) = 1$ and $x(t) = \cos(t)u(t)$ **(10 Marks)**

c. Realize Direct Form – I and Direct Form – II block diagrams for the system given by the difference equation: $y(n) + \frac{1}{4}y(n-1) - y(n-3) = 5x(n-1) + 3x(n-2)$. **(04 Marks)**

4 a. State and prove the following properties of DTFS:

i) Frequency shift

ii) Convolution

iii) Perseval's theorem. **(12 Marks)**

b. Consider the periodic waveform:
$x(t) = 4 + 2\cos 3t + 3\sin 4t$

i) Find the complex Fourier coefficients.

ii) Using Parseval's theorem, find the power spectrum.

iii) Find the total average power. **(08 Marks)**

PART – B

5 a. Find DTFT of the following signals:

i) $x(n) = \{1, 2, \underset{\uparrow}{3}, 2, 1\}$

ii) $x(n) = (0.5)^{n+2}u(n)$

iii) $x(n) = n(0.5)^{2n}u(n)$ **(08 Marks)**

b. Using convolution theorem, find the inverse DTFT of $X(e^{j\Omega})$, given $X(e^{j\Omega}) = \frac{1}{(1-ae^{-j\Omega})^2}$, $|a| < 1$. **(08 Marks)**

c. Find inverse Fourier transform of $X(\omega) = \frac{j\omega}{(j\omega+2)^2}$. **(04 Marks)**

6 a. Find the frequency response and impulse response of the system having the output y(t) for the input x(t) as given below:
$x(t) = e^{-t}u(t)$; $y(t) = e^{-2t}u(t) + e^{-3t}u(t)$ **(06 Marks)**

b. Find the Fourier Transform representation for the periodic signal $x(t) = 3 + 2\cos \pi t$ and draw the spectrum. **(06 Marks)**

c. Specify the Nyquist rate and Nyquist intervals for the following signals:

i) $x_1(t) = \sin C(200t)$

ii) $x_2(t) = \sin C^2(200t)$

iii) $x_3(t) = \sin C(200t) + \sin C^2(200t)$ **(08 Marks)**

7 a. Find Z-transform of given x(n). Sketch ROC, poles and zeros of x(z)

$$x(n) = 3\left(-\frac{1}{2}\right)^n u(n) - 2\left[3^n u(-n-1)\right]$$ **(04 Marks)**

b. Determine the signal x(n) whose z-transform is given by, $x(z) = \log(1 - az^{-1})$; $|z| > |a|$ by using properties of z-transform. **(04 Marks)**

c. Find inverse z-transform of the following:

i) $x(z) = \frac{z}{3z^2 - 4z + 1}$; ROC : $|Z| > 1$: Use partial fraction expansion method

ii) $x(z) = \frac{z}{2z^2 - 3z + 1}$; ROC : $|Z| < \frac{1}{2}$: Use long division method. **(08 Marks)**

d. Find $x(\infty)$ if x(z) is given by,

i) $\frac{z+2}{(z-0.8)^2}$ ii) $\frac{z+1}{3(z-1)(z+0.9)}$ **(04 Marks)**

8 a. A causal system has input x(n) and output y(n). Find the impulse response of the system if,

$$x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$$

$$y(n) = \delta(n) - \frac{3}{4}\delta(n-1).$$ **(08 Marks)**

b. A LTI discrete time system is given by the system function $H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$

Specify the ROC of H(z) and determine h(n) for the following conditions:

i) the system is stable

ii) the system is causal **(06 Marks)**

c. Solve the following difference equation using unilateral z-transform for the given input and initial conditions.

$y(n) + 3y(n-1) = x(n)$ with $x(n) = u(n)$ and $y(-1) = 1$. **(06 Marks)**

* * * * *

USN | | | | | | | | | | |

10EC45

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Fundamentals of HDL

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Mention the styles/ types of HDL Description. Explain any 2 types with an example of half adder in both VHDL and verilog. **(10 Marks)**

b. Mention the Data types used in VHDL and verilog. **(04 Marks)**

c. Distinguish between Verilog and VHDL. **(06 Marks)**

2 a. Write a dataflow description for 4bit ripple carry adder in VHDL and verilog. **(10 Marks)**

b. Explain the signal declaration and variable assignment statement used in HDL with an example. **(06 Marks)**

c. What are vector data types? Explain them in VHDL and verilog. **(04 Marks)**

3 a. Write behavioral description of 2 : 1 multiplexor using if-else in VHDL and verilog. **(08 Marks)**

b. Write behavioral description of half addressing VHDL. **(04 Marks)**

c. Write VHDL and verilog codes for 4 ×4 bit Booth algorithms. **(08 Marks)**

4 a. With Logic diagram, write structural description for 2 × 4 decoder with 3 state output both in VHDL and verilog. **(10 Marks)**

b. Mention different types of binding. Discuss binding between
i) 2 modules in verilog ii) between library and component in VHDL. **(10 Marks)**

