KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2016
Department of Electronics and Communication Engineering
ECE 2101
(Analog Electronics II)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Explain the LC parallel resonance circuit. Draw the phase diagram of a parallel resonance circuit and prove that resonance is occurred when the circuit power is unity. (06+08)
   b) Graphically prove that the bandwidth of a tuned circuit is proportional to the resistance of inductor and selectivity is inversely proportional to the resistance of inductor. (08)
   c) What do you mean by Q factor? What is the effect of the Q on the resonance curve? (07)
   d) It is desired to obtain a bandwidth of 250 kHz at an operating frequency of 10 MHz using a double tuned circuit. What value of co-efficient of coupling should be used? (06)

2. a) What is an oscillator? What are the conditions to work a transistor as an oscillator? (07)
   b) What is Barkhausen criterion? Why is it important for oscillator circuit? (06)
   c) Explain the principle of phase shift circuit of a phase shift oscillator. Explain the operation of a phase shift oscillator circuit. (06+06)
   d) In the Wien bridge oscillator shown in Fig. 2(d) below, $R_1=R_2=220\ k\Omega$ and $C_1=C_2=250$ pF. Determine the frequency of oscillations. (10)

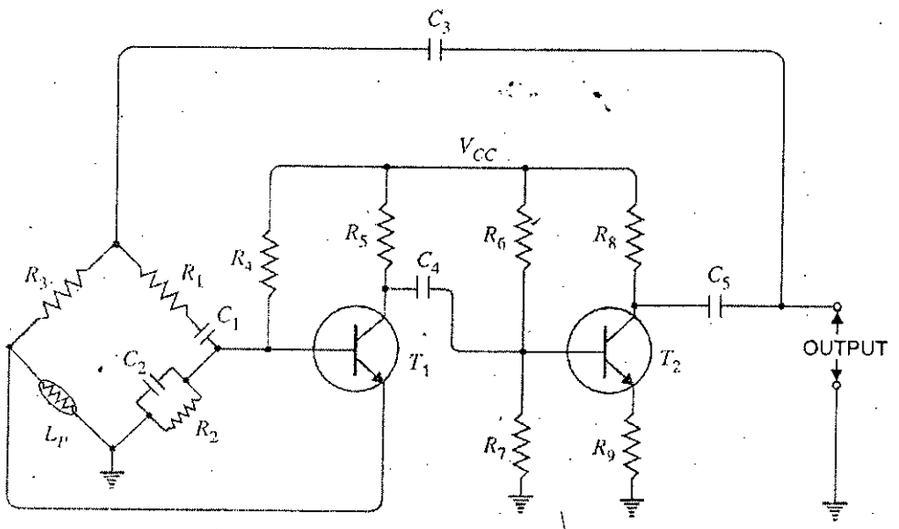

Fig. of Q. 2(d)

3. a) What are the limitations of LC and RC oscillators? Explain the frequency response of crystal. (03+06)
   b) Why does negative feedback increase the bandwidth of an amplifier? (08)
   c) Explain the relationship between the output impedances without feedback amplifier and with voltage series feedback amplifier. (10)
   d) An amplifier is required with a voltage gain of 100 which does not vary by more than 1%. If it is to use negative feedback with a basic amplifier, the voltage gain of which can vary by 20%, determine the minimum voltage gain required and the feedback factor. (08)

4. a) Prove that the gain of a practical feedback amplifier is inversely proportional to the feedback factor. (10)

b) Explain the reason of nonlinear distortion in feedback amplifier. Prove that the total harmonic distortion of feedback amplifier is lower than that of without feedback amplifier. (05+10)

c) An amplifier has an open loop gain A=100000. A negative feedback of 10 dB is applied. Find: i) voltage gain with feedback, ii) value of feedback fraction, β. (10)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What is IC? What are the characteristics of an ideal op-amp? (06)

b) For the circuit shown in Fig. 5(b), assume ideal op-amp unless otherwise mentioned: (12)

i) Name the feedback topology and calculate the feedback factor.

ii) Calculate V_o/V_i.

iii) Assume R_2 is replaced by a capacitor; draw the circuit diagram and find $V_o(t)$.

