S.E. Sem IV (CBSGS) Rev. 2012. May 2018.
(Elect.)
Maths IV.

Q. P. Code: 11573

(3 HOURS) **MARKS: 80**

N.B. (i) Question no. ONE is compulsory.

(ii) Attempt any THREE questions out of the remaining five questions.

(iii) Figures to right indicate full marks.

Q.1 (a) Find the eigen values and eigen vectors of the following matrix. 5

$$A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$$

(b) Define the following terms (i) Signature and Index of the quadratic forms 5
(ii) Positive definite quadratic forms

(c) Find the extremal of $\int_0^1 (xy + y^2 - 2y^2 y') \, dx$ 5

(d) Verify Cauchy- Schwartz inequality for the vectors 5
$u = (-4,2,1)$ *and* $v = (8,-4,-2)$

Q.2 (a) Find the eigen values of adjoint of $A = \begin{bmatrix} 2 & 0 & -1 \\ 0 & 2 & 0 \\ -1 & 0 & 2 \end{bmatrix}$ 6

(b) Find the extremal of $\int_{x_0}^{x_1} \left[16y^2 - y''^2 + x^2 \right] dx$ 6

[TURN OVER

(c) Obtain the Taylor's and Laurent's series for the function 8

$$f(z) = \frac{1}{(1+z^2)(z+2)} \quad \text{for (i) } 1 < |z| < 2 \quad \text{ii) } |z| > 2$$

Q.3 (a) Evaluate $\oint_C \frac{z-1}{z^2+2z+5}\,dz$ where C is the circle 6

i) $|z| = 1$, ii) $|z+1+i| = 2$, iii) $|z+1-i| = 2$

(b) Verify Cayley-Hamilton Theorem for 6

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & -1 \end{bmatrix}$$ and hence find A^{-1}

(c) Find the curve C of given length l which encloses a maximum area. 8

Q.4 (a) Let R^4 have the Euclidean inner product. Use Gram-Schmidt Process to transform the basis (u_1, u_2, u_3) into orthogonal basis, where 6

$u_1 = (1,0,1,1)$ $u_2 = (-1,0,-1,1)$ $u_3 = (0,-1,1,1)$

(b) Find A^{100}, if $A = \begin{bmatrix} 2 & 3 \\ -3 & -4 \end{bmatrix}$ 6

(c) Reduce the quadratic form to 8

$2x_1^2 + x_2^2 - 3x_3^2 - 8x_2x_3 - 4x_3x_1 + 12x_1x_2$ to normal form through congruent transformations. Also find its rank , signature and value class.

[TURN OVER

Q.5 (a) Solve by Rayleigh- Ritz method the boundary value problem 6

$$I = \int_0^1 \left(2xy - y^2 - y'^2 \right) dx \quad \text{given} \quad y(0) = 0,\ y(1) = 0$$

(b) Show that $v = \{ (x, y) \mid x = 3y \}$ is a subspace of R^2 6

State all Possible subspaces of

(c) Show that the following matrix A is diagonalizable. Find its transforming 8

matrix and the diagonal matrix $A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$

Q.6 (a) Evaluate $\int_0^{2\pi} \frac{\cos 3\theta}{5 - 4\cos\theta} d\theta$ 6

(b) Evaluate $\int_{-\infty}^{\infty} \frac{x^2 + x + 2}{x^4 + 10x^2 + 9} dx$ using contour integration. 6

(c) Find the singular value decomposition of 8

$$A = \begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}$$

Analog Electronics II

QP CODE : 22624

(3 Hours) Marks : 80

N.B. : (1) Question No. **1** is **compulsory.**

(2) Solve any **three** questions from the remaining **five**

(3) Figures to the right indicate full marks

(4) Assume suitable data if necessary and mention the same in answer sheet.

Q.1 Attempt any 5 questions [20]

a) Compare series and shunt regulator.
b) What are the major limitation of class B power amplifier and how to overcome the same?
c) What is the need of dual power supply biasing for differential amplifier?
d) Which type of biasing technique is used to bias Integrated Circuit
e) Draw and explain frequency response of BJT CE amplifier.
f) Explain line regulation and load regulation of voltage regulator. Draw the line and load regulation characteristics of ideal and practical voltage regulator.

