KHULNA UNIVERSITY OF ENGINEERING &TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2018

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) What do you mean by tuned amplifier? Why tuned amplifier is not suitable for audio frequency amplification? (07)

   b) Briefly discuss parallel resonance circuit. Draw the phase diagram of a parallel resonance circuit and prove that resonance is occurred when the circuit power is unity. (13)

   c) Define Q-factor. Graphically show that smaller resistance provides higher quality factor. (07)

   d) A parallel resonant circuit has a capacitor of $100pF$ in one branch and inductance of $100\mu H$ plus a resistance of 10Ω in parallel branch. If the supply voltage is 10V, calculate (i) resonance frequency; (ii) impedance of the circuit and line current at resonance. (08)

2. a) Explain the operation of double tuned amplifier. Also, graphically show that loose coupling provides better frequency response than tight coupling. (10)

   b) What are the requirements to work a transistor as an oscillator? Write down the name of commonly used transistor oscillatory circuits. (09)

   c) Describe the conditions of making undamped oscillations from a tank circuit. (09)

   d) A tank circuit of tuned amplifier has a capacitance of $0.1\mu F$ and inductance of $33mH$ plus a resistance of 25Ω. Determine (i) the resonant frequency; (ii) the Q of tank circuit; and (iii) bandwidth of the amplifier. (07)

3. a) Give the graphical explanation of barkhausen criterion. (08)

   b) Explain the principle of phase shift oscillator. (08)

   c) Describe the circuit operation and feedback fraction of Colpitts's oscillator. (11)

   d) The ac equivalent circuit of a crystal has three values: $L = 1H, C = 0.001pF, R = 1000\Omega$ and $C_m = 20pF$. Calculate f_s and f_p of the crystal. (08)

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

   b) Derive the expressions for output impedance of voltage series and current series feedback circuits. (12)

   c) Describe how stable the feedback amplifier gain is compared to an amplifier without feedback. (05)

   d) Calculate the gain without and with feedback for the FET amplifier circuit of **Fig. 4(d)** and the following circuit values: $R_1 = 80k\Omega, R_2 = 20k\Omega, R_0 = 10k\Omega, R_D = 10k\Omega$ and $g_m = 4000\mu S$. (08)

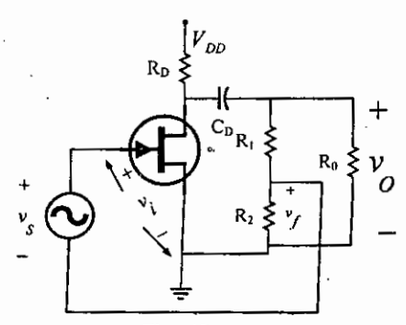


Fig. 4(d)

SECTION B

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

5. a) Write down the ideal characteristics of an op-amp. Also, explain the four basic building blocks of an op-amp. (12)

   b) Prove that the closed loop voltage gain of a non-inverting op-amp amplifier is lower than its open loop voltage gain. (05)

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

   d) In the circuit of **Fig. 5(d)**, $R_1 = R_2 = 1k\Omega$, $R_F = R_3 = 10k\Omega$, and the op-amp is a 741C. (10)

      i. What are the gain and input resistance of the amplifier?

      ii. Calculate the output voltage v_0 if $v_x = 2.7V_{pp}$ and $v_y = 3V_{pp}$ sine wave at 100Hz.

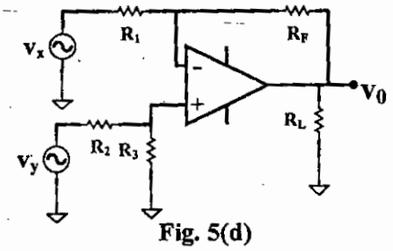


Fig. 5(d)

6. a) When a non-inverting amplifier is called a voltage follower? Also, mention its benefits. (05)

   b) Design and draw a circuit diagram with op-amp amplifier of having three input-signals of each $1V_{pp}$, $100Hz$ to produce an output signal of $30V_{pp}$, $100Hz$. (07)

   c) What are meant by 20 dB/decade and 40 dB/decade in the stopband of a filter? Design a low-pass filter at a cutoff frequency of 1 kHz with a passband gain of 2. (12)

   d) Design a differentiator to differentiate an input signal that varies from 10Hz to 1kHz. (11)

