KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

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

Department of Electronics and Communication Engineering

ECE 2201

(Analog Communications)

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 OSI? Write the name of layers in OSI model. (3+3)

   b) Explain the modulation index using four possible ways and necessary diagrams. What will happen if $E_m > E_c$ in amplitude modulation? (8+4)

   c) What is the range of modulation index in amplitude modulation? Prove that the bandwidth of the amplitude modulated wave is two times of the modulating signal. (5+5)

   d) Determine the percentage of the radio of the sidebands power to the total output power of the AM wave for $m = 0.7$ and $m = 0.4$. (07)

2. a) What are the differences between modulation and multiplexing? Why modulation is necessary for radio transmission? (5+5)

   b) Prove that the tone-modulated FM signal has a carrier component and an infinite number of sideband frequencies. (16)

   c) What are the functions detector? Explain the comparisons between the linear and square law diode detectors? (09)

3. a) What are the benefits and disadvantages of SSB modulation? Explain the SSB modulation using frequency domain description. (4+6)

   b) What are the conditions of wide-band FM? Explain the Carson's rule and its advantages. (5+5)

   c) For a modulating signal $m(t) = 2\,cos100t + 18\,cos200\pi t$. (10)

      i. Write expression for $\varphi_{FM}(t)$ and $\varphi_{PM}(t)$ when $A = 10$, $\omega_c = 10^6$, $k_f = 1000\pi$, $k_p = 1$. For determining $\varphi_{FM}(t)$, use the indefinite integral of $m(t)$, that is, take the value of the integral at $t = -\infty$ to be 0.

      ii. Estimate the bandwidth of $\varphi_{FM}(t)$ and $\varphi_{PM}(t)$, assume the bandwidth of $m(t)$ to be the fifth harmonic frequency of $m(t)$.

   d) What are the advantages of FM over AM? (05)

4. a) Why Armstrong method is called indirect method? Explain the indirect method of Armstrong for FM. (4+8)

   b) What is meant by stereophonic FM radio? What are the requirements for making stereophonic FM compatible with the monophonic FM. Draw the block diagram of stereophonic FM transmitter and receiver? (12)

   c) Over an interval $|t| \leq 1$, an angle modulated signal is given by $\varphi_{EM}(t) = 10 \cos 13000t$, it is known that the carrier frequency $\omega_c = 10000$. (11)

      i. If this were a PM signal with $k_p = 1000$, determine $m(t)$ over the interval $|t| \leq 1$.

      ii. If this were a FM signal with $k_f = 1000$, determine $m(t)$ over the interval $|t| \leq 1$.

SECTION B

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

5. What are the difference between interference and distortion? (06)

   What is internal noise? Write short notes one: (i) Partition noise, (ii) Shot noise, (iii) Burst noise. (08)

   c) In which condition noise figure will be a better measurement of noise performance than equivalent noise resistance? Express noise figure in terms of generator resistance and equivalent noise resistance. (13)

   d) The equivalent noise resistance for an amplifier is 300 Ω, and the equivalent shot current is 5 μA. The amplifier is fed from a 150Ω, 10μV rms sinusoidal signal source. Calculate the individual noise voltages at the input and the input SNR in deibles. The noise bandwidth is 10MHz. (08)

6. a) Why an amplifier with high gain and low-noise figure should be used at the first stage of a cascaded system? Explain with the proper diagrams and a mathematical expressions. (12)

   A mixer stage has a noise figure of 20dB, and this is followed by an amplifier that has a noise figure of 9 dB and an available power gain of 15dB. Calculate the overall noise figure referred to the input. (08)

   Deduce the Rayleigh energy theorem and from that obtain the ESD of any energy signal. (08)

   Why the ESD of any white noise cannot be obtained? Find the PSD & autocorrelation of any white noise. (07)

7. Show that for a fixed transmitted power, the SNR at the demodulator output is the same for the baseband and the DSB-SC systems. (13)

   What are differences between TDM and FDM? Draw the block diagram of North American FDM hierarchy. (5+7)

   c) What are disadvantages of FDM technique? Design an FDM system that can occupy 4 voice channels, each having 4 kHz of bandwidth. Show the configuration using frequency domain. Use 30-50kHz frequency space in the spectrum and also use guard bands of 1 kHz. (10)