Q.2 a) For the circuit shown in Fig. 2a, the transistor parameters are [10] $V_{BE(on)}$ = 0.7V, β=100, C_π = 2 pF, Cμ = 0.2 pF. Find lower cutoff frequency and midband gain.

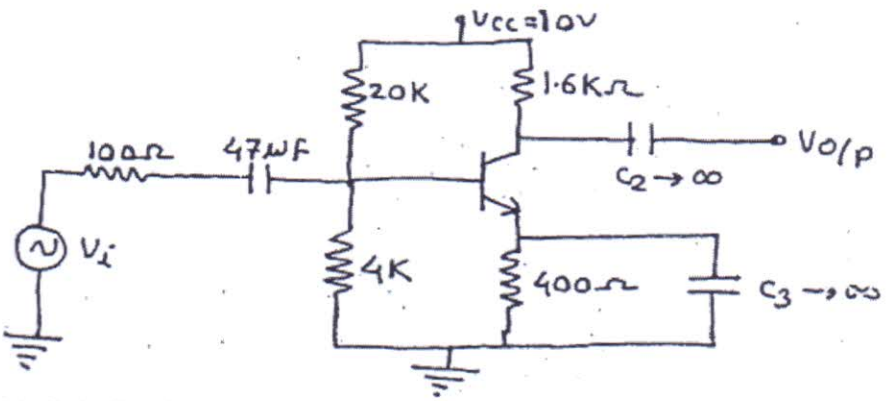


Fig.2a

b) Determine unity gain bandwidth of N channel MOSFET with parameters [10] K_n = 0.25 mA/V², V_{TN} = 1V, λ=0, C_{gd} = 0.04 pF, C_{gs} = 0.2 pF, V_{GS} = 3V. If a 10 kΩ load is connected to the output between drain and source determine the Miller capacitance and cut-off frequency.

Q.3 a) Draw circuit diagram of MOSFET based differential amplifier and derive [10] the expression for differential gain, common mode gain and CMRR.

b) Determine overall input resistance and output resistance of the circuit as [10] shown below in Fig. 3b. For both the transistors β=120

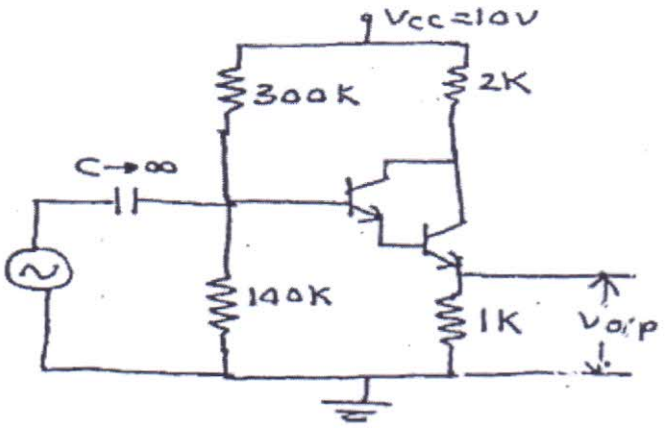


Fig. 3b

Q.4 a) Explain the working of two transistor (BJT) current source with the help of necessary current relationships. Also explain the effect of finite output resistance on current source performance and techniques to improve the same. [10]

b) Draw the circuit of V_{BE} multiplier biased class AB amplifier and explain the working and advantages of V_{BE} multiplier biased class AB amplifier. [5]

c) What are the ideal characteristics of opamp and also explain the effect of high frequency on OPAMP gain and phase. [5]

Q.5 a) Draw the circuit diagram of transformer coupled class A power amplifier. Also draw ac and dc loadlines for the same. Derive the expression for its power conversion efficiency. [10]

b) Explain the working of basic differentiator with the help of input and output waveforms. Also derive the expression for the output voltage. What are the limitations of basic differentiator and how to overcome these limitations. [10]

Q.6 Short notes on: (Attempt any four) [20]

a) Zener voltage regulator
b) Power MOSFET
c) Class AB power amplifier
d) High pass and Low pass filter using OPAMP
e) High Frequency hybrid pi model of BJT

S.E. (ET) SEM IV (CBSGS) R-2012.