PART – B

5 a. Write VHDL description of an N – bit – ripple carry adder using procedures and verilog description using tasks. **(10 Marks)**

b. Write verilog function to find greater of 2 signed numbers. **(05 Marks)**

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

6 a. With a block diagram and function table of SRAM, write HDL codes for 16 × 8 SRAM. **(12 Marks)**

b. Write a VHDL code for addition of two 5 × 5 matrices, using a package. **(08 Marks)**

7 a. How do you invoke VHDL entity from verilog module? Explain with an example. **(08 Marks)**

b. With the help of block dia explain mixed language description of 9 bit adder. **(12 Marks)**

8 a. What is meant by synthesis? List and explain the steps involved in synthesis. **(08 Marks)**

b. Design gate level synthesis and write VHDL description for the information given below

Input		Outputs
a	b	z
00 (cent)	0 – 7	z = temperature
01 (offset)	0 – 7	z = temperature +4
10 (half)	0 – 7	z = temperature / 2
11	xx	z = 15
xx	> 7	z = 15

(12 Marks)

* * * * *

USN | | | | | | | | | | |

10EC46

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Linear ICs and Applications

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Missing data, if any, may be assumed suitably.

PART – A

1 a. With a neat circuit diagram, explain the basic op-amp circuit. **(06 Marks)**

b. The non – inverting amplifier uses μA 741 op-amp with $R_1 = R_3 = 2.2K$ and $R_2 = 220$ K. Determine maximum possible output offset voltage due to :
i) input offset voltage of 5 mV
ii) input bias current of $I_{B\ (max)} = 500\eta A$
iii) Input offset current of $I_{i(OS)} = 200\ \eta A$
iv) iv) resistance tolerance of ± 10%. **(10 Marks)**

c. Obtain the expression for output voltage for the two input inverting summing amplifier circuit. **(04 Marks)**

2 a. Draw a neat circuit diagram of a capacitor coupled voltage follower and explain its operation with necessary design steps. **(08 Marks)**

b. Design a high impedance capacitor – coupled non–inverting amplifier to have a low cutoff frequency of 200 Hz. The input and output voltages are to be 16 mV and 4V respectively and minimum load resistance is 10 KΩ. Select $R_2 = 1$ MΩ and $C_1 = 0.1$ μF. **(06 Marks)**

c. Explain how the upper cutoff frequency can be set for inverting amplifier with the help of neat circuit diagram and also explain design steps. **(06 Marks)**

3 a. Define loop gain, loop phase shift, pole frequency and phase margin. **(04 Marks)**

b. Explain miller effect compensation. **(06 Marks)**

c. For the circuit shown in Fig. Q3(c), calculate :
i) Full power bandwidth of 1 V peak input and op-amp slew rate of 250 V/μs
ii) Maximum peak output voltage obtain for input signal of 100 KHz and with slew rate of 0.5 V/μs. **(04 Marks)**

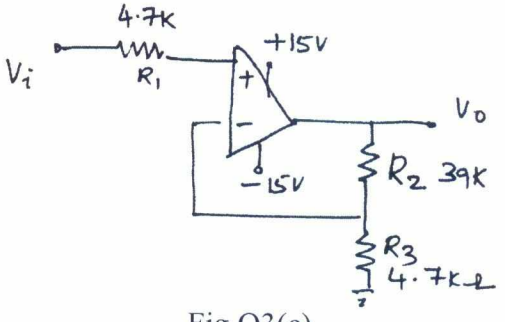

Fig.Q3(c)

d. List the precautions to be observed for op-amp circuit stability. **(06 Marks)**

4 a. Design the current source circuit shown in Fig. Q4(a) to produce a 100mA output to a 40 Ω load. Use a ± 12V supply and an LM 108 op-amp. **(06 Marks)**

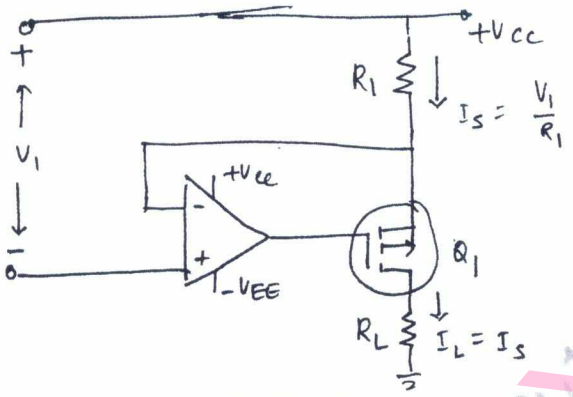

Fig.Q4(a)

b. Sketch the circuit of a current amplifier with floating load. Explain circuit operation and derive an equation for current gain. **(06 Marks)**

c. What are the advantages of precision rectifier over ordinary rectifier? Explain the working of a full wave precision rectifier. **(08 Marks)**

PART – B

5 a. With relevant diagram, explain the operation of negative clamper circuit using op-amp. **(06 Marks)**

b. Design a triangular waveform generator to produce a ±2V, 1 KHz output. Use a ±15V supply. Also calculate the minimum op-amp slew rate. **(08 Marks)**

