KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2015
Department of Electronics & 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) Define tuned amplifier. Write down the differences between single tuned amplifier and double tuned amplifier. (08)
   b) Explain the LC parallel resonance circuit. Draw the phase diagram of a parallel resonance circuit and prove that the resonance is occurred when the circuit power factor is unity. (14)
   c) What do you mean by quality factor, Q? Graphically show that smaller resistance provides higher quality factor. (07)
   d) For the tuned amplifier shown in Fig. 1(d) below, determine: i) resonant frequency, ii) the Q of tank circuit and iii) bandwidth of the amplifier. (06)

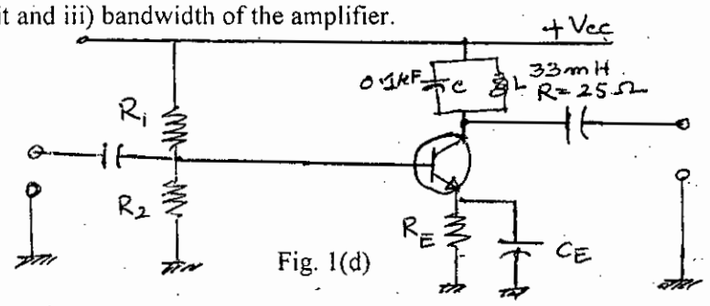


Fig. 1(d)

2. a) What is an oscillator? Explain the operation of a tank circuit with neat diagrams. (08)
   b) Explain different types of coupling of double tuned amplifier. Graphically show that loose coupling provides better frequency response than tight coupling. (12)
   c) What are the requirements to work a transistor as an oscillator? Write down the name of commonly used transistor oscillator circuits. (09)
   d) Determine the i) operating frequency and ii) feedback fraction for Colpitt's oscillator shown in Fig 2(d). (06)

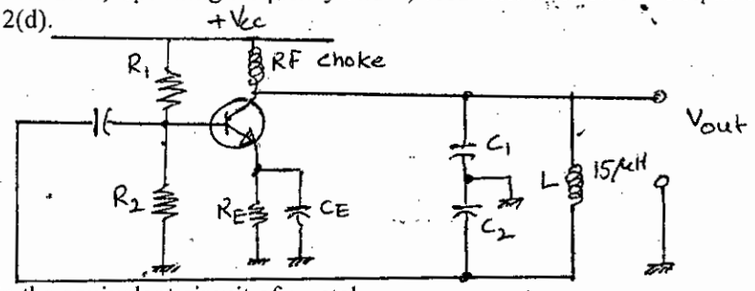


Fig. 2(d)

3. a) Explain the equivalent circuit of crystal. (05)
   b) Explain the Wien bridge oscillator. What is the function of tungsten lamp in the Wien bridge oscillator? Also mention the advantages and disadvantages of this bridge oscillator. (15)
   c) Why negative feedback is necessary. What are the advantages of negative feedback? (07)
   d) The overall gain of a multistage amplifier is 140. When negative voltage feedback is applied, the gain is reduced to 17.5. Find the fraction of the output that is feedback to the input. (08)

4. a) Explain the effect of negative feedback on gain and bandwidth of a feedback amplifier. (10)
   b) Prove that the gain of a practical feedback amplifier is inversely proportional to the feedback factor. (10)
   c) Define piezoelectric crystal. What are the advantages of crystal oscillator over RC oscillator? (10)
   d) An amplifier has an open-loop gain A=100000. A negative feedback of 10dB is applied. Find, i) voltage gain with feedback and ii) value of feedback fraction, β. (05)

SECTION B

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

5. a) Define: i) Input offset voltage, ii) Input offset current, iii) Slew rate and iv) Input bias current. (08)
   b) Explain the single ended and double ended operations of op-amp. (07)
   c) Show that the closed loop voltage gain of an non-inverting amplifier is $A_F = 1 + R_F / R_I$, where the symbols have their usual meaning. (10)
   d) The 741C op-amp having the following parameters is connected as a non-inverting amplifier as shown in Fig. 5(d), with R_1 = 1kΩ, R_F = 10 kΩ, A = 200,000, R_i = 2MΩ, R_0 = 75Ω, f_0 = 5 Hz, supply voltages = ±15V, output voltage swing = ±13 V. Compute the values of A_F, R_{iF}, R_{oF}, f_F and V_{00T}. (10)