Q.P. CODE: 36047

Wave theory & Propagation.

[Time: 3 Hours] **[Total Marks: 80]**

Note the following instructions.

1. Question **No. 1** is **compulsory.**
2. Attempt **any three out of the remaining five**
3. Draw neat diagrams wherever necessary.
4. Assume data, if missing, with justification
5. Figures to the Right indicate full marks.

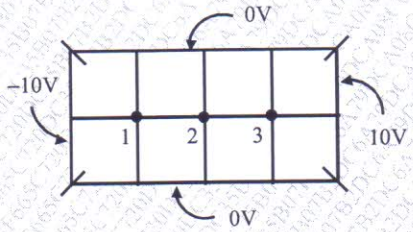
Q1. **Attempt ANY FOUR out of the FIVE**

(a) Define parallel polarization and perpendicular polarization with the help of a diagram. **[05]**

(b) Find the charge in the volume defined by $0 \leq x \leq 1m$, $0 \leq y \leq 1$ m, if the $\rho v = 120x^2y\ \mu C/m^3$. **[05]**

(c) Explain the term super refraction with a neat labeled diagram. **[05]**

(d) Determine the potential at the free nodes in the potential system of the following figure using Finite Difference Method (Band Matrix Method). **[05]**



(e) State the Maxwell's Equations in free space in terms of E and H only. Explain its significance in wave motion. **[05]**

Q2. **(a)** Derive boundary conditions for electric field for a dielectric-dielectric interface stating its significance. **[05]**

(b) In free space ($z \leq 0$), a plane wave with $Hi = 10\cos(10^8t - \beta z)a_x$ mA/m is incident normally on a lossless medium ($\varepsilon = 2\varepsilon o$, $\mu = 8\mu o$) in the region $z \geq 0$. Determine the reflected wave Hr, Er and the transmitted wave Ht, Et. **[10]**

(c) Define Polarization of a wave. State the conditions to achieve Linear polarization. **[2+3]**

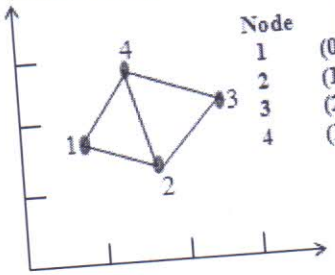
Q3. **(a)** A 300MHz wave is propagating through fresh water. Assuming a lossless medium $\mu_r = 1$, $\varepsilon_r = 78$ (at 300MHz). Find the phase constant, the velocity of propagation, the wavelength and the intrinsic impedance. If E_o = 0.1V/m, also find E_x and H_y. **[8+2]**

(b) Derive an expression for the Maximum Usable Frequency (MUF) in terms of the skip distance and virtual height. **[05]**

(c) A VHF communication is to be established with a 35W transmitter at 90MHz. Determine the distance up to which LOS communication may be possible if the height of the transmitting and receiving antennae are 40mts and 25mts respectively. **[05]**

Q4. **(a)** Obtain reflection coefficient and transmission coefficient of perpendicularly polarized wave incident on a dielectric-dielectric boundary with oblique incidence. Define the Brewster angle for this case. **[8+2]**

(b) Consider the two element mesh shown in the fig below. Using the finite element method, determine the potentials within the mesh. **[10]**



Node	(x, y)
1	(0.8, 1.8)
2	(1.4, 1.4)
3	(2.1, 2.1)
4	(1.2, 2.7)

Q5. **(a)** What is the loss tangent of a material? How does it classify materials? **[2+3]**

(b) Derive Helmholtz equations. **[5]**

(c) A point charge $Q_1 = 10\mu C$, is located at $P_1(1, 2, 3)$ in free space, while $Q_2 = -5\mu C$ is at $P_2(1, 2, 10)$. **[5+5]**

(a) Find the vector force exerted on Q_2 by Q_1.

(b) Find the coordinates of P_3 at which a point charge Q_3 experiences no force.

