

Revised Course Structure

B. Tech. (Electronics and Communication Engineering)



**Department of Electronics and Communication,
Faculty of Science
University of Allahabad, Prayagraj-211002
(Session 2025-26 onwards)**

Department of Electronics and Communication
(J. K. Institute of Applied Physics and Technology)
University of Allahabad, Prayagraj

B. Tech. (Electronics and Communication Engineering)

B. Tech. 1st Semester (ECE)						
Paper	Course Code	L-T-P-C	Credits	Theory Papers/ Practical Labs	Sessional Marks	End Semester Marks
Paper-1	BET101	3-0-0-3	3	Engineering Mathematics I	40	60
Paper-2	BET102	3-0-0-3	3	Circuit Theory	40	60
Paper-3	BET103	3-0-0-3	3	Engineering Physics and Materials	40	60
Paper-4	BET104	3-0-0-3	3	Basic Electronics	40	60
Paper-5	BET105	3-0-0-3	3	Computer and Programming Fundamentals	40	60
Paper-6	BET106	3-0-0-3	3	Communication Skill I	40	60
Practical Lab	BEP131	0-0-6-3	3	Electronics Lab I	40	60
	BEP132	0-0-6-3	3	Computer Lab: Programming	40	60

B. Tech. 2nd Semester (ECE)						
Papers	Course Code	L-T-P-C	Credits	Theory Papers/ Practical Labs	Sessional Marks	End Semester Marks
Paper-1	BET201	3-0-0-3	3	Engineering Mathematics II	40	60
Paper-2	BET202	3-0-0-3	3	Applied Numerical Analysis	40	60
Paper-3	BET203	3-0-0-3	3	Digital Electronics	40	60
Paper-4	BET204	3-0-0-3	3	Electronic Devices and Circuits	40	60
Paper-5	BET205	3-0-0-3	3	Network Analysis and Synthesis	40	60
Paper-6	BET206	3-0-0-3	3	Communication Skill II	40	60
Practical Lab	BEP231	0-0-6-3	3	Electronics Lab II	40	60
	BEP232	0-0-6-3	3	Communication Skill Practice	40	60

B. Tech. 3rd Semester (ECE)						
Paper	Course Code	L-T-P-C	Credits	Theory Papers/ Practical Labs	Sessional Marks	End Semester Marks
Paper-1	BET301	3-0-0-3	3	Electronic Instrumentation and Measurement	40	60
Paper-2	BET302	3-0-0-3	3	Signals and Systems	40	60
Paper-3	BET303	3-0-0-3	3	Analog Circuits and Systems	40	60
Paper-4	BET304	3-0-0-3	3	Electrical Engineering	40	60
Paper-5	BET305	3-0-0-3	3	Computer Architecture and Organization	40	60
Paper-6	BET306	3-0-0-3	3	Industrial Management	40	60
Practical Lab	BEP331	0-0-6-3	3	Microprocessor Lab	40	60
	BEP332	0-0-6-3	3	Engineering Drawing and Workshop	40	60

B. Tech. 4th Semester (ECE)						
Paper	Course Code	L-T-P-C	Credits	Theory Papers/ Practical Labs	Sessional Marks	End Semester Marks
Paper-1	BET401	3-0-0-3	3	EM Wave Theory	40	60
Paper-2	BET402	3-0-0-3	3	Semiconductor Devices and Technology	40	60
Paper-3	BET403	3-0-0-3	3	Communication System	40	60
Paper-4	BET404	3-0-0-3	3	Control Systems	40	60
Paper-5	BET405	3-0-0-3	3	Fiber Optic communication I	40	60
Paper-6	BET406	3-0-0-3	3	Power Electronics	40	60
Practical Lab	BEP431	0-0-6-3	3	Instrumentation and Control Lab	40	60
	BEP432	0-0-6-3	3	Electrical Engineering Lab	40	60

B. Tech. 5th Semester (ECE)

Paper	Cours e Code	L-T-P-C	Credits	Theory Papers/ Practical Labs	Sessional Marks	End Semester Marks
Paper-1	BET501	3-0-0-3	3	Antenna and Wave Propagation	40	60
Paper-2	BET502	3-0-0-3	3	IC Technology	40	60
Paper-3	BET503	3-0-0-3	3	Fiber Optic Communication II	40	60
Paper-4	BET504	3-0-0-3	3	Computer Networks	40	60
Paper-5	BET505	3-0-0-3	3	Machine Learning and Artificial Intelligence	40	60
Paper-6	BET506	3-0-0-3	3	Digital Communication Systems	40	60
Practical Lab	BEP531	0-0-6-3	3	Analog and Digital Communication Lab	40	60
	BEP532	0-0-6-3	3	Design Lab I	40	60