8. What are the functions of CRT in TV receiver? What are the differences between color and Black and White CRT? (4+8)

   Draw the block diagram of color TV receiver. (08)

   What type of modulation is used in TV transmission? Explain the necessity of color killer circuit in a color TV receiver. (3+5)

   c) Explain the composite video signal with necessary diagrams. (07)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

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

Department of Electronics and Communication Engineering

ECE 2205

(Electromagnetic Fields and Waves)

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) Write down the fundamental postulates of electrostatics in free space in both differential and integral form and also write down their physical significance. (08)
   b) Define electric field intensity and electric potential. Also derive the relation between them when caused by a point charge. (10)
   c) Show that the total electric flux density in a dielectric material is $\vec{D} = \varepsilon_o \vec{E} + \vec{P}$, where the symbols have their usual meanings. (07)
   d) A negative point charge of magnitude 2 μC is situated in air at origin and two positive point charges of 1 μC each are at points $y = \pm 2$ meters. Calculate the electric field strength and electric potential at a point 4 meters from the origin on the x axis. (10)

2. a) State and explain Gauss's law. Using this law determine electric field intensity and electric potential of an infinitely long straight line charge of a uniform density ρ_e in air. (12)
   b) Define electric dipole moment. Deduce the electric field intensity of an electric dipole in terms of its dipole moment. (13)
   c) Write down the Laplace and Poisson's equation. Using Laplace equation find out the capacitance of a parallel plate capacitor as shown in Fig. 2(c). (10)

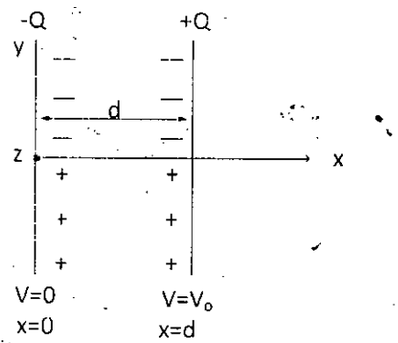


Fig. of Q 2(c).

3. a) Determine the normal and tangential components of electric field intensity $\vec{E}$, and electric flux density, $\vec{D}$ at the boundary of a conductor and free space. (09)
   b) Write down the differential and integral form of Maxwell's equations and identify each equation with proper experimental law. (07)
   c) Define displacement current. Determine the displacement current in between two parallel plates of a capacitor energized by an alternating current source. (07)
   d) Using Lorentz's gauge deduce the nonhomogeneous wave equation for vector potential $\vec{A}$ and scalar potential V. (12)

4. a) Starting from Maxwell's equations obtain homogeneous vector Helmholtz's equation. (10)
   b) Explain line of sight communication mode. Determine the maximum distance between two antennas in case of line of sight communication. (11)
   c) Write short notes on: i) Skip distance, ii) Virtual height, and iii) Critical frequency. (06)
   d) Why ground wave propagation is not suitable for more than 2 MHz? Also explain the effects of earth's curvature on radio wave propagation. (08)

SECTION B

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

5. a) State and explain Ampere's circuital law. (08)

b) State Biot-Savart law. A direct current I flows in a straight wire of length 2L. Find the magnetic flux density $\vec{B}$ at point located at a distance r from the wire in the bisecting plane of Fig. 5(b): i) by determing the vector magnetic potential $\vec{A}$ first, and ii) by applying Biot-Savart law. (18)

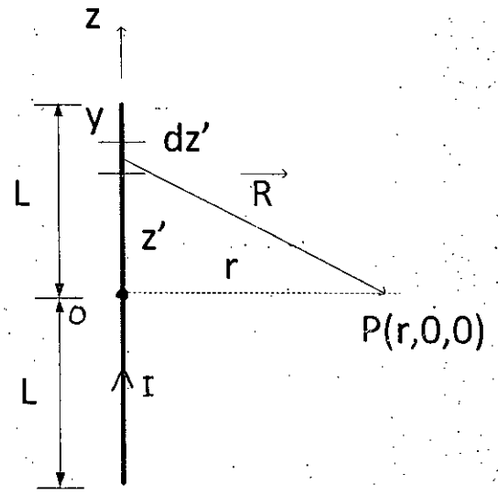


Fig. of Q. 5(b)

c) Explain the following terms: (09)
i) Vector magnetic potential, ii) magnetic dipole moment, iii) magnetic field intensity.

