

Syllabus of  
UNDERGRADUATE DEGREE COURSE

**Electronics Instrumentation & Control**



Rajasthan Technical University, Kota

Effective from session: 2024 – 2025



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI2-01: Advance Engineering Mathematics-I

3 Credits

Max. Marks: 100 (IA:30, ETE:70)

3L:0T:0P

End Term Exam: 3 Hours

SN	Contents	Hours
1	<b>Numerical Methods - 1</b> Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	10
2	<b>Numerical Methods - 2</b> Numerical solution of ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predictor-corrector methods. Solution of polynomial and transcendental equations-Bisection method, Newton-Raphson method and Regula-Falsi method.	8
3	<b>Laplace Transform:</b> Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace transforms method.	10
4	<b>Fourier Transform:</b> Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations only).	7
5	<b>Z-Transform:</b> Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.	5
<b>Total</b>		<b>40</b>



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## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI1-02/4EI1-02: Technical Communication

2 Credit

Max. Marks: 100 (IA:30, ETE:70)

2L:0T:0P

End Term Exam: 2 Hours

SN	Contents	Hours
1	<b>Introduction to Technical Communication-</b> Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication.	4
2	<b>Comprehension of Technical Materials/Texts and Information Design &amp; development-</b> Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media.	6
3	<b>Technical Writing, Grammar and Editing-</b> Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings.	8
4	<b>Advanced Technical Writing-</b> Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles.	8
	<b>Total</b>	<b>26</b>



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## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

3EI1-03/4EI1-03: Managerial Economics And Financial Accounting

2 Credit

Max. Marks: 100 (IA:30, ETE:70)

2L:0T:0P

End Term Exam: 2 Hours

SN	Contents	Hours
1	<b>Basic economic concepts-</b> Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement.	4
2	<b>Demand and Supply analysis-</b> Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting -purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.	5
3	<b>Production and Cost analysis-</b> Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.	5
4	<b>Market structure and pricing theory-</b> Perfect competition, Monopoly, Monopolistic competition, Oligopoly.	4
5	<b>Financial statement analysis-</b> Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	8
	<b>Total</b>	<b>26</b>



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI4-04: Digital System Design

3 Credits

Max. Marks: 100 (IA:30, ETE:70)

3L:0T:0P

End Term Exam: 3 Hours

SN	Contents	Hours
1	Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.	7
2	MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU	8
3	Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of Synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.	9
4	Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using programmable devices.	8
5	VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.	8
	<b>Total</b>	<b>40</b>



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EI4-04	Digital System Design	CO 1	Develop the understanding of number system and its application in digital electronics.
		CO 2	Development and analysis of K-map to solve the Boolean function to the simplest form for the implementation of compact digital circuits.
		CO 3	Design various combinational and sequential circuits using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power.
		CO 4	Understanding Interfacing between digital circuits and analog component using Analog to Digital Converter (ADC), Digital to Analog Converter (DAC) etc.
		CO 5	Design and implement semiconductor memories, programmable logic devices (PLDs) and field programmable gate arrays (FPGA) in digital electronics.

### CO-PO Mapping:

Subject	Course Outcomes	PO											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EI4-04 Digital System Design	CO 1	3	2	2	1		1						
	CO 2	3	2	3	2								
	CO 3	2	2	3	1	1							
	CO 4	3	2	1	1	1							
	CO 5	2	1	3	1	1							

3: Strongly

2: Moderate

1: Weak

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# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Zero Lecture
Lecture 2	Review of Boolean Algebra
Lecture 3	DeMorgan's Theorem, SOP & POS forms,
Lecture 4	Problem of SOP and POS forms of boolean functions.
Lecture 5	Simplification of karnaugh map up to 6 variables
Lecture 6	Simplification of karnaugh map up to 6 variables
Lecture 7	Simplification of karnaugh map up to 6 variables
Lecture 8	Binary codes and code conversion
Lecture 9	Binary codes and code conversion
Lecture 10	Encoder, Decoder
Lecture 11	Half and Full Adders, Subtractors, Serial and Parallel Adders
Lecture 12	BCD Adder, Barrel shifter
Lecture 13	S-R FF, edge triggered and level triggered
Lecture 14	D and J-K FF
Lecture 15	Master-Slave JK FF and T FF
Lecture 16	Ripple and Synchronous counters
Lecture 17	Other type of counters
Lecture 18	Shift registers, Finite state machines, Asynchronous FSM
Lecture 19	Design of synchronous FSM
Lecture 20	Design of synchronous FSM
Lecture 21	Design of synchronous FSM
Lecture 22	Designing synchronous circuits (pulse train generator, pseudo random binary sequence generator, clock generation)