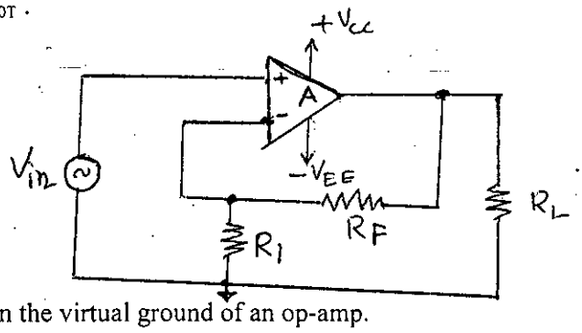


Fig. 5(d)

6. a) Briefly explain the virtual ground of an op-amp. (10)
   b) Define: i) transition time, ii) Settling time, iii) Symmetrical triggering, iv) Unsymmetrical triggering, and v) Notch filter. (10)
   c) Define CMRR. Explain the use of an op-amp as an integrator. (08)
   d) Design a differentiator to differentiate an input signal that varies from 10 Hz to 1 kHz. (07)

7. a) Define multivibrator. With the aid of circuit diagram briefly explain the operation of bistable multivibrator. (12)
   b) What is Schmitt trigger? Describe its input-output response with hysteresis properties. (10)
   c) Discuss about order of filter. What are the advantages of active filters over passive filters? (05)
   d) Design a 555 astable multivibrator to give a pulse repetition frequency (PRF) of 2 kHz and duty cycle 66%. Use V_{cc} = 18 V. (08)

8. a) What do you know about PLL? With the help of block diagram briefly explain its construction and operating principle. (11)
   b) What do you mean by clipping circuit? Give some application of the clipper. (09)
   c) Draw the output waveshapes of the following circuits shown in Fig. 8(c). Consider the diode as an ideal one in each case. (15)