B. Tech. 6th Semester (ECE)

Paper	Cour se Cod e	L-T-P-C	Credits	Theory Papers/ Practical Labs	Sessional Marks	End Semester Marks
Paper-1	BET601	3-0-0-3	3	Microelectronics and VLSI Design	40	60
Paper-2	BET602	3-0-0-3	3	Satellite Communication	40	60
Paper-3	BET603	3-0-0-3	3	Radar Engineering and Navigational Aids	40	60
Paper-4	BET604	3-0-0-3	3	Mobile Ad Hoc Networks	40	60
Paper-5	BET605	3-0-0-3	3	Digital Signal Processing	40	60
Paper-6	BET606	3-0-0-3	3	Internet of Things	40	60
Practical Lab	BEP631	0-0-6-3	3	Digital Signal Processing Lab	40	60
	BEP632	0-0-6-3	3	Design Lab II	40	60

B. Tech. 7th Semester (ECE)

Paper	Cou rse Co de	L-T-P-C	Credits	Theory Papers/ Practical Labs	Sessional Marks	End Semester Marks
Paper-1	BET701	3-0-0-3	3	Microwave Technology	40	60
Paper-2	BET702	3-0-0-3	3	Mobile Communication	40	60
Paper-3	BET703	3-0-0-3	3	Microcontroller and Microprocessor Interfacing	40	60
Paper-4	BET7##	3-0-0-3	3	Elective I	40	60
Paper-5	BET7\$\$	3-0-0-3	3	Elective II	40	60

Practical Lab	BEP731	0-0-6-3	3	Microwave and Optical Communication Lab	40	60
	BEP732	0-0-6-3	3	Mini Project	40	60
	BEP733	0-0-6-3	3	Educational Tour/Training	40	60

B. Tech. 8th Semester (ECE)						
Paper	Course Code	L-T-P-C	Credits	Internship / Project	Sessional Marks	End Semester Marks
Internship / Project	BEP831	0-0-12-6	6	Internship / Project (seminar)	80	120
	BEP832	0-0-24-12	12	Internship / Project (Dissertation and Viva)	160	240
Comprehensive Viva	BEP833	0-0-12-6	6	Comprehensive Viva	80	120

NOTE:

1. Tests for sessional marks evaluation will be held in hybrid mode.
2. End semester examination will be held in offline mode only.

List of Elective 1 for B.Tech 7th sem

##

1. BET751 Image Processing
2. BET752 Technology of Digital Vision
3. BET753 Operating System for Smart Devices
4. BET754 Data Structure with C

List of Elective 2 for B.Tech 7th sem

\$\$

1. BET771 Application-Specific Integrated Circuits
2. BET772 Wireless Communication
3. BET773 Introduction to Robotics
4. BET774 Organic Electronic Devices and Circuits

(Dr. Lucky Agarwal)

(Er. Rajeev Srivastava)

(Prof. R. K. Srivastava)

(Prof. J. A. Ansari)

PO's and PSO

Program Outcome

PO No.	Program Outcome
PO1	Apply knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Identify, formulate, research literature, and analyze engineering problems to reach substantiated conclusions using first principles of mathematics and engineering sciences.
PO3	Design solutions for engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health, safety, and environmental factors.
PO4	Conduct investigations of complex problems using research-based knowledge, including design of experiments, analysis, and interpretation of data.
PO5	Use modern tools, techniques, and software in electrical engineering to predict and model system behavior and solve problems.
PO6	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues relevant to engineering practice.
PO7	Understand the impact of engineering solutions on the environment and demonstrate the knowledge of sustainable development.
PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large.
PO11	Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team.
PO12	Recognize the need for lifelong learning and have the ability to engage in continuous professional development.

Program Specific Outcome

PSO No.	Program Specific Outcome
PSO1	Apply the principles of electronics and communication engineering to design and analyze electronic circuits and systems.
PSO2	Utilize modern simulation tools, programming, and hardware platforms to develop and test communication and embedded systems.
PSO3	Demonstrate professional skills and awareness of technological, societal, and environmental aspects in electronics and communication applications.