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Lecture 23	TTL NAND gate, specifications, noise margin, propagation delay, fan-in, fan-out
Lecture 24	TTL NAND gate
Lecture 25	Tristate TTL, ECL
Lecture 26	CMOS families and their interfacing
Lecture 27	CMOS families and their interfacing
Lecture 28	Read-Only Memory, Random Access Memory
Lecture 29	Programmable Logic Arrays (PLA)
Lecture 30	Programmable Array Logic (PAL),
Lecture 31	Field Programmable Gate Array (FPGA)
Lecture 32	Combinational PLD-Based State Machines,
Lecture 33	State Machines on a Chip
Lecture 34	Schematic, FSM & HDL
Lecture 35	Different modeling styles in VHDL
Lecture 36	Data types and objects, Data flow
Lecture 37	Behavioral and Structural Modeling
Lecture 38	Behavioral and Structural Modeling
Lecture 39	Simulation VHDL constructs and codes for combinational and sequential circuits
Lecture 40	Simulation VHDL constructs and codes for combinational and sequential circuits

### Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs

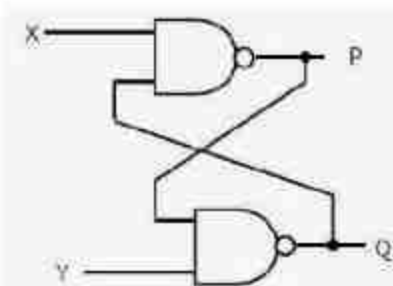


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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Sample Assignments:

<b>Assignment 1</b>	<p><b>Q1.</b> Using K-maps, find the minimal Boolean expression of the following SOP and POS representations.</p> <p>a. <math>f(w,x,y,z) = \Sigma (7,13,14,15)</math> b. <math>f(w,x,y,z) = \Sigma (1,3,4,6,9,11,14,15)</math> c. <math>f(w,x,y,z) = \Pi(1,4,5,6,11,12,13,14,15)</math> d. <math>f(w,x,y,z) = \Sigma (1,3,4,5,7,8,9,11,15)</math> e. <math>f(w,x,y,z) = \Pi (0,4,5,7,8,9,13,15)</math></p> <p><b>Q2.</b> Find the function <math>h(a,b,c,d)</math> such that <math>f = f^c</math>. <math>f(a,b,c,d) = a \cdot b \cdot c + (a \cdot c + b) \cdot d + h(a,b,c,d)</math></p> <p><b>Q3.</b> Using K-maps of the functions <math>f_1</math> and <math>f_2</math>, find the following: (provide the canonical form expression and simplify)</p> <p>a. <math>T_1 = f_1 \cdot f_2</math> b. <math>T_2 = f_1 + f_2</math> c. <math>T_3 = f_1 \oplus f_2</math></p> <p>where <math>f_1(w,x,y,z) = \Sigma (0,2,4,9,12,15)</math>, <math>f_2(w,x,y,z) = \Sigma (1,2,4,5,12,13)</math></p>
<b>Assignment 2</b>	<p><b>Q1.</b> Draw the state diagram of a serial adder.</p> <p><b>Q2.</b> In the following circuit, given binary values were applied to the</p> <p>Inputs X and Y inputs of the NAND latch shown in the figure. X =</p> <p>0, Y = 1; X = 0, Y = 0; X = 1, Y = 1. Find out the corresponding stable output P, Q.</p> 

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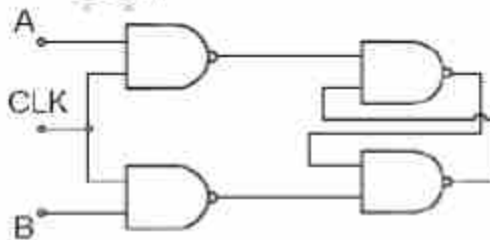
# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

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**Q3.** When the race around condition will occur in the circuit given

Below;





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## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI4-05: Signals & Systems

3 Credits

Max. Marks: 100 (IA:30, ETE:70)