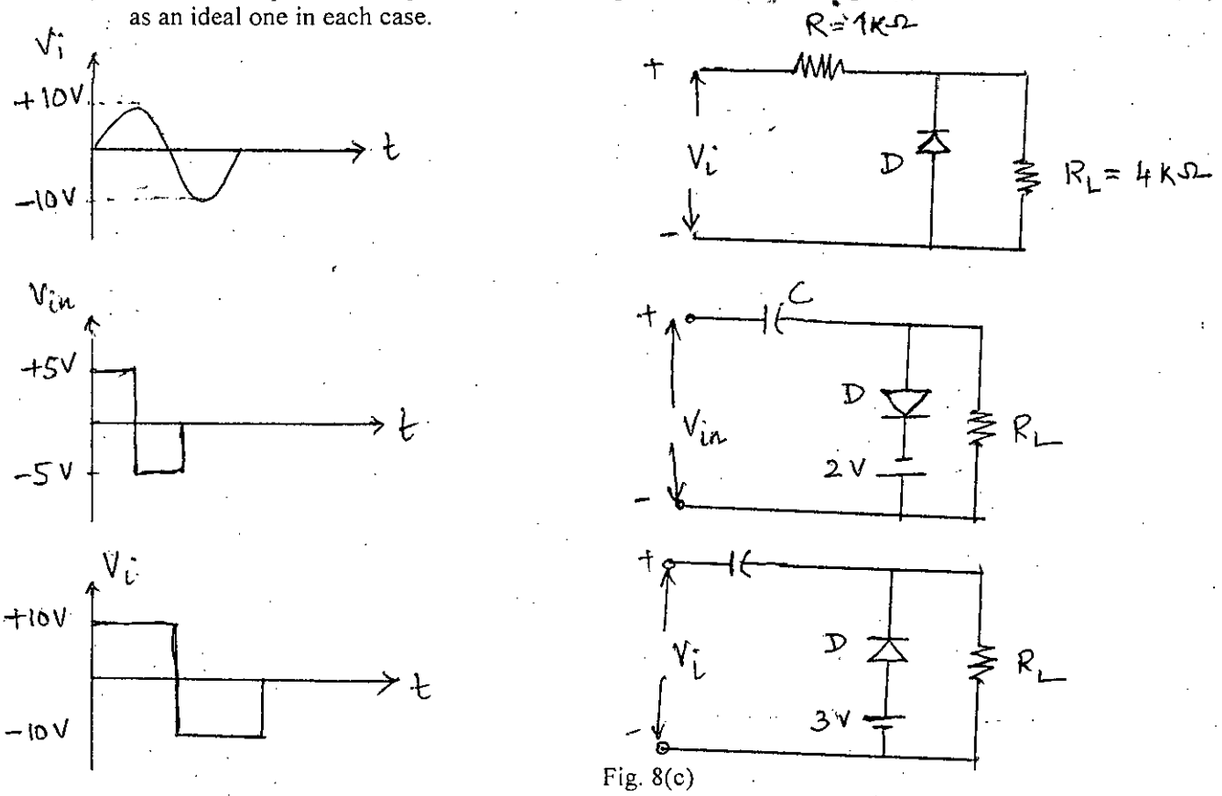


Fig. 8(c)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd year 1st Term Examination, 2015

Department of Electronics and Communication Engineering

ECE-2103

(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) 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) Perform the subtraction with the following binary numbers using (*i*) 2's complement and (*ii*) 1's complement. Check the answer by straight subtraction: (13)

$$(1110110\text{-}111)_2$$

c) Define the following terms: (10)

(i) Duality principle (ii) Canonical form (iii) Standard form (iv) Positive and Negative logic system (v) IC logic families.

2. a) Show that (i) The Dual of the exclusive-OR is equal to its complement (ii) a Positive-logic AND gate is a Negative-logic OR gate and Vice-versa. (12)

b) Express the following function in a Sum of Minterms and a Product of Maxterms. (12)

$$F(A,B,C,D) = (A+B'+C)(A+B')(A+C'+D')(A'+B+C+D')(B+C'+D')$$

c) Implement the following function using the don't-care conditions. Assume that both the normal and complement inputs are available. (11)

$$F = A'B'C' + AB'D + A'B'CD'$$

$$d = ABC + AB'D'$$

with no more than Two NOR gates.

3. a) Show that the circuit in Fig. 3(a) is an Exclusive-OR. (11)

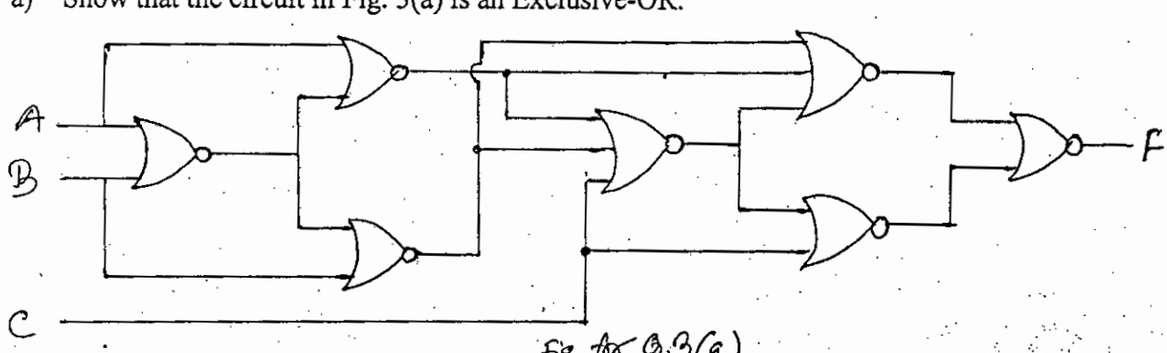


Fig. for Q.3(a)

b) Implement the Four Boolean functions listed using three Half-Adder circuits. (12)

$$D = A \oplus B \oplus C$$

$$E = A'BC + AB'C$$

$$F = ABC' + (A' + B')C$$

$$G = ABC$$

c) Design a combinational circuit to check for even parity of four bits. A logic-1 output is required when the four bits do not constitute an even parity. (12)

4. a) "Open collector TTL gates are tied together to form a wired-AND logic"-Justify the statement. (11)

b) Design a combinational circuit using a ROM. The circuit accepts a 3-bit number and generates an output binary number equal to the square of the input number. (12)

c) A combinational circuit is defined by the functions: (12)

$$F_1(A,B,C) = \sum(3,5,6,7)$$

$$F_2(A,B,C) = \sum(0,2,4,7)$$

Implement the circuit with PLA having three inputs, four product terms and two outputs.