B.TECH FIRST SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET101
Paper 1: Engineering Mathematics I

Total Lectures: 40

Unit 1: Linear Algebra:

Linear Algebra: Matrices, Determinants, Elementary Properties, Eigen values and Eigen vectors, CHT, Rank, Consistency of algebraic equations.

Unit 2: Calculus:

Calculus: Limit, Continuity and Differentiability of real valued functions, Properties of continuous functions on closed intervals, Expansion of functions, Definite and Improper integrals

Unit 3: Vector Differential Calculus:

Vector Calculus: Partial differentiation, Directional derivatives, Gradient and Curl Divergence, Conservative fields, Simple applications, Multiple integrals, Basic applications.

Unit 4: Differential Equations:

ODE: Order and degree, First order equations, Existence and uniqueness of solutions, Higher order ODE with constant coefficients, Wronskian, Equations reducible to constant coefficients.

Unit 5: Complex Functions

Complex Functions: Basic algebra, Complex functions, Analytical functions, C-R equations, Complex integration, Basic results, General Contour integrals.

References:

1. Linear Algebra: K. Hoffman and R. Kunze (Pearson).
2. A Course in Ordinary Differential Equations: Rai, Chaudhary, Freedman (Narosa).
3. Foundation of Complex Analysis: S. Ponnusami, (Narosa).
4. Calculus, Vol. I: T. M. Apostol. (Wiley).
5. Advanced Engineering Mathematics: E. Kreyszig (John Wiley and Sons).

CO1	Apply the concepts of matrices, determinants, eigenvalues, and eigenvectors to solve systems of linear equations and analyze their consistency.
CO2	Examine the behavior of real-valued functions using limits, continuity, and differentiability, and evaluate definite and improper integrals for engineering applications.
CO3	Compute gradient, divergence, and curl of vector fields and apply multiple integrals to solve physical and geometrical problems.

CO4	Formulate and solve ordinary differential equations of various orders to model and interpret dynamic systems in engineering contexts
CO5	Analyze and apply properties of analytic functions, Cauchy–Riemann equations, and complex integration to evaluate contour integrals and interpret results in engineering problems.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	-	1	3	2	1
CO2	3	3	2	2	1	-	-	-	-	-	-	1	3	2	1
CO3	3	3	2	3	1	-	-	-	-	-	-	1	3	2	2
CO4	3	3	2	3	1	-	-	-	-	-	-	1	3	3	2
CO5	3	3	3	3	2	-	-	-	-	-	-	2	3	3	3

B.TECH FIRST SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET102
Paper 2: Circuit Theory

Total Lectures: 40

Unit 1: Resistive Circuit Analysis

Circuit elements and their classification; LLFPB circuits; Nodal and Mesh analysis; Equivalence of networks; Duality; Source transformations; T- π T-transformation.

Unit 2: Networks Theorems

Superposition, Thevenin and Norton, Maximum Power Transfer, Reciprocity, Millman, Substitution and Tellgene's theorems and their applications

Unit 3: Transient Circuit Analysis

Natural and forced response; Evaluation of initial conditions; Transient and steady state responses of simple RL, RC and RLC circuits to arbitrary excitations.

Unit 4: Sinusoidal Analysis

Sinusoidal and Complex forcing functions; Phasor representation of Complex functions; sinusoidal steady-state response; Concept of Complex frequency; Damped Sinusoidal forcing function- Natural and forced response: Frequency response - parallel and series resonance. Mutual Impedance and coefficient of coupling; Unity Coupled Coils.

Unit 5: Classical Filters

Characterization of Two ports, z,y, h and transmission parameters, Interconnection of two ports, Analysis of common two ports.

Filter fundamentals -pass and stop bands, The Constant -K low-pass and high-pass filters; The m-derived T and π sections; Band-pass and Band-elimination filters; Impedance Matching half- π sections.