7. a) What are the differences between a comparator and Schmitt trigger? Why Schmitt trigger is known as regenerative comparator? (08)

   b) Define multivibrator. With the aid of circuit diagram briefly explain the operation of monostable multivibrator. Also, mention its applications. (12)

   c) Explain the internal block diagram of 555IC. (08)

   d) In the following circuit of **Fig. 7(d)**, $R_1 = 10k\Omega$, the output pulse width $t_p = 100ms$. Determine the value of C. (07)

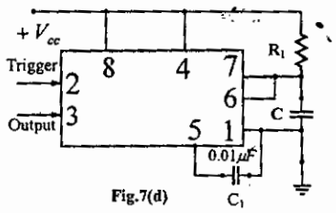


Fig.7(d)

8. a) Write a short note about PLL. With the aid of block diagram briefly explain its construction and operating principle. (12)

   b) What do you mean by clamper circuit? Give some application of the clamper. (08)

   c) Draw the output waveshapes of the following circuits shown in **Fig. 8(c)**. Consider the diode as ideal one in each case. (15)

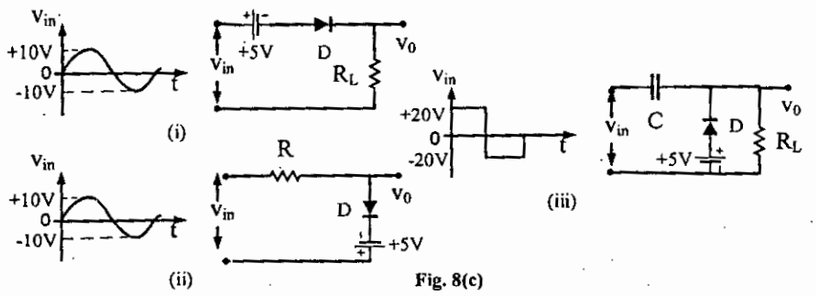


Fig. 8(c)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2018

Department of Electronics and Communication Engineering

ECE2103

(Digital Electronics and 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) Explain the distinction between number system and code with example. Convert the decimal number $(605)_{10}$ into following forms: (i) BCD code; ii) 5211 code; and iii) Gary code number. (12)

   b) What is duality principle? Find the complement of the following Boolean function and reduce this complement function to a minimum number of literals: (10)

   $$F = [(AB)'A]\,[(AB)'B]$$

   c) Perform the subtraction with following binary number using i) 2's complement, ii) 1's complement; iii) Check the answer by straight subtraction 100 -11000. (09)

   d) Explain the differences between error detecting codes and error correcting codes (04)

2. a) Show that (i) the dual of the exclusive OR is equal to its compliment and (ii) a positive logic AND a negative logic OR gate and vice-versa (10)

   b) With the use of K-map, find the simplest sum- of -products from of the function $F = fg$. Where $f = abc' + c'd + a'cd' + b'cd'$ and $g = (a + b + c' + d')(b' + c' + d)(a' + c + d')$ (10)

   c) Simplify the logic circuit as shown in Fig. 2(c) and construct the simplified circuit using only NAND gates. (10)

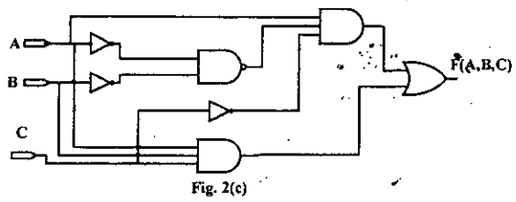


Fig. 2(c)

   d) Define and explain prime implicants. (05)

3. a) Design a combination circuit that accepts a four-bit BCD number and generates output binary number same as the excess-3 code of corresponding BCD number. (10)

   b) Implement the four Boolean functions listed below using three half adder circuits: (10)

   $$D = A \oplus B \oplus C, \quad E = A'BC + AB'C, \quad F = ABC' + (A' + B')C, \quad G = ABC$$

   c) Show that the output carry in a full-adder circuit can be expressed as (10)
   $C_{i+1} = G_i + P_iC_i = G_i'P_i' + G_i'C_i'$ for the full adder circuit shown in Fig. 3(c).