SECTION B

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

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

b) Draw the logic diagram of a clocked master-slave JK flip-flop. (10)

c) Show the operation of the D-type edge-triggered flip-flop with necessary diagram. (10)

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

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

b) Write down the state table and draw the state diagram of the following sequential circuit. (12)

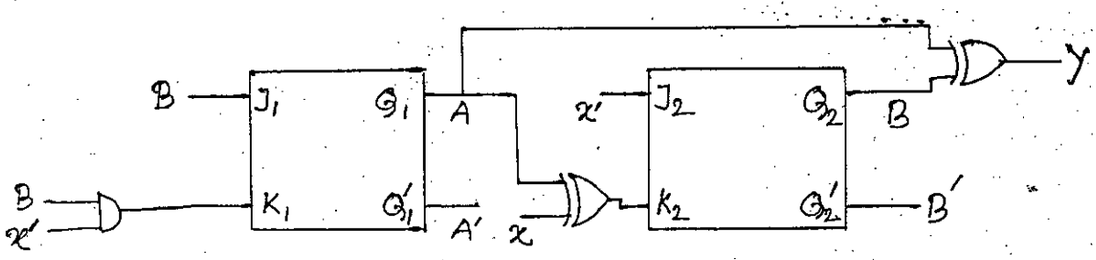


Fig. for Q.6(b)

c) What is register? Design a 4-bit register with parallel load using D flip-flops and explain its operation. (15)

7. a) Design a synchronous counter that will count 15-10-9-8-7-6 and repeat by using JK flip-flops. (13)

b) Construct a Johnson counter with Ten timing signals. (10)

c) Show that in a Dual slope A/D converter the output of the converter is proportional to the analog input voltage. (12)

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

b) Design a 2-decade BCD D/A converter. (10)

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

d) Write short notes on EPROM and E^2PROM. (07)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2015
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) Show that $\rho = \frac{1}{\sigma} = \frac{m_e}{ne^2\tau}$, where the symbols have their usual meanings. Explain the importance of drift mobility in semiconductor device. (12)

c) 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 $gmol^{-1}$. (11)

d) Write short notes on i) Smart materials ii) Metamaterials. (06)

2. a) Derive the time dependent Schrödinger equation for one dimension. Write down the significance of Schrödinger equation and limitations of wave function 'ψ'. (15)

b) Define 'Phonons'. What are the basic assumptions of Debye's theory of specific heat? Show that at low temperature specific heat at constant volume (C_v) drops following 'T^3' law with decreasing temperature. (12)

c) According to the wave mechanics, the charge distribution corresponding to the electron in the ground state of a hydrogen atom is an exponential function of the type $\rho(r) = A\exp(-2r/r_1)$, where A and r_1 are constant and r represents the distance from the nucleus. Given that the total charge must be equal to –e, show that, $A = -e/\pi r_1^3$. (08)

3. a) Describe various defects in crystal structure. Mention their significance in the device performance. (08)

b) Explain how capacitance increases while inserting a dielectric medium between the parallel plates of a capacitor. (09)

c) Explain quantum tunneling effects in solids and its application in semiconductor diode. (08)

d) Consider the CsCl crystal which has one Cs^+–Cl^- pair per unit cell and a lattice parameter a of 0.412 nm. the electronic polarizability of Cs^+ and Cl^- ions is 3.35×10^{-40} Fm^2 and 3.40×10^{-40} Fm^2 respectively, and the mean ionic polazability per ion pair is 6×10^{-40} Fm^2. What is the dielectric constant at low frequencies and that at optical frequencies? (10)

4. a) Derive Bragg's law of X-ray diffraction in crystals and mention some of its application. (07)

b) Briefly explain different types of polarization in dielectrics. Using Langevin's theory of polarization, explain the temperature dependency of orientation polarization. (12)

c) Consider a FCC unit cell of Cu crystal. (11)
   i) How many atoms are there per unit cell?
   ii) If R is the radius of the Cu atoms, show that the lattice parameters 'a' is given by $a = 2\sqrt{2}R$.
   iii) Calculate the packing factor assuming the radius of the Cu atom is 0.128 nm.

