EC 304 CIRCUIT THEORY AND NETWORKS
Contact: 4P
Credits: 4

Prerequisites: Basic Electrical

Course objective:

The objective of the course is to understand the analysis of circuits using Kirchhoff's current and voltage laws (KCL and KVL), theorems, create current and voltage equations, solve various cases of problems.

Module 1

Resonant Circuits: Series and Parallel resonance, Impedance and Admittance Characteristics, Quality Factor, Half Power Points, Bandwidth, Phasor diagrams, Practical resonant and series circuits. 4L

Module 2

Mesh Current Network Analysis: Kirchoff's Voltage law, Formulation of mesh equations, Solution of mesh equations by Cramer's rule and matrix method, Solution of problems with DC and AC sources. 3L

Node Voltage Network Analysis: Kirchoff's Current law, Formulation of Node equations and solutions, Solution of problems with DC and AC sources. 3L

Module 3

Network Theorems: Definition and Implication of Superposition Theorem, Thevenin's theorem, Norton's theorem , Reciprocity theorem, Compensation theorem, maximum Power Transfer theorem , Millman's theorem, Star delta transformations , Solutions and problems with DC and AC sources. 10L

Graph of Network: Concept of Tree and Branch, tree link, junctions, Incident matrix, Tie set matrix, Determination of loop currents and node voltages. 6L

Two Port Networks: Relationship of Two port network variables, short circuit admittance parameters, open circuit impedance parameters, transmission parameters, relationship between parameter sets. 6L

Module 4

Circuit transients: DC transients in R-L and R-C Circuits with and without initial charge, R-L-C Circuits, AC Transients in sinusoidal R-L, R-C and R-L-C Circuits, Solution of Problems. 6L

Laplace transform: Concept of Complex frequency , transform of f(t) into F(s) , transform of step, exponential, over damped surge, critically damped surge, damped and un-damped sine functions, properties of Laplace transform , linearity, real differentiation, real integration, initial value theorem and final value theorem, inverse Laplace transform , application in circuit analysis, Partial fraction expansion, Heaviside's expansion theorem, Solution of problems. Laplace transform and Inverse Laplace transform. 6L

Learning outcomes:

At the end of course student should analyze a circuit given sinusoidal inputs. Compute average power consumed or supplied by a circuit. Design simple circuits for maximum power transfer to a load.

	a	b	C	d	e	f	g	h	i	j	k	l
	√		√	√	√							

Reference Books:

1. A.B.Carlson-Circuits- Cenage Learning
2. John Bird- Electrical Circuit Theory and Technology- 3/e- Elsevier (Indian Reprint)

3. Skilling H.H.: “Electrical Engineering Circuits”, John Wiley & Sons.
4. Edminister J.A.: “Theory & Problems of Electric Circuits”, McGraw-Hill Co.
5. Kuo F. F., “Network Analysis & Synthesis”, John Wiley & Sons.
6. R.A.DeCarlo & P.M.Lin- Linear Circuit Analysis- Oxford
7. P.Ramesh Babu- Electrical Circuit Analysis- Scitech
8. Sudhakar: “Circuits & Networks:Analysis & Synthesis” 2/e TMH
9. M.S.Sukhija & T.K.NagSarkar- Circuits and Networks-Oxford
10. Sivandam- “Electric Circuits and Analysis”, Vikas
11. V.K. Chandna, “A Text Book of Network Theory & Circuit Analysis”,Cyber Tech
12. Reza F. M. and Seely S., “Modern Network Analysis”, Mc.Graw Hill .
13. M. H. Rashid: “Introduction to PSpice using OrCAD for circuits and electronics”, Pearson/PHI
14. Roy Choudhury D., “Networks and Systems”, New Age International Publishers.
15. D.Chattopadhyay and P.C.Rakshit: “Electrical Circuits” New Age

EC301 DIGITAL ELECTRONICS & COMPUTER ARCHITECTURE

Contact: 4P

Credits: 4

Prerequisites: Mathematics (1st year)

Objective: The main objective of this course is to obtain a basic level of Digital Electronics knowledge and set the stage to perform the analysis and design of complex digital electronic circuits.

Module 1:

Number systems and arithmetic (Fixed and floating point) **6L**

Module 2: Combinational logic analysis and design: logic minimisation methods, Combinational design using MSI, LSI and PLDs **8L**

Module 3: Sequential logic design: latches and flip-flops (SR,D,JK,T), Setup and Hold time , Clock frequency, , counters, shift registers **8L**

Module 4: Finite state machine design, ASM charts, state minimization, state assignment, synthesis using D-FF and JK-FF **6L**

Module 5: Logic families (TTL, ECL, CMOS, BICMOS), Delay, Hazards, MSI devices as state machines, Memory cells. **6L**

Module 6: **6L**

Introduction to computer architecture (basic idea): Instruction Set, Architecture, Processor Design: Data path, Control unit, Instruction types, addressing modes, pipelining.

P.O TABLE

Paper Code	a	b	c	d	e	f	g	h	i	j	k	l
EC301	√	√			√							

P.O STATEMENT

1. Engineering knowledge: Students will be able to apply this knowledge in professional field.
2. Problem analysis: Strong foundation in theoretical/experimental work for being able to analyze, synthesize and design engineering products (eg digital electronics

3. Modern tool usage: Competence to acquire knowledge on one's own through libraries/online journals for contributing to knowledge assimilation, creation, dissemination & life-long learning;

Learning Outcome: Idea of history and development of digital electronics.

1. Recognize the number systems use in digital logic design and its conversion.
2. Identify and describe the six basic logic gates and combinational circuits in digital electronics.
3. Identify and describe flip-flop circuits.
4. Describe and demonstrate the use digital test equipment and its operating characteristics.
5. Examine purpose of digital integrated circuits.

Textbooks:

1. A.Anand Kumar, Fundamentals of Digital Circuits- PHI
2. A.K.Maini- Digital Electronics- Wiley-India
3. Kharate- Digital Electronics- Oxford

Reference:

1. Morries Mano- Digital Logic Design- PHI
2. R.P.Jain—Modern Digital Electronics, 2/e , Mc Graw Hill
3. H.Taub & D.Shilling, Digital Integrated Electronics- Mc Graw Hill.
4. D.Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
5. Givone—Digital Principles & Design, Mc Graw Hill
6. Tocci, Widmer, Moss- Digital Systems,9/e- Pearson
7. S.K.Mandal, Digital Electronics Principles and Applications- Mc Graw Hill.
8. J.Bignell & R.Donovan-Digital Electronics-5/e- Cenage Learning.
9. Leach & Malvino—Digital Principles & Application, 5/e, Mc Graw Hill
10. Floyed & Jain- Digital Fundamentals-Pearson.
11. P.Raja- Digital Electronics- Scitech Publications
12. S.Aligahanan, S.Aribazhagan, Digital Circuit & Design- Bikas Publishing

EC302 SIGNALS AND SYSTEMS
Contact: 3P
Credits:

Prerequisite: Basic Electronics

Program Objectives:
Objective of the course is to understand signal types, properties and analysis, demonstrate and understand the fundamental properties of linear time-invariant systems.

Module 1

Introduction to signal and systems:

Continuous and discrete time signals: Classification of Signals – Periodic aperiodic even – odd – energy and power signals – Deterministic and random signals – complex exponential and sinusoidal signals – periodicity –unit impulse – unit step – Transformation of

independent variable of signals: time scaling, time shifting. System properties: Linearity Causality, time invariance and stability. **8L**

Module 2

Time domain analysis of discrete-time and continuous time systems:

Natural response, forced response, impulse response, representation of discrete time signals, properties of convolution, Convolution in time (both discrete and continuous), deconvolution, correlation of two sequences. **5L**

Module 3

Fourier series analysis of continuous-time periodic sigals:

Dirichlet' conditions, Determination of Fourier series , coefficients of signal, symmetry conditions, properties of CTFS. **7L**

Module 4

Signal Transformation:

Fourier transformation of continuous-time signals, fourier transform of standard signals, properties of fourier transform. Z-Transforms: Basic principles of z-transform - z-transform definition –, Relationship between z-transform and Fourier transform, region of convergence – properties of ROC – Properties of z-transform – Poles and Zeros – inverse z-transform using Contour integration - Residue Theorem, Power Series expansion and Partial fraction expansion. **10L**

Module 5

Sampling Theorem: Representation of continuous time signals by its sample –Types of sampling, Sampling theorem. Reconstruction of a Signal from its samples, aliasing –sampling of band pass signals. **4L**

Learning Outcome:

1. Identify, formulate and solve problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.
2. In-depth knowledge that allows a fundamentals-based principles ,analytical approach of linear time variant system.
3. Create, select and apply appropriate techniques, resources, and matlab tools, including programme and modelling with an understanding of the limitations
4. Understand the impact of solutions for response of any system and knowledge for implementation of those system for future development.

	a	b	c	d	e	f	g	h	i	j	k	l
	√		√	√	√							

Text books:

1.B.P. Lathi-Linear sysytems and signals, Oxford
2. P.Ramesh Babu, R. Anandanatarajan- Signals & systems, Scitech
3. A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals & Systems, Pearson
4. S.Haykin & B.V.Veen, Signals and Systems- John Wiley
5. A.Nagoor Kani- Signals and Systems- McGraw Hill

References:

1. J.G.Proakis & D.G.Manolakis- Digital Signal Processing Principles, Algorithms and Applications, PHI.
2. C-T Chen- Signals and Systems- Oxford

EC303 SOLID STATE DEVICES
Contact: 3P
Credits: 3
Lectures: 40
Pre-requisites: College Mathematics with PDE. Modern Physics with Q. Mech
Program objectives:
1. Understanding of solid-state device physics at an introductory level.
2. Understanding of basic circuit uses of solid-state devices
Module 1**: Energy Band Theory 8L**
Energy Bands in Matter 3L
Concept of Schrodinger's equation in formation of energy bands in crystal. Free electron theory, Band theory, formation of allowed and forbidden energy bands, Concept of effective mass – electrons and holes, Hall effect.
Semiconductors 5L
Semiconductors and insulators –direct & indirect band gaps, Fermi-Dirac distribution function
(temperature dependence-qualitative discussions). Fermi level for intrinsic and extrinsic semiconductors (dependence on temperature and doping concentration viz. p type, ntype, p-n, npn and pnp); Diffusion and drift current Generation and recombination, quasi-Fermi energy level
Module 2: **Device Fabrication and Junctions 16L**
Device Fabrication Technology 6L
Semiconductor crystal structure, growth of single crystal silicon with Czokralski process, Photolithography, Common methods of device growth: Chemical Vapour Deposition, Vapour
Phase Epitaxy, Molecular Beam Epitaxy, Liquid Phase Epitaxy. Formation of p-n junction.
Junctions 4L
I-V relation, Junction capacitances, Homo- and Hetero-junctions –examples of semiconductor-semiconductor junction (Homo) & Metal-metal, Metal-S.C. junctions (Hetero-), application of Diode capacitance in Varactor Diodes, Diode switching, Law of junctions, Plot of junction voltage, field and depletion charge with distance by solving simple 1D
Poisson's Equation,
Diodes 6L
Classification of different types of diode on the basis of doping concentration: rectifier diode,
Zener diode, tunnel diode, photodiodes, photo voltaic effects, PNPN transistors - simple working principle, I-V characteristics
Module 2: **Transistors 16L**
Bipolar Junction Transistor 8L
Physical mechanism, current gain, minority current distribution; Solution of continuity equation

and Poisson's equation for BJT. Punch-through and avalanche effect; Frequency limitations, high
frequency transistors, Power transistors.

Field Effect Transistors 8L

Field effect transistors: MOS-capacitors, flat band and threshold voltages; p and n channel MOSFETS, CMOS and VLSI MOSFETS, channel modulation & channel isolation, channel inversion, Ideal Threshold voltage , depletion width, surface field and potential (gradual channel & depletion approximations); I-V characteristics with expressions for saturation and non-saturation regions; Equivalent circuit for MOSFET, MOSFET for VLSI -scaling issues (basic concept of Short Channel Effects only),

Learning outcomes:

1. Understand the basic physics of electrons in solids and carriers and carrier transport in semiconductors.
2. Understand the physics and design elements of p-n junctions,silicon MOSFETs, homojunction
bipolar transistors.
3. Introduction to advanced contemporary devices qualitatively.