6. a) Find the magnetic flux density at a distant point of a small circular loop of radius b that carries current I in terms of dipole moment as shown in Fig. 6(a). (14)

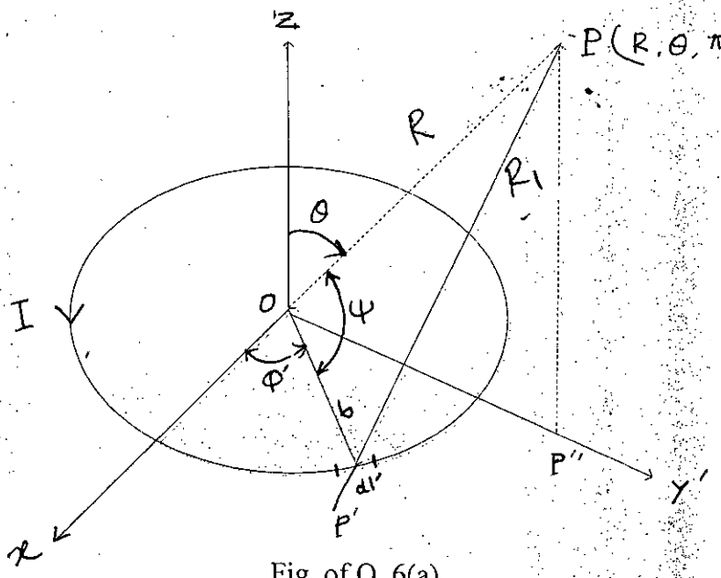


Fig. of Q. 6(a)

b) Briefly explain magnetization vectors. Show that volume current density and surface current density are expressed as $\vec{J}_m = \vec{\nabla} \times \vec{M}$ (A/m^2) and $\vec{J}_{ms} = \vec{M} \times \vec{a}_n$ (A/m) respectively, where the symbols have their usual meanings in electromagnetics. (11)

c) A cylindrical bar magnet of radius b and length L has a uniform magnetization $\vec{M} = \hat{a}_z M_o$ along its axis as shown in Fig. 6(c). Use the equivalent magnetization charge density concept to determine the magnetic flux density at an arbitrary distant point. (10)

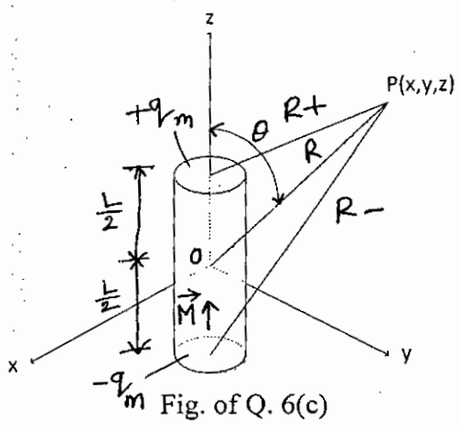


Fig. of Q. 6(c)

7. a) What are the boundary conditions for magnetostatic fields at an interface between two magnetic media? Suppose two magnetic media with permeabilities μ_1 and μ_2 have a common boundary as shown in Fig. 7(a). The magnetic field intensity in medium 1 at the point P has a magnitude H_1 and makes an angle α_1 with the normal. Determine the magnitude and the direction of the magnetic field intensity at point P_2 in medium 2. (14)

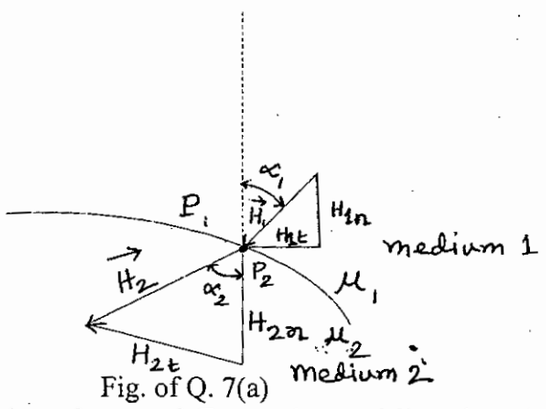


Fig. of Q. 7(a)

b) What is meant by polarization of a wave? Two orthogonal linearly polarized waves are combined. State the conditions under which the resultant will be: i) another linearly polarized wave, ii) a circularly polarized wave, and iii) an elliptically polarized wave. (12)

c) Explain the following terms: (09)
i) Doppler effect in electromagnetics, ii) Skin depth of a conductor, iii) Plasma frequency and plasma oscillation.