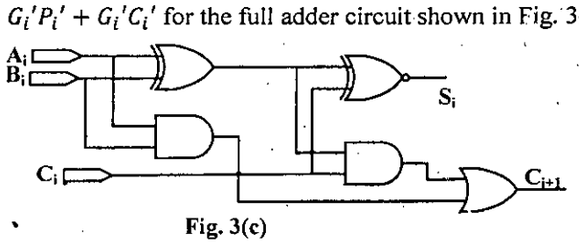


Fig. 3(c)

   d) Draw the block diagram of PLA. (05)

4. a) Design a 4 -to- 1line multiplexer using NAND gates. (10)

   b) Define the following terms that relate with the characteristics of digital logic families: (08)

i) Fan out; ii) Power distribution; iii) Propagation delay; and iv) Noise margin.

c) What is a Decoder? Implement the following function using Decoder, (08)

$$F(A,B,C,D) = \sum(0,1,3,4,8\,9,10,11)$$

d) Describe the operation of the Fig.4(d) and find out the output value of y for all possible combination of inputs A, B and C. (09)

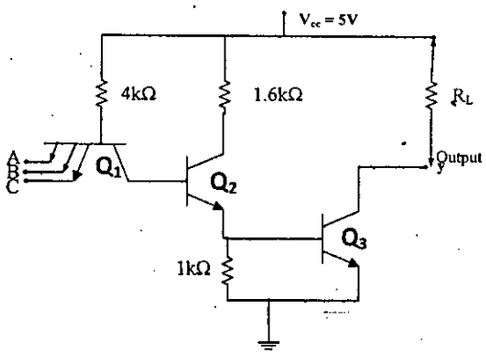


Fig. 4(d)

SECTION B

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

5. a) What is flip-flop? Why flip-flop is called one-bit memory cell? (10)

b) Write down the characteristics table and excitation table of RS, JK, D and T flip-flop. (10)

c) Convert a SR flip-flop to a JK flip-flop. (10)

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

6. a) Reduce the number of state in the following state table and tabulate the reduced state table: (10)

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

b) The content of a 4-bit shift register is initially 1101.The register shifted six times to right with the serial input being 101101. Show the content of the register after each shift? (12)

c) A flip-flop has a 20-ns delay from the time, its CP input goes from 1 to 0 to the time the input is complemented. What is the maximum delay in a 10-bit binary ripple counter that use these flip-flops? What is the maximum frequency that the counter can operate at reliably? (13)

7. a) What the difference between serial and parallel transfer? What type of register is used in each case? (07)

b) What is memory element? Show the information transfer process in a magnetic core memory during write operation? (08)

c) What is Ripple counter. Draw the diagram of a 4-bit synchronous binary up-down counter. (10)

d) Construct a Johnson counter with 10 timing signals. (10)

8 a) Show that in a dual slope A/D converter, the output of the converter is proportional to the analog input voltage. (10)

b) Write down the differences between R-2R ladder and weighted register D/A converter. (07)

c) Show the successive approximation A/D conversion process with necessary diagram. (10)

d) Write short note on EPROM and E^2P ROM (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B. Sc. Engineering 2nd Year 1st Term Examination, 2018

Department of Electronics and Communication Engineering

ECE-2105

(Science of Materials)

TIME: 3 hours FULL MARKS: 210

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

SECTION A

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

1. a) Define crystal lattice, basis and crystal structure. Show that the packing factor for face centered cube (FCC) lattice is $\pi\sqrt{2}/6$. 13
   b) Describe various types of crystal imperfections with proper diagram. 12
   c) The energy of formation of a vacancy in the aluminum (Al) crystal is about 0.70 eV. Calculate the fractional concentration of vacancies in Al at room temperature, 300 K, and very close to its melting temperature 660 °C. What is the vacancy concentration at 660 °C given that the atomic concentration in Al is about 6.0×10^{22} cm^{-3}? 10

2. a) State the assumptions of classical theory of lattice specific heat. Also derive the expression for the frequency of a classical oscillator. 10
   b) State the salient features of Einstein's model discussing the molar lattice specific heat. Explain Einstein's equation for molar lattice specific heat both at lower and higher temperatures. Discuss its agreement with the experimental data. 15
   c) Discuss the salient features of Debye's theory of specific heat of solids. How much Debye's theory conforms to the experimental results? 10

3. a) Discuss the breakdown of classical theory with special reference to mean free path of electrons and molar specific heat of metals. 10
   b) Describe the "free electron" model of a metal, introduced by Sommerfeld. What are the achievements of this model? Where did it fail? 13
   c) A current of density 500 A/m^2 flows through an n-type germanium crystal. This crystal has resistivity 0.05 Ω-m and the electron mobility of 0.4 m^2/Vs. Calculate the drift velocity and time taken by the electrons to travel 100 m in the crystal. 12