3L:0T:0P

End Term Exam: 3 Hours

SN	Contents	Hours
1	Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.	6
2	Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations	7
3	Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases	8
4	The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.	6
5	The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.	5
6	State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.	8
<b>Total</b>		<b>40</b>



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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EI4-05	Signals & Systems	CO 1	Analyze different types of signals and system properties
		CO 2	Represent continuous and discrete systems in time and frequency domain using different transforms
		CO 3	Investigate whether the system is stable.
		CO 4	Sampling and reconstruction of a signal.
		CO 5	Acquire an understanding of MIMO systems

### CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EI4-05 Signals & Systems	CO 1	3	3	1	2	2			1				2
	CO 2	3	1		2	3			1				2
	CO 3	3	2	2	3								2
	CO 4	3	2	3	3	1							
	CO 5	3	2	2	3	1			2				1

3: Strongly

2: Moderate

1: Weak

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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Zero Lecture
Lecture 2	Energy signals power signals
Lecture 3	Continuous and discrete time signals
Lecture 4	Continuous amplitude signals
Lecture 5	and discrete amplitude signals
Lecture 6	System properties: linearity: additivity and homogeneity
Lecture 7	shift-invariance, causality
Lecture 8	stability, realizability.
Lecture 9	Linear shift-invariant (LSI) systems
Lecture 10	impulse response
Lecture 11	Step response
Lecture 12	Convolution.
Lecture 13	Input output behavior with aperiodic convergent inputs
Lecture 14	Characterization of causality and stability of linear shift-invariant systems.
Lecture 15	System representation through differential equations and difference equations.
Lecture 16	Characterization of causality and stability of linear shift-invariant systems.
Lecture 17	System representation through differential equations and difference equations.
Lecture 18	Periodic and semi-periodic inputs to an LSI system
Lecture 19	The notion of a frequency response.
Lecture 20	Its relation to the impulse response
Lecture 21	Fourier series representation
Lecture 22	Fourier Transform
Lecture 23	Convolution/multiplication and their effect in the frequency

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### 2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

	domain
Lecture 24	Magnitude and phase response
Lecture 25	Fourier domain duality.
Lecture 26	The Discrete-Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT).
Lecture 27	Parseval's Theorem. The idea of signal space and orthogonal bases
Lecture 28	The Laplace Transform
Lecture 29	Notion of eigen functions of LSI systems
Lecture 30	A basis of eigen functions, region of convergence
Lecture 31	Poles and zeros of system, Laplace domain analysis,
Lecture 32	Solution to differential equations and system behavior.
Lecture 33	The z-Transform for discrete time signals and systems- eigen functions,
Lecture 34	Region of convergence, z-domain analysis.
Lecture 35	State-space analysis and multi-input, multi-output representation.
Lecture 36	The state-transition matrix and its role.
Lecture 37	The Sampling Theorem and its implications- Spectra of sampled signals.
Lecture 38	Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on
Lecture 39	Aliasing and its effects.
Lecture 40	Relation between continuous and discrete time systems.

#### Content delivery method:

1. Chalk and Duster
2. PPT
3. Animation
4. Hand-outs



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

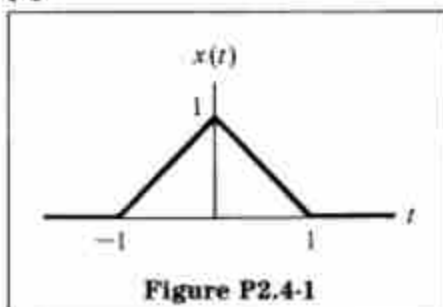
2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Assignments:

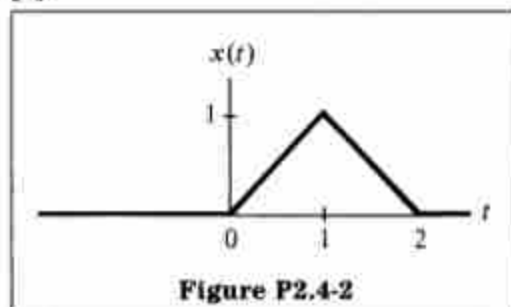
#### Assignment 3

For each of the following signals, determine whether it is even, odd, or neither.

