

B.E. /B.Tech in Computer Science & Business Systems

Semester 2

TCS

Computer Science & Business Systems

Semester 2 Curriculum

B.E. /B.Tech in Computer Science & Business Systems

Semester 2

LINEAR ALGEBRA

Introduction to Matrices and Determinants; Solution of Linear Equations; Cramer's rule; Inverse of a Matrix.

Vectors and linear combinations; Rank of a matrix; Gaussian elimination; LU Decomposition; Solving Systems of Linear Equations using the tools of Matrices.

Vector space; Dimension; Basis; Orthogonality; Projections; Gram-Schmidt orthogonalization and QR decomposition.

Eigenvalues and Eigenvectors; Positive definite matrices; Linear transformations; Hermitian and unitary matrices;

Singular value decomposition and Principal component analysis (Non-credit and optional); Introduction to their applications in Image Processing and Machine Learning (one or two classes).

Note:

Assignments & tutorials covering the following: Vectors and linear combinations, Matrices, Linear transformations, Complete solution to $Ax = b$, Determinants, Eigenvalues and Eigenvectors

Text Books:

1. *Higher Engineering Mathematics*, B. S. Grewal, Khanna Publishers.

Reference Books:

1. *Advanced Engineering Mathematics*, (Seventh Edition), Peter V. O'Neil, Cengage Learning.
2. *Advanced Engineering Mathematics*, (Second Edition), Michael. D. Greenberg, Pearson.
3. *Introduction to linear algebra*, (Fifth Edition), Gilbert Strang, Wellesley-Cambridge Press.
4. *Applied Mathematics* (Vol. I & II), P. N. Wartikar & J. N. Wartikar, Pune Vidyarthi Griha Prakashan.
5. *Digital Image Processing*, R C Gonzalez and R E Woods, Pearson.
6. <https://machinelearningmastery.com/introduction-matrices-machine-learning/>

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STATISTICAL METHODS + Lab

Sampling Techniques: Random sampling. Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement), Sampling distribution of sample mean, stratified random sampling

Linear Statistical Models: Scatter diagram. Linear regression and correlation. Least squares method. Rank correlation. Standard multiple regression models with emphasis on detection of collinearity, outliers, non-normality and autocorrelation, Validation of model assumptions. Multiple correlation, Analysis of variance (one way, two way with as well as without interaction)

Estimation: Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation.

Test of hypothesis: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Procedures of testing

Non-parametric Inference: Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearman's and Kendall's test.

Basics of Time Series Analysis & Forecasting: Stationary, ARIMA Models: Identification, Estimation and Forecasting.

Laboratory

R statistical programming language: Introduction to R, Functions, Control flow and Loops, Working with Vectors and Matrices, Reading in Data, Writing Data, Working with Data, Manipulating Data, Simulation, Linear model, Data Frame, Graphics in R

Text Books:

1. *Probability and Statistics for Engineers* (4th Edition), I.R. Miller, J.E. Freund and R. Johnson.
2. *Fundamentals of Statistics* (Vol. I & Vol. II), A. Goon, M. Gupta and B.Dasgupta.
3. *The Analysis of Time Series: An Introduction*, Chris Chatfield.

Reference Books:

1. *Introduction to Linear Regression Analysis*, D.C. Montgomery & E. Peck
2. *Introduction to the Theory of Statistics*, A.M. Mood, F.A. Graybill & D.C. Boes.
3. *Applied Regression Analysis*, N. Draper & H. Smith
4. *Hands-on Programming with R*, Garrett G. Grolemund
5. *R for Everyone: Advanced Analytics and Graphics*, Jared P. Lander

Data Source:

- www.rbi.org.in

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DATA STRUCTURES AND ALGORITHMS + Lab

Basic Terminologies and Introduction to Algorithm & Data Organisation: Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction

Linear Data Structure: Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures

Non-linear Data Structure: Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree) and Graphs (Directed, Undirected), Various Representations, Operations & Applications of Non-Linear Data Structures

Searching and Sorting on Various Data Structures: Sequential Search, Binary Search, Comparison Trees, Breadth First Search, Depth First Search Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heapsort, Introduction to Hashing

File: Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Laboratory

1. Towers of Hanoi using user defined stacks.
2. Reading, writing, and addition of polynomials.
3. Line editors with line count, word count showing on the screen.
4. Trees with all operations.
5. All graph algorithms.
6. Saving / retrieving non-linear data structure in/from a file

Text Books:

1. *Fundamentals of Data Structures*, E. Horowitz, S. Sahni, S. A-Freed, Universities Press.
2. *Data Structures and Algorithms*, A. V. Aho, J. E. Hopperoft, J. D. Ullman, Pearson.