References:

1. Engineering Circuit Analysis: William H. Hayt, Jr. and E. Kemmerly(TM)
2. Electric Circuits: David A. Bell(PHI)
3. Network Analysis: Van Valkenburg(PHI)
4. Basic Circuit Theory: Desoer and Kuh(TM)
5. Network and System: D. Roy. Chandhary (NewAge International)
6. Circuit theory: Chakrabarti (Dhanpatrai and Sons)

CO1	Apply mesh and nodal analysis, source transformations, and network equivalence to analyze and
-----	---

	simplify DC resistive circuits.
CO2	Demonstrate and apply network theorems such as Superposition, Thevenin, Norton, and Maximum Power Transfer to solve linear electrical networks efficiently
CO3	Analyze transient and steady-state responses of RL, RC, and RLC circuits to determine the time-domain behavior under various excitations.
CO4	Evaluate AC circuits using phasor and complex frequency methods to interpret sinusoidal steady-state response and examine resonance and coupling effects.
CO5	Design and analyze two-port networks and classical filters (constant-K and m-derived types) to achieve desired frequency response and impedance matching.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	1	3	2	2
CO2	3	3	2	3	3	-	-	-	-	-	-	1	3	3	2
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3
CO5	3	3	3	3	3	1	1	-	-	-	1	2	3	3	3

B.TECH FIRST SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET103
Paper 3: Engineering Physics and Materials

Total Lectures: 40

Unit 1: Optics and Lasers:

Interference of light: Interference in thin films, Newton's rings Diffraction: Fresnel and Fraunhofer diffraction, Plane diffraction grating, Measurement of wave length, Dispersive power of grating, Resolving power, Rayleigh criterion

Unit 2: Lasers:

Basic principles of laser, spontaneous emission- stimulated emission-population inversion, spatial and temporal coherence- coherence length, optical amplification, laser rate equations, gain coefficient, threshold condition

Unit 3: Introduction to quantum theory

Wave particle duality, matter waves, group and phase velocity, uncertainty principle, wave packets, Schrodinger equation

Unit 4: Solid State Physics

Bonding in solids, Elastic properties of solids, Defects in crystals, Lattice vibrations and thermal properties of solids, Free electron theory, Band theory of solids, Metals, Semiconductors and insulators, Electrical conductivity of simple metals (Free Electron Theory)

Unit 5: Nano Physics:

Introduction to nanophysics, energy levels, density of states, quantum wire, single electron tunneling, quantum dot, nano-transistors and FET, NEMS and sensors.

References:

1. Modern Physics: J.B.Rajam
2. Solid State Physics: Charles Kittel
3. Optics: Ajoy Ghatak
4. Statistical Physics: Charles Kittel
5. Modern Physics: Beiser

CO1	Explain interference and diffraction phenomena to determine optical parameters experimentally.
CO2	Apply laser principles to understand generation, coherence, and amplification of light.
CO3	Interpret quantum concepts and apply Schrödinger equation to explain particle behavior.
CO4	Analyze bonding, band theory, and electrical/thermal properties of solids.
CO5	Explain and apply quantum phenomena to understand nanoscale materials and devices.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	1	3	2	2
CO2	3	3	2	3	3	-	-	-	-	-	-	1	3	3	2
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3
CO5	3	3	3	3	3	1	1	-	-	-	1	2	3	3	3

B.TECH FIRST SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET104
Paper 4: Basic Electronics

Total Lectures: 40

Unit 1: Semiconductors and PN Junction Diode

Properties of semiconductors, Intrinsic and extrinsic semiconductors, P and N type of impurities and doping Charge densities and potential barrier, Drift and diffusion currents, PN junction working and characteristics, It's applications as– Rectifier: Half wave, Full wave, Bridge Rectifier and their calculation for ripple, Efficiency and PIV; Clipper, Clamper, Zener and Avalanche breakdown diodes, Tunnel diode, Thermistor

Unit 2: Bipolar Transistor

Transistor action with simple bias conditions, Working and basic characteristics, CB, CE and CC configuration of transistor amplifiers, Analysis for CB and CE basic amplifiers- Determination of Q-point, dc load line and calculations for gains and impedances, Effect of load and ac load line

Unit 3: Transistor biasing

Biasing circuits for CB and CE configurations, Leakage currents in CB and CE and it's effect, Thermal stabilization and Stability factor, Different biasing arrangements for CE- their advantages and drawbacks, Transistor thermal power dissipation and rating

Unit 4: Equivalent Circuits of Transistor

Transistor as four port device, Impedance, Z-parameters and circuits representation, Admittance Y parameters and circuit representation, h-parameters and circuit representation; Analysis of CB and CE circuits using h parameters for gains and impedances