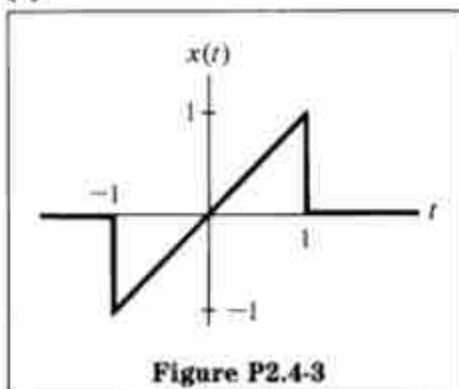
(a)



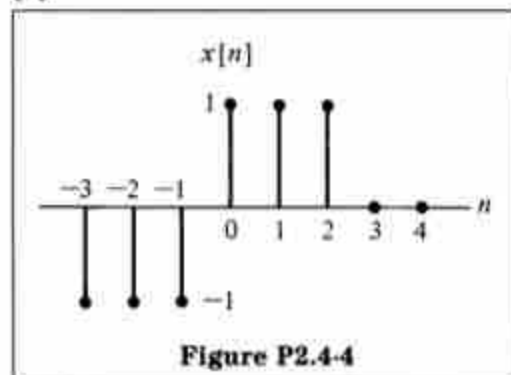
(b)



(c)



(d)



Q1.



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Evaluate the following sums:

(a)  $\sum_{n=0}^5 2 \left(\frac{3}{a}\right)^n$

(b)  $\sum_{n=-2}^0 b^n$

(c)  $\sum_{n=0}^{\infty} \left(\frac{2}{3}\right)^{2n}$

*Hint:* Convert each sum to the form

$$C \sum_{n=0}^{N-1} \alpha^n = S_N \quad \text{or} \quad C \sum_{n=0}^{\infty} \alpha^n = S_{\infty}$$

and use the formulas

$$S_N = C \left( \frac{1 - \alpha^N}{1 - \alpha} \right), \quad S_{\infty} = \frac{C}{1 - \alpha} \quad \text{for } |\alpha| < 1$$

**Q2.**

The first-order difference equation  $y[n] - ay[n-1] = x[n]$ ,  $0 < a < 1$ , describes a particular discrete-time system initially at rest.

(a) Verify that the impulse response  $h[n]$  for this system is  $h[n] = a^n u[n]$ .

(b) Is the system

- (i) memoryless?
- (ii) causal?
- (iii) stable?

Clearly state your reasoning.

(c) Is this system stable if  $|a| > 1$ ?

**Q3.**



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

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### 2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

#### Assignment 4

Consider a discrete-time system with impulse response

$$h[n] = \left(\frac{1}{2}\right)^n u[n]$$

Determine the response to each of the following inputs:

(a)  $x[n] = (-1)^n = e^{j\pi n}$  for all  $n$

(b)  $x[n] = e^{j(\pi n/4)}$  for all  $n$

(c)  $x[n] = \cos\left(\frac{\pi n}{4} + \frac{\pi}{8}\right)$  for all  $n$

**Q1.**

Consider two specific periodic sequences  $x[n]$  and  $y[n]$ .  $x[n]$  has period  $N$  and  $y[n]$  has period  $M$ . The sequence  $w[n]$  is defined as  $w[n] = x[n] + y[n]$ .

(a) Show that  $w[n]$  is periodic with period  $MN$ .

(b) Since  $x[n]$  has period  $N$ , its discrete Fourier series coefficients  $a_k$  also have period  $N$ . Similarly, since  $y[n]$  has period  $M$ , its discrete Fourier series coefficients  $b_k$  also have period  $M$ . The discrete Fourier series coefficients of  $w[n]$ ,  $c_k$ , have period  $MN$ . Determine  $c_k$  in terms of  $a_k$  and  $b_k$ .

**Q2.**

The sequence  $x[n] = (-1)^n$  is obtained by sampling the continuous-time sinusoidal signal  $x(t) = \cos \omega_0 t$  at 1-ms intervals, i.e.,

$$\cos(\omega_0 nT) = (-1)^n, \quad T = 10^{-3} \text{ s}$$

Determine three *distinct* possible values of  $\omega_0$ .