4. a) What are the postulates of wave mechanics? Derive the Schrodinger's wave equation for the motion of an electron. What is the significance of the wave function Ψ? 15
   b) Explain quantum mechanical tunneling in solids and its significance. 10
   c) Estimate the probability that a roller coaster carriage, which weighs 100 kg and released from point A as shown in Fig. 4(c) from a height at 10 m, can reach point E over a hump that is 15 m high and 10 m wide. 10

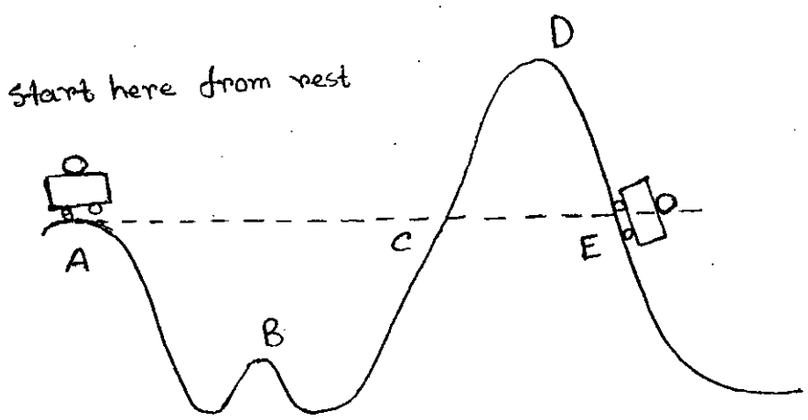


Fig- 4(c)

SECTION B

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

5. a) How can the material science contribute in research and development of Electronics and Communication Engineering? Explain with a relevant example. 10

   b) What are the different polarization mechanisms in dielectrics? Prove that orientational polarization is inversely proportional to temperature and proportional to the square of the permanent dipole moment. 16

   c) Two parallel conducting plates of a capacitor are separated by 2 mm and the space between them is filled with a dielectric of dielectric constant 3. The electric field intensity in the dielectric is 10^6 volts/m. Calculate: 09
      i) the free charge per unit area on the conducting plates,
      ii) the polarization P in the dielectric, and
      iii) the displacement D in the dielectric.

6. a) How does ε_r vary with temperature in the vicinity of Curie temperature? 12

   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. 13

   c) A magnetizing field of 500 Am^{-1} produces a magnetic flux of 2.4×10^{-5} Weber in an iron bar of 0.2 cm^2 cross-sectional area. Compute the permeability and susceptibility of the bar. 10

7. a) Write down the key differences between diamagnetic and ferromagnetic materials. 08

   b) What do you know about the domain walls of magnetic materials? How does potential energy change with the increase of domain wall thickness? 08

   c) What is superconductor? Show that the superconductor is an ideal diamagnet. 03+06

   d) Determine the transition temperature and critical field at 4.2 K for a given specimen of a superconductor, if the critical fields are 1.41×10^5 and 4.205×10^5 amp/m at 14.1 K and 12.9 K, respectively. 10

8. a) "We are living in the smart material world" – Explain your opinion with relevant examples. 10

   b) Discuss the M versus H behavior of polycrystalline materials. 13

   c) Consider the solar cell that driving a typical load. This cell has an area of 3 cm × 3 cm and is illuminated with light of intensity 700 Wm^{-2}. Find the power delivered to the load, efficiency and fill factor of the solar cell. Assume that output current and voltage are 157 mA and 0.475 V and their maximum values are 178 mA and 0.58 V, respectively. 12

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2018

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 signal? Explain the operations performed on the independent variables in the processing of discrete signals mathematically & graphically. (11)

   b) Distinguish between (i) deterministic and nondeterministic signals; (ii) even and odd signals. (06)

   c) Determine whether $x(n) = \begin{cases} \cos(\pi n); & -4 \le n \le 4 \\ 0 & ; otherwise \end{cases}$ is energy or power signal and also find its energy/power. (06)

   d) Find the even and odd components of the given signal: $x(t) = cos(20\pi t - 5\pi)$ and also, sketch the signal. (05)

   e) Sketch single and double-sided frequency spectra of the signal (07)
   $$x(t) = 12\sin(5\pi t - {}^{\pi}/_{2}).$$