1	2	3	4	5	6	7	8	9	10	11	12
√	√	√		√		√	√	√			

Text Books :

1. Streetman & Banerjee, "Solid State Electronic Devices", Pearson Prentice Hall
2. Neamen- Semiconductor Physics and Devices TMH
3. Bhattacharya & Sharma- Solid State Electronic Devices- Oxford
4. Maini & Agrawal- Electronics Devices and Circuits- Wiley

Reference Books :

1. Sze & Tg, "Physics of Semiconductor Devices" Wiley Inter Science
2. Milman, Halkias & Jit- Electronics Devices and Circuits- TMH
3. Bell-Electronics Devices and Circuits-Oxford
4. Bhattacharya & Sharma- Solid State Electronic Devices- Oxford
5. Singh & Singh- Electronics Devices and Integrated Circuits –PHI
6. Bogart, Bisley & Rice- Electronics Devices and Circuits- Pearson

Environment and Ecology
Paper code: CH301
Contacts: 3L
Credits: 2

Module 1
General: Definition, Scope & Importance, Need For Public Awareness- Environment definition, Eco system – Balanced ecosystem, Material cycles- Carbon, Nitrogen and Sulphur Cycles. Human activities – Food, Shelter, Economic and social Security. Basics of Environmental Impact Assessment. Sustainable Development. 5L

Module 2:
Natural Resources: Water Resources- Availability and Quality aspects. Water borne diseases, Water induced diseases, Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Rain water harvesting, 3L
Forest Resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. 1L
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources. 1L
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. 2L
Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources Different types of energy, Electro-magnetic radiation. Conventional and Non-Conventional sources – Hydro Electric, Fossil Fuel based, Nuclear, Solar, Biomass and Bio-gas. Hydrogen as an alternative future source of Energy. 2L

Module 3
Pollution: Population Growth and Urbanization 2L Environmental Pollution and their effects (Previous disaster) 1L Air Pollution (Atmospheric structure, Primary and Secondary pollutant, Green house effect and Global warming, Acid Rain, Ozone Layer depletion, Smog, Control measure). 3L Water pollution (Effects of heavy metals, Sewage, BOD, COD, Water treatment). 3L

Land pollution and Solid waste management. Noise pollution, e-Waste. 4L

Module 4
Environmental Management:
Objectives, components, Environmental Impact Assessment-basic elements, design.
Environmental Audit for sustainable development

Green chemistry: Introduction, Goals Significance, Basic ideas in the field of green chemistry research. Industrial applications of green chemistry. 2L

Reference Books
1. Garg, S.K and Garg, R., Ecological and Environmental Studies, Khanna Publishers, Delhi, 2012.
2. Henry J.G. and Heinke G.W., Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, New Delhi, 2004.

3. Masters G.M., Introduction to Environmental Engineering and Science, 2nd Edition, Prentice Hall of India, New Delhi, 2004.

M(ECE)-301
MATHEMATICS FOR ELECTRONICS & COMMUNICATION ENGG
Contact: 4P
Credits: 2

Linear Algebra: Basis, Vector Spaces and Subspaces, Inverse by partitioning, Linear Transformations, Rank and Echelon matrices, Homogeneous linear equations, Basic Solutions, Similarity, Symmetric matrices, Diagonalization, Quadratic forms, Rotation of co-ordinates, Orthogonal Transformations. Probability Theory and Applications: Random Variables and Transformations, Bernoulli, Binomial, Poisson, Uniform, Gaussian, Raleigh, Ricean probability distributions, Expectations, Moments and generating functions, Inequalities, Limit Theorems, Random Processes, Markov and Poisson Random processes, Error function, Complementary Error function, Q function and their applications Theory of Complex variables: Functions of Complex variables, Cauchy-Riemann equations, Properties of analytic functions, Conformal mapping, Line Integrals in a complex plane. Cauchy's Theorems, Evaluation of standard real line integrals using contour integration. Numerical Methods: Introduction, Solution of equations by iteration, Interpolation, Numerical Integration and Differentiation, Solution of Linear equations and Differential equations. Finite fields and PN sequences: Polynomials and Euclidean algorithm, constructing finite fields, subfields, Properties of PN sequences, Generation of PN sequences application of PN sequences

TEXT BOOKS:

E. Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 1993.
G. Strang, Linear Algebra and its applications, Cenage Learning, 2006
C.W. Therrien and M. Tummala, Probability for Electrical and Computer Engineers, CRC Press, 2005.
T.K Moon and W.C Stirling, Mathematical Methods and Algorithms for Signal Processing, Pearson Education, 2000.

1. Introduction to Digital Electronics Lab- Nomenclature of Digital Ics, Specifications, Study of the Data Sheet, Concept of Vcc and Ground, Verification of the Truth Tables of Logic Gates using TTL ICs.

2. Implementation of the Given Boolean Function using Logic Gates in Both Sop and Pos Forms.

3. Verification of State Tables of Rs, J-k, T and D Flip-Flops using NAND & NOR Gates

4. Implementation and Verification of Decoder/De-Multiplexer and Encoder using Logic Gates.

5. Implementation of 4x1 Multiplexer using Logic Gates.

6. Implementation of 4-Bit Parallel Adder Using 7483 IC.

7. Design , and Verify the 4- Bit Synchronous Counter

8. Design, and Verify the 4-Bit Asynchronous Counter.

9. Simulation of MOS Inverter with different loads using PSPICE software

10. Simulation of CMOS Inverter for different parameters Kn, Kp as a design variable in suitable circuit simulator software.

11. Design of a 4-bit Multiplexer using VHDL\Verilog

12. Design of a decade counter using VHDL\Verilog.

13. Design of a 3-input NAND gate and its simulation using suitable logic simulator

1. Introduction to Digital Electronics Lab- Nomenclature of Digital Ics, Specifications, Study of the Data Sheet, Concept of Vcc and Ground, Verification of the Truth Tables of Logic Gates using TTL ICs.

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2015

B. TECH. (3rd Sem)

(ECE)

Paper Name : Circuit Theory and Networks

Paper Code : EC-304

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for Part-A and Part-B.

PART - A

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following : $1 \times 5 = 5$

   i) The internal resistance of an ideal voltage source is

   a) 0

   b) ∞

   c) 1

   d) $\frac{1}{2}$

ii) In the series circuit, the resonance condition is

a) $X_L = X_C$

b) $X_C = 0$

c) $X_L = 0$

d) $X_C = 1$.

iii) For inductor, the current _____ from voltage.

a) 90° leads

b) 90° lags

c) 45° leads

d) 30° lags.

iv) Energy stored in a inductor is

a) $\frac{1}{2}LI^2$

b) 0

c) $\frac{1}{4}LI^2$

d) 1

v) Maximum power transfer occurs at circuit efficiency of

a) 100%

b) 50%

c) 70%

d) 30%

vi) The nodal analysis is based on

a) KCL and KVL

b) KVL

c) KCL

d) None of these.

vii) In a Thevenin's equivalent circuit $V_{th} = 10V$ and $R_{th} = 5\Omega$, then the current flowing through load is

a) 2 A

b) 1 A

c) less than 2A

d) more than 2 A.

viii) Capacitor blocks

a) DC signal

b) AC signal

c) Both AC and DC

d) None of these.

GROUP - B

(Short Answer Type Questions)

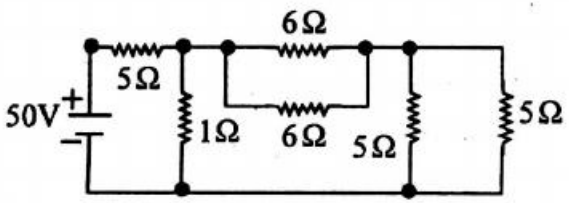
Answer any **three** of the following : 5×3=15

2. Explain the current division and voltage division rules. $2\frac{1}{2}+2\frac{1}{2}=5$

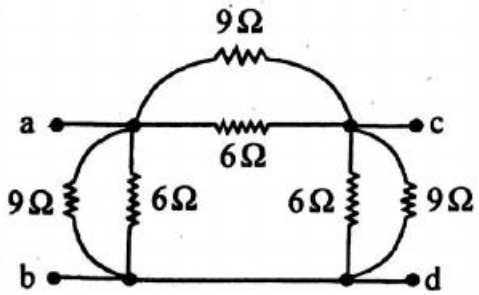
3. Derive delta to star transformation formula of an electric network. 5

4. What is Reciprocity theorem in electric circuit? Write down the limitation of this theorem. 4+1=5

5. Calculate the equivalent resistance of the following combination of resistors and source current: 5

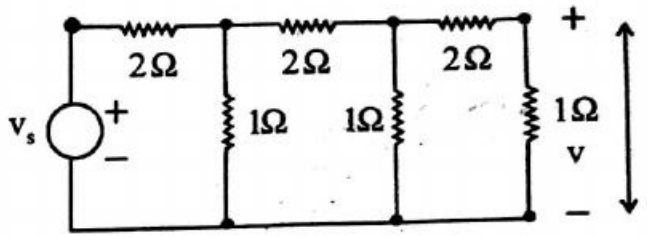


6. Find out equivalent star-network.



5

7. Find out V interms of V_s only. 5

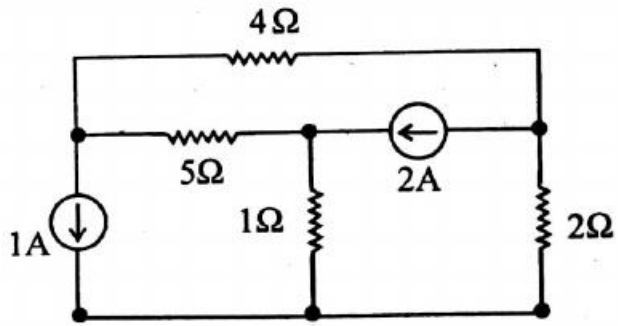


GROUP - C

(Long Answer Type Questions)

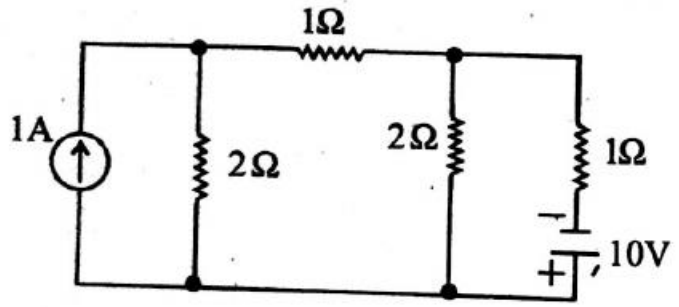
Answer any **one** of the following : 15×1=15

8. a) Using nodal method, find current and voltage drop in 5Ω resistor.



$7\frac{1}{2}$

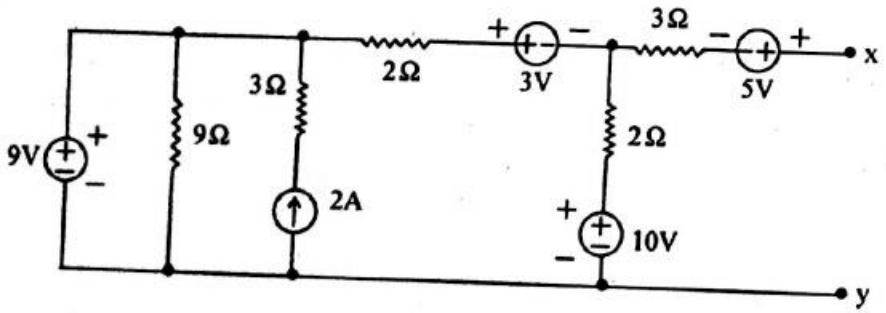
b) Using mesh analysis, obtain the current through 10V battery for the Ckt (circuit) shown.



$7\frac{1}{2}$

9. a) Explain about Thevenin's theorem with proper circuit diagrams. $7\frac{1}{2}$

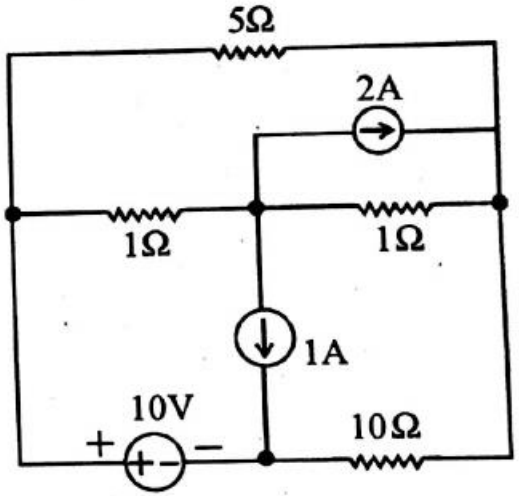
b) Find Thevenin's equivalent circuit across x–y terminals.



$7\frac{1}{2}$

10. a) State superposition theorem in electrical circuits. 5

b) Find the current in the 10Ω resistor using superposition theorem.



10

PART-B

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following : $1\times5=5$

   i) A dc voltage V is applied to series RL circuit at t = 0. The current at time t is

   a) $\frac{V}{R}e^{-\frac{Rt}{L}}$

   b) $\frac{V}{R}\left(1-e^{-\frac{Rt}{L}}\right)$

   c) $\frac{V}{R}e^{\frac{Rt}{L}}$

   d) 0

   ii) A capacitor C is charged to voltage V. It is connected to a resistor R at t = 0. The voltage across the capacitor at t is

   a) $Ve^{-\frac{t}{RC}}$

   b) $Ve^{\frac{t}{RC}}$

   c) $V\left(1-e^{-\frac{t}{RC}}\right)$

   d) $V\left(1-e^{\frac{t}{RC}}\right)$

   iii) An inductor at time $t = 0^+$, with zero initial current acts as a

   a) short circuit

   b) open circuit

   c) constant voltage source

   d) constant current source.

   iv) Transient current in a circuit results from

   a) voltage applied to circuit

   b) impedance of the circuit

   c) resistance of circuit

   d) changes in stored energy in inductor and capacitor.

   v) Kirchhoff's laws fail in the case of

   a) linear network

   b) non-linear network

   c) dual network

   d) distributed parameter.

   vi) If all the n sources in a linear network are multiplied by a factor of m, the response is multiplied by

   a) n

   b) m

   c) mn

   d) n/m.

vii) A minimum reactance function is one where

a) no zeros at origin

b) no poles at origin

c) no zero at imaginary axis

d) no poles at imaginary axis.

viii) The impulse response of a single pole system would approach a non-zero constant as $t \to \infty$ if and only if the pole is located in

a) –ve real axis

b) at origin

c) on +ve real axis

d) an imaginary axis.