Reference Books:

1. *The Art of Computer Programming: Volume 1: Fundamental Algorithms*, Donald E. Knuth.
2. *Introduction to Algorithms*, Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, The MIT Press.
3. *Open Data Structures: An Introduction (Open Paths to Enriched Learning)*, (Thirty First Edition), Pat Morin, UBC Press.

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PRINCIPLES OF ELECTRONICS ENGINEERING + Lab

Semiconductors: Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P-N-type semiconductors, drift & diffusion carriers.

Diodes and Diode Circuits: Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

Bipolar Junction Transistors: Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor

Field Effect Transistors: Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles

Feed Back Amplifier, Oscillators and Operational Amplifiers: Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability; effect of positive feedback: instability and oscillation, condition of oscillation, Barkhausen criteria. Introduction to integrated circuits, operational amplifier and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator

Digital Electronics Fundamentals: Difference between analog and digital signals, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

Laboratory

1. *Semiconductor Diodes and application,*
2. *Transistor circuits,*
3. *JFET, oscillators and amplifiers.*

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PRINCIPLES OF ELECTRONICS ENGINEERING + Lab (continued)

Text Books:

1. *Microelectronics Circuits*, Adel S. Sedra and Kenneth Carless Smith, Oxford University Press.
2. *Millman's Integrated Electronics*, Jacob Millman, Christos Halkias, Chetan Parikh, McGraw Hill Education.
3. *Digital Logic & Computer Design*, M. Morris Mano, Pearson

Reference Books:

1. *Electronic Devices and Circuit Theory*, Robert L. Boylestad, Louis Nashelsky.
2. *Solid State Electronic Devices*, 6th Edition, Ben Streetman, Sanjay Banerjee
3. *Electronic Principle*, Albert Paul Malvino.
4. *Electronics Circuits: Discrete & Integrated*, D Schilling C Belove T Apelewicz R Saccardi.
5. *Microelectronics*, Jacob Millman, Arvin Grabel.
6. *Electronics Devices & Circuits*, S. Salivahanan, N. Suresh Kumar, A. Vallavaraj
7. *Electronic Devices & Circuit Theory*, 11th Edition, Robert L. Boylestad, Louis Nashelsky.

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FUNDAMENTALS OF ECONOMICS

Microeconomics: *Principles of Demand and Supply* - Supply Curves of Firms - Elasticity of Supply; *Demand Curves of Households* - Elasticity of Demand; Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve); *Welfare Analysis* - Consumers' and Producers' Surplus - Price Ceilings and Price Floors; *Consumer Behaviour* - Axioms of Choice - Budget Constraints and Indifference Curves; *Consumer's Equilibrium* - Effects of a Price Change, Income and Substitution Effects - Derivation of a Demand Curve; *Applications* - Tax and Subsidies - Intertemporal Consumption - Suppliers' Income Effect; *Theory of Production* - Production Function and Iso-quants - Cost Minimization; *Cost Curves* - Total, Average and Marginal Costs - Long Run and Short Run Costs; *Equilibrium of a Firm Under Perfect Competition*; *Monopoly and Monopolistic Competition*

Macroeconomics: *National Income and its Components* - GNP, NNP, GDP, NDP; Consumption Function; Investment; *Simple Keynesian Model of Income Determination and the Keynesian Multiplier*; *Government Sector* - Taxes and Subsidies; *External Sector* - Exports and Imports; *Money* - Definitions; *Demand for Money* - Transactionary and Speculative Demand; *Supply of Money* - Bank's Credit Creation Multiplier; *Integrating Money and Commodity Markets* - IS, LM Model; *Business Cycles and Stabilization* - Monetary and Fiscal Policy - Central Bank and the Government; *The Classical Paradigm* - Price and Wage Rigidities - Voluntary and Involuntary Unemployment

Text Books:

1. *Microeconomics*, Pindyck, Robert S., and Daniel L. Rubinfeld.
2. *Macroeconomics*, Dornbusch, Fischer and Startz.
3. *Economics*, Paul Anthony Samuelson, William D. Nordhaus.

Reference Books:

1. *Intermediate Microeconomics: A Modern Approach*, Hal R, Varian.
2. *Principles of Macroeconomics*, N. Gregory Mankiw.

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ENVIRONMENTAL SCIENCES (Non-Credit)

(To be finalised by Respective Institute)