**Q3.**



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI4-06: Network Theory

4 Credits

Max. Marks: 100 (IA:30, ETE:70)

3L:1T:0P

End Term Exam: 3 Hours

SN	Contents	Hours
1	Node and Mesh Analysis, matrix approach of network containing voltage and current sources, reactances, source transformation and duality.	7
2	Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tellegen's theorem as applied to AC. circuits.	7
3	Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.	8
4	Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.	8
5	Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.	10
<b>Total</b>		<b>40</b>



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Course Outcome:

Course Code	Course Name	Course Outcome	Details
3E14-06	Network Theory	CO 1	Apply the basic circuit law and simplify the network using network theorems
		CO 2	Appreciate the frequency domain techniques in different applications.
		CO 3	Apply Laplace Transform for steady state and transient analysis
		CO 4	Evaluate transient response and two-port network parameters
		CO 5	Analyze the series resonant and parallel resonant circuit and design filters

### CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3E14-06 Network Theory	CO 1	3	2		3	2							
	CO 2	3	3	1	2	2							1
	CO 3	3	2	2		2							1
	CO 4	2	3	2	2	1							
	CO 5	2	3	3	2	1							

3: Strongly

2: Moderate

1: Weak



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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Overview of Network Theory and its significance
Lecture 2	Node and Mesh Analysis
Lecture 3	matrix approach of network containing voltage and current sources and reactances
Lecture 4	source transformation and duality
Lecture 5	Network theorems: Superposition and reciprocity
Lecture 6	Thevenin's and Norton's theorem
Lecture 7	Maximum power Transfer theorem
Lecture 8	compensation and Tellegen's theorem as applied to AC. Circuits
Lecture 9	Trigonometric and exponential Fourier series
Lecture 10	Fourier series: Discrete spectra and symmetry of waveform
Lecture 11	Steady state response of a network to non-sinusoidal periodic inputs
Lecture 12	power factor and effective values
Lecture 13	Fourier transform and continuous spectra
Lecture 14	three phase unbalanced circuit and power calculation
Lecture 15	three phase unbalanced circuit and power calculation
Lecture 16	Laplace transforms
Lecture 17	Laplace transforms
Lecture 18	Laplace transforms properties: Partial fractions
Lecture 19	singularity functions and waveform synthesis
Lecture 20	analysis of RC networks
Lecture 21	analysis of RL networks
Lecture 22	analysis of RLC networks
Lecture 23	Analysis of networks with and without initial conditions
Lecture 24	Analysis of networks with and without initial conditions
Lecture 25	Analysis of networks with and without initial conditions with lapalace transforms evaluation
Lecture 26	Analysis of networks with and without initial conditions with lapalace transforms evaluation of initial condition
Lecture 27	Transient behavior
Lecture 28	concept of complex frequency
Lecture 29	Driving points and transfer functions poles and zeros of immittance function
Lecture 30	Driving points and transfer functions poles and zeros of immittance function: their properties
Lecture 31	sinusoidal response from pole-zero locations

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### 2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

Lecture 32	sinusoidal response from pole-zero locations
Lecture 33	convolution theorem
Lecture 34	sinusoidal response from pole-zero locations
Lecture 35	Two four port network and interconnections
Lecture 36	Two four port network and interconnections
Lecture 37	Behaviors of series and parallel resonant circuits
Lecture 38	Introduction to band pass and low pass
Lecture 39	Introduction to high pass and reject filters
Lecture 40	Spill over class

#### Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs

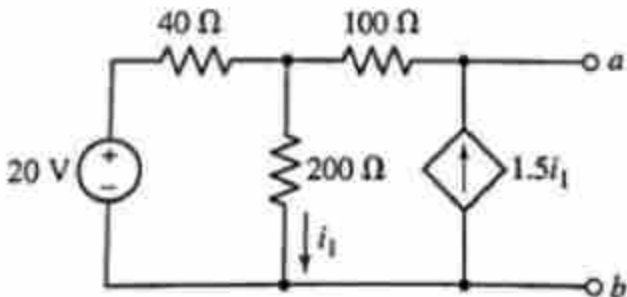
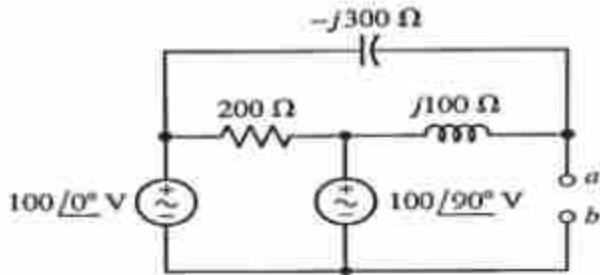


# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Sample assignments:

Assignment 1	Q1. Elaborate the significance of source transformation with relevant example
	Q2. State and prove time differentiation theorem in Laplace Transform
	Q3. Find the Thevenin equivalent of the network shown in figure. What power would be delivered to a load of 100 ohms at $a$ and $b$ ? 
Assignment 2	
Q4. Calculate Thevenin equivalent circuit with respect to terminals $a$ and $b$ . 	
Q5. Derive transient current and voltage responses of sinusoidal driven RL and RC circuits.	
Q6. Specify the restrictions on pole and zero locations for transfer functions and driving-point functions.	