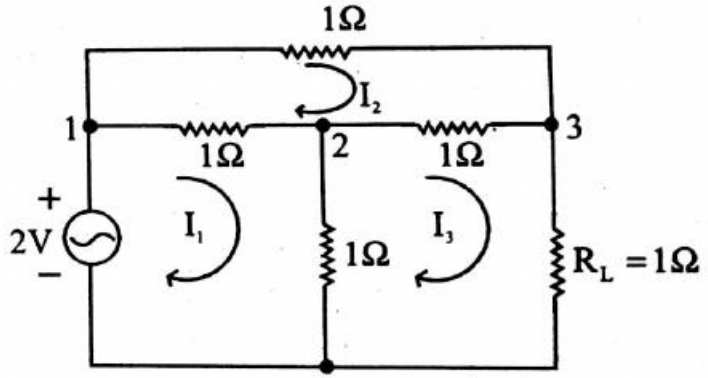
GROUP - B

(Short Answer Type Questions)

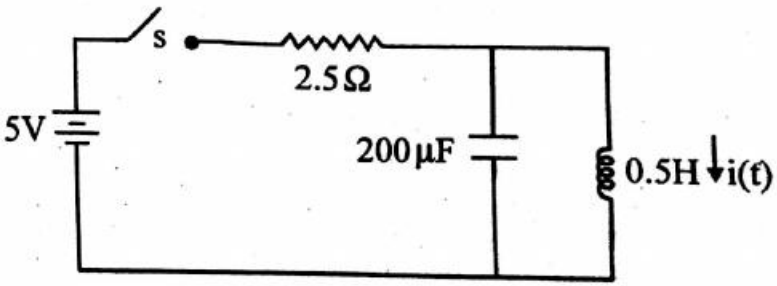
Answer any **three** of the following : 5×3=15

2. Explain the dual network. Are dual network inverse network? Prove that product of driving point impedance of two dual network is constant. 5

3. Transform the voltage source in following figure into equivalent current source and find out the current in R_L: 5

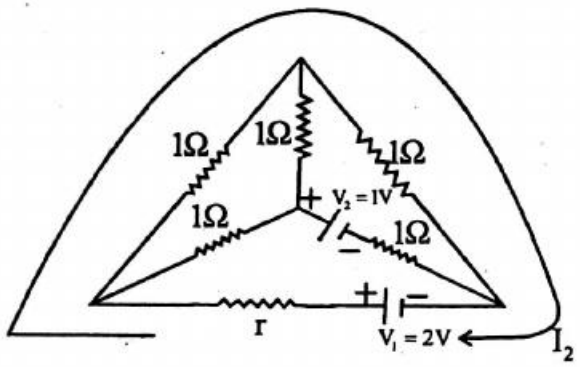


4. In the network shown below the switch S is closed and a steady state is attained. If the switch is opened at t = 0 then find out i(t) through L. 5



5. State and prove maximum power transfer theorem in an electric circuit. 5

6. In the following circuit determine the value of r so that the current supplied by V_2 is zero. 5

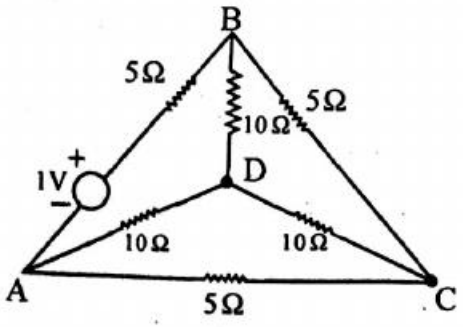


GROUP - C

(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

7. For the following network write down the tie set. What are the branch voltages? 15



8. i) Consider $\frac{P_1(s)}{q(s)} = \frac{s^2+3s+4}{s+2}$

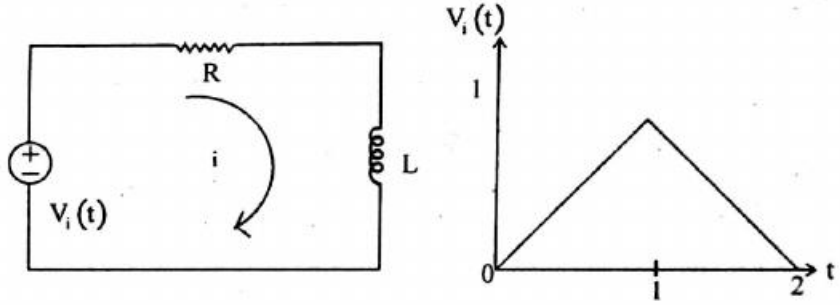
Write the direct converted result after applying Heaviside's partial fraction expansion.

ii) Solve the following equation :

$2\ddot{x} + 7\dot{x} + 6x = 0 \quad x(0) = 0 \;\&\; \dot{x}(0) = 1.$

5+5+5=15

9. A triangular wave is applied as input to a series R-L circuit with $R = 2\Omega$, $L = 2H$. Calculate i(t):



15

2015

B. TECH. (3rd Sem)

(ECE)

Paper Name : Digital Electronics and Computer Architecture

Paper Code : EC-301

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for Part-A and Part-B.

PART - A

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following : 1×5=5

   i) How many clock pulses are required to completely load serially an 8-bit shift register?

   a) 8

   b) 7

   c) 4

   d) 5

ii) In a _____ shift register, data is entered into a register 1 bit at a time and all data outputs at a time.

a) SIPO

b) SISO

c) PIPO

d) PISO

iii) The number of flip-flops required for a MOD-5 counter is

a) 1

b) 2

c) 3

d) 4.

iv) Ring shift and Johnson counters are

a) synchronous counter

b) asynchronous counter

c) binary counter

d) both (a) & (c).

v) A twisted ring counter consisting of 6 flip-flops, will have

a) 6 states

b) 12 states

c) 64 states

d) 128 states.

vi) Which logic family is fastest?

a) TTL

b) ECL

c) RTL

d) CMOS

vii) Which part interprets instructions and initiates control operation?

a) Input

b) Storage unit

c) Logic unit

d) Control unit

viii) An ALU makes use of _____ to store the intermediate results.

a) Accumulator

b) Internal register

c) Stack

d) Heap.

GROUP - B

(Short Answer Type Questions)

Answer any **three** of the following : 5×3=15

2. Design asynchronous MOD5 UP counter. Draw its timing diagram. 5

3. Design 4 bit SISO register. Draw its timing diagram. 5

4. Write a short note on triggering of flip-flops. 5

5. Draw and explain the operation of TTL NAND Gate. 5

6. Describe the characteristics of digital IC's as Fan-In, Power dissipation, Speed of Operation. 5

7. Draw the block diagram of basic CPU Architecture and explain its components. 5

GROUP - C

(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

8. a) Design a 4 bit Ring counter. Explain its operation with timing diagram. 8

   b) What do you mean by Lock Out in Ring Counter? Design self correcting Ring Counter to avoid Lock Out. 7

9. a) Define MOORE circuit with block diagram. 5

   b) List the steps involved in the design using ASM charts. 5

   c) Design a synchronous counter with irregular sequence as - 5

   1 — 3 — 4 — 6 — 2 — 1 — 3.....

10. a) Design MOD 6 synchronous UP Counter. 9

    b) Design MOD 5 Ripple Counter. 6

PART - B

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following : $1 \times 5 = 5$

i) Sum of the two binary numbers $+(11101.01)_2$ and $-(100110.10)_2$ is

a) $-(001001.01)_2$

b) $-(101001.01)_2$

c) $-(010001.01)_2$

d) $-(101001.01)_2$

ii) The difference of two decimal numbers 690.15–569.28 using BCD notation is

a) 0010 0010 0000·1000 0111

b) 0001 0010 0001·1000 0111

c) 0001 0010 0101·1001 1000

d) 0011 0010 0101·1000 0111

iii) The SOP form of $(A+B+\bar{C})\ (\bar{A}+B+\bar{C})\ (\bar{A}+B+C)\ (A+B+C)$

a) $\bar{A}B\bar{C} + \bar{A}BC + AB\bar{C} + ABC$

b) $\bar{A}B\bar{C} + A\bar{B}\bar{C} + AB\bar{C} + ABC$

c) $\bar{A}B\bar{C} + \bar{A}BC + \bar{A}B\bar{C} + ABC$

d) $\bar{A}B\bar{C} + \bar{A}BC + AB\bar{C} + A\bar{B}\bar{C}$

iv) Which of the following uses the least power?

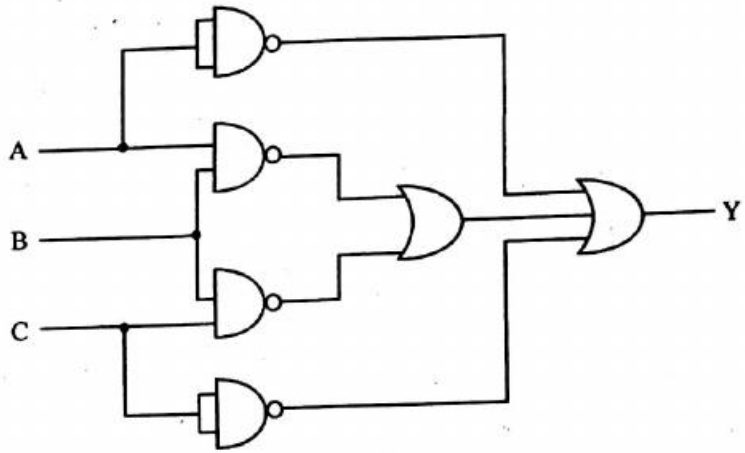
a) TTL

b) ECL

c) CMOS

d) DTL

v) For the logic circuit below, the output Y is equal to



a) $\overline{ABC}$

b) $\bar{A} + B + \bar{C}$

c) $A\bar{B} + B\bar{C}$

d) $ABC + \bar{A}B\bar{C}$.

vi) The minimum number of NAND gates required to implement $A + A\bar{B} + A\bar{B}C$ are

a) 1
b) 4
c) 7
d) 0

vii) With 4 Boolean variables, how many Boolean expressions can be formed ?

a) 16
b) 256
c) 1024
d) 64K

viii) The minimum number of 2-input NAND gates to design a full adder is

a) 10
b) 8
c) 9
d) 12.

GROUP - B

(Short Answer Type Questions)

Answer any **three** of the following : 5×3=15

2. Show that for a 3-variable function F(A, B, C,)

$F(\underline{A, B, C}) = \Pi\ M\ (0, 1, 4, 5)$

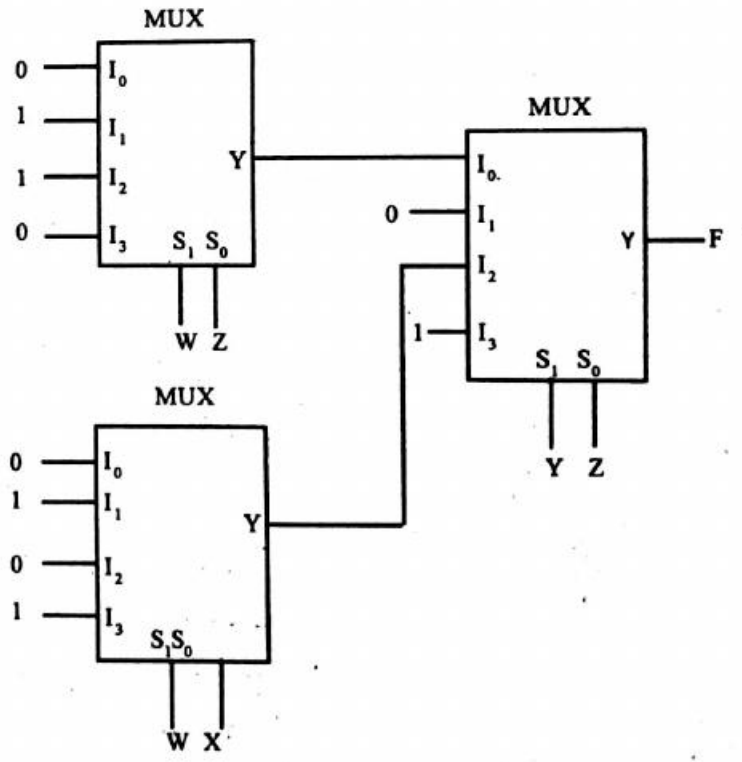
the F(A, B, C) is $\Pi\ M(2, 3, 6, 7)$

3. Express the function F(X, Y, Z) = (XY + Z) (Y + XZ) in canonical POS form.

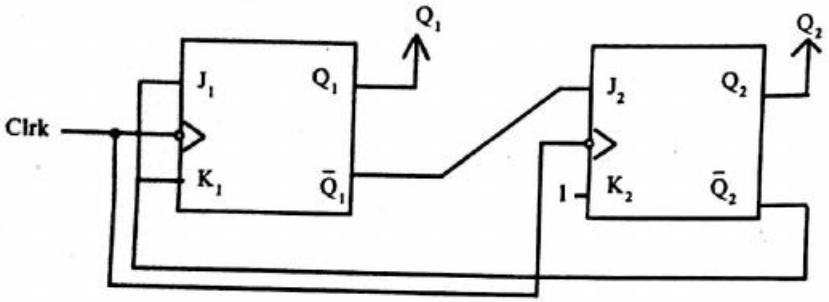
4. Find out the essential prime implicants and the minimum SOP expression for the following function :

$F(W, X, Y, Z) = \Sigma m(0, 1, 2, 3, 5, 7, 11, 15)$

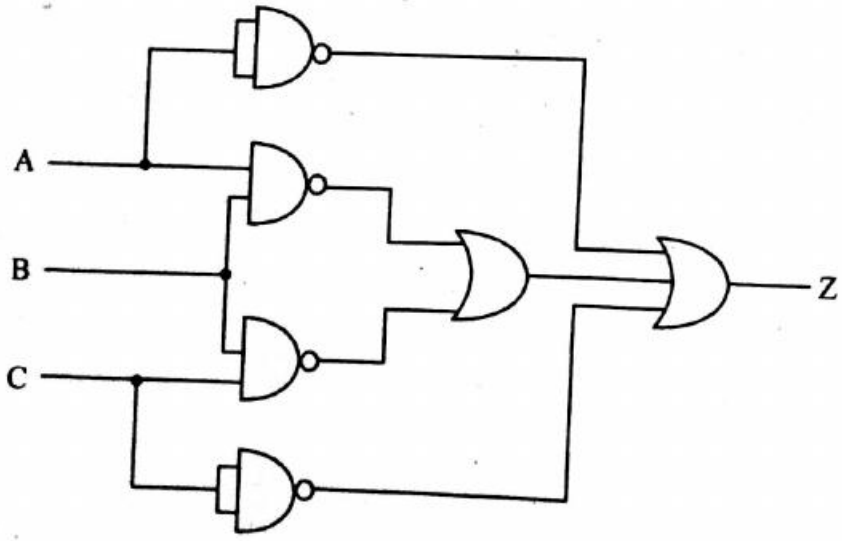
5. Find out the expression of F for the following circuit using three 4-to-1 MUXs.