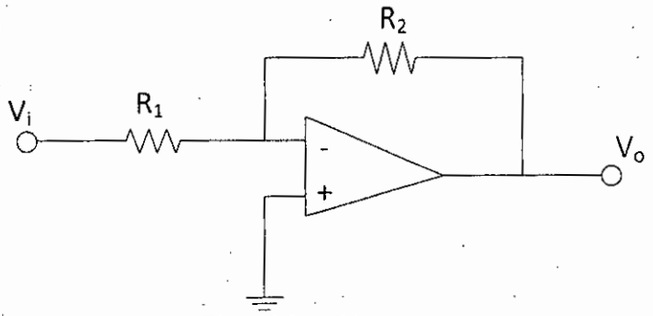

Fig. of Q. 5(b)

c) Define CMRR. Determine the output voltages of an op-amp for input voltages V_{i1}=150 μV and V_{i2}=140 μV. The amplifier has a differential gain of A_d=4000 and the value of CMRR is i) 100 and ii) 10^5. (08)

d) The following specifications are given for the differential amplifier of Fig. 5(d): $R_1=R_3$=680 Ω and $R_F=R_2$=6.8 kΩ, V_x=-1.5 V pp, and V_y=-2 V pp sine waves at 1 kHz. The op-amp is a IC 741C. Calculate i) voltage gain and the input resistance and ii) the output voltage of the amplifier. Assume that the output is initially nulled (V_{oot}=0 V). (09)

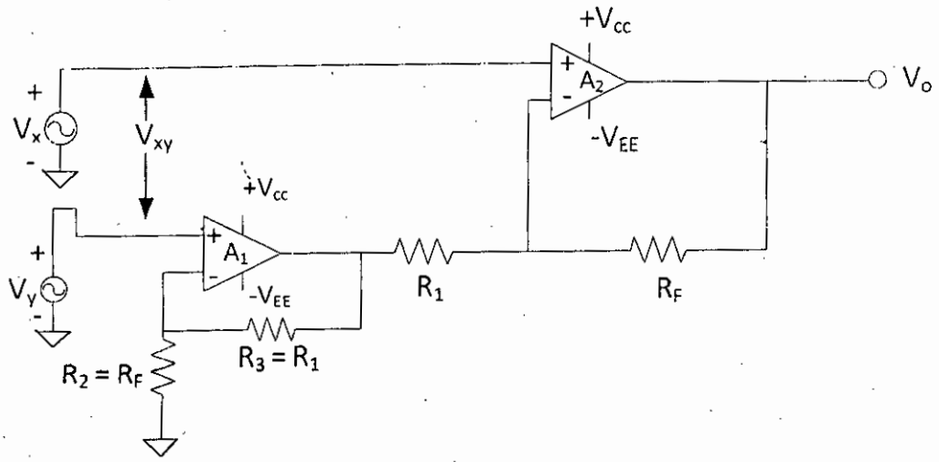

Fig. of Q. 5(d)

6. a) What is cut-off frequency? What are the differences between band-pass and band-stop filters? (02+06)

b) Explain the differences between i) inverting and differential summing amplifiers and ii) inverting and non-inverting averaging amplifiers. (07)

c) What do you mean by the order of filter? Write down the advantages of active filter over passive filter. (06)

d) Design a low-pass filter at a cut-off frequency of 1 kHz with a pass band gain of 2. (07)

e) Design a differentiator to differentiate an input signal that varies in frequency from 10 Hz to about 1 kHz. (07)

7. a) What is the difference between a comparator and Schmitt trigger? Why Schmitt trigger is known as regenerative comparator? (10)

b) Explain the internal block diagram of 555 IC. (09)

c) What are the differences between oscillator and multivibrator? Explain operation of transistor astable multivibrator. (03+06)

d) In the circuit of Fig. 7(d), R_A=10 kΩ, the output pulse width t_p=10 ms. Determine the value of C. (07)