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI4-07: Electronic Devices

4 Credits

Max. Marks: 100 (IA:30, ETE:70)

3L:1T:0P

End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction to Semiconductor Physics: Introduction, Energy band gap structures of semiconductors, Classifications of semiconductors, Degenerate and non-degenerate semiconductors, Direct and indirect band gap semiconductors, Electronic properties of Silicon, Germanium, Compound Semiconductor, Gallium Arsenide, Gallium phosphide & Silicon carbide, Variation of semiconductor conductivity, resistance and bandgap with temperature and doping. Thermistors, Sensitors.	6
2	Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors.	6
3	Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode.	8
4	Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell.	11
5	Integrated circuit fabrication process: oxidation, diffusion, ion implantation, Photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.	9
	<b>Total</b>	<b>40</b>



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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Course Outcome:

Course Code	Course Name	Course Outcome	Details
3E14-07	Electronic Devices	CO 1	Understanding the semiconductor physics of the intrinsic, P and N materials.
		CO 2	Understanding the characteristics of current flow in a bipolar junction transistor and MOSFET.
		CO 3	Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.
		CO 4	Analyze the characteristics of different electronic devices such as Amplifiers, LEDs, Solar cells, etc.
		CO 5	Theoretical as well as experimental understanding of Integrated circuit fabrication.

### CO-PO Mapping:

Subject	Course Outcomes	POs											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3E14-07 Electronic Devices	CO 1	3	1		2	1	1						
	CO 2	3	2	1			2						
	CO 3	2	1		2		1	2					
	CO 4	3	1	1				2					
	CO 5	3	1	1	1	1							2

3: Strongly

2: Moderate

1: Weak

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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Zero Lecture
Lecture 2	Introduction to Semiconductor Physics
Lecture 3	Introduction to Semiconductor Physics
Lecture 4	Introduction to Semiconductor Physics
Lecture 5	Review of Quantum Mechanics
Lecture 6	Electrons in periodic Lattices
Lecture 7	E-k diagrams
Lecture 8	Energy bands in intrinsic and extrinsic silicon
Lecture 9	Carrier transport: diffusion current, drift current, mobility and resistivity
Lecture 10	Sheet resistance and design of resistors
Lecture 11	Generation and recombination of carriers
Lecture 12	Poisson and continuity equation
Lecture 13	P-N junction characteristics and their I-V characteristics
Lecture 14	P-N junction characteristics and their I-V characteristics
Lecture 15	P-N junction small signal switching models
Lecture 16	P-N junction small signal switching models
Lecture 17	Avalanche breakdown
Lecture 18	Zener diode and Schottky diode
Lecture 19	Basics of Bipolar Junction Transistor
Lecture 20	I-V characteristics of BJT
Lecture 21	Ebers-Moll Model
Lecture 22	MOS capacitor



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Lecture 23	MOS capacitor
Lecture 24	C-V characteristics
Lecture 25	Basics of MOSFET
Lecture 26	Basics of MOSFET
Lecture 27	I-V characteristics of MOSFET
Lecture 28	Small signal models of MOS transistor
Lecture 29	Small signal models of MOS transistor
Lecture 30	Light Emitting Diode
Lecture 31	Photodiode and solar cell
Lecture 32	Basics of Integrated Circuits
Lecture 33	Advancement in Integrated Circuits
Lecture 34	Oxidation, diffusion and ion implantation
Lecture 35	Photolithography and etching
Lecture 36	Chemical vapor deposition
Lecture 37	Sputtering
Lecture 38	Twin-tub CMOS process
Lecture 39	Spill over class
Lecture 40	Spill over class

#### Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs



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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Sample assignments:

<b>Assignment 1</b>	<b>Q1.</b> Investigates the input/output characteristics of various diodes?
	<b>Q2.</b> Investigate the applications of various diodes?
	<b>Q3.</b> A p-type sample of silicon has a resistivity of 5 $\Omega$ -cm. In this sample, the hole mobility, $\mu_p$ , is 600 $\text{cm}^2/\text{V-s}$ and the electron mobility, $\mu_n$ , is 1600 $\text{cm}^2/\text{V-s}$ . Ohmic contacts are formed on the ends of the sample and a uniform electric field is imposed which results in a drift current density in the sample is $2 \times 10^3 \text{ A/cm}^2$ . [1]. What are the hole and electron concentrations in this sample? [2]. What are the hole and electron drift velocities under these conditions? [3]. What is the magnitude of the electric field?
<b>Assignment 2</b>	<b>Q1.</b> Discuss the applications of Ebers-Moll Model.
	<b>Q2.</b> Discuss different types of fabrication techniques.
	<b>Q3.</b> Discuss various characteristics of CMOS transistor.



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## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI4-21: Electronics Devices Lab

1 Credit

Max. Marks: 100 (IA:60, ETE:40)

OL:OT:2P

#### List of Experiments

Sr. No.	Name of Experiment
1.	Study the following devices: (a) Analog & digital multimeters (b) Function/Signal generators (c) Regulated d. c. power supplies (constant voltage and constant current operations) (d) Study of analog and digital CRO, measurement of time period, amplitude, frequency & phase angle using Lissajous figures.
2.	Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse Saturation current and static & dynamic resistances.
3.	Plot the output waveform of half wave rectifier and effect of filters on waveform. Also calculate its ripple factor.
4.	Study bridge rectifier and measure the effect of filter network on D.C. voltage output & ripple factor.
5.	Plot and verify output waveforms of different clipper and clamper.
6.	Plot V-I characteristic of Zener diode
7.	Study of Zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator
8.	Plot input-output characteristics of BJT in CB, CC and CE configurations. Find their h-parameters.
9.	Study of different biasing circuits of BJT amplifier and calculate its Q-point.
10.	Plot frequency response of two stage RC coupled amplifier & calculate its bandwidth .
11.	Plot input-output characteristics of field effect transistor and measure $I_{DSS}$ and $V_p$ .
12.	Plot frequency response curve for FET amplifier and calculate its gain bandwidth product.

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## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EI4-21	Electronic Devices Lab	CO 1	Understand the characteristics of different Electronic Devices.
		CO 2	Verify the rectifier circuits using diodes and implement them using hardware.
		CO 3	Design various amplifiers like CE, CC, common source amplifiers and implement them using hardware and also observe their frequency responses
		CO 4	Understand the construction, operation and characteristics of JFET and MOSFET, which can be used in the design of amplifiers.
		CO 5	Understand the need and requirements to obtain frequency response from a transistor so that Design of RF amplifiers and other high frequency amplifiers is feasible

### CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		3EI4-21 Electronic Devices Lab	CO 1	3	2	3	2	1					
	CO 2	2	3	1	3	3							2
	CO 3	2	1	2	3	3							
	CO 4	3	2	3	2	2							1
	CO 5	3	2	1	2	2							

3: Strongly

2: Moderate

1: Weak

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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI4-22: Digital System Design Lab

1 Credit

Max. Marks: 100 (IA:60, ETE:40)

OL:OT:2P

#### List of Experiments

S. No.	Name of Experiment
<b>Part A: Combinational Circuits</b>	
1.	To verify the truth tables of logic gates: AND, OR, NOR, NAND, NOR, Ex-OR and Ex-NOR
2.	To verify the truth table of OR, AND, NOR, Ex-OR, Ex-NOR logic gates realized using NAND & NOR gates.
3.	To realize an SOP and POS expression.
4.	To realize Half adder/ Subtractor & Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables
5.	To realize a 4-bit ripple adder/ Subtractor using basic Half adder/ Subtractor & basic Full Adder/ Subtractor.
6.	To design 4-to-1 multiplexer using basic gates and verify the truth table. Also verify the truth table of 8-to-1 multiplexer using IC
7.	To design 1-to-4 demultiplexer using basic gates and verify the truth table. Also to construct 1-to-8 demultiplexer using blocks of 1-to-4 demultiplexer
8.	To design 2x4 decoder using basic gates and verify the truth table. Also verify the truth table of 3x8 decoder using IC
9.	Design & Realize a combinational circuit that will accept a 2421 BCD code and drive a TIL -312 seven-segment display
<b>Part B: Sequential Circuits</b>	
10.	Using basic logic gates, realize the R-S, J-K and D-flip flops with and without clock signal and verify their truth table.
11.	Construct a divide by 2, 4 & 8 asynchronous counter. Construct a 4-bit binary counter and ring counter for a particular output pattern using D flip flop.
12.	Design and construct unidirectional shift register and verify the
13.	Design and construct BCD ripple counter and verify the function.
14.	Design and construct a 4 Bit Ring counter and verify the function
15.	Perform input/output operations on parallel in/Parallel out and Serial in/Serial out registers using clock. Also exercise loading only one of multiple values into the register using multiplexer.