Q6. **(a)** A 5nC point charge is located at A(2, -1, -3) in free space. Find E, at the origin. **[05]**

(b) Define skin depth. Most microwave ovens operate at 2.45GHz. Assume $\sigma = 1.1 \times 10^{\wedge}6$mho/m and $\mu_r = 600$ for the stainless steel interior. Find the depth of penetration. **[05]**

(c) Explain Ducting. State the conditions under which a duct is formed. **[05]**

(d) With respect to the application of Electromagnetic Waves, explain the working of an Electromagnetic Pump. **[05]**

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S.E. (ET) Sem IV (CBSGS) Rev. 2012 — May 2018

Signals & Systems.

Q. P. Code: 39055

(3 Hours) [Total Marks: 80]

N.B.:

1. Question No.1 is compulsory.
2. Attempt any three questions out of the remaining five.
3. Assume suitable data wherever necessary.

Q1 a) State and prove time shifting property of Z-transform 20

b) Determine the even and odd part of the following time signals.
i) $x(t) = 3 + 2t + 5t^2$ ii) $x(t) = e^t$

c) Explain in brief ROC (Region of Convergence) condition for Laplace transform.

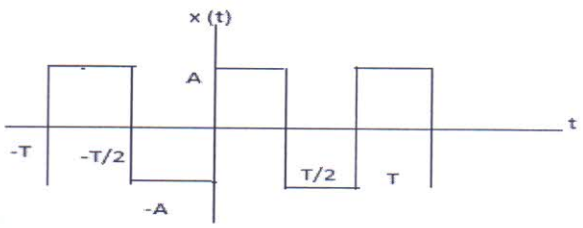
d) Sketch signal $e^{-5t}u(t)$ and determine power and energy of signal.

e) For the unit step response of continuous time signal, determine the transfer function of the system: $s(t) = u(t) + e^{-2t}u(t)$

Q2. a) Define the following Continuous Time signals: 10

i) Deterministic and Non Deterministic Signals
ii) Periodic and Non periodic Signal
iii) Causal and Non causal Signal
iv) Even and odd Signal

b) Determine the Fourier series of the following signal: 10



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Q3. a) Define and prove the following properties of Laplace transforms: 10

i) Time and frequency shifting

ii) Amplitude Scaling and Linearity

b) Find impulse response and step response of continuous time systems governed by 10

Following transfer functions.

$$H(s) = \frac{s+3}{s^2+6s+8}$$

Q4. a) Determine the Laplace transform of the following signals: 5

i) $X(t) = \sin\Omega 0t\ u(t)$

ii) $X(t) = \cos\Omega 0t\ u(t)$

b) Explain Gibbs Phenomenon in detail. 5

c) A stable system has input x (t) and output y (t). Determine transfer function and Impulse response h (t) by using Laplace transform. 10

$x(t) = e^{-2t}u(t)$; $y(t) = -2\,e^{-t}u(t) + 2\,e^{-3t}u(t)$

Q5. a) An LTI system is described by the equation: 10

$y(n) = x(n) + 0.8\,x(n-1) + 0.8\,x(n-2) - 0.49\,y(n-2)$, determine the transfer function of The system and also sketch the poles and zeros on the z-plane.

b) Determine the Z- transform and ROC of the given discrete time signal: 5

$x(n) = 0.5^{n}\,u(n)$

c) Why linear Convolution is important in signals and System? 5
Differentiate linear Convolution with Circular Convolution.

Q6. a) Compute the convolution $y(n) = x(n) * h(n)$ using tabulation method 10

Where $x(n) = \{1, 1, \underset{\uparrow}{0}, 1, 1\}$ and $h(n) = \{1, -2, -3, \underset{\uparrow}{4}\}$

b) Determine the impulse response h (n) for the system described by 10

Second order difference Equation, $y(n) - 4\,y(n-1) + 4\,y(n-2) = x(n-1)$

S.E (EIBSGS) / EXTC / Sem IV May 2018
Control Systems.