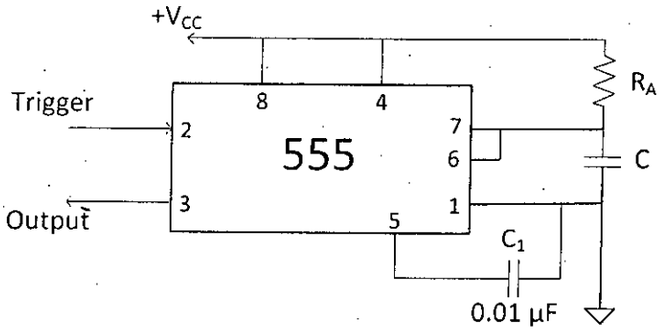

Fig. of Q. 7(d)

8. a) What is PLL? What are the applications of PLL in communication systems? (04+04)

b) Define and classify clipper. Why clipper is used in electronic system? (07)

c) Draw the output waveshapes of the following clipper circuits. Assume diodes are ideal. (10)

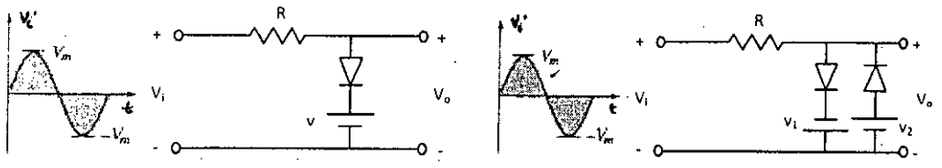

Fig. of Q. 8(c)

d) Draw the output waveshapes of the following clamper circuits. Assume diodes are ideal. (10)

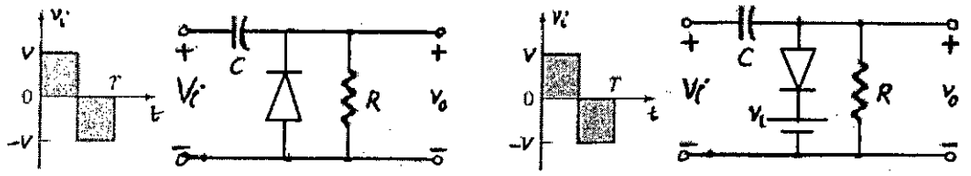

Fig. of Q. 8(d)

Y OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2016

Department of Electronics and Communication Engineering

ECE 2103

(Digital Electronics & Logic Circuits)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Convert the following numbers from the given base to the bases indicated: (12)
   (i) Decimal number 249.6 to base-3, base-4, and base-7.
   (ii) Hexadecimal 2AC5.D to decimal, octal and binary.

   b) A and B are integer variables in a computer program, with $A = (25)_{10}$ and $B = -(46)_{10}$. Assuming that the computer uses 8-bit two's complement arithmetic, show how it would compute $A + B$, $A - B$, $B - A$ and $-A - B$. (13)

   c) Define the following terms: (*i*) Duality principle, (*ii*) canonical form, (*iii*) standard form, (*iv*) positive and negative logic system, (*v*) IC logic families. (10)

2. a) Given the function $f(A, B, C) = (A + B + C')(A + B' + C')(A' + B + C')(A' + B' + C')$, let construct the truth table and express the function in both maxterm and minterm forms. (12)

   b) Find a simplified switching expression and logic network for the logic circuit as shown in Fig. 2(b.) (12)

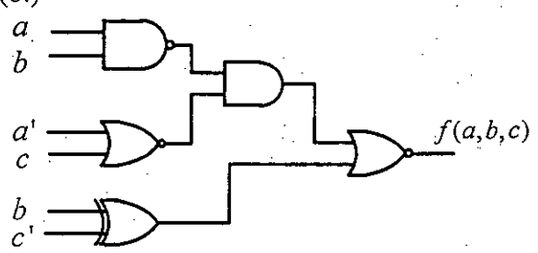

Fig.2(b)

   c) John and Jane Doe have two children, Joe and Sue. When eating out they will go to a restaurant that serves only vegetables or one that serves only chicken. Before going out, the family votes to decide on the restaurant. The majority wins, except Mom and Dad agree, and in that case they win. Any other tie votes produce a trip to the chicken restaurant. We wish to design a logic circuit that will automatically select the restaurant when everyone votes. (11)