8. a) Find the equation of the total power flowing in a closed surface due to electromagnetic waves at any instant. (13)

b) If an electromagnetic wave follows normal incidence at a plane dielectric boundary, show that the reflection coefficient Γ, and transmission coefficient, τ and related by: $1+\Gamma = \tau$. (14)

c) A y-polarized uniform plane wave ($\vec{E}_i, \vec{H}_i$) with a frequency 100 MHz propagates in air in the $+x$ direction and impinges normally on a perfectly conducting plane at x=0. Assuming the amplitude of $\vec{E}_i$ to be 6 mV/m, write the phasor and instantaneous expressions for (i) $\vec{E}_i$ and $\vec{H}_i$ of the incident wave; (ii) $\vec{E}_r$ and $\vec{H}_r$ of the reflected wave. (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

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

Department of Electronics and Communication Engineering

CSE 2209

(Data Structures and Algorithms)

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 data, information, field, record and file? Explain with suitable example. (10)

   b) Consider linear arrays AA (5: 50), $BB(-5: 10)$ and $CC(18)$. (13)

   i. Find the number elements in each array
   ii. Suppose base $(AA) = 300$ and $w = 4$ words per memory cell for AA. Find the address of AA [10], AA[35] and AA[55].

   c) Find the number C of comparisons and the number D of interchanges which alphabetize the n=8 letters in "COMPUTER". (12)

2. a) How do you minimize overflow in stack, while the size of stack is fixed. (08)

   b) What do you mean by recursion? Write an algorithm that can find the Fibonacci sequence recursively. (12)

   c) Consider the following arithmetic expression P: (15)

   $$P: (5 + 6) \uparrow 2 - 8 * (9 + 3)$$

   Using stack:

   i. Translate P into its equivalent ~~position~~ post fix expression.
   ii. Evaluate the post fix expression.

   Finally verify that your translation and evaluation are correct.

3. a) Write down the algorithms to insert and delete item for QUEUE. (13)

   b) Consider the following deque of characters where DEQUE is a circular array which is allocated in six memory cells: (12)

   LEFT=2, RIGHT=4, DEQUE: - , A, C, D, - , -.

   Describe the deque while the following operations take place sequentially:

   i. F is added to the right of the deque.
   ii. Two letters on the right are deleted.
   iii. K, L and M are added to the left of the deque.
   iv. One letter on the left is deleted.

   c) Consider the following items: 80 2 0 −8 99 4 10. Using Bubble sort algorithm, sort the above items in ascending order. Show every steps of comparisons. How many comparisons are required to sort the above items? (10)

4. a) Write down the principle criteria for the selection of a hash function. (06)

   b) Show the steps if you apply merge sort algorithm for the following data: (09)

   66, 33, 40, 22, 53, 88, 60, 11, 80, 20

   c) Suppose a table T has 13 memory locations $T[1], T[2], \ldots\ldots, T[13]$ and the file F has 9 records which are below with hash address. (12)

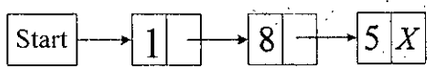
   d) How does Radix sort work? Explain with a suitable example. (08)

SECTION B

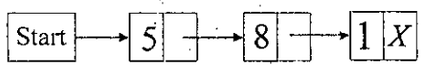
(Answer **ANY THREE** questions from this section in Script B)

5. a) What do you mean by linked list? Describe the memory representation of linked list. (10)

b) Say you are given a link list as follows: (08)

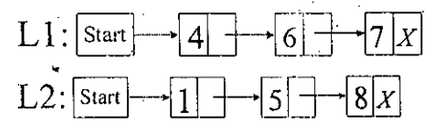


Now write an algorithm to reverse the linked list so that if becomes:

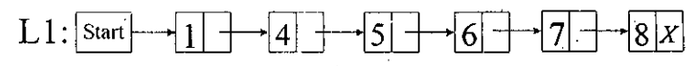


(Only start and next link may be changed. Do not change data part of any node).

c) Consider two sorted linked lists: (10)



Now write an algorithm to merge L2 with L1 so that, L1 becomes:



After merging is complete delete the L2 linked list.

d) Write an algorithm which removes the K^{th} element of a list and adds it to the end of list.(Only start and next link may be changed. Do not change data part of any node) (07)

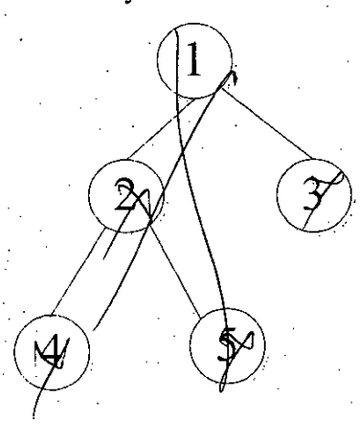
6. a) "Creation of binary search tree depends on the order of data"- Justify the statement. (05)

b) A binary tree T has 9 nodes. The in order and post order traversals of T yield following sequences of nodes: (05)

In order	E A C K F H D B G
Post order	E C K A H B G D F

Draw the tree T.

c) The sequential representation of binary tree is as follows: (05)



Draw the tree T.

d) "Searching item in a Binary Search Tree is faster than searching in a linked list."- Justify the statement. (05)

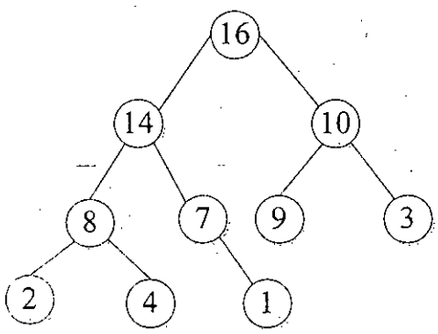
e) Write down stack based non-recursive algorithms for (i) in order tree traversal; (ii) post order tree traversal. (15)

7. a) What is a heap? Differentiate between maxheap and minheap. (06)

b) Construct a max heap step by step using the following data: (09)

DATA: 10, 5, 8, 12, 15, 25, 35, 98, 80, 10.

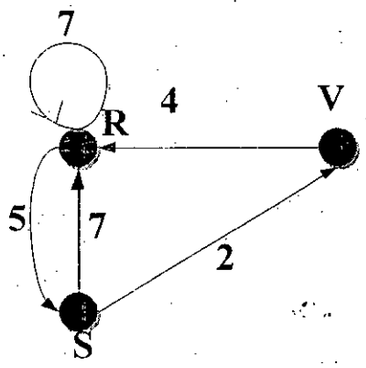
c) Describe the steps of inserting a new item into a maxheap-show stepwise sorting of the following maxheap using heap sort algorithm: (15)



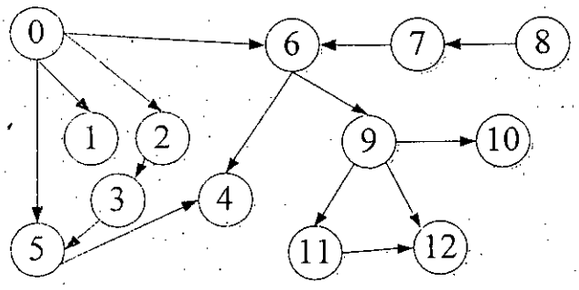
d) If A be the adjacency matrix of graph G then prove that $a_k(i,j)$, the ij entry in the matrix A^k, gives the number paths of length k from v_i to v_j. (05)

8. a) Define complete graph and connected graph with proper example(s). (05)

b) Consider the graph G in the figure given below. Find the path matrix (calculate Q_0, Q_1, Q_2, Q_3) of G using Warshalls algorithm. (15)



c) Sort the nodes of the following graph topologically showing finishing time and visiting time for each node. (15)



KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

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

Department of Electronics and Communication Engineering

EEE 2209

(Electrical Drives & Instrumentations)

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 electrical drives. Mention the principle components of electrical drives and explain them briefly. (05)
   b) What is armature reaction? Why does a generator fail to build up? How can each failure be corrected? (10)
   c) Deduce the generalized *emf* equation of a simple wave wound dc generator. Mention whether induced *emf* is dc or ac. Explain your answer. (15)
   d) A dc motor developing 150 N-m torque is subjected to condition that should decrease the flux by 45 percent and increase the armature current by 15 percent. Find the new torque developed. (05)