Q. P. Code: 36810

(3 Hours) Max Marks: 80

Note:
1. **Question No. 1 is compulsory.**
2. **Out of remaining questions, attempt any three questions.**
3. **Assume suitable additional data if required.**
4. **Figures in brackets on the right hand side indicate full marks.**

1. **(A)** Explain Mason's Gain Formula. **(05)**
   (B) Differentiate between Open Loop and Closed Loop Control System **(05)**
   (C) Explain the concept of relative stability. **(05)**
   (D) Explain the concept of Neuro-Fuzzy adaptive control system. **(05)**

2. **(A)** The open-loop transfer function of a unity feedback system is – **(10)**

$$G(s) = \frac{20}{s(1+4s)(1+s)}$$

Evaluate the static error coefficients for the system. Obtain the steady-state error of the system when subjected to an input given by the polynomial –

$$r(t) = 2 + 4t + \frac{t^2}{2}$$

(B) Test the stability of the system represented by following characteristic equations.

i) $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$.

ii) $s^5 + 2s^4 + 3s^3 + 6s^2 + 2s + 1 = 0$.

3. **(A)** For the given transfer function, find Tp, % MP, Ts, and Tr. **(10)**

$$G(s) = \frac{2s}{s^2 + 6s + 25}$$

(B) Sketch the root locus for the below given System. **(10)**

$$G(s)H(s) = \frac{K}{s(s+3)(s+5)}$$

4. **(A)** Determine the C(s)/R(s) of the signal flow graph given in Fig. 4(a). **(10)**

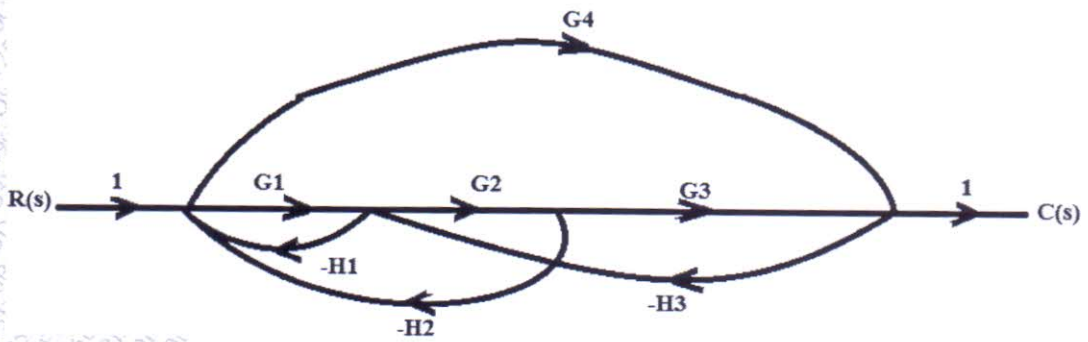


Fig. 4(a): Signal flow graph

(B) Draw the Bode diagram for the transfer function

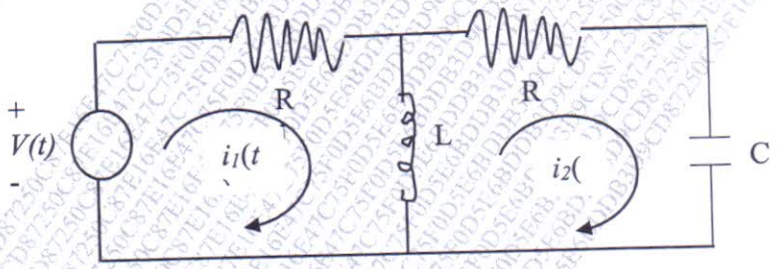
$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$$

Determine gain K for gain cross over frequency ω_{gc} to be 5 rad/sec. Comment on the stability.

5. (A) Explain Controllability and Observability analysis of LTI System using Suitable example.

(B) Draw block diagram of Model Reference Adaptive Control and explain its function.

(C) Define the transfer function and find the transfer function of following electrical network



6. (A) Sketch the polar plot for the following system.

$G(s) = \frac{1}{s(1+s)(1+2s)}$. Determine the gain and phase margin of the system.

(B) A linear time invariant system is characterized by the state variable model. Examine the observability of the system.

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}, \quad B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix}, \quad C = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$