3. a) Minimize the following function in both SOP and POS forms using K-maps. (13)

$$f(A, B, C, D) = \sum m(1, 3, 4, 7, 11) + d(5, 12, 13, 14, 15)$$

   b) Design a 16-to-1 multiplexer by using 4-to-1 multiplexers that can be used for a tree type network. (12)

   c) Implement the following function with a multiplexer. (10)

$$f(A, B, C, D) = \sum (0, 1, 3, 4, 8, 9, 15)$$

4. a) Define the following terms that relate with the characteristics of digital logic families. (*i*) Fan-out, (*ii*) Power distribution, (*iii*) Propagation delay, (*iv*) Noise margin. (10)

   b) Show that the circuit shown in Fig. 4(b) behaves as an inverter with the following parameters: (13)

$$R_C = 1\ k\Omega, R_B = 22\ k\Omega, V_{CC} = 5\ V, h_{fe} = 50, H = 5V\ (High\ level\ voltage), L = 0.2V\ (Low\ level\ voltage)$$

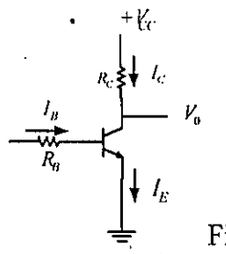

Fig. 4(b)

c) A combinational circuit is defined by the following three equations: $F_1 = x'y' + xyz'$, $F_2 = x' + y$, $F_3 = xy + x'y'$. Design the circuit with a decoder and external gates. (12)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What is sequential circuit? Write down the state table and draw the sate diagram of the following sequential circuit. (10)

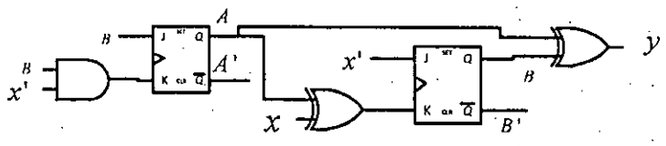

Fig.5(a)

b) Draw the diagram of RS, JK, D and T flip-flop. From these diagram write their characteristics tables and derive characteristics equations. (12)

c) Show the operation of the D –type edge-triggered flip-flop with necessary diagram. (08)

d) Write down the state reduction algorithm. (05)

6. a) Define state table, state diagram, and state equation. (08)

b) Reduce the number of states shown in the following sate table and tabulate the reduced sate table. Starting from state a of the reduced state table, find the output sequence generated with an input sequence of 01110010011. (15)

Present State	Next State		Output	
	$x = 0$	$x = 1$	$x = 0$	$x = 1$
a	f	b	0	0
b	d	c	0	0
c	f	c	0	0
d	g	a	1	0
e	d	c	0	0
f	f	b	1	1
g	g	h	0	1
h	g	a	1	0

c) Design a counter that counts the decimal digits according to $84\bar{2}\bar{1}$ code using T flip-flop. (12)

7. a) What is shift register? Draw the diagram of a 4-bit register with parallel load using D flip-flop. (10)

b) The content of the shift register A is 1101 in Fig. 7(b), what will be the content of register A and B after 6 clock pulses considering register B is initially cleared. Show the result for each clock pulse. (10)

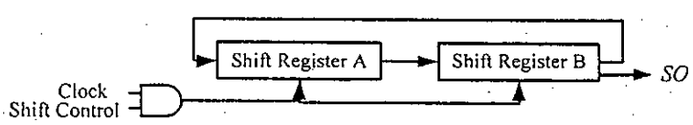

Fig. 7(b)

c) Design a synchronous counter that will count 15-10-9-7-8-6 and repeat using JK flip-flops. (15)

8. a) Write is down the basic properties of the components that forms the binary cells of registers in memory unit? (06)

b) Show the information transfer process in a magnetic core memory during write operation. (10)

c) Show that in a Dual slop A/D converter, the output of the converter is proportional to the analog input voltage. (11)

d) Write short notes on EPROM and E^2PROM. (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2016

Department of Electronics and Communication Engineering

ECE 2105

(Science of Materials)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A) –

1. a) Why should we study the science of materials? Explain briefly. (06)
   b) Describe various defects in crystal structure. Also mention their significance in the device performance. (10)
   c) For metallic alloy, why the resistivity due to impurity atoms is independent of temperature? (07)
   d) Consider the BCC unit cell of Sodium crystal. (12)
      i. How many atoms are there per unit cell?
      ii. If R is the radius of Na atom, show that the lattice parameter a is given by $a=4R/\sqrt{3}$.