2. a) Why starter is needed for dc motor? How does a 4-point starter overcome the limitations of a 3-point starter? (10)
   b) Prove that a rotating flux of constant magnitude is produced when a 3-φ supply is fed to a 3- φ induction motor. (15)
   c) In a 120 V compound generator, the resistances of armature, shunt, and series windings are 0.06 Ω, 25 Ω, and 0.04 Ω respectively. The load current is 100 A at 120 V. Find the induced *emf* and armature current when the machine is connected as i) long-shunt and as ii) short-shunt. (10)

3. a) Explain the principle of operation of a universal motor with proper connection diagram. State some applications of this motor. (10)
   b) What are the four parameters of a transformer? How they can be determined using open and short circuit test of a transformer? (10)
   c) Derive the condition for maximum efficiency of a dc generator. (06)
   d) A 25-KVA transformer has 500 turns on the primary and 50 turns on the secondary winding. The primary is connected to 3000V, 50 Hz supply. Find the full load primary and secondary currents, secondary *emf* and maximum flux density in the core. Neglect leakage drops and no load primary current. (09)

4. a) What is synchronization of an alternator? What are the conditions to be maintained for parallel operation of two alternators? Mention some applications of synchronous motor. (10)
   b) What is back *emf*? Mention the methods of speed control of dc motor. Explain one of them. (13)
   c) How rotating flux of constant magnitude is produced in 3-phase induction motor? (12)

SECTION B

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

5. a) Define the following terms: (10)
i) True value, ii) Loading effect, iii) Accuracy, iv) Precision, and v) Drift.

b) What is spectrum analyzer? Draw and explain the block diagram of a typical spectrum analyzer. (10)

c) What is transducer? Define primary and secondary transducer. Deduce the expression $G_f=1+2\nu$ for the strain gauge where G_f= Gauge factor and ν=Poisson's ratio. (15)

6. a) How does linear variable differential transformer (LVDT) work? Write down its advantages and applications. (15)

b) What do you mean by piezo-electric effect? A barium titanate pick up has the dimension of 5mm×5mm×1.25mm. The force acting on it is 5N. The charge sensitivity of barium titanate is 150 pC/N and its permittivity is 12.5×10^{-9} F/m. If the modulus of elasticity of barium titanate is 12×10^{6} N/m^2. Calculate strain, charge and capacitance. (10)

c) What is Q-meter? For a typical Q-meter, show that the voltmeter connected across the capacitor can be calibrated to read the value of Q directly. (10)

7. a) Show that the output voltage of logarithmic amplifier is constant times the natural logarithm of the output. (10)

b) Explain how dc amplification is possible by using chopper stabilized amplifier. (10)

c) For the following Lissajous pattern shown in Fig. 7(c) determine the unknown frequency if the known frequency is 60 Hz. (10)

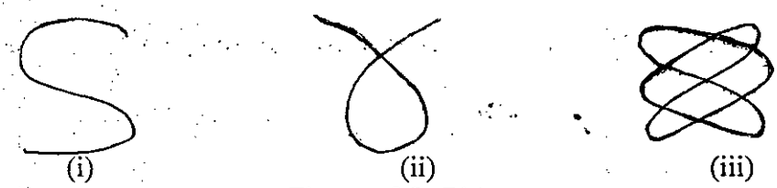


Figure of Q. 7(c)

d) Show the resistance versus temperature characteristics of a thermistor. Why is platinum not used as a temperature sensor? (05)

8. a) What is recorder? Classify it. Explain the working principle of X-Y recorder with necessary diagram. (15)

b) Draw the block diagram of a data acquisition system and different amplifiers (voltage comparator, voltage follower, differential amplifier, instrumentation amplifier) used for signal conditioning. (10)

c) Write down the advantages and disadvantages of LEDs in electronic display. (10)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

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

Department of Electronics and Communication Engineering

Math 2209

(Mathematics-IV)

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 terms: argand diagram, detected neighborhood and interior points. (06)

b) Verify whether or not the function $f(z) = u(x,y) + i\,v(x,y) = \sin x \cosh y + \cos x \sinh y$ is the Cauchy Riemann equation. Is the function analytic? (09)

c) Represent the set of points graphically in the finite z-plane of $|z+i| + |z-i| \leq 3$. (08)

d) State Taylors Theorem. Find the Laurent series expansion of the function $f(z) = \frac{3}{z^2+z-2}$, valid for the region $0 < |z+2| < 3$. (12)