2. a) What is impulse response? Determine the impulse response for the system given by the difference equation: $y(n) + 4y(n-1) + 3y(n-2) = 2x(n) - x(n-1)$. (10)

   b) Draw the block diagram of the system described by the difference equation (07)
   $$y(n) + \frac{1}{3}y(n-1) + \frac{1}{5}y(n-3) = x(n-1)$$

   c) The discrete-time system is represented by the following difference equation in which $x(n)$ is input and $y(n)$ is output: (12)
   $$y(n) = 4y^2(n-1) - nx(n) + 3x(n-1) - 2x(n+1)$$
   Determine whether it is, (i) time invariant; (ii) causal; (iii) linear; and (iv) FIR/IIR system.

   d) Define system. What are the properties of a system? (06)

3. a) Given two sequences of length, N=4 defined by $x_1(n) = \{0,1,2,3\}$ and $x_2(n) = \{1,1,2,2\}$. Determine their linear and periodic convolution. (10)

   b) Determine the output of the system described by the difference equation with input and initial conditions as specified: $y(n) - \frac{1}{9}y(n-2) = x(n-1)$, where $x(n) = u(n-1)$, $y(-1) = 1,\ y(-2) = 0$. (08)

   c) Given an RC series circuit in **Fig. 3(c)** whose input is e(t) and output is $i(t)$. (12)
      i. Obtain a difference equation describing the system.
      ii. How many energy storage devices are there and why?
      iii. Determine its homogenous solution.
      iv. Determine its particular solution, if $e(t) = \cos(\omega t)$.
      v. Determine the complete solution of the circuit to an input $e(t) = \cos(t)u(t)$ V, when $R = 1\Omega, C = 1F$ & initial volatage across capacitor is $v_c(0) = 3V$.

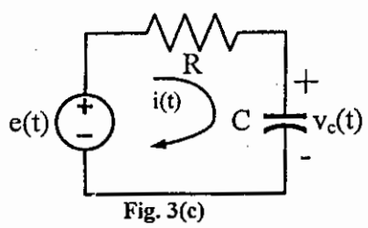


Fig. 3(c)

   d) Find the magnitude and phase response for the system characterized by the difference equation $y(n) = \frac{1}{6}x(n) + \frac{1}{3}x(n-1) + \frac{1}{6}x(n-2)$. (05)

4. a) State and prove Shannon-Nyquist sampling theorem. Classify the sampling techniques. (10)

   b) Find the state variable description of the circuit in **Fig. 4(b).** Choose the state variables as the voltage across the capacitor and current through the inductor. (10)

c) Write short notes on (i) over-sampling; (ii) aliasing. (05)

d) From the electrical circuit in **Fig. 4(d)**, 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. (10)

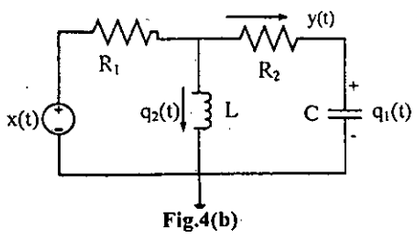


Fig.4(b)

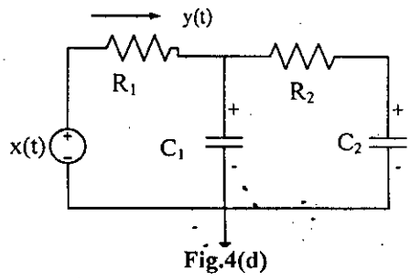


Fig.4(d)

SECTION B

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

5. a) Define Fourier series. State necessary and sufficient conditions for the existence of the Fourier series representation for a signal. (07)

b) Show that the convolution of the signals in the time domain is equal to the multiplication of their individual Fourier transforms in the frequency domain. (11)

c) Regarding Fourier series representation, show that odd functions have only sine term coefficients. (05)

d) The complex exponential Fourier representation of a signal $x(t)$ over period $(0, T)$ is (12)

$$x(t) = \sum_{n=\infty}^{-\infty} \frac{3}{4 + (n\pi)^2} e^{3jn\pi t}$$

Determine, (i) the value of period T; (ii) what percent of energy is contained in the first five terms, if the maximum power is 0.7?