2. a) What is the basic assumption of Einstein's theory of specific heat? Derive an expression for the specific heat of a solid on the Einstein model and show that at low temperature it drops exponentially with decreasing temperature. (13)
   b) Define Phonon. What are the assumptions of Debye's theory? Show that at lower temperatures C_v varies directly at T^3. (10)
   c) Describe briefly the quantum free electron theory of metals, introduced by Sommerfield. What are the achievements of the model? Where does it fail? (12)

3. a) Write down the Schrödinger's wave equation for stationary states. Solve it for particles in a cubical box of side 'a' and hence obtain expressions for the allowed wave functions and discrete energies of the particle. (12)
   b) Explain quantum tunneling effects in solids and its application in semiconductor diode. (06)
   c) Briefly explain Wiedemann-Franz-Lorenz law. Discuss, how thermal conductivity is related to electrical conductivity with the variation of temperature? (08)
   d) Given that, the mean speed of conduction electrons in Copper is 1.5×10^6 ms^{-1} and the frequency of vibration of the Copper atoms at room temperature is about 4×10^{12} s^{-1}, estimate the drift mobility of electrons and the conductivity of Copper. The density d of Copper is 8.96 $g.cm^{-3}$ and atomic mass M_{at} is 63.56 $gmol^{-1}$. (09)

4. a) What is meant by polarization in dielectrics? Show that $P=E\,\varepsilon_0\,(\varepsilon-1)$, where P is the electric polarization and E is the electric field. (08)
   b) Briefly discuss different polarization mechanism in dielectrics. (11)
   c) Write Clausius-Mostti equation and explain how it can be used to determine the relation between dielectric constant and the refractive index. (07)
   d) Consider a pure Si crystal that has $\varepsilon_r=11.9$. (09)
      i. What is the electric polarizability due to valance electrons per Si atom?
      ii. Suppose that a Si crystal is electroded on opposite faces and has a voltage applied across it. By how much is the local field greater than the applied field?
      iii. What is the resonant frequency f_o corresponding to ω_0? The number of Si atoms per unit volume, N, is given by 5×10^{28} m^{-3}.

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Explain the magnetic dipole moment with relevant figure. "Magnetic moment is proportional to the orbital momentum through a factor that has the change to mass ratio of the electron"- justify the statement. (13)

   b) Show that the magnetic dipole moment per unit volume is the same as the magnetization current on the surfaces per unit length of the specimen. (10)

   c) Define the following terms: (12)
   i) Bohr magneton, ii) Relative permeability, iii) Magnetic susceptibility, and iv) Barkhausen effect.

6. a) Write down the differences between paramagnetism and ferromagnetism. (08)

   b) What is superconductivity? Write down the characteristics of Type I and Type II supereonductors. (10)

   c) Discuss the M versus H behavior of polycrystalline materials. (12)

   d) Consider a toroidal coil with a ferrite core. Suppose that the coil has 200 turns and is used in HF work will small signals. The mean diameter of the toroid is 2.5 cm and the core diameter is 0.5 cm. if the core is MnZn ferrite, what is the approximate inductance of coil? Noted that the μ_{ri} of MnZn ferrite is equal to 2×10^3. (05)

7. a) Consider the permanent magnet in Figure 7(a). There is a small air gap of length l_g where there is an external magnetic field that is available to work. For example, if we were to insert an appropriate coil in the gap and pass a current through the coil, it would rotate as in a moving coil panel meter. Show that the magnetic energy per unit volume stored in the gap is proportional to the maximum value of BH. (10)