Unit 5: Field Effect Transistors

Basic configuration of JFET, Biasing, Principle of operation and basic characteristics, Basics of MOSFET

References:

1. Electronic Devices and Circuits: Allen Moterned
2. Integrated Electronics: Jacob Millman
3. Electronic Devices and Circuit Theory: L. Boylestad and Nashelsky
4. Handbook of Electronics: Gupta and Kumar

CO1	Explain semiconductor properties and analyze diode operation and applications..
-----	---

CO2	Apply transistor principles to analyze amplifier configurations and calculate gains/impedances.
CO3	Evaluate biasing techniques for thermal stability and proper amplifier operation..
CO4	Construct and analyze transistor equivalent circuits using h-, z-, and y-parameters..
CO5	Describe and apply JFET and MOSFET principles in basic circuits.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	-	1	3	2	2
CO2	3	3	3	3	2	-	-	-	-	-	-	1	3	3	2
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3
CO5	3	3	3	3	3	1	1	-	1	1	1	3	3	3	3

B.TECH FIRST SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET105
Paper 5: Computer Programming and Fundamentals

Total Lectures: 40

Unit 1: Introduction of Hardware:

Brief introduction of binary numbers, Functional block diagram of a computer, Stored program machine, Generation of computers, CPU, I/O, Secondary storage, Memory and its classifications.

Unit 2: Introduction of Software:

Generations of programming languages, introduction to applications and system software, File storage, DOS and windows environment.

Unit 3: Algorithms:

Flow charts, Structure and properties of algorithm, Algorithms for g.c.d., Factorial, Fibonacci series, Prime number generation etc.

Unit 4: Basics of C Language:

C preprocessor, Variables, Operators, Expressions, Control flow, Data types, Arrays, Pointers, Storage classes, Scope and initialization, Input/output, String processing, Pointers, Dynamic data structures, Structures and unions, File handling

Unit 5: Basics of Python Language:

Introduction to Python, Variables, data types, and operators, Input and output operations, Control Flow and Functions, Data Structures in Python, File Handling and Exception Handling, NumPy and Pandas for Data Analysis, Data Visualization using Matplotlib

References:

1. The Design and Analysis of Computer Algorithms: A. Aho, J. Hopcraft and Ullman (Addison)
2. Fundamentals of Computer Algorithms: E. Horowitz and S. Sahani (Galgotia, New Delhi)
3. Introduction to the Design and Analysis of Algorithms: S.E. Goodman et al (McGraw-Hill)
4. Algorithms: G. Brassard and P. Bratley (PHI)
5. Programming Languages: R. Sethi (Addison-Wesley)

CO1	Explain the basic structure and functional components of a computer, including CPU, memory, I/O devices, and storage, and classify different types of memory and computer generations...
CO2	Describe the generations of programming languages, types of software, and operating system environments (DOS, Windows), and demonstrate file handling and basic system operations

CO3	Design and analyze algorithms for basic computational problems such as GCD, factorial, Fibonacci series, and prime number generation using flowcharts and structured approaches.
CO4	Implement programs in C using variables, control structures, arrays, pointers, structures, unions, and file handling to solve computational problems
CO5	Develop Python programs using data types, control structures, functions, data structures, file handling, and libraries like NumPy, Pandas, and Matplotlib to analyze and visualize data.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	-	1	3	2	1
CO2	3	3	2	2	2	-	-	-	-	1	-	1	3	3	2
CO3	3	3	3	2	3	-	-	-	-	-	-	1	3	3	3
CO4	3	3	3	3	3	-	-	-	1	1	-	2	3	3	3
CO5	3	3	3	3	3	-	-	1	2	2	1	3	3	3	3

B.TECH FIRST SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET106
Paper 6: Communication Skills I

Total Lectures: 40

Unit 1: Introduction to Communication:

Importance of communication, Communication in primitive societies, Ways of communication: One way and two way, Principles of communication: Clarity, Completeness, Conciseness, Consideration, Courtesy, Correctness, Coherency, Level of communication- inter and intra personal, group to person, group to group, Methods of effective oral, Written and non-verbal communication, Process of communication (flow): Downward, Upward and horizontal communication, Official Hierarchy

Unit 2: Speaking Skills:

Verbal, non-verbal and Visual Communication, Elementary phonetics: speech sounds, Consonant and Vowel Sounds,

Unit 3: Reading Skills

Phonetic symbols, Horizons-tone, frequency, rate, volume, depth, extempore speech, Rate of speech

Unit 4: Writing Skills:

Comprehension of ideas in a passage, Expansion of an idea for a particular purpose, Change of words into different parts of speech, Idioms, Antonyms and synonyms.