6. For the following circuit using JK flip-flops find out count sequence with clocks



7. Find out the expression for z for the following circuit :



GROUP - C

(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

8. Simplify the following Boolean expression using Quine-McClusky method

$Y(A, B, C, D) = \bar{A}BC\bar{D} + A\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + AB\bar{C}D + AB\bar{C}\bar{D}$.

9. Simply the following Boolean expression using Quine-McClusky method

$Y(A, B, C, D) = \sum m(6, 8, 1, 12, 13)$

10. Design a circuit using comparators to output a logic-1 whenever a number $X = X_3X_2X_1X_0$ whenever the input X satisfies the condition $4<X<12$.

2014

B. TECH (3rd Sem)

(ECE)

Paper Name : Digital Electronics & Computer Architecture

Paper Code : EC-301

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for Part-A and Part-B.

PART–A

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives of the following : $1 \times 5 = 5$

i) A set of flip-flops integrated together is called

a) Counter

b) Adder

c) Register

d) None of these.

ii) The number of Full and Half adder required to add 6 bit number is

a) 1H/A, 5F/A

b) 8H/A, 8F/A

c) 4H/A, 12F/A

d) 16H/A, 0F/A.

iii) 8085 micro-processor is a

a) 8 bit

b) 16 bit

c) 64 bit

d) 4 bit processor.

iv) The Logical Signal that either disables or enables a logic circuit is called the

a) Control signal

b) Chip enable/disable signal

c) Strobe signal

d) All of the above.

v) If an IC contains around 50 gates per chip, then it will come under which of the following techniques?

a) LSI

b) MSI

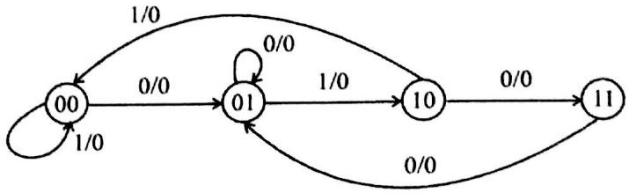
c) SSI

d) VLSI.

Group - B

(Short Answer Type Questions)

Answer any **three** of the following: 5×3=15

2. 

From the given state diagram construct the State table and Exitation table. 5

3. Draw the circuit diagram of TTL NAND gate and explain its functions. 5

4. Draw and explain the 1 bit memory cell using transistor. 5

5. Briefly describe state diagram and state table for logical operation. $2\frac{1}{2}\times2$

6. a) Define fan-in and fan-out of a logic circuit. 3

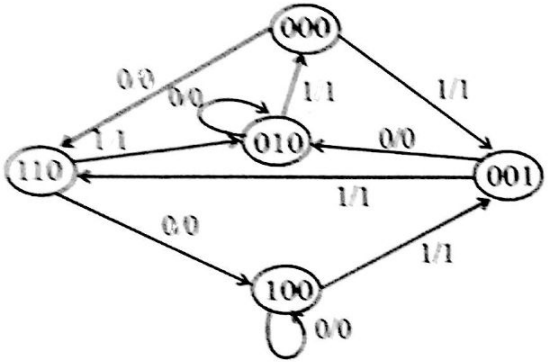
   b) Describe briefly Noise-Immunity of a logic gate. 2

7. What is BiCMOS Logic Circuits? With suitable illustration explain its functioning. 5

Group - C
(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

8. a) Implement the following state diagram using D-F F. 12



b) What is state reduction? 3

9. a) What is BUS in Computer Architecture? 3

b) Discuss different kinds of BUSes used in processor with Block diagram. 12

10. Write short notes (any **three**): 5×3

a) Static RAM

b) EPROM

c) TTL Logic

d) Preset & Clear of F/F.

PART - B
(Marks : 35)
Group - A
(Multiple Choice Type Questions)

11. Choose the correct alternatives of the following : 1×5=5

i) The binary equivalent of 57 decimal is

a) 111001

b) 01010111

c) 101111

d) 010111.

ii) The code used to reduce the error due to the ambiguity in reading a binary encode is

a) Octal code

b) Excess-3 code

c) BCD code

d) Gray code.

iii) The minimum number of NAND gates required to implement $A + A\bar{B} + A\bar{B}C$ is

a) 0

b) 1

c) 4

d) 7.

iv) For a binary half-subtractor having two inputs A and B, the correct logic expressions for the difference (D) and the borrow (X) are

a) $D = AB + \bar{A}B,\ X = \bar{A}B$

b) $D = \bar{A}B + A\bar{B},\ X = A\bar{B}$

c) $D = \bar{A}B + A\bar{B},\ X = \bar{A}B$

d) $D = AB + \bar{A}\bar{B},\ X = A\bar{B}$.

v) A pulse train with a frequency of 1 MHz is counted using MOD-1024 ripple counter built with JK flip-flops. For proper operation of the counter, the maximum permissible delay per flip-flop is

a) 100 nsec

b) 50 nsec

c) 20 nsec

d) 10 nsec.

Group - B

(Short Answer Type Questions)

Answer any **three** of the following. 5×3=15

12. What is BCD code? What are the rules for BCD addition? Explain with suitable examples. 1+2+2

13. a) Perform the following subtraction using

i) 1's complement method

ii) 2's complement method

iii) $(11010)_2 - (10000)_2$

iv) $(1000100)_2 - (1010100)_2$

b) Perform the following operation

$(738)_8 - (123)_{16} + (100)_{10}$. 1+1+3

14. What is meant by canonical SOP form? Convert the following function in canonical SOP form:

$F(A,B,C,D) = \bar{A} + BC\bar{D} + A\bar{C}$. 5

15. Design a combinational circuit with three input variables that will produce logic-1 output when more than one input variables are logic-1. 5

16. Design a MOD-6 asynchronous counter using JK flip-flop and other necessary logic gates. 5

Group-C

(Long Answer Type Questions)

Answer any **one** of the following: 15×1=15

17. Implement the following output functions using suitable PLA

$F_1(A,B,C,D) = \Sigma m(3,7,8,9,11,15)$

$F_2(A,B,C,D) = \Sigma m(3,4,5,7,10,14,15)$

$F_3(A,B,C,D) = \Sigma m(1,5,7,11,15)$ 15

18. Draw a neat diagram of Master/Slave JK flip-flop using NAND gates. Explain the working of the circuit for the following conditions of J and K inputs.

CLK	J	K	O/P(Q_{n+1})
0	1	0	1
1	1	1	$\overline{Q}_n$

15

19. Why the Excess-3 code is called a self-complementing code? Design a BCD-to-excess-3 code converter using truth table, K-maps and logic circuit. 3+12

2014

B. TECH (3rd Sem)

(ECE)

Paper Name : Signal and Systems

Paper Code : EC-302

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for Part-A and Part-B.

PART - A

(Marks : 35)

GROUP-A

(Multiple Choice Type Questions)

1. Choose the correct alternatives of the following : $1\times5=5$

i) Fourier transform of a sinusoidal $2\sin\Omega_0 t$ is

a) $\frac{2\pi}{j}\left[\delta(\Omega-\Omega_0)-\delta(\Omega+\Omega_0)\right]$

b) $\frac{\pi}{2j}\left[\delta(\Omega-\Omega_0)-\delta(\Omega+\Omega_0)\right]$

c) $\frac{2\pi}{j}\left[\delta(\Omega+\Omega_0)-\delta(\Omega-\Omega_0)\right]$

d) $\frac{\pi}{j}\left[\delta(\Omega-\Omega_0)-\delta(\Omega+\Omega_0)\right]$.

ii) If Fourier transform of x(t) is X(Ω) then Fourier transform of $e^{-j\Omega_0 t}x(t)$ is

a) $\frac{X(\Omega)}{\Omega_0}$ b) $X(\Omega-\Omega_0)$

c) $X(\Omega+\Omega_0)$ d) $\Omega_0 X(\Omega)$.

iii) If X(s), Y(s) and H(s) are Laplace transform of input, output and impulse response of LTI continuous time system respectively then

a) $x(t)=\alpha^{-1}\left\{\frac{H(s)}{Y(s)}\right\}$

b) $x(t)=\alpha^{-1}\left\{\frac{Y(s)}{H(s)}\right\}$

c) $x(t)=\alpha^{-1}\left\{\frac{1}{Y(s)H(s)}\right\}$

d) $x(t)=\alpha^{-1}\{Y(s)H(s)\}$.

iv) The system $y(n+2)+y(n+1)=x(n+2)$ is

a) causal and memory less

b) causal and has memory

c) causal

d) non-causal.

v) The system $y(n)=x(n)x(n-1)$ is

a) dynamic and linear

b) dynamic and non-linear

c) causal and time-invariant

d) both (b) and (c).

GROUP–B

(Short Answer Type Questions)

Answer any **three** of the following : 5×3=15

2. a) What is quarter wave symmetry in Fourier series?

b) Explain with suitable diagram of an odd and half wave symmetry waveform and evaluate co-efficients. 2+3

3. Show that x(n)*h(n), where x(n) and h(n) are i/p sequence and impulse response, will be y(n), o/p sequence. 5

4. Check whether the signal $x(t)=r(t)-r(t-2)$ is energy or power signal. Define energy signal. 4+1

5. a) What is periodic signal? Write the condition for periodicity, if a signal is a sum of two periodic signal.

   b) Check whether $\text{Cos}\left(\frac{n}{4}\right)$ is periodic or not. 1+2+2

6. Define unit step, unit ramp and unit impulse function for continuous signal. 5

GROUP–C

(Long Answer Type Questions)

Answer any **one** of the following questions : 15×1=15

7. a) Determine the trigonometric form of Fourier series of the signal shown in figure-1.

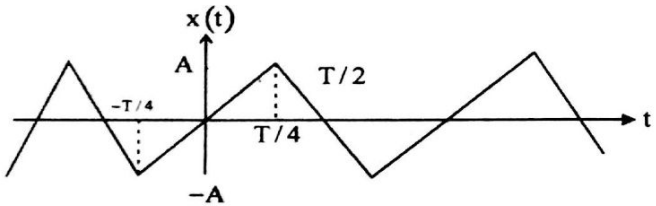


Fig-1

   b) Determine the Fourier transform of $x(t)=e^{-at}\cos\Omega_0 t\ u(t)$. 8+7

8. a) Derive the relation between Fourier and Laplace transform.

   b) Determine the inverse laplace transform of

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

   c) Perform convolution of $x_1(t)=tu(t)$ and $x_2(t)=e^{-5t}\ u(t)$. 3+7+5

9. a) Write the condition of BIBO stability for discrete system. Check whether the system is stable or not if impulse function is $h(t)=e^{-t}\cos 2tu(t)$.

   b) For a given system

$$y(t)\frac{d^2y(t)}{dt^2}+\frac{3tdy(t)}{dt}+y(t)=x(t)$$

   Check whether it is

   a) Static or dynamic

   b) Linear or non-linear

   c) Causal or non-causal

   d) Time variant or invariant. 15

PART - B

(Marks : 35)

GROUP-A

(Multiple Choice Type Questions)

10. Choose the correct alternatives of the following : $1\times5=5$

i) The probability distribution function defined as $f(x)=\left(x/\sigma^2\right)\exp\left\{x^2+a^2/2.\sigma^2\right\}.\frac{I_0ax}{\sigma^2}$ is called

a) Poisson PDF b) Binomial PDF

c) Ricean PDF d) Rayleigh PDF.

ii) Suppose events A and B are mutually exclusive (or disjoint) and P(A) = 0.3 and P(B) = 0.4. What is P(A ∪ B)?

a) 0.12 b) 0.58

c) 0.70 d) 0.88.

iii) If the frequency spectrum of a signal has a bandwidth of 500 Hz with highest frequency at 600 Hz. What should be the sampling rate according to Nyquist?

a) 200 samples/sec

b) 500 samples/sec

c) 1000 samples/sec

d) 1200 samples/sec.

iv) The phenomenon of aliasing occurs if the sampling frequency is

a) less than the Nyquist rate

b) more than the Nyquist rate

c) equal to the Nyquist rate

d) None of the above.

v) The property by which the z-transform of x(n–k) is $z^{-K}x(z)$ is called

a) linearity b) scaling

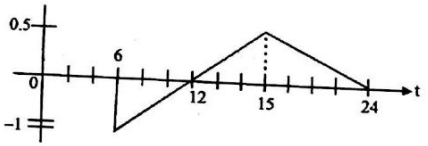
c) correlation d) time shifting.