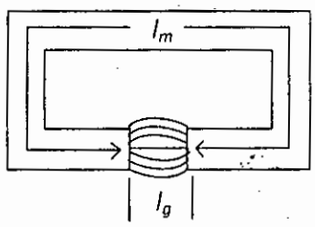

Figure of Q. 7(a)

   b) Derive Cauchy short-form dispersion equation. (18)

   c) Show that the group index of the medium $N_g = n - \lambda\frac{dn}{d\lambda}$, where the symbols have their usual meanings. (07)

8. a) Write down the differences between absorption and scattering of light. (08)

   b) Write down the significance of complex relative permittivity. (06)

   c) Spectroscopic ellipsometry measurements on a Silicon crystal at a wavelength of 826.6 nm show that the real and imaginary parts of the complex relative permittivity are 13.488 and 0.038 respectively. Find the complex refractive index, the reflectance and absorption coefficient α at this wavelength, and the phase velocity. (15)

   d) Define the following terms: (06)
   i) Luminescence and ii) Phosphorescence

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2016

Department of Electronics and Communication Engineering

ECE 2107

(Signal & Systems)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is signal? What are the major classifications of signals? (08)
   b) Consider a signal $x(t) = 5cos(\pi t) + \sin(5\pi t), -\infty < t < \infty$. Determine if it is an energy signal or a power signal and also find its energy/power. (07)
   c) Consider a signal: $x(t) = 10sin\sqrt{5}\pi t$, (*i*) Is it periodic ? If it is, find its fundamental period. (*ii*) Is it even or odd? (08)
   d) Sketch the following signals: (i) $(t) = \prod(2t + 3)$,(ii) $x(t) = cos(20\pi t - 5\pi)$. (08)
   e) Draw the double side frequency spectrum of (04)
   $$x(t) = 8sin\left(20\pi t - \frac{\pi}{4}\right), -\infty < t < \infty$$

2. a) What is system? What are the properties of a system? (06)
   b) What are the methods for representing a system? Draw the block diagram of the system described by the difference equation $y(n) + \frac{1}{2}y(n-1) + \frac{1}{4}y(n-2) = x(n-1)$. (10)
   c) Write short notes on : (*i*) invertible system, (*ii*) memoryless system, (*iii*) recursive system (09)
   d) What do you mean by system stability? What is necessary & sufficient condition for the stability of a DSP system? Also determine H(z) and its poles & zeros if (10)
   $$y(n) + \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + x(n-1)$$

3. a) What is LTI system? Determine whether the system described by differential equation $\frac{dy(t)}{dt} + 3y(t) + 4 = x(t)$ is linear. (10)
   b) What is the impulse response? Determine the impulse response for the system given by the difference equation: $y(n) + 3y(n-1) + 2y(n-2) = 2x(n) - x(n-1)$. (12)
   c) Find the complete solution of the first order recursive system of Fig. 3(c), if the input is $x(n) = \left(\frac{1}{2}\right)^n u(n)$, initial condition $y(-1) = 8$ and $p = \frac{1}{4}$. (13)

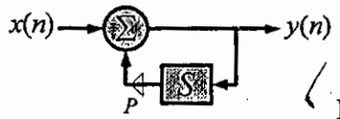

Fig. 3(c)

4. a) What is the state of a system? Find the state variable description corresponding to the system depicted in Fig. 4(a) by choosing the state variables to be the outputs of the unit delays. (12)

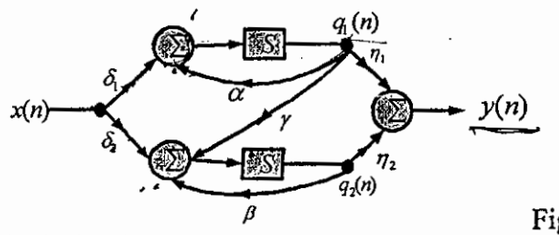

Fig. 4(a)

   b) From the electrical circuit in Fig. 4(b), derive a state-variable description of this system if the input is applied voltage $x(t)$ and the output is the current $y(t)$ through the resistor R_1. (12)