Unit 5: Business Correspondence

Drafting Business letters, CV and Resume, Application for jobs, PowerPoint presentation, Using Microsoft Office

References:

1. Essentials of Business Communication: Rajendra Pal and J S Korlahalli
2. Business Communication: Gyani
3. Effective Communication: Ludlow and Panthon
4. A Practical English Grammar: Thomson and Marlinet
5. English Conversation Practice: Grount Taylor
6. Developing Communication Skills: Krishna Mohan and Meera Banerji
7. Business Correspondence and Report Writing: R C Sharma and Krishna Mohan
8. Communication Skill: R Datta Roy and K K Dhir

CO1	Explain the importance and principles of communication, and analyze different methods (oral, written, non-verbal) and levels (interpersonal, group) for effective interaction.
CO2	Demonstrate verbal, non-verbal, and visual communication skills, and apply elementary phonetics to improve pronunciation and clarity of speech.
CO3	Interpret written material using phonetic symbols, tone, frequency, rate, and volume, and apply these skills to enhance comprehension and oral expression.
CO4	Construct written communication by expanding ideas, transforming words, and using idioms, synonyms, and antonyms to develop clarity, coherence, and correctness.
CO5	Design effective business letters, CVs, resumes, and presentations using Microsoft Office tools to communicate professionally in formal and organizational contexts

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	1	-	-	-	1	3	-	2	1	1	1
CO2	2	2	2	-	1	1	-	-	1	3	1	2	1	1	1
CO3	2	2	2	-	1	-	-	-	1	3	1	2	1	1	1
CO4	1	2	2	-	1	-	-	-	3	3	2	2	1	1	1
CO5	1	1	1	-	1	2	1	3	2	3	2	3	1	1	1

B.TECH SECOND SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET201
Paper 1: Engineering Mathematics II

Total Lectures: 40

Unit 1: Laplace Transform

Existence, Basic properties, Inverse Transform, Convolution theorem, Inverse results, Application in ODE and Integral equations.

Unit 2: Fourier Transform

Existence basic properties, Inverse Transform, Convolution and Inversion properties, Transform of periodic functions, Cosine and Sine Transforms

Unit 3: Fourier Series:

Introduction, Different forms, Euler formula, Functions with period 2π and arbitrary periods, Even Odd functions, Half range series, Fourier integrals.

Unit 4: Special Mathematical Functions:

Singular and non-singular points, Gamma function, Recurrence formula, Beta function, Error function, Complementary error functions, Simple Applications.

Unit 5: Series Solution of ODE:

Existence, Power series and convergence, Legendre and Bessel's equations, General properties and Applications.

References:

1. Differential Equations with Applications and Historical Notes: G. F. Simmons (CRC Press)
2. Mathematical Methods: M. Potter and J. Goldberg (PHI).
3. Applied Mathematics For Engineers And Physicists: L. A. Pipes and L. R. Harvill (Dover).
4. Advanced Engineering Mathematics: E. Kreyszig (John Wiley and Sons).

CO1	Explain the importance and principles of communication, and analyze different methods (oral, written, non-verbal) and levels (interpersonal, group) for effective interaction.
CO2	Demonstrate verbal, non-verbal, and visual communication skills, and apply elementary phonetics to improve pronunciation and clarity of speech.
CO3	Interpret written material using phonetic symbols, tone, frequency, rate, and volume, and apply these skills to enhance comprehension and oral expression.
CO4	Construct written communication by expanding ideas, transforming words, and using idioms, synonyms, and antonyms to develop clarity, coherence, and correctness.
CO5	Design effective business letters, CVs, resumes, and presentations using Microsoft Office tools to communicate professionally in formal and organizational contexts

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	-	-	-	-	1	3	2	1
CO2	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
CO4	3	3	2	2	2	-	-	-	-	-	-	2	3	3	3
CO5	3	3	3	3	3	-	-	-	1	1	-	3	3	3	3

B.TECH SECOND SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET202
Paper 2: Applied Numerical Analysis

Total Lectures: 40

Unit 1

Errors, Sources and types of errors, measurements. Significant digits. Floating point representation of numbers. Roots of Non-linear Algebraic and Transcendental Functions, Bisection, Regula-Falsi, Secant and Newton-Raphson Methods, Fixed points iteration, Rate of convergence.