GROUP–B

(Short Answer Type Questions)

Answer any **three** of the following : $5\times3=15$

11. For the signal x(t) shown below, find the signals



i) x(t–4)

ii) x(t/1.5)

iii) x(2t–4)

iv) x(2–t). 1+1+2+1

12. State and prove the final value theorem for z-transform.

13. Find the inverse z-transform of

$$X(z)=\frac{(z+0.8)}{(z-0.5)(z+0.2)}.$$

14. Write down the dissimilarities between a deterministic signal and a probabilistic signal.

15. Explain aliasing effect in signal reconstruction. How it can eliminate this?

GROUP–C

(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

16. Write short notes on (any **three**): 5×3

    i) Total Probability Theorem

    ii) Concept of Negative Frequency

    iii) Properties of z-transform

    iv) Nyquist Sampling Theorem.

17. i) A binary symmetric channel (BSC) error probability is Pe. The probability of transmitting 1 is Q and that of transmitting 0 is (1–Q). Determine the probabilities of

receiving 1 and 0 at the receiver. Draw proper diagrams.

    ii) What do you mean by a continuous random variable? Explain cumulative distribution function. Write down its properties. 7+8

18. i) Write down some of the application of sampling theorem.

    ii) Prove that a signal cannot be simultaneously time limited and band limited.

    iii) What is time division multiplexing?

5+5+5

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2014

B. TECH (3rd Sem)

(ECE)

Paper Name : Solid State Devices

Paper Code : EC-303

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for Part-A and Part-B.

PART - A

(Marks : 35)

GROUP-A

(Multiple Choice Type Questions)

1. Choose the correct alternative of the following : 1×5=5

i) Electrons in solids obey the following distribution function

a) Maxwell-Boltzman

b) Ferm-Dirac

c) Bose-Einstein

d) Newton-Brown.

ii) Scattering of electrons by atoms in crystal lattice causes

a) Inductance b) Resistance

c) Capacitance d) Light.

iii) Among the following which is not an N-type dopant for silicon?

a) Arsenic b) Phosphorus

c) Sulphur d) Antimony.

iv) Zener Breakdown happens in

a) Forward Bias

b) Reverse Bias

c) Foward and Reverse bias

d) High Temperature.

v) Effective Mass of electron depends on

a) Band Gap

b) Curvature of Band

c) Doping

d) Temperature.

GROUP-B

(Short Answer Type Questions)

Answer any **three** of the following: 5×3=15

2. What is law of mass action? Explain with band diagram intrinsic semiconductor, p-type and n-type semiconductors. 2+3

3. What are the variables in Schrodinger's equation? Solve the time-independent Schrodinger's equation for infinite potential well of width L. 1+4

4. a) Draw the band diagram of a p-n junction diode under equilibrium, forward bias and reverse bias.

b) Write the diode equation and draw the graph for forward and reverse bias. 3+2

5. What is drift current? Derive the equation relating drift velocity and drift current. 2+3

6. Mobility of electrons in silicon 1400 $cm^2/V\text{-}s$, concentration of electrons in an n-type semiconductor is $10^{16}/cm^{-3}$. Find out the conductivity of the sample. 5

GROUP-C

(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

7. a) Explain the formation of energy bands from discrete energy levels of individual atoms to continues energy bands in crystalline solid.

b) Explain photo-electric effect.

c) Determine the concentration of free electrons and holes in a sample of Silicon which has concentration of donor atoms is 2×10^{14} atoms/cm^3 and a concentration of acceptor atoms of 10^{15} atoms/cm^3. State whether the conductivity is primarily due to electrons and holes. 5+5+5

8. Explain with diagram the process of

a) Chemical Vapour Diposition

b) Vapour Phase Epitaxy

c) Molecular Beam Epitaxy

d) Liquid Phase Epitaxy 3+4+4+4

9. a) Explain the process of flow of current in forward biased p-n junction diode.

b) What is avalanche breakdown?

c) Calculate the drift velocity of free electrons in a metal of area cross-section $2\times10^{-4}m^{-2}$ in which current of 150A is flowing. The density of free electrons in the metal is $7.23\times10^{28}/m^3$. 5+5+5

PART - B

(Marks : 35)

GROUP-A

(Multiple Choice Type Questions)

10. Choose the correct alternative of the following : 1×5=5

i) Which of the following terms is not related to a MOSFET ?

a) Source b) Drain

c) Gate d) Collector.

ii) As channel length is reduced, the transconductance of a MOSFET

a) increases

b) decreases

c) remains constant

d) increases initially followed by a sharp decrease.

iii) The overall capacitance of a MOSFET depends on a fixed gate capacitance C_i and the voltage dependent semiconductor capacitance C_s of the channel. The inversion charge per unit area is approximately

a) $C_i\left(V_G+\frac{V_T}{2}\right)$

b) $\left(C_i+\frac{C_s}{2}\right)(V_G+V_T)$

c) $C_i(V_G - V_T)$

d) $\left(\frac{C_i + C_S}{2}\right)\left(V_G + \frac{1}{2}V_T\right)$.

iv) Which of the following does not influence the threshold voltage of a MOSFET?

a) Oxide Thickness

b) Semiconductor doping

c) Temperature

d) metal-semiconductor work function difference.

v) The most important and widely used photodetector for application in fiber optic communication system at 1.55 μm is

a) p-i-n detector

b) p-n photodetector

c) Avalanche photodiode

d) Photomultiplies.

GROUP–B

(Short Answer Type Questions)

Answer any **three** of the following : 5×3=15

11. What do you understand by the term "MOS capacitor"?

12. Draw the variation of charge density across the p-n junction in an ideal MOS capacitor.

13. Distinguish between MOSFET and CMOS. Draw the cross-sectional view of an n-channel enhancement type MOS and draw also the I_D vs. V_D characteristics.

14. A typical depletion type MOSFET has $I_{DSS} = 12$ mA and $V_{GS(off)} = -6$V. Discuss whether it is an n-channel or p-channel device. Find also the value of I_D at (i) $V_{GS} = -3$V and (ii) $V_{GS} = +4$V.

15. What do you understand by (i) Saturation and (ii) non-saturation regions? Draw the equivalent circuit of a MOSFET.

16. Discuss the principle of operation of a p-n junction LED. What do you understand by a Direct Gap Semiconductor?

GROUP–C

(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

17. a) Define the terms "Threshold Voltage", "Pinch-off" and "Channel Modulation".

b) Draw and discuss Schematic diagrams showing n-channel MOSFET cross-sections under different operating conditions :

(i) Linear Region

(ii) Onset of saturation at Pinch-off

(iii) Strong saturation. 6+9

18. a) What do you understand by the terms "Internal Quantum Efficiency" and "External Quantum Efficiency" for a semiconductor LED?

b) Derive an expression for the Internal Quantum Efficiency η in terms of the net excess carrier lifetime and radiative recombination lifetime.

c) Discuss the variation of the external Quantum Efficiency of a GaP LED with acceptor doping. 4+8+3

19. a) Distinguish between Quantum wells and Quantum Wires.

b) What is density of states function? Draw and explain the density of states vs. energy diagrams for

(i) one dimensional confinement

(ii) two dimensional confinement and

(iii) three dimensional confinement.

c) What is VLSI scaling? Discuss. 2+10+3

2014

B. TECH (3rd Sem)

(ECE)

Paper Name : Circuit Theory & Networks

Paper Code : EC-304

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for Part-A and Part-B.

PART–A

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternative of the following : $1 \times 5 = 5$

i) In series resonance, the resonance condition is

a) $X_L = X_C$

b) $X_C = 1$

c) $X_L = 0$

d) $X_L = 1$.

ii) If the graph has N no. of nodes, the tree will have _____ branches.

a) N

b) (N–1)

c) (N+2)

d) 0.

iii) Tree has _____ closed path.

a) no

b) one

c) more than one

d) None of these.

iv) Laplace Transform of f(t) = t is

a) $\frac{1}{S}$

b) $\frac{1}{S^2}$

c) S

d) S^2.

v) Time constant in R-L series circuit is

a) $\frac{L}{R}$

b) $\frac{R}{L}$

c) R

d) R.L.

GROUP - B

(Short Answer Type Questions)

Answer any **three** of the following: 5×3=15

2. What is the resonance frequency of a series R-L-C circuit where $R = 10\Omega$, $L = 25mH$ and $C = 100\mu F$? 5

3. Write down the properties of resonance of parallel RLC circuit. 5

4. Obtain the incidence matrix of the graph shown in Figure-1. 5

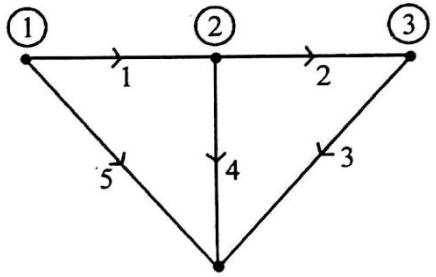


Figure-1

5. What is the Laplace Transform of a derivative [df(t)/dt]? 5

6. Obtain the Laplace Transform of $\delta(t) = (1 - e^{-at})$. (a = constant). 5

7. What is Final value theorem? 5

GROUP - C

(Long Answer Type Questions)

Answer any **one** of the following : $15\times1=15$

8. Describe about the transient response in series R-L circuit having DC excitation (charging and dis-charging both) (no initial condition). $7\frac{1}{2}+7\frac{1}{2}$

9. a) Write down the properties of a tree in a graph. 4

   b) What is the relation between twigs and links? 3

   c) A series R-L circuit has $R = 25\Omega$ and $L=5H$. A dc voltage of 100V is applied at $t = 0$. Find—

      i) the equations for charging current, voltage across R and L.

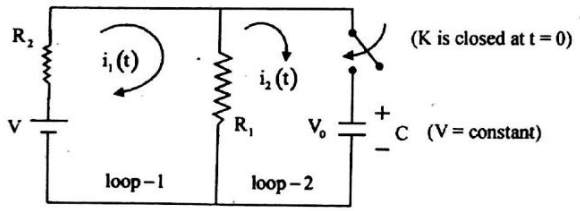
      ii) the current in the circuit 0.5 sec later.

      iii) the time at which the drops across R and L are same. 4+2+2

10. a) What is Laplace transform? 3

    b) Obtain the Laplace transform of $e^{-\theta t}\cos(\omega t).\ (\theta = \text{constant})$ 4

    c) Find the loop currents in S-domain and also in matrix form. 8



PART - B

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

11. Choose the correct alternative of the following : $1\times5=5$

    i) A four terminal electric circuit is linear if and only if

       a) The voltage at the output port is a linear function of time

       b) Both the input and the output voltages are linear functions of time.

       c) Superposition principle holds.

       d) Values of the circuit components are linear functions of time.

    ii) Let the currents that are flowing into a particular node are $i_1 = a_1 \sin\omega_1 t$ and $i_2 = a_2 \sin\omega_2 t$ and the currents that are flowing out of the node are $i_3 = a_3 \sin\omega_3 t$ and $i_4 = a_4 \sin\omega_4 t$. From Kirchoff's current law we get

       a) $i_1 + i_2 + i_3 + i_4 = 0$

       b) $i_1 + i_2 - i_3 - i_4 = 0$

       c) $a_1 + a_2 + a_3 + a_4 = 0$

       d) $a_1 + a_2 - a_3 - a_4 = 0$.

iii) Let us denote the Z-parameters of a two port passive symmetric linear network by $\begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix}$. z_{11} is the input impedance measured at port 1 when

a) Port 2 is short circuited

b) Port 2 is open circuited

c) Port 2 is terminated to the characteristic impedance of the network

d) Port 2 is terminated to z_{22}.

iv) A voltage source V with internal impedance Z_i, is connected across load impedance Z_L. For maximum power transfer we require

a) $Z_i = Z_L^*$

b) $Z_i = 0$

c) $Z_i = Z_L$

d) $\text{Real}(Z_i) = \text{Real}(Z_L)$.

v) Thevenin's equivalent circuit of an ideal current source is

a) $V_\circ = 0, Z_\circ = 0$

b) $V_\circ = \infty, Z_\circ = 0$

c) $V_\circ = 0, Z_\circ = \infty$

d) $V_\circ = \infty, Z_\circ = \infty$.