**Note:** Minimum 6 experiments to be conducted from **Part-A** & 4 experiments to be conducted from **Part-B**.

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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EI4-22	Digital System Design Lab	CO 1	
		CO 2	To minimize the complexity of digital logic circuits.
		CO 3	To design and analyse combinational logic circuits.
		CO 4	To design and analyse sequential logic circuits.
		CO 5	Able to implement applications of combinational & sequential logic circuits.

### CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EI4-22 Digital System Design Lab	CO 1	3	3	1									1
	CO 2	3	3	2	1	1							1
	CO 3	3	3	3	2	3	1						2
	CO 4	3	3	3	2	3	1						2
	CO 5	3	3	3	3	3	3						3

3: Strongly

2: Moderate

1: Weak



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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI4-23: Signal Processing Lab

1 Credit

Max. Marks: 100 (IA:60, ETE:40)

OL:OT:2P

#### List of Experiments

Sr. No.	Name of Experiment (Simulate using MATLAB environment)
1.	Generation of continuous and discrete elementary signals (periodic and non periodic) using mathematical expression.
2.	Generation of Continuous and Discrete Unit Step Signal.
3.	Generation of Exponential and Ramp signals in Continuous & Discrete domain.
4.	Continuous and discrete time Convolution (using basic definition).
5.	Adding and subtracting two given signals. (Continuous as well as Discrete signals)
6.	To generate uniform random numbers between (0, 1).
7.	To generate a random binary wave.
8.	To generate and verify random sequences with arbitrary distributions, means and variances for following: (a) Rayleigh distribution (b) Normal distributions: $N(0, 1)$ . (c) Gaussian distributions: $N(m, x)$
9.	To plot the probability density functions. Find mean and variance for the above distributions



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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### Course Outcome:

Course Code	Course Name	Course Outcome	Details
3E14-23	Signal Processing Lab	CO 1	Able to generate different Continuous and Discrete time signals.
		CO 2	Understand the basics of signals and different operations on signals.
		CO 3	Develop simple algorithms for signal processing and test them using MATLAB
		CO 4	Able to generate the random signals having different distributions, mean and variance.
		CO 5	Design and conduct experiments, interpret and analyse data and report results.

### CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		3E14-23 Signal Processing Lab	CO 1	2		1		2					
	CO 2	3		1									
	CO 3	1	2	3	1	3							
	CO 4	2	1	1		2							
	CO 5	1	1	2	2	2							

3: Strongly

2: Moderate

1: Weak

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2<sup>nd</sup> Year - III Semester: B.Tech. (Electronics Instrumentation & Control)

### 3EI3-24: Computer Programming Lab-I

1 Credit

Max. Marks: 100 (IA:60, ETE:40)

OL:OT:2P

1.	Write a simple C program on a 32 bit compiler to understand the concept of array storage, size of a word. The program shall be written illustrating the concept of row major and column major storage. Find the address of element and verify it with the theoretical value. Program may be written for arrays upto 4-dimensions.
2.	Simulate a stack, queue, circular queue and dequeue using a one dimensional array as storage element. The program should implement the basic addition, deletion and traversal operations.
3.	Represent a 2-variable polynomial using array. Use this representation to implement addition of polynomials.
4.	Represent a sparse matrix using array. Implement addition and transposition operations using the representation.
5.	Implement singly, doubly and circularly connected linked lists illustrating operations like addition at different locations, deletion from specified locations and traversal.
6.	Repeat exercises 2, 3 & 4 with linked structures.
7.	Implementation of binary tree with operations like addition, deletion, traversal.
8.	Depth first and breadth first traversal of graphs represented using adjacency matrix and list.
9.	Implementation of binary search in arrays and on linked Binary Search Tree.
10.	Implementation of insertion, quick, heap, topological and bubble sorting algorithms.