Unit 2

Numerical solution of system of linear equations, Gauss elimination method, LU decomposition, ill-conditioned systems, Gauss-Seidel and Jacobi method, Rate of convergence.

Unit 3

Polynomial interpolation: Finite differences, Newton's forward and backward differences interpolation polynomials, Newton's divided differences interpolation polynomial, Lagrange's polynomial. Curve fitting: Method of least squares.

Unit 4

Numerical differentiation and integration, Formulae for derivatives in the case of equally spaced points, Trapezoidal and Simpson's rules, Errors in integration formulae. Monte-Carlo Method for integration.

Unit 5

Single-step and multistep methods for solving ordinary differential equations, Taylor series method, Euler's method, Modified Euler's method, Runge-Kutta methods. Adam's and Milne's method. Numerical solution for boundary value problems, Finite difference methods for solving Laplace's equation in a rectangular region.

References:

1. Introductory Methods of Numerical Analysis: S. S. Sastry (Prentice Hall India)
2. Computer-Oriented Numerical Methods: V. Rajaraman (Prentice Hall India)
3. Applied Numerical Analysis: Gerald and Wheatley (Pearson)
4. Elementary Numerical Analysis: An Algorithmic Approach: S.D. Conte and Carl de Boor (McGraw-Hill.)
5. Numerical Recipes in C: W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery (Cambridge)

CO1	Explain sources and types of errors in numerical computations, and apply iterative methods (Bisection, Regula-Falsi, Secant, Newton-Raphson, Fixed Point Iteration) to find roots of non-linear algebraic and transcendental equations..
CO2	Analyze and solve systems of linear equations using Gauss Elimination, LU Decomposition,

	Jacobi, and Gauss-Seidel methods, and evaluate convergence and conditioning of solutions.
CO3	Apply polynomial interpolation techniques (Newton's forward/backward, divided differences, Lagrange) and construct curve fitting models using the method of least squares.
CO4	Implement numerical differentiation and integration formulas (Trapezoidal, Simpson's rules), and analyze errors; apply Monte Carlo methods for integration of complex functions.
CO5	Solve ordinary differential equations using single-step and multi-step methods (Taylor, Euler, Runge-Kutta, Adam's, Milne's) and apply finite difference methods to boundary value problems like Laplace's equation.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	-	-	-	-	1	3	2	1
CO2	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	3	3
CO4	3	3	2	3	3	-	-	-	-	-	-	2	3	3	3
CO5	3	3	3	3	3	-	-	-	1	2	1	3	3	3	3

B.TECH SECOND SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET203
Paper 3: Digital Electronics

Total Lectures: 40

Unit 1: Binary Systems and Boolean Algebra

Binary, octal, hexadecimal and decimal Number systems and their inter conversion, BCD numbers (8421-2421), gray code, excess-3 code, cyclic code, code conversion, ASCII, EBCDIC codes. Binary addition and subtraction, signed and unsigned binary numbers, 1's and 2's complement representation.
Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR and their truth tables), Universal Gates, Laws of Boolean algebra, De-Morgan's theorem, Min term, Max term, POS, SOP, Karnaugh maps, Simplification by Boolean theorems, don't care condition

Unit 2: Combinational Logic Design

Combinational Logic Circuits: Adders, Subtractors, Encoder, Decoder Multiplexer, Demultiplexer, decoder, Magnitude Comparator.

Unit 3: Sequential logic design

Sequential Logic Circuits: Set-Reset latch, D-flipflop, R-S flip-flop, T flip-flop, J-K Flip-flop, Master Slave Flip flop, Edge triggered flip-flops.

Unit 4: Registers and Counters

Registers: Serial in/Serial out shift register, Serial in/Serial out shift register, Serial in/parallel out shift register, parallel in/ parallel out shift register, parallel in/Serial out shift register, Bi-directional register.

Counters: Design of FSM, Synchronous/Asynchronous counter operation, Up/down synchronous counter, Decade counter, Ripple counter, Ring counter, n-bit Johnson counter, Application of counter.