6. a) Show that the normalized Gaussian pulse is its own Fourier transform. (10)

b) Briefly explain the properties of Fourier transform. (07)

c) Determine the Fourier transform for the double exponential pulse shown in **Fig. 6(c)**, whose function is given by $f(t) = e^{-a|t|}$. (09)

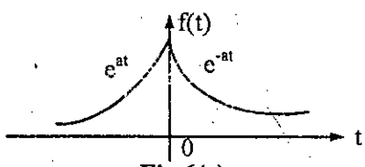


Fig.6(c)

d) 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 $i(t)$. (09)

7. a) Define zeros and poles. How the stability of a system is determined? (07)

b) What is region of convergence? Explain it with example. (08)

c) Find the Laplace transform of a signal sawtooth pulse shown in Fig. 7(c). (08)

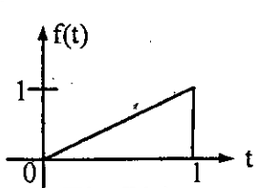


Fig.7(c)

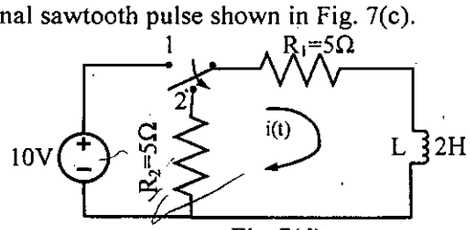


Fig. 7(d)

d) For the circuit shown in **Fig. 7(d)**, determine the current $i(t)$ when the switch is at position 2. The switch S is moved from position 1 to 2 at time t=0. Initially the switch has been at position 1 for a long time. (12)

8. a) Define Z-transform and Inverse Z-transform. Determine the Z-transform of the signal, $x(n) = \delta(n+1) + 3\delta(n) + 7\delta(n-3) - 3\delta(n-4)$. (07)

b) Find the convolution and correlation of the two sequences $x(n) = \{3,1,0,1,5\}$ and $h(n) = \{1,2,4,1\}$. (10)

c) Find the inverse Z-transform of $H(z) = \frac{-4+8z^{-1}}{1+6z^{-1}+8z^{-2}}$. (10)

d) By applying time shifting property, determine the inverse Z-transform of the system $X(z) = \frac{z^{-1}}{1-3z^{-1}}$. (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B. Sc. Engineering 2nd Year 1st Term Examination, 2018
Department of Electronics and Communication Engineering

Math -2109
(Mathematics III)

TIME: 3 hours FULL MARKS: 210

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

SECTION A

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

1. a) A particle moves so that its position vector is given by $\underline{r} = \cos\omega t\,\hat{i} + \sin\omega t\,\hat{j}$, where ω is a constant. Show that i) the velocity $\underline{V}$ of the particle is perpendicular to $\underline{r}$, ii) the acceleration $\underline{a}$ is directed toward the origin and has magnitude proportional to the distance from the origin, and iii) $\underline{r} \times \underline{V} = a$ constant vector. 13

   b) Evaluate $\iint_S \underline{A}.\underline{n}ds$, where $\underline{A} = z\underline{i} + x\underline{j} - 3y^2z\underline{k}$ and S is the surface of the cylinder $x^2 + y^2 = 16$ included in the first octant between $z = 0$ and $z = 5$. 13

   c) Evaluate $\nabla^2\left(\frac{1}{r}\right)$, where r is the magnitude of the position vector $\underline{r}$ at (x, y, z). 09

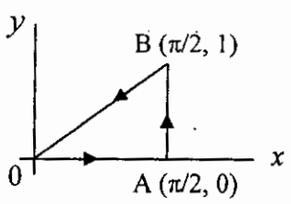
2. a) Find the value of a if the vector $\underline{A} = (ax^2y + yz)\hat{i} + (xy^2 - xz^2)\hat{j} + (2xyz - 2x^2y^2)\hat{k}$ has zero divergence. Find the curl of the above vector which has zero divergence. 12

   b) Find equations for the tangent plane and normal line to the surface $4z = x^2 - y^2$ at the point (3, 1, 2). 13

   c) Find the work done in moving a particle once around a circle C in the xy plane, if the circle has center at the origin and radius 3, and if the force field is given by $\underline{F} = (2x - y + z)\underline{i} + (x + y - z^2)\underline{j} - (3x - 2y + 4z)\underline{k}$. 10