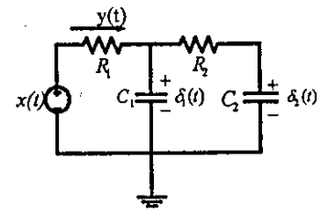

Fig. 4(b)

c) State sampling theorem. Write short notes on : (*i*) Over-sampling, (*ii*) Nyquist rate sampling, (*iii*) Aliasing (11)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) "A periodic signal can be represented as a summation of a number of sinusoidal wave with different frequencies"-Justify the statement. (08)

b) What is Fourier transform? What are the effects in discrete spectrum if the time period (T) of a period signal $f(t)$? (10)

c) State Parseval's theorem and discuss on its importance in signal processing. (06)

d) Obtain the Fourier transform of the given function: $f(t) = 5[u(t+3) + u(t+2) - u(t-2) - u(t-3)]$. (11)

6. a) Define Laplace transform. State the initial and final value theorems and mention their applications. (10)

b) Determine the output response $y(t)$ of the *RC* low-pass network shown in Fig. 6(b) due to an input $x(t) = te^{-t/RC}$ by convolution. (12)

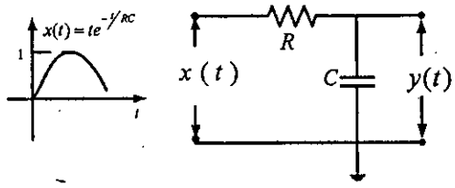

Fig. 6(b)

c) Draw the poles and zeros for the current $I(s)$ in a network given by $I(s) = \frac{3s}{(s+2)(s+4)}$, and hence obtain $i(t)$. (13)

7. a) Determine the inverse Laplace transform of $F(s) = \frac{2s^2+3s+3}{(s+1)(s+3)^3}$. Draw the pole-zero diagram for the given function. (12)

b) In the series RL circuit shown in Fig. 7(b), find the current *i*(t) & draw its *s*-domain equivalent circuit. (08)

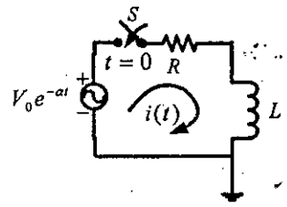

Fig. 7(b)

c) In the circuit of Fig. 7(c), (i) find the current $i_1(t)$ and $i_2(t)$ and the output voltage across 5Ω resistor when the switch is closed, and (b) also determine the initial and final values of current. (15)

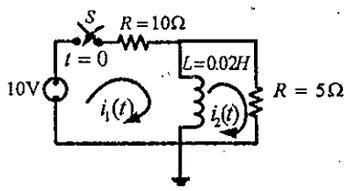

Fig. 7(c)

8. a) Define z-transform. What are the applications of z-transform in signal & system analysis? (06)

b) Determine the convolution and correlation of the two sequences $x(n) = \{1,0,1,0,5\}$ and $h(n) = \{1,1,2,2\}$. (10)

c) Determine the casual signal *x*(n) having the z-transform (10)

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

d) Determine the z-transform for the following signals: (09)

i. $x(n) = \{2,4,5,7,6,1,2\}$
ii. $x(n) = \delta(n-k)$
iii. $x(n) = u(n-k)$

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2016

Department of Electronics and Communication Engineering

Math 2109

(Mathematics-III)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define the following terms with example: (12)
i) Skew symmetric matrix, ii) Elementary matrix, iii) Submatrices of a matrix, and iv) Hermitian matrix.

b) If A and B are square matrices of the same order and A and B anti-commute then prove that $(A+B)^2=A^2+B^2$. (05)

c) Define inverse of a matrix. Test whether the matrix $A=\begin{bmatrix} 1 & -3 & 2 \\ -3 & 3 & -1 \\ 2 & -1 & 0 \end{bmatrix}$ has an inverse. If so find the inverse of A using row transformation only. Show that inverse of a matrix if exists, is unique. (18)