d) The electronic polarizability of Ar atom is 1.7×10^{-40} Fm^2. What is the static dielectric constant of solid argon if its density is 1.8 $g.cm^{-3}$? (05)

SECTION B

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

5. a) Explain the terms susceptibility and permeability in magnetism. (06)
   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) Explain clearly the differences between hard and soft magnetic materials. Mention their uses. (07)
   d) The maximum magnetization M_{sat} in iron is 1.75×10^{6} Am^{-1}. This corresponds to all possible net spins aligning parallel to each other. Calculate the effective number of Bohr magnetrons per atom that would give M_{sat}, given that the density and relative atomic mass of iron are 7.86 g-cm^{-3} and 55.85 respectively. (12)

6. a) Explain the different contributions for the formation of domains in a ferromagnetic materials and show how the hysteresis curve is explained on the basis of the domain theory. (11)
   b) Distinguish between ferromagnetic, ferromagnetic and antiferromagnetic materials. Give an example of each class of material. (09)
   c) Briefly explain how does the temperature affect the properties of ferromagnetic materials. (08)
   d) What is superconductivity? Which type of superconductor is used in all engineering application? (07)

7. a) Derive an expression for the complex dielectric constant giving the optical properties of a metal of electron concentration, n and constant relaxation time, τ. How are the real and imaginary parts ε_1 and ε_2 related to the conductivity? (12)
   b) Define dispersion. Illustrate the relationship of refractive index with wavelength by showing related figure and deducing the equation to calculate the refractive index. (13)
   c) Consider a light wave travelling in a pure Sio_2 (silica) glass medium. If the wavelength of light is 1300 nm and the refractive index at this wavelength is 1.447, what is the phase velocity, group index (N_g) and group velocity (V_g)? (10)

8. a) Explain briefly why is silicon used for solar cells but not for LEDs? (05)
   b) Briefly explain the Kramers-Kronig relations. (05)
   c) Consider a semiconductor sample with conductivity σ and a refractive index n. Show that the absorption coefficient due to free carrier absorption (due to conductivity) is given by $\alpha = (1/c\varepsilon_0)\sigma/n$, where the symbols have their usual meaning. (10)
   d) Spectroscopic ellipsometry measurements on a solid 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 the absorption coefficient at this wavelength and the phase velocity. (15)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd Year 1st Term Examination, 2015

Department of Electronics and Communication Engineering

ECE-2107

(Signals & 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. (12)

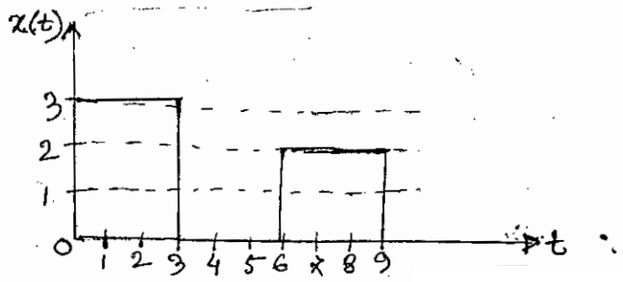
b) Determine whether the signal, $x(t) = \sin\sqrt{2\pi}\ t + \sin 15\pi t$ is periodic or not, then find its fundamental period. Also, compute the energy of that signal. (10)

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

d) Sketch the following signal: $x(t) = r(-0.5t + 2)$ (04)

e) Write down the corresponding equation for the given signal in figure 1(e). (04)
i) Represent through addition of unit step functions.
ii) Represent through multiplication of unit step functions.

Fig. 1(e)



2. a) Define system. Distinguish between: (06)
(i) Causal and Non-causal system.
(ii) FIR & IIR System

b) Find the impulse response for the causal system $y(n) - y(n-1) = x(n) + x(n-1)$. Also find the response of the system if input is $x(n) = u(n)$. (08)

c) The discrete-time system is represented by the following difference equation in which x(n) is input & y(n) is output: (09)

$$y(n) = 3y^2(n-1) - nx(n) + 4x(n-1) - 2x(n+1)$$

Determine whether it is-
i) Time invariant, ii) Linear, iii) Causal.

d) Deduce the sufficient & necessary condition for Bounded Input Bounded Output (BIBO) stability of an LTI system. Also check the BIBO stability for the digital filter: (12)
$y(n) = x(n) + e^{\alpha} y(n-1)$.