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

6 a. With relevant diagrams, explain basic inverting and non-inverting comparator circuit with $V_{ref} = 0V$. **(06 Marks)**

b. With a neat circuit diagram, explain the operation of inverting Schmitt trigger circuit and discuss the design procedure. **(10 Marks)**

c. Using 741 op-amp, design the first –order active low-pass filter to have a cutoff frequency of 1.2 KHz. **(04 Marks)**

7 a. Briefly explain the standard representation of 78XX series 3–terminal IC regulators and enumerate the characteristics of this type of regulators. **(08 Marks)**

b. With the help of neat diagram, explain the operation of adjustable regulator using fixed 3–terminal regulator. **(06 Marks)**

c. Explain the operation of basic high voltage regulator using IC 723. **(06 Marks)**

8 a. Explain the operation of a mono – stable multivibrator using 555 IC timers. **(06 Marks)**

b. Explain the operation of phase – locked loop (PLL) with the help of neat block schematic diagram. **(08 Marks)**

c. What output voltage would be produced by DAC whose output range is 0 to 10 V and whose input binary number is

i) 10 (2 bit DAC)
ii) 0 1 1 0 (4 bit DAC)
iii) 1 0 1 1 1 1 0 0 (for 8 bit DAC). **(06 Marks)**

* * * * *

USN | | | | | | | | | | |

MATDIP401

Fourth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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

1 a. Find the direction cosines of the line which is perpendicular to the lines with direction cosines (3, -1, 1) an (-3, 2, 4). **(06 Marks)**

b. If $\cos\alpha$, $\cos\beta$, $\cos\gamma$ are the direction cosines of a line, then prove the following:

i) $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 2$

ii) $\cos 2\alpha + \cos 2\beta + \cos 2\gamma = -1$ **(07 Marks)**

c. Find the projection of the line AB on the line CD where A = (1, 2, 3), B = (1, 1, 1), C = (0, 0, 1), D = (2, 3, 0). **(07 Marks)**

2 a. Find the equation of the plane through (1, -2, 2), (-3, 1, -2) and perpendicular to the plane $2x - y - z + 6 = 0$. **(06 Marks)**

b. Find the image of the point (1, -2, 3) in the plane $2x + y - z = 5$. **(07 Marks)**

c. Find the shortest distance between the lines $\frac{x-8}{3} = \frac{y+9}{-16} = \frac{z-10}{7}$ and $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$. **(07 Marks)**

3 a. Find the constant 'a' so that the vectors $2i - j + k$, $i + 2j - 3k$ and $3i + aj + 5k$ are coplanar. **(06 Marks)**

b. Prove that $\left[\vec{a}+\vec{b},\ \vec{b}+\vec{c},\ \vec{c}+\vec{a}\right] = 2\left[\vec{a},\vec{b},\vec{c}\right]$. **(07 Marks)**

c. Find the unit normal vector to both the vectors $4i - j + 3k$ and $-2i + j - 2k$. Find also the sine of the angle between them. **(07 Marks)**

4 a. A particle moves along the curve $x = t^3 + 1$, $y = t^2$, $z = 2t + 5$ where t is the time. Find the components of its velocity and acceleration at time t = 1 in the direction of $2i + 3j + 6k$. **(06 Marks)**

b. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $x = z^2 + y^2 - 3$ at the point (2, -1, 2). **(07 Marks)**

c. Find the directional derivative of $\phi = xy^2 + yz^3$ at the point (1, -2, -1) in the direction of the normal to the surface $x\log z - y^2 = -4$ at (-1, 2, 1). **(07 Marks)**

5 a. Prove that $\text{div}(\text{curl}\,\vec{A}) = 0$. **(06 Marks)**

b. Find $\text{div}\,\vec{F}$ and $\text{curl}\,\vec{F}$ where $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$. **(07 Marks)**

c. Show that the vector $\vec{F} = (3x^2 - 2yz)i + (3y^2 - 2zx)j + (3z^2 - 2xy)k$ is irrotational and find ϕ such that $\vec{F} = \text{grad}\,\phi$. **(07 Marks)**

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

b. Find: i) $L\{e^{-t}\cos^2 t\}$, ii) $L\{te^{-t}\sin 3t\}$. **(07 Marks)**

c. Find: $L\left\{\frac{\cos at - \cos bt}{t}\right\}$. **(07 Marks)**

7 a. Find: $L^{-1}\left\{\frac{4s+5}{(s-1)^2(s+2)}\right\}$. **(06 Marks)**

b. Find: i) $L^{-1}\left\{\frac{s+2}{s^2-4s+13}\right\}$, ii) $L^{-1}\left\{\log\left(\frac{s+a}{s+b}\right)\right\}$. **(07 Marks)**

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

8 a. Using Laplace transforms, solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = e^{2t}$ with $y(0) = 0$, $y'(0) = 1$. **(10 Marks)**

b. Using Laplace transformation method solve the differential equation $y'' + 2y' - 3y = \sin t$, $y(0) = y'(0) = 0$. **(10 Marks)**

* * * * *