GROUP - B

(Short Answer Type Questions)

Answer any **three** of the following : 5×3=15

12. Find Y parameters for the circuit shown in Fig 1(a). Hence find the Norton's equivalent circuit for the network shown in Fig 1(b). Assume $y_{11} = y_{22} = 2$ mho and $y_{12} = y_{21} = -3$ mho and G = 4 mho. 5

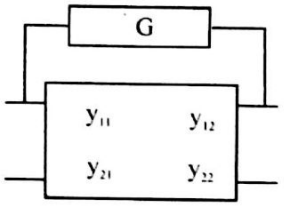


Fig 1(a)

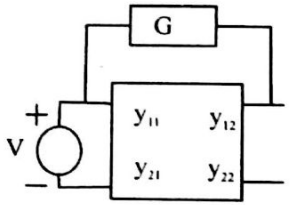


Fig 1(b)

13. Write down the set of loop equations for the circuit shown in Fig 2. Find the output voltage V_0. Assume $R_1 = R_2 = R_3 = 10\Omega$ and $V_1 = V_2 = 10$ volts. 5

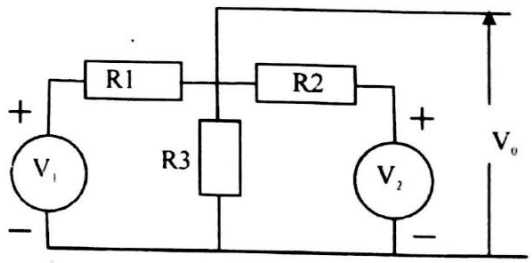


Fig 2

14. Write down the necessary node equations for the circuit shown in Fig 3. Hence find the output voltage V_0. Assume that $R1 = R2 = R = 10\Omega$ and $I_1 = I_2 = 5$ Amp. 5

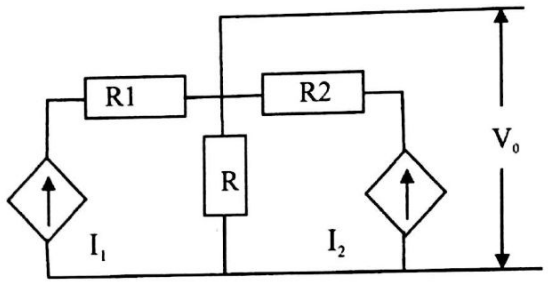


Fig 3

15. Using Superposition theorem find the current that flows through the resistance R of the circuit shown in Fig 4. Assume $R = 5\Omega$. 5

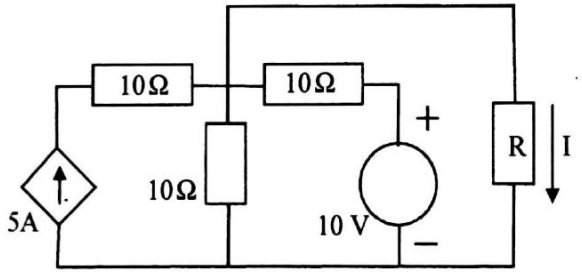


Fig 4

16. Find Y parameters for the circuit shown in Fig 5. Assume $R1 = 10\Omega$ and $R2 = 20\Omega$. 5

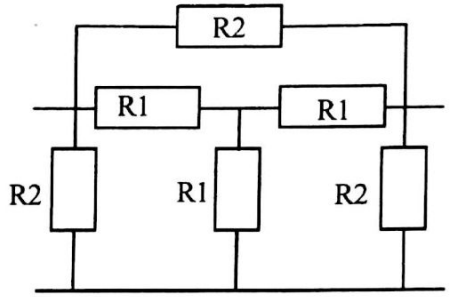


Fig 5

GROUP - C

(Long Answer Type Questions)

Answer any one of the following: $15 \times 1 = 15$

17. A four terminal network is connected to a voltage source with an internal resistance R_0 and a load resistance R_L as shown in Fig 6. Find the values of R_0 and R_L such that maximum power transfer theorem gets satisfied both at the generator end and at the load end. 15

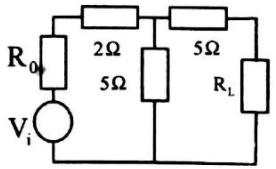


Fig 6

18. Derive the condition for symmetry and reciprocity for a four terminal network in terms of its Y-parameters. Determine the Y-parameters of the network shown in Fig.7. Show that the network is reciprocal and symmetrical. 15

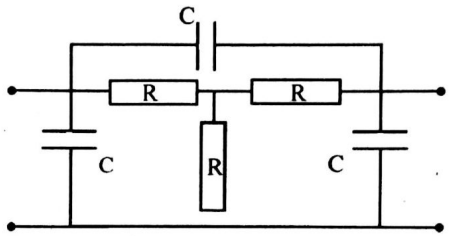


Fig.7

19. State and explain Norton's theorem. Find Norton's equivalent for the circuit shown in Fig 8. 15

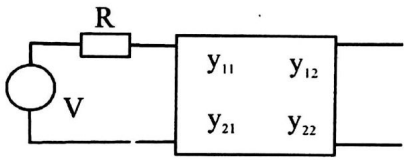


Fig. 8

2014

B. TECH (3rd Sem)

(ECE)

Paper Name : Mathematics for Electronics and Communication Engineering

Paper Code : M(EC)-301

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for Part-A and Part-B.

PART - A

(Marks : 35)

GROUP-A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following: 1×5=5

   i) If $f(x)$ is a periodic function with period T then $f(ax)$ is a periodic function with period

   a) $\frac{T}{a}$

   b) Ta

   c) T

   d) None of these.

ii) $f(x) = -k, \quad -a < x < 0$
$= k, \quad 0 < x \le a$

and $f(x+2a) = f(x) \; \forall x$

The above function generally termed as–

a) square waveform

b) saw-toothed waveform

c) triangular waveform

d) None of these.

iii) If $f(x)$, $-\infty < x < \infty$ is an odd function, its Fourier transform be $F(s)$, Fourier sine transform be $F_s(s)$, then the correct statement is–

a) $F(s) = 2F_s(s)$

b) $F(s) = 2iF_s(s)$

c) $F(s) = -2F_s(s)$

d) $F(s) = -2iF_s(s)$.

iv) If $f(x) = e^{-\frac{x^2}{2}}$, then its Fourier transform will be –

a) $\sqrt{2\pi}\, e^{-\frac{s^2}{2}}$

b) $2\pi e^{-s^2}$

c) $\sqrt{2\pi}\, e^{-s^2}$

d) $\sqrt{2\pi e^{-\frac{s^2}{2}}}$.

v) If the Fourier transform of $f(x)$ be $F(s)$, then Fourier transform of $f(ax)$ will be –

a) $F\left(\frac{s}{a}\right)$

b) $F(as)$

c) $\frac{1}{a}F\left(\frac{s}{a}\right)$

d) $aF(as)$.

vi) The C-R Equation for a complex function $f(z) = u(x,y) + iv(x,y)$ is –

a) $u_x = v_y$ and $u_y = v_x$

b) $u_x = v_y$ and $u_y = -v_x$

c) $u_x = -v_y$ and $u_y = v_x$

d) $u_x = -v_y$ and $u_y = -v_x$.

vii) If α is an interior point of any simple closed curve C, then $\oint_c \frac{dz}{(z-\alpha)^n}$ for $n = 2, 3, \ldots$ will be–

a) -1

b) 1

c) $2\pi i$

d) 0.

viii) If $f(z)$ is analytic in a domain D and $\alpha \in D$. If $f(\alpha) = f^{(1)}(\alpha) = \ldots = f^{(m-1)}(\alpha) = 0$ but $f^{(m)}(\alpha) \neq 0$; $f^{(n)}(\alpha)$ denotes n-th derivative of f, then α is called zero of $f(z)$ of order –

a) $m-1$

b) m

c) $m+1$

d) None of these.

GROUP-B

(Short Answer Type Questions)

2. Answer any **three** of the following: $5\times3=15$

i) Obtain the Fourier series to represent $f(x) = x^2$ in $-\pi \le x \le \pi$. Hence prove that

$$\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\ldots=\frac{\pi^2}{6}.$$

ii) Let $f(x) = \frac{1}{4} - x, \quad 0 < x \le \frac{1}{2}$.

$= x - \frac{3}{4}, \quad \frac{1}{2} < x < 1.$

Find the half-range Fourier sine series of $f(x)$.

iii) Show that $e^{-\frac{x^2}{2}}$ is its own Fourier transform.

iv) Evaluate $F^{-1}\left(\frac{1}{s^2+4s+13}\right)$. [Fourier inverse transform $\equiv F^{-1}$]

v) Prove that $u = 2x - 2xy$ is a harmonic function. Determine its harmonic conjugate and find the corresponding analytic function $f(z)$ in terms of z.

vi) Evaluate $\oint_c |z|^2 dz$ around the square with vertices at $(0,0), (1,0), (1,1), (0,1)$.

GROUP-C

(Long Answer Type Questions)

3. Answer any **one** of the following: $15\times1=15$

i) a) Show that every function can be represented as a sum of an even function and an odd function.

b) Find the Fourier expansion of the function $f(x)$ of period 2π defined as

$$f(x) = 0, \quad -\pi \le x \le 0$$
$$= x, \quad 0 < x \le \pi \ .$$

Find the sum of the series at $x = -5\pi$.

c) Write Parseval's Identity corresponding to the Half Range cosine series of the function $f(x) = x, \ 0 < x < 2$.

4+6+5

ii) a) Find the Fourier transform of the function

$$f(x) = 1, \quad |x| \le a$$
$$= 0, \quad |x| > a$$

Hence evaluate $\int_{-\infty}^{\infty} \frac{\sin sa \cos sx}{s} ds$.

b) Find Fourier sine transform of $\frac{e^{-ax}}{x}$.

c) If $f(x)$ and $g(x)$ are two functions having Fourier Transforms then prove $F(c_1 f(x) + c_2 g(x)) = c_1 F(f(x)) + c_2 F(g(x))$.

6+6+3

iii) a) Evaluate $\oint_c \frac{z}{(2z+1)(z-3)} dz$, $c : |z-1| = 5$.

b) Expand $f(z) = \frac{z-1}{z+1}$ about $z = 0$ in Taylor's series.

c) Using Cauchy's Residue theorem, prove that $\oint_c \frac{z \cos z}{\left(z - \frac{\pi}{2}\right)^3} dz = -2\pi i$, $c : |z-1| = 1$.

5+5+5

PART - B

(Marks : 35)

GROUP : A

(Multiple Choice Type Questions)

4. Choose the correct alternatives for any **five** of the following: $1\times5=5$

i) If X is discrete random variable, then –

a) $E(1\times1)\le|E(X)|$

b) $E(1\times1)\ge|E(X)|$

c) $E(1\times1)=|E(X)|$

d) None of these.

ii) $P_n(1)$ is equal to

a) 0

b) $(-1)^n$

c) 1

d) None of these.

iii) The mean of the Binomial distribution $B\left(10,\frac{2}{5}\right)$ is –

a) 0

b) 4

c) 5

d) 6.

iv) Which one of the following is true?

a) $\int_{-1}^{1}P_m(x)P_n(x)dx=0$ if $m\neq n$

b) $\int_{-1}^{1}[P_n(x)]^2dx=0$ if $m=n$

c) $\int_{-\infty}^{\infty}[P_n(x)]^2dx=\frac{2}{2n+1}$ if $m=n$

d) None of these.

v) $J_{-\frac{1}{2}}(x)$ is equal to

a) $\sqrt{\frac{2}{\pi x}}\sin x$

b) $\sqrt{\frac{2}{\pi x}}\cos x$

c) $\sqrt{\frac{2}{n\pi}}\sin x$

d) None of these.

vi) The distribution for which mean and variance are equal is –

a) Poisson

b) Normal

c) Binomial

d) Exponential.

vii) Which of the following is true?

a) $J_0' = -J_1$

b) $J_0' = J_1$

c) $J_0' = J_1'$

d) $J_0' = -J_1'$.

viii) The condition for independence of two events A and B is –

a) $P(A \cap B) = P(A).P(B)$

b) $P(A + B) = P(A).P(B)$

c) $P(A - B) = P(A).P(B)$

d) $P(A \cap B) = P(A).P(B/A)$.

GROUP : B

(Short Answer Type Questions)

Answer any **three** of the following: 5×3=15

5. What is the probability that a leap year, selected at random, will contain 53 Fridays?

6. If X is normally distributed with mean 3 and s.d. 2, find c such that

$$P(X > c) = 2P(X \le c).$$

7. Prove the recurrence relation:

$$nP_n = x p_n' - P_{n-1}'.$$

8. Prove that $\frac{d}{dx}(x^n J_n) = x^n J_{n-1}$.

9. For any two events A_1, A_2 (may not be mutually exclusive), prove that

$$P(A_1 \cup A_2) = P(A_1) + P(A_2) - P(A_1 \cap A_2).$$

GROUP-C

(Long Answer Type Questions)

Answer any **one** of the following: 15×1=15

10. i) Use Laplace transform to solve the one dimensional wave equation

$$\frac{\partial^2 u}{dt^2} = c^2 \frac{\partial^2 u}{dx^2} \ (x > 0, \ t > 0),$$

where $u(x,0) = 0, \ \frac{\partial u}{\partial t}(x,0) = 0, \ x > 0$

$$u(0,t) = F(t), \ u(\infty, t) = 0, \ t \ge 0.$$

ii) Show that when n is a positive integer

$$J_{-n}(x) = (-1)^n J_n(x).$$ 10+5

11. i) If X has the normal distribution with parameters μ and σ, then prove that

a) the mean of X is μ.

b) the s.d. of X is σ.

ii) If X is uniformly distributed over $[1, 2]$, find U so that $P(X > U + \bar{X}) = \frac{1}{6}$. 8+7

12. i) State Baye's theorem.

ii) In a bolt factory machines A, B and C manufacture respectively 25%, 35% and 40% of the total of their output. 5%. 4% and 2% are defective bolts. A bolt is drawn at random from the product and is found to be defective. What are the probabilities that it was manufactured by machines A, B and C?

iii) A random variable X has the following probability mass function:

X :	0	1	2	3	4	5	6	7
$P(X=k)$:	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

a) Determine the constant k.

b) Evaluate $P(X<6), P(X\geq 6), P(3<X<6)$ and $P(3<X/X\leq 6)$. 2+7+6

2015

B. TECH (3rd Sem)

(ECE, EIE, EE, ME)

Paper Name : Mathematics-III

Paper Code : M-301

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for PART-A and PART-B.