2. a) Reduce the matrix $B=\begin{bmatrix} 1 & -2 & -3 & 2 \\ 2 & -5 & 1 & 2 \\ 3 & -8 & 5 & 2 \\ 5 & -12 & -1 & 6 \end{bmatrix}$ to echelon form and then to canonical and hence find its rank. Is the echelon form of a matrix unique? (14)

b) In an electric network the following equations were obtained for the currents i_1, i_2, and i_3: (12)

$$i_1 - 3i_2 - 8i_3 + 10 = 0$$
$$3i_1 + i_2 - 4 = 0$$
$$2i_1 + 5i_2 + 6i_3 - 13 = 0$$

Find i_1, i_2, and i_3.

c) Verify Cayley Hamilton theorem for the matrix $A=\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$. (09)

3. a) Write down three properties of Eigen value. (06)

b) Find the value of the constant a so that the vector $\bar{F} = (axy - z^3)\underline{i} + (a-2)x^2\underline{j} + (1-a)xz^2\underline{k}$ is irrotational. (09)

c) Using Divergence theorem find the flux of the electric field $\bar{E} = 4xz\underline{i} - y^2\underline{j} + 2yz\underline{k}$ over the closed surface S consisting of the planes x=0, y=0, z=0, and $2x$+2y+z=4. (20)

4. a) Evaluate $\oint_c [(xy + y^2)dx + x^2 dy]$, where c is the closed curve formed by $y = \frac{1}{2}x^2$ and $y=x$ by using Green's theorem. (10)

b) Calculate $\int_c \bar{F} \bullet d\bar{r}$, where c is the part of the spiral $\bar{r} = (a\cos\theta, a\sin\theta, a\theta)$ corresponding to $0 \le \theta \le \pi/2$ and $\bar{F} = r^2\hat{i}$. (10)

c) Evaluate: $\int_c \bar{F} \times d\bar{r}$ where $\bar{F} = xy\underline{i} - z\underline{j} + x^2\underline{k}$ and c is the curve given by $x=t^2$, $y=2t$, $z=t^3$ from t=0 to t=1. (15)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Suppose a periodic function f(t) has its period T. Now write the formula for Fourier coefficients as well as its Fourier series.

   b) Find the Fourier series of the function:

$$f(x)=\begin{cases}2, & for\ -2\le x<0\\ x, & for\ 0<x<2\end{cases},$$

   Where $f(x+4)=f(x)$.

   c) An alternating current, after passing through a rectifier, has the form:

$$i=\begin{cases}I_0\sin x, & for\ 0\le x\le\pi\\ 0, & for\ \pi<x\le 2\pi\end{cases}$$

   Where I_0 is the maximum current and the period is 2π. Sketch the graph of the given function in the interval $[-2\pi$ to $2\pi]$ and express i as a Fourier series.

6. a) Find the harmonics and amplitude spectrum of $f(t)=\begin{cases}\pi & ;\ -\pi\le t<0\\ \pi-t & ;\ 0\le t\le\pi\end{cases}$ considering the logical period of $f(t)$.

   b) Find the Fourier transform of $f(t)=\begin{cases}t & ;\ |t|\le b\\ 0 & ;\ |t|>b\end{cases}$. (10)

   c) Find the Fourier cosine transform of $f(x)=e^{-2x}+4e^{-3x}$. (10)

7. a) Find the half range sine series for the function $f(x)=\begin{cases}x, & for\ 0<x<\pi/2\\ \pi-x, & for\ \pi/2<x<\pi\end{cases}$ (11)

   b) Define piecewise continuity of a function. Give examples of piecewise continuous function as well as piecewise discontinuous function. (05)

   c) Evaluate $\int_0^\infty te^{-2t}\cos t\,dt$ using Laplace transform. (09)

   d) If $L\{f'''(t)\}=\tan^{-1}(1/s)$, $f(0)=2$ and $f'(0)=-1$, find $L\{f(t)\}$. (10)

8. a) Find $L^{-1}\left\{\dfrac{s^2}{(s^2+4)^2}\right\}$. (10)

   b) Solve $y''+9y=\cos 2t$ if $y(0)=1$, and $y(\pi/2)=-1$ by the method of Laplace transform. (14)

   c) Define directional derivative. Find the directional derivative of $f(x,y,z)=xy^2+yz^3$ at the point (2, -1, 1) in the direction of the vector $\hat{i}+2\hat{j}+2\hat{k}$. (11)