3. a) Show that the output response of an LTI system is the convolution sum of the input signal & impulse response of the system. (08)

b) Find the output response of an FIR filter with impulse response $h(n) = \{1, \underset{\uparrow}{2}, -2, -1, 0\}$ and input sequence $x(n) = \{\underset{\uparrow}{1}, 2, 3, 0\}$ using linear convolution graphically. (12)

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

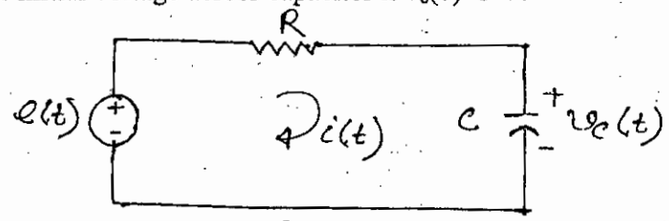


fig. 3(c)

4. a) i) State sampling theorem; ii) Show the criteria and frequency spectrum in case over-sampling, under-sampling & Nyquist rate sampling; iii) Explain aliasing effect and anti-aliasing filter briefly. (03+04+04)

b) Draw the block diagram of the system: (06)
$y(n)+0.5y(n-1)+0.25y(n-2)=x(n-1)$.

c) Evaluate the state variable description corresponding to the system in figure 4(c) by choosing the state variables to be the outputs of the unit delays. (10)

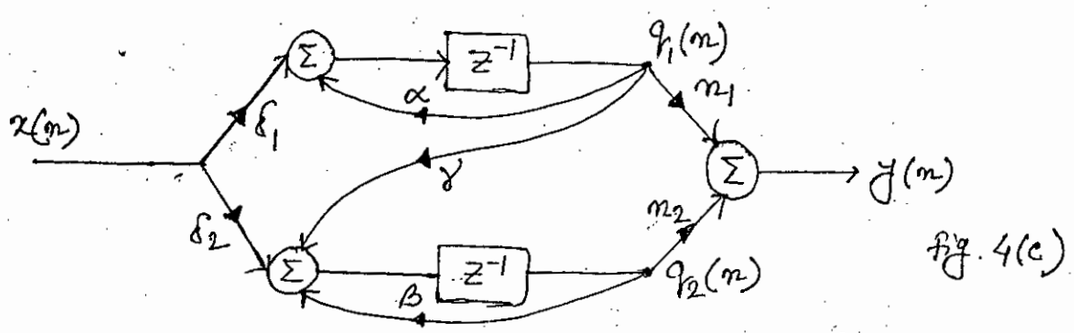


fig. 4(c)

d) Given the 2nd order difference equation is: (08)
$y(n)+y(n-1)+\frac{1}{4}y(n-2)=x(n)+2x(n-1)$. Find the two output values y(1) and y(2) for the system; assuming that the input is $x(n)=\left(\frac{1}{2}\right)^n u(n)$ and initial conditions are y(-1)=1 & y(-2)= -2.

$\int_{-\infty}^{\infty} x(t)e^{-j\omega t}dt$

SECTION B

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

5. a) Define and explain cross correlation and auto-correlation of sampled signals. (10)

b) How is z-transform obtained from Laplace transform? (08)

c) Determine $x(n)$ for $X(z)$ given by (10)
$$X(z)=\frac{z-0.5}{z(z-0.8)(z-1)}$$

d) Prove that the final values of $x(n)$ for $X(z)=\frac{z^2}{(z-1)(z-0.2)}$ is 1.25 and its initial value is unity. (07)

6. a) Define the Fourier transform of a time function and explain under what condition it exits. (10)

b) Evaluate the Fourier transform of the given function, (13)
$$f(t)=5\left[u(t+3)+u(t+2)-u(t-2)-u(t-3)\right]$$

c) What would be the energy signal of $x(t)e^{-at}u(t)$? Also determine the frequency ω so that the energy contributed by the spectrum components of all frequencies below ω is 95% of the signal energy E_x. (12)

a) State and explain Laplace transform and its inverse transform. (06)

b) Explain the following terms in relations to Laplace transform: i) Linearity ii) Scaling, iii) Time-shift, iv) Frequency differentiation, v) Time correlation. (10)

c) Obtain $v_0(t)$ using loop equation from following circuit as shown in figure 7(c) (09)