3. a) Evaluate $\iint_S \underline{F}.\underline{n}ds$, where $\underline{F} = 2xy\underline{i} + yz^2\underline{j} + xz\underline{k}$ and S is the surface of the parallelepiped bounded by $x = 0$, $y = 0$, $z = 0$, $x = 2$, $y = 1$ and $z = 3$. 11

   b) State Green's theorem for the plane. Evaluate $\oint_C (y - \sin x)dx + \cos x\,dy$, where C is the triangle of the adjoining figure. 15



   c) Show that $\nabla\phi$ is a vector perpendicular to the surface $\phi(x, y, z) = c$ where c is a constant. 09

4. a) Show that an even function can have no *sine* term in its Fourier series. 10

   b) Find the Fourier series corresponding to the function $f(x) = \begin{cases} 0, & -5 < x < 0 \\ 3, & 0 < x < 5 \end{cases}$, where $f(x + 10) = f(x)$. 12

   c) Find the Fourier transform of $F(x) = \begin{cases} 1, & \text{when } -a < x < a \\ 0, & \textit{elsewhere} \end{cases}$. Hence show that $\frac{\pi}{2} = \int_0^\infty \frac{\sin\lambda a}{\lambda} d\lambda$. 13

SECTION B

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

5. a) Define Hermitian and skew-Hermitian matrices. Express $\begin{bmatrix} -3 & -4 & 6 \\ 2 & 0 & 8 \\ 8 & 12 & 1 \end{bmatrix}$ as the sum of a symmetric and a skew-symmetric matrices. 12

b) Let $A = \begin{bmatrix} 3 & -6 \\ -1 & 2 \end{bmatrix}$. Construct a 2×2 matrix B such that AB is a zero matrix, where B has two different non-zero columns. 08

c) If $A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, then verify which of the following statements are true: (show detail calculations) 15

i) A and B are commute,
ii) A and B are periodic with period 3,
iii) A and B are nilpotent,
iv) A and B are involutory, and
v) A and B are anti-commute.

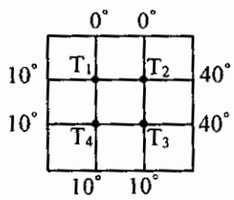
6. a) Test the possibility of existing the inverse of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 0 \\ 0 & 1 & 2 \end{bmatrix}$ and if possible find its inverse by elementary transformation. 13

b) Find the row canonical form of the matrix $A = \begin{bmatrix} 0 & 3 & 6 & 6 & 4 & -5 \\ 3 & -7 & 8 & -5 & 8 & 9 \\ 3 & -9 & 12 & -9 & 6 & 15 \end{bmatrix}$. What is its rank? 12

c) Check whether the system of homogeneous equations possesses non-trivial solution and find it, if exist: 10

$$x_1 - 2x_2 - x_3 + 3x_4 = 0$$
$$-2x_1 + 4x_2 + 5x_3 - 5x_4 = 0$$
$$3x_1 - 6x_2 - 6x_3 + 8x_4 = 0$$

7. a) The steady state temperature distribution of a thin uniform metal plate is shown in the following figure. If the temperature at the four interior nodes of the mesh are T_1, T_2, T_3 and T_4, and the temperature of these nodes are approximately equal to the average of the four nearest nodes, determine the temperature at each node. 17



b) Define eigen value and eigen vector. Check whether the vectors $\mathbf{X}_1 = \begin{bmatrix} 6 \\ -5 \end{bmatrix}$ and $\mathbf{X}_2 = \begin{bmatrix} 3 \\ -2 \end{bmatrix}$ are the eigen vectors of the matrix $A = \begin{bmatrix} 1 & 6 \\ 5 & 2 \end{bmatrix}$ or not. If not, find the eigen vectors of A and the invertible matrix P such that $P^{-1}AP$ is a diagonal matrix. 18

8. a) Find the Laplace transform of the piecewise continuous function $f(t)$ given by 08

$$f(t) = \begin{cases} e^t; & 0 < t < 1 \\ 0; & t > 1 \end{cases}$$

b) Find the inverse Laplace transform of $\frac{4}{s^2(s-4)}$ by using convolution property. 10

c) In an electrical circuit with electromagnetic force $E(t)$, resistance R and inductance L, the current i build up at the rate given by $L(di/dt) + Ri = E(t)$. If the switch is connected at $t = 0$ and disconnected at $t = 3$, find the current i at any instant (use Laplace transform method). 17