2. a) If $f(z) = \begin{cases} \frac{z^2+9}{z+3i}, & if\ z \neq -3i \\ 4+3i, & if\ z = -3i \end{cases}$, find $\lim_{z\to -3i} f(z)$, if exists. Is the function continuous at $z = -3i$. (09)

b) Define harmonic function and singular point. If $w = f(z) = \frac{1+z}{1-z}$, find $\frac{dw}{dz}$ using the harmonic function and singular point. (10)

c) Evaluate $\int_0^{2\pi} \frac{d\theta}{3+2\cos\theta}$ using the method of contour integration. (16)

3. a) State Cauchy integral theorem. Use this theorem to find the value of $\oint_C \frac{z+4}{z^2+2z+5} dz$, where C is the circle $|z+1| = 1$. (12)

b) Evaluate any one of the integrals by contour integration: (i) $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+a^2)^2} dx$, $a > 0$, (ii) $\int_0^{\infty} \frac{\cos 2\pi x}{x^2+1} dx$ (17)

c) Locate and name all the singularities of (i) $\frac{\ln(z-2)}{(z^2+2z+2)^4}$, (ii) $\frac{1}{\sin^3 z}$ (06)

4. a) Evaluate $\oint_C \frac{dz}{z(2z-5)(z-4)}$, where C is the circle $|z| = 1$ using any appropriate theorem with the statement of the theorem. (15)

b) Write down the one and two dimensional wave equations. A tightly, stretched string with fixed end points $x = 0$ and $x = 2$ is initially at a position given by $y = \frac{a}{4}\left(3\sin\frac{\pi x}{2} - \sin\frac{3\pi x}{2}\right)$, where a is a constant. If it is released from the rest from this position, find the displacement $y(x,t)$ at any time $t > 0$ at any position x. (20)

SECTION B

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

5. a) Prove that $2nJ_n(x) = x[J_{n-1}(x) + J_{n+1}(x)]$, where $J_n(x)$ is the Bessel's function of the first kind. Also show that $J_2(x) = \frac{2}{x}[J_1(x) - J_0(x)]$. (13)

   b) Find an expression in terms of $J_1(x)$ and $J_0(x)$ for integral $\int x^2 J_2(x)\, dx$. (10)

   c) Establish the following relationship between trigonometric functions and Bessel functions: (12)

$$\cos x = J_0(x) - 2J_2(x) + 4J_4(x) - \cdots$$

$$\sin x = 2J_1(x) - 2J_3(x) + 5J_5(x) - \cdots$$

6. a) Find the solution of the wave equation $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}$, if $u(x, 0) = \frac{1}{2}x(1 - x)$. (15)

   b) Define Central moments and raw moments and also establish a relation between them. How moments are used to measure skewness and kurtosis? (10)

   c) Let the continuous random variable x denotes the current measured in a thin copper wire in milli-amperes. Assume that the range of X is $[0, 20mA]$ and the probability density function of X is $f(x) = 0.05$ for $0 \leq x \leq 20$. Find the expected value and variance of X. (10)

7. a) The following table shows the distribution of the maximum loads in kilo-newton's supported by certain cables produced by a company: (25)

Maximum loads(kN)	Number of cables
93-97	2
98-102	5
103-107	12
108-112	17
113-117	14
118-122	6
123-127	3
128-132	1

Determine the followings:

(i) the mean maximum loads, (ii) the median of the maximum loads, (iii) mode of the maximum loads, (iv) range, (v) mean deviation, (vi) quartile deviation, (vii) 10-90 percentile range, (viii) standard deviation, (ix) coefficients of variations.

   b) Discuss different types of frequency curves. (10)

8. a) What is meant by binomial distribution? Mention some properties of the binomial distribution. (06)

   b) The overall percentage of failures in a certain examinations is 20. If 6 candidates appear in the examination, what is the probability that at least 5 candidates pass the examination? (09)

   c) If the height of 300 students are normally distributed with mean 68.0 inches and standard deviation 3.0 inches. How many students have heights greater than 72 inches? (10)

   d) The number of arrivals of customers during any days follows Poisson distribution with a mean of 6 customers. What is the probability that the total number of customers on two days selected at random is less than 2 ? (10)