PART–A

(Marks : 35)

GROUP–A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following: $1\times5=5$

i) If $f(x)=x+x^2,\ -\pi\le x\le\pi$ be represented in a Fourier Series as

$$\frac{a_0}{2}+\sum_{n=1}^{\infty}\left(a_n\cos nx+b_n\sin nx\right),$$

then the value of a_0 is

a) $\frac{\pi^3}{3}$

b) $\frac{\pi^2}{3}$

c) $\frac{2\pi^2}{3}$

d) $\frac{\pi^2}{6}$.

ii) If $F(s)$ is the Fourier transform of $f(x)$, then the Fourier transform of $f(ax)$ is

a) $aF\left(\frac{s}{a}\right)$

b) $\frac{1}{a}F\left(\frac{s}{a}\right)$

c) $\frac{1}{a}F\left(\frac{a}{s}\right)$

d) $aF\left(\frac{a}{s}\right)$.

iii) The period of the function $f(x) = 4 + \sin 4\pi x$ is

a) 1

b) 2π

c) 4π

d) $\frac{1}{2}$.

iv) The waveform of the periodic function $f(x)$ defined by $f(x) = x$, $-a < x \le a$, and $f(x+2a) = f(x)$ for all x is

a) Triangular waveform

b) Saw-toothed waveform

c) Square waveform

d) Half wave rectifier.

v) A function $u(x, y)$ will be harmonic if it satisfies

a) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$

b) $\frac{\partial^2 u}{\partial x^2} - \frac{\partial^2 u}{\partial y^2} = 0$

c) $\frac{\partial u}{\partial x} = \frac{\partial u}{\partial y}$

d) $\frac{\partial u}{\partial x} = -\frac{\partial u}{\partial y}$.

vi) The singularity of the complex function $f(z) = \frac{1}{1+z}$ is at

a) $z = 1$

b) $z = -1$

c) $z = -i$

d) $z = i$.

vii) If $F(s)$ is the Fourier transform of $f(x)$, then the Fourier transform of $f(x-5)$ is

a) $e^{-5is}F(s)$

b) $e^{5s}F(s)$

c) $e^{i5s}F(s)$

d) $\frac{1}{5}F\left(\frac{s}{5}\right)$.

viii) The value of $\oint_C \frac{dz}{(z-\alpha)^n}$, $n = 2, 3, 4, \ldots$, when α is an interior point is

a) 0

b) $+1$

c) -1

d) $2\pi i$.

GROUP–B

(Short Answer Type Questions)

Answer any **three** of the following: $5\times3=15$

2. Find the Fourier Transform of the function

$$f(x) = \begin{cases} 1-x^2, & |x|\le 1 \\ 0, & |x|>1. \end{cases}$$

Hence evaluate $\int_0^\infty \frac{x\cos x - \sin x}{x^3}\cos\frac{x}{2}dx$.

3. Evaluate $F^{-1}\left(\frac{1}{s^2+4s+13}\right)$.

4. Find Fourier sine transform of $\frac{e^{-ax}}{x}$.

5. Find the value of integral $I = \int_C \bar{z}\,dz$ when C is the right hand half of $|z|=2$ (i.e. from $z=-2i$ to $z=2i$).

6. Let C be the positively oriented circle $|z|=2$.

$$f(z) = \frac{z}{9-z^2}, \quad [z_0 = -i \text{ is interior to C}]$$

Evaluate $\int_C \frac{f(z)}{z+i}dz$.

7. Find the harmonic conjugate of the given harmonic function $u(x, y) = y^3 - 3x^2y$.

GROUP–C

(Long Answer Type Questions)

Answer any **one** of the following: $15\times1=15$

8. i) a) If C is the positively oriented unit circle $|z|=1$ and $f(z)=e^{2z}$, then evaluate $\int_C \frac{e^{2z}}{z^4}dz$.

b) Let z_0 be any point interior to a positively oriented simple closed contour C, $f(z)=1$, evaluate $\int_C \frac{dz}{z-z_0}$

and $\int_C \frac{dz}{(z-z_0)^{n+1}}$. 4+4=8

ii) Represent the function $f(z)=\frac{z}{(z-1)(z-3)}$ by a series of positive and negative powers of $(z-1)$ which converges to $f(z)$ when $0<|z-1|<2$. 7

9. i) Find the Fourier expansion of x^2 on $[-\pi, \pi]$.

Hence show that $1-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}+\ldots=\frac{\pi^2}{12}$.

8

ii) Expand the following function $f(x)$ into a Fourier cosine series, where 7

$$f(x) = 1 \quad , \quad 0 \le x < \frac{1}{3}\pi$$
$$= 0 \quad , \quad \frac{1}{3}\pi \le x \le \frac{2}{3}\pi$$
$$= -1 \quad , \quad \frac{2}{3}\pi < x \le \pi$$

Is the series convergent at all values of x?

10. i) Show that $f(z)=z^2$ is differentiable everywhere hence find $f'(z)$. 5

ii) Verify the nature of zero of the entire function $f(z)=z(e^z-1)$. 5

iii) Find the residue of the function

$$f(z)=\frac{z}{z^4+4}$$

at the isolated singular point $z_0=\sqrt{2}e^{i\pi/4}$. 5

PART–B

(Marks : 35)

GROUP–A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following: $1\times5=5$

i) The probability density function of the random variable X is

$$f(x)=k(2x-1),\ 0\le x\le 2.$$

The value of k is

a) 1

b) $\frac{1}{2}$

c) $\frac{1}{3}$

d) $\frac{2}{3}$.

ii) The generating function for the Legendre function $P_n(x)$ is

a) $(1-2xz+z^2)^{\frac{1}{2}}$

b) $(1+2xz+z^2)^{-\frac{1}{2}}$

c) $(1-2xz+z^2)^{-\frac{1}{2}}$

d) None of these.

iii) $\frac{d}{dx}\left(x^{-n}J_n(x)\right)$ is equal to

a) $x^{-n}J_{n+1}(x)$

b) $-x^{-n}J_{n+1}(x)$

c) $x^nJ_{n+1}(x)$

d) $-x^nJ_{n+1}(x)$.

iv) The singular points of $(x-x^2)y''+(1-x)y'-y=0$ is/are

a) 1, –1

b) 0, 1

c) 0, –1

d) 1, 2.

v) The variance of a random variable X is

a) $[E(X)]^2$

b) $E(X)^2$

c) $E(X^2)-\{E(X)\}^2$

d) $E(X^2)-E(X)$.

vi) The regular singular points of the following equation

$x^2(x-2)^2\frac{d^2y}{dx^2}+2(x-2)\frac{dy}{dx}+(x+3)y=0$ is

a) 0

b) 2

c) 0 and 2

d) None of these.

vii) When A and B are not mutually exclusive. then

a) $P(A+B) \le P(A)+P(B)$

b) $P(AB) = P(A)+P(B)$

c) $P(A+B) = P(A)+P(B)$

d) $P(A+B) > P(A)+P(B)$.

viii) Two-dimensional Laplace equation is given by

a) $k\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$

b) $\frac{\partial^2 u}{\partial t^2} = C^2\frac{\partial^2 u}{\partial x^2}$

c) $\frac{\partial^2 u}{\partial x^2} = -\frac{\partial^2 u}{\partial y^2}$

d) None of these.

GROUP–B

(Short Answer Type Questions)

Answer any **three** of the following: $5\times3=15$

2. A random variable X has the following probability mass function:

x:	−2	−1	0	1	2	3
f(x):	0.1	2k	0.2	3k	0.3	4k

i) find k

ii) evaluate $P(x<2)$, $P(X\le 2)$, $P(-2<X<2)$.

3. Express $P(x) = x^3+3x^2+x-3$ in terms of Legendre's polynomial.

4. Prove that $\frac{d}{dx}(x^n J_n) = x^n J_{n-1}$.

5. The probability density of a continuous distribution is given by

$$f(x) = \frac{5}{8}x(2-x),\ 0<x<2.$$

Compute mean and variance.

6. Prove that $\frac{d}{dx}\{x\ {}^nJ_n(x)\} = -x\ {}^nJ_{n-1}(x)$.

7. Prove that $\int_{-1}^{1}\{P_n(x)\}^2 dx = \frac{2}{2n+1}$ if $m=n$.

GROUP–C

(Long Answer Type Questions)

Answer any **one** of the following: $15\times1=15$

8. i) Using Fourier Transform solve the equation

$$\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2},\ x>0, t>0$$

subject to the conditions

$u(0, t) = 0$; $u(x, 0) = e^{-x}$, $x>0$ and $u(x, t)$ is bounded.

ii) Prove that $\int_{-1}^{1} P_m(x)P_n(x)dx = 0$ if $m\ne n$.

10+5

9. i) If X has a binomial distribution with parameters n and p then prove that

   a) the mean of X is np

   b) and the s.d. of X is npq where $q = 1 - p$.

   ii) Solve in series the equation $\frac{d^2y}{dx^2} + xy = 0$.

8+7

10. i) Prove that $J_n(-x) = (-1)^n J_n(x)$ for +ve or –ve integers.

   ii) A car hire firm has two cars, which hires out by the day. The number of demands for a car on each day is Poisson distributed with parameter 1.3. Calculate the proportion of days on which neither of the cars is used and the proportion of days on which some demand can't be met for lack of cars.

   iii) Determine the regular and irregular singular points of the following equations:

   a) $x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - n^2)y = 0$

   b) $(x-1)^4 \frac{d^2y}{dx^2} + 2(x-1)\frac{dy}{dx} + y = 0$.

6+5+4

2015

B. TECH. (3rd Sem)

(ECE)

Paper Name : Signals and Systems

Paper Code : EC-302

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for Part-A and Part-B.

PART - A
(Marks : 35)
GROUP - A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following : 1×5=5

   i) The set of values of z in the z-plane for which the magnitude of x(z) is finite, is called

      a) Unit circle

      b) Poles

      c) Zeroes

      d) Region of convergence.

ii) The Z-transform of $\{A\delta(n-m)\}$ will be

a) A

b) Az^{-1}

c) Az^{-m}

d) 1, where $\delta(n)$ is impulse function.

iii) ROC of x(n) contains

a) poles

b) zeros

c) no poles

d) no zeros.

iv) If all the poles of the system function W(z) have magnitude smaller than 1, then the system will be

a) stable

b) unstable

c) BIBO stable

d) both (a) and (c)

v) The Fourier coefficient 'a_n' can be evaluated as

a) $a_n = \frac{2}{T}\int_{-\infty}^{\infty} x(t)\cos n\Omega_0 t\,dt$

b) $a_n = \frac{2}{T}\int_{0}^{T} x(t)\cos n\Omega_0 t\,dt$

c) $a_n = \frac{2}{T}\int_{-T/2}^{T/2} x(t)\sin n\Omega_0 t\,dt$

d) $a_n = \frac{2}{T}\int_{0}^{\infty} x(t)\cos n\Omega_0 t\,dt$.

vi) The necessary and sufficient condition for x(t) to be real is

a) $X^*(j\Omega) = X(j\Omega)$

b) $X^*(j\Omega) = X(-j\Omega)$

c) $X(j\Omega) = X^*(-j\Omega)$

d) None.

vii) For a signal $x(t) = e^{-|t|}$, the Fourier transform is

a) $\frac{2}{1+\Omega^2}$

b) $\frac{2}{1-\Omega^2}$

c) $\frac{1}{2-\Omega^2}$

d) $\frac{1}{2+\Omega^2}$

viii) The initial value of a continuous time signal in frequency domain is,

a) $X(0)=\int_{0}^{\infty} x(t)dt$

b) $X(0)=\frac{1}{2\pi}\int_{-\infty}^{\infty} x(j\Omega)dt$

c) $X(0)=\frac{1}{2\pi}\int_{-\infty}^{\infty} x(t)d\Omega$

d) $X(0)=\int_{-\infty}^{\infty} x(t)dt$.

GROUP - B
(Short Answer Type Questions)

Answer any **three** of the following : 5×3=15

2. Determine the Z-transform of a discrete-time signal,

if $x(n)$ is $=a_n$ for $n\geq 0$

$=0$ for $n<0$.