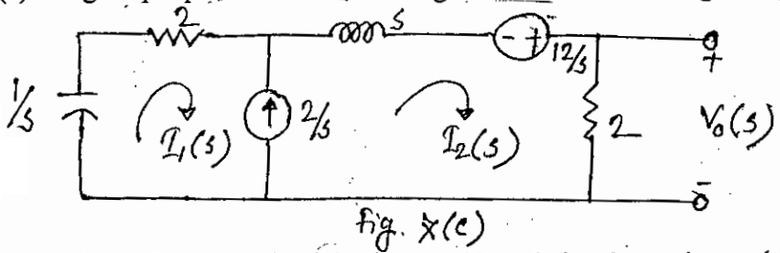


fig. 7(c)

d) Draw s-domain circuit from circuit of the figure 7(d) and also determine $v_0(t)$, t > 0. (10)

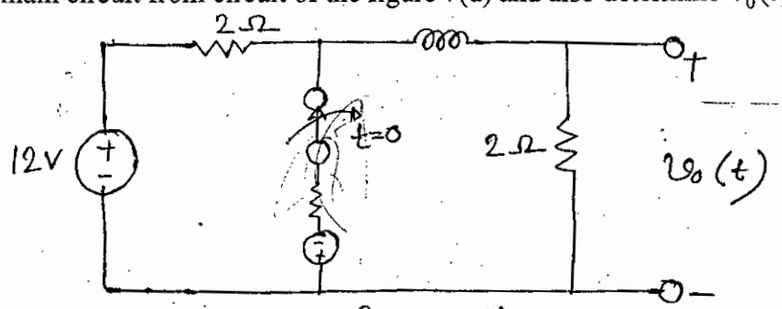


fig. 7(d)

8. a) What is region of convergence? Describe the properties of region of convergence (ROC) with proper illustration. → Z transform (13)

b) Discuss the concept of transfer function and its application. (10)

c) Determine the inverse Laplace transform of (12)

$$F(s) = \frac{2s^2 + 3s + 3}{(s+1)(s+3)^3}$$, Draw the pole-zero diagram for the given function.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 2nd year 1st Term Examination, 2015

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 matrices with example: (12)
(i) Upper triangular matrix (ii) Equivalent matrix (iii) Skew-Hermitian matrix .

b) Show that the matrix $A = \frac{1}{3}\begin{bmatrix} -1 & 2 & 2 \\ 2 & -1 & 2 \\ 2 & 2 & -1 \end{bmatrix}$ is orthogonal. (05)

c) Define inverse of a matrix. Find the inverse of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 7 \\ -2 & -4 & -5 \end{bmatrix}$, if possible, by the method of elementary transformations. (12)

d) Find the symmetric and skew-symmetric parts of the matrix $A = \begin{bmatrix} 1 & 2 & 4 \\ 6 & 8 & 1 \\ 3 & 5 & 7 \end{bmatrix}$ (06)

2. a) Define nilpotent matrix. Show that $A = \begin{Bmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \\ -1 & -2 & -3 \end{Bmatrix}$ is a nilpotent matrix of order 2. (10)

b) Define the normal form of a matrix. Reduce the matrix A to its row canonical form and then normal form and hence find the rank of A, where (16)

$$A = \begin{pmatrix} 1 & 1 & 2 & -3 \\ 4 & 1 & 0 & 2 \\ 0 & 3 & 0 & 1 \\ 0 & 1 & 0 & 2 \end{pmatrix}$$

c) Write the vector $v = (2, -5, 3)$ as a linear combination of the vectors $v_1 = (1,-3,2)$, $v_2 = (2,-4,-1)$ and $v_3 = (1,-5,7)$. (09)

3. a) Define eigenvalues and eigenvectors. Find the eigenvalues and eigenvector corresponding to the largest eigenvalue for the matrix $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$. (14)

b) Construct the matrix form for the system of m simultaneous linear equations in m unknowns. Solve the following system of linear equations by the matrix method: (13)

$$x + 2y + 3z = 14$$
$$3x + y + 2z = 11$$
$$2x + 3y + z = 11$$

c) Find the finite Fourier sine transform of $F(x) = x$ such that $0 < x < 2$. (08)

4. a) Find the Fourier series of sines and cosines of multiples of x which represents $f(x)$ in the interval $-\pi < x < \pi$ where, $f(x) = \begin{cases} 0, & \text{when } -\pi < x < 0 \\ \dfrac{\pi x}{4}, & \text{when } 0 < x < \pi \end{cases}$, such that $f(2\pi + x) = f(x)$.

b) Develop Fourier series of a periodic function $f(x)$ in the internal (-2, 2) defined by $f(x) = 0$ for $-2 < x < 0$ and $f(x) = 1$ for $0 < x < 2$. (15)

SECTION B

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

5. a) A particle moves along the curve $x = 2t^2$, $y = t^2 - 4t$, $z = 3t-5$, where t is the time. Find the components of its velocity and acceleration at time $t = 1$ in the direction $\underline{i} - 3\underline{j} + 2\underline{k}$. (10)

b) What is meant by the gradient? What is the physical meaning of the gradient? Find the values of the a, b, c so that the directional derivative of $\varphi = axy^2 + byz + cz^2x^3$ at (1,2,-1) has a maximum of magnitude 64 in a direction parallel to the z-axis. (15)

c) If $\underline{A} = x^2yz\underline{i} - 2xz^3\underline{j} + xz^2\underline{k}$ and $\underline{B} = 2z\underline{i} + y\underline{j} - x^2\underline{k}$, Find $\dfrac{\partial^2}{\partial x \partial y}(\underline{A} \times \underline{B})$ at (1,0,-2). (10)

6. a) If $\nabla.\underline{E} = 0$, $\nabla.\underline{H} = 0$, $\nabla \times \underline{E} = -\dfrac{\partial \underline{H}}{\partial t}$, $\nabla \times \underline{H} = -\dfrac{\partial \underline{E}}{\partial t}$, where $\underline{E}$ and $\underline{H}$ represent the electric and magnetic fields, then show that $\underline{E}$ and $\underline{H}$ satisfy the wave equation $\nabla^2 u = \dfrac{\partial^2 u}{\partial t^2}$ (10)

b) What is meant by the conservative force field? If $\underline{E} = r\underline{r}$ is an electric filed, then show that $\underline{E}$ is conservative. Also determine the scalar potential φ such that, $\underline{E} = -\nabla\varphi$. (12)

c) Evaluate $\iint_s \underline{A}.\underline{n}\, ds$, where $\underline{A} = 18z\underline{i} - 12\underline{j} + 3y\underline{k}$ and s is that part of the plane $2x + 3y + 6z = 12$ which is located in the first octant. (13)

7. a) Use Gauss divergence theorem to 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 $z = 3$. (10)

b) State Green's theorem. Verify Green's theorem in the plane for $\oint_c (xy + y^2)dx + x^2dy$, where c is the closed curve of the region bounded by $y = x$ and $y = x^2$. (15)

c) For the particle moving in a plane, find the position $\underline{r}(t)$ and the velocity $\underline{v}(t)$ given that the acceleration $\underline{a}(t) = 6t\underline{i} + 12t^2\underline{j}$ and the position and velocity at time $t = 0$ are $\underline{r}(0) = \underline{i} + \underline{j}$ and $\underline{v}(0) = 0$ (10)

8. a) Define the Laplace transform. Draw the graph of $f(t)$, where (10)

$$f(t) = \begin{cases} \sin t, & 0 < t < \pi \\ 0, & \pi < t < 2\pi \end{cases}$$

Extended periodically with period 2π. Also find $L\{f(t)\}$

b) State the convolution theorem for the inverse Laplace transform. Use this theorem to evaluate $L^{-1}\left\{\dfrac{1}{s^2(s+1)^2}\right\}$. (10)

c) An inductor of 2 henrys, a resistor of 16 ohms and a capacitor of 0.02 farads are connected in series with an *e.m.f* of 300 volts. At $t = 0$, the charge on capacitor and current in the circuit are zero. Find the charge and current at any time $t > 0$ by using the Laplace transform. Also draw this circuit. (15)