Draw the ROC for the above signal. 4+1

3. Write the time-shifting property of Z-transform. Determine the inverse Z-transform of $x(z)=\frac{0.5z^{-1}}{1-0.5z^{-1}}$, using time shifting property. 5

4. Write the initial and final value theorems of Z-transform. 5

5. Find the Z-transform of an impulse response for a system $y(n)-3y(n-1)-4y(n-2)=x(n)+2x(n-1)$ 5

6. What is the expression of unit impulse signal? With suitable derivation draw the magnitude spectrum of impulse signal. 2+3

7. Write the Dirichlet condition of Fourier transform. What is the difference between magnitude and frequency spectrum? 3+2

GROUP - C
(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

8.

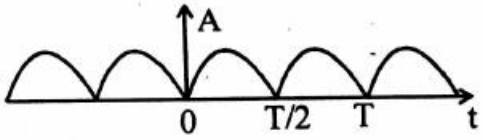


Figure-1

Determine the trigonometric form of Fourier series of the above full wave rectified sine wave shown in figure-1. Write the condition for frequency shifting of fourier transform. 15

9. a) A transfer function of a discrete-time LTI system is expressed as,

$$H(z)=\frac{1}{\left(1+\frac{1}{3z^{-1}}\right)\left(1-\frac{1}{6}z^{-1}\right)}$$, then find out the system equation.

b) Determine the inverse Z-transform of $X(z)=\frac{3z^2+2z+1}{z^2+3z+2}$, using partial fraction method.

c) Write a short note on ROC. 5+7+3

10. Write a short note on: 5×3=15

a) Aliasing and folding

b) Comparison between Fourier and Laplace transform

c) Zero padding and its necessity.

PART-B

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following : 1×5=5

i) The value of $\int_{-\infty}^{+\infty}\varphi(t)\,\delta(t-T)dt$ is

a) $\delta(t-T)$

b) $\varphi(0)\delta(t)$

c) $\varphi(T)$

d) $\varphi(t-T)$.

ii) A voltage v(t) which is a gaussian ergodic random process with a mean of zero and a variance of 16 volt^2, is measured by a true r.m.s meter. The output of the meter is

a) 4 volts

b) 2 volts

c) 8 volts

d) 0 volt.

iii) If $f[k]\Leftrightarrow F[z]$ then the Z-transform of Ku[k] is

a) $\frac{z}{z-1}$

b) $\frac{z}{(z-1)^2}$

c) $\frac{z}{z+1}$

d) $\frac{(z-1)^2}{z}$.

iv) The even components of the function $f(t)=e^{-at}u(t)$ is

a) $\frac{1}{2}[e^{-at}u(t)+e^{at}u(-t)]$

b) $\frac{1}{2}[e^{-at}u(t)-e^{at}u(-t)]$

c) $\frac{1}{2}[e^{at}u(t)+e^{-at}u(-t)]$

d) $\frac{1}{2}[e^{-at}u(-t)+e^{at}u(t)]$

v) If $g_1(t)$ and $g_2(t)$ have bandwidths B_1 and B_2 Hz respectively, the bandwidth of $g_1(t)g_2(t)$ is

a) B_1+B_2 Hz

b) B_1B_2 Hz

c) B_1-B_2 Hz

d) $\frac{B_1}{B_2}$ Hz.

vi) When the ensemble and time averages of a random process are identical, the process is referred to as

a) Stationary process

b) Ergodic process

c) Static process

d) Correlated process.

vii) If $f_1[k] * f_2[k]=c[k]$ then the value of $f_1[k-m] * f_2[k-n]$ is

a) $C[k-m-n]$

b) $C[k+m+n]$

c) $C[2k+m+n]$

d) $C[2k-m-n]$.

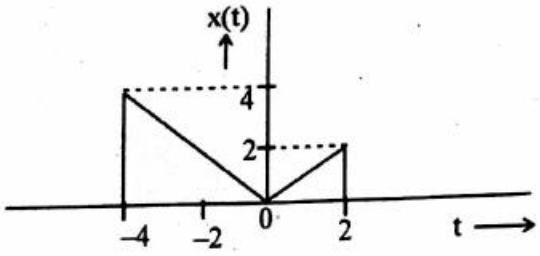
GROUP - B

(Short Answer Type Questions)

Answer any **three** of the following : 5×3=15

2. Differentiate between continuous time and discrete time signals. 5

3. For the signal $x(t)$ shown below, sketch $x(t-4)$ and $x(2t-4)$. 2+3



4. Find the inverse Z-transform of $Y(z)=\frac{z(z-4)}{z^2-5z+6}$. 5

5. What do you mean by random variable? Define continuous random variable. Give one example. 2+2+1

6. State and prove the sampling theorem in time domain. 5

GROUP - C

(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

7. a) If $f[k]u[k] \Leftrightarrow F(z)$

then prove that $f[k-m]u[k-m]=\frac{1}{z^m}F(z)$.

b) Find the Z-transform and the corresponding region of convergence for the signal

$y[k]=\cos\beta k\ u[k]$.

c) Prove that $k a^k\ u[k] \Leftrightarrow \frac{az}{(z-a)^2}$. 5+5+5

8. a) State and prove time convolution theorem related to continuous time signal. 2+5

b) What do you mean by Probability Distribution Function (PDF)? Define Gaussian Probability Distribution Function. Also mention the importance of Gaussian PDF. 2+4+2

9. State the differences between the following: 5×3

a) Causal and non-causal systems

b) Linear and non-linear systems

c) Time variant and time invariant systems.

2015

B. TECH. (3rd Sem)

(ECE)

Paper Name : Solid State Devices

Paper Code : EC-303

Full Marks : 70 Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Separate answer booklet to be used for Part-A and Part-B.

PART - A

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any **five** of the following : $1 \times 5 = 5$

   i) Current in Bipolar Junction Transistor is due to

   a) Majority carrier

   b) Minority carrier

   c) Majority and minority carrier

   d) Intrinsic carrier.

ii) The channel in MOSFET is formed due to application of gate bias. This effect is called

a) Inversion

b) Depletion

c) Accumulation

d) Overdrive.

iii) For transistor to be used as amplifier it should operate as

a) Voltage dependent voltage source

b) Voltage dependent current source

c) Current dependent current source

d) Current dependent voltage source.

iv) In linear region MOSFET acts as

a) Voltage dependent resistor

b) Current dependent resistor

c) Independent of gate voltage

d) Independent of drain voltage.

v) For good base efficiency of a BJT, there should be

a) No recombination in base region

b) Large recombination in base region

c) Small recombination in base region

d) Efficiency is independent of recombination in base region.

vi) In forward active region of BJT operation

a) E-B junction is reverse bias, C-B junction is forward bias

b) E-B junction is forward bias, C-B junction is forward bias

c) E-B junction is forward bias, C-B junction is reverse bias

d) E-B junction is reverse biased, C-B junction is reverse biased.

vii) The gate capacitance of MOSFET is combination of

a) gate oxide capacitance and drain capacitance

b) gate oxide capacitance only

c) channel depletion capacitance

d) gate oxide capacitance and channel depletion capacitance.

viii) MOSFET device saturation condition is

a) $(V_{GS} - V_t) = V_{DS}$

b) $(V_{GS} - V_t) > V_{DS}$

c) $(V_{GS} - V_t) \leq V_{DS}$

d) $(V_{GS} - V_t) >> V_{DS}$.

GROUP - B

(Short Answer Type Questions)

Answer any **three** of the following : 5×3=15

2. Draw the band diagram of BJT across emitter base and collector in unbiased equilibrium and forward active mode of operation showing conduction band, valence band and Fermi level. 5

3. Draw the physical cross-section of a MOSFET showing different regions. Briefly explain MOSFET channel formation. 3+2

4. The equation for collector current is given as $I_C = I_s\left(e^{V_{BE}}/v_t - 1\right)$. From this equation find the value of trans conductance $g_m = \frac{\partial I_C}{\partial V_{BE}}$,

for $I_s = 10^{-7}$A, $V_{BE} = 0.7$V, $V_t = 0.025$V. 5

5. Write the equation for depletion width of a p-n junction, and derive the expression of junction capacitance. 5

6. MOSFET gate capacitance can be considered as parallel plate capacitance under ideal approximation. For parallel plate capacitor the formula is $C = \frac{\varepsilon A}{d}$.

Find the gate oxide capacitance of a MOSFET with gate length (L) and width to be $W = 2\times10^{-5}$m, $L = 10^{-5}$m, $\varepsilon_{ox} = 10^{-12}$ Fm^{-2}. 5

7. Explain the forward active mode of operation of B-J-T in common-emitter configuration with V_{CE} vs I_C graph. Explain cut-off, active and saturation region in the graph. 5

8. Formulate an expression for depletion depth under the gate-oxide of MOSFET. Find the charge stored in the region. The expression should contain gate voltage (V_G), bulk doping concentration (N_B) and semiconductor permittivity (t_s). 5

GROUP–C

(Long Answer Type Questions)

Answer any **one** of the following : 15×1=15

9. Write the equations for linear region and saturation region operation for n-channel MOSFET in terms of V_{GS}, V_{th}, W, L, V_{DS}, ε_{ox}, t_{ox} and μ_n.

In the above equations find I_D for

$W = 10^{-4}$m,

$L = 10^{-6}$m, $\mu_n = 0.14$m^{2}v^{-1}s^{-1},

$t_{ox} = 10^{-7}$m, $V_{th} = 0.7$V.

$\varepsilon_{ox} = 10^{-12}$ Fm^{-2},

a) $V_{GS} = 0.8$V $V_{DS} = 0.2$V

b) $V_{GS} = 1$V $V_{DS} = 5$V. 15

10. For an uniformly doped n-p-n bipolar junction transistor with base width W and Emitter Base area A derive the expression for emitter current with approximation that minority carrier gradient in base region is linear. The expression would be in terms of Base-Emitter bias voltage, base width, emitter carrier concentration. 15

11. In an n-channel MOSFET operating in saturation region, we have the following values :

$W = 10^{-3}m$, $\mu_n = 0.14\ m^2v^{-1}s^{-1}$,

$L = 10^{-5}m$, $V_{th} = 0.7V$.

$t_{ox} = 10^{-6}m$,

$\varepsilon_{ox} = 10^{-12}\ m^{-2}F$,

Find the value of drain current I_D for $V_{GS} = 0.8V$.

Find the value of transconductance $g_m = \frac{\partial I_D}{\partial V_{GS}}$

for : a) $V_{GS} = 0.7V$

b) $V_{GS} = 0.8V$. 15

12. Write short notes on (any **three**) : 5×3=15

a) Ebers-Moll model of BJT

b) Threshold voltage of MOSFET

c) MOSFET as capacitor

d) Base depletion region spreading and Early effect

e) Four terminal MOSFET model

f) Law of Mass Action

g) Hall effect.

h) Diffusion equation for current conduction in semiconductor.

PART - B

(Marks : 35)

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives of the following : $1\times5=5$

i) At small forward biases, tunnel diode conducts due to

a) avalanche multiplication in the space charge layer

b) the diffusion of carriers across the space charge layer.

c) tunnelling of carriers across the forbidden energy gap.

ii) In a reverse biased p-n junction almost no current flows because

a) electrons and holes recombine before they can cross the junction

b) only minority carriers whose densities are very small, contribute to the current when cross the junction

c) the electric field in the neutral regions is very small.

iii) A particular semiconductor in equilibrium has $10^{12}/cm^3$ donor atoms and $1.1\times10^{7}/cm^3$ acceptor atoms. If the intrinsic carrier density (n_i) of the semiconductor is $10^{12}/cm^3$, then electron density in it will be

a) $10^{16}/cm^3$

b) $10^{12}/cm^3$

c) $10^{7}/cm^3$.

iv) A varacter is a reverse biased p-n junction whose capacitance varies with voltage due to the variation is the

a) Conductivity of the space charge region

b) injected minority carrier density

c) Space charge layer width.

v) The electrical power output of a photodiode is maximum when

a) Small reverse bias exists across it

b) Small forward bias exists across it

c) Large reverse bias exists across it.

GROUP - B

(Short Answer Type Questions)

Answer any **three** of the following : $5\times3=15$

2. i) Define photovoltaic potential.

ii) Explain the proper diagram volt-ampere characteristics of a photovoltaic diode.

iii) What is the maximum output power of a photovoltaic diode?

3. With proper diagram explain the operation of a zener diode. How it can be used to maintain constant voltage output in a circuit?

4. What is meant by diffusion and drift current in a semiconductor P-N junction? Define breakdown in a p-n junction.

5. What are the special characteristic of a varacter diode ? With proper diagram show how a varacter diode operates. Mention main application of varacter diode.

6. What are the different types of diode depending on basis of doping concentration? State working principle of photodiode, PNPN transistors.

GROUP - C

(Long Answer Type Questions)

Answer any **one** of the following : $15 \times 1 = 15$

7. i) Discuss how to use Schrodinger's equation to form energy bands in crystal.

ii) Discuss how forbidden gap between two bands decreases as the atomic spacing decreases.

iii) How can band structure explained for conductor, insulators, semiconductor?

8. i) How a semiconductor photodiode can be constructed for proper use?

ii) Discuss the operation of a photodiode and its volt-ampere characteristic.

iii) Draw the sensitivity of a semiconductor photodiode as a function of the distance of the light spot from the junction.

9. Explain the operation of a Zener diode with the help of proper characteristic curve. What are different applications of Zener diode? With proper circuit diagram show how regulated output can be obtained by using Zener diode.