Unit 5: Logic Families

Digital logic families performance parameters, logic families- DTCL, RTL, DTL, HTL, IIR, TTL, ECL and CMOS. Comparison of performance parameters.

References

1. Modern Digital Electronics: R. P. Jain, Tata McGraw-Hill, 4th edition, 2009.
2. Digital Electronics - An introduction to theory and practice: W. H. Gothmann PHI, 2nd edition, 2006.
3. Digital Circuits and Systems: D. V. Hall, Tata McGraw-Hill, 1989.
4. Digital Design: M. Morris Mano, Michael D. Ciletti, Pearson Education Limited, 2013.

CO1	Explain different number systems, codes, and their conversions; apply Boolean algebra, De-
-----	--

	Morgan's theorem, and Karnaugh maps to simplify digital logic expressions
CO2	Design and analyze combinational circuits such as adders, subtractors, encoders, decoders, multiplexers, and magnitude comparators..
CO3	Implement and analyze sequential circuits including latches and flip-flops (SR, D, T, JK, Master-Slave) and demonstrate edge-triggered behavior.
CO4	Design registers (SISO, SIPO, PISO, PIPO, Bi-directional) and develop counters (synchronous, asynchronous, up/down, ring, Johnson) for specific applications using FSM concepts.
CO5	Compare different digital logic families (DTCL, RTL, DTL, HTL, IIR, TTL, ECL, CMOS) based on performance parameters and select appropriate families for practical circuit design.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	1	3	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	1	3	3	3
CO3	3	3	3	2	3	-	-	-	1	-	-	1	3	3	3
CO4	3	3	3	2	3	-	-	-	1	1	1	2	3	3	3
CO5	3	3	3	3	3	-	-	-	2	2	1	3	3	3	3

B.TECH SECOND SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET204
Paper 4: Electronic Devices and Circuits

Total Lectures: 40

Unit 1: Transistors Amplifiers:

Classification of amplifiers, Comparative study of CB, CE and CC amplifiers characteristics RC coupled amplifiers – analysis of gain in different frequency ranges and BW calculations, Multistage coupling –Cascade, cascade Darlington pair, effect of coupling on gain and BW, Transformer coupled amplifiers, DC coupled amplifiers, Difference amplifiers.

Unit 2: Power amplifiers:

Class A, Class B, and Push-Pull amplifiers- Their working, advantages and drawbacks, comparison; Class C, Class D amplifiers, stagger tuned amplifiers; FET amplifier configurations and analysis.

Unit 3: Feedback Amplifiers:

Types of feedback and different feedback schemes in amplifiers; General characteristics of negative feedback amplifiers and their effect on gain impedances, distortion, and noise, Emitter follower.

Unit 4: Oscillators:

Barkhausen criterion for oscillations Tuned collector oscillator, RC phase shift and Wein bridge oscillator, Crystal oscillator, Frequency stabilization.

Unit 5: Power supplies:

Block diagram of Power Supply (PS) and it's constituent circuits, Electronics voltage stabilizer, Zenner and Transistor circuits for stabilization, Constant current, and current limited PS, Basics of SMPS and UPS.

References:

1. Integrated Electronics: Jacob Millman and C Halkias
2. Electronics Devices and Circuits Theory: Robert L. Boylestad and Nashelsky
3. Handbook of Electronics: Gupta and Kumar

CO1	Explain the classification and characteristics of CB, CE, and CC amplifiers; analyze RC-coupled, DC-coupled, transformer-coupled, multistage, Darlington pair, and difference amplifiers for gain and bandwidth.
CO2	Describe the working principles, advantages, and drawbacks of Class A, B, C, D, and push-pull amplifiers; analyze FET amplifier configurations for practical applications
CO3	Differentiate types of feedback; analyze negative and positive feedback in amplifiers, and

	evaluate their effects on gain, impedance, distortion, and noise.
CO4	Apply the Barkhausen criterion to design RC, LC, Wein bridge, crystal, and tuned collector oscillators; analyze frequency stabilization techniques for precision applications.
CO5	Explain the block diagram and functioning of regulated power supplies, zener and transistor voltage stabilizers, current-limited supplies, SMPS, and UPS; analyze their performance for practical circuits.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	-	1	3	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	3	3	-	-	-	-	1	1	2	3	3	3
CO5	3	3	3	3	3	-	-	-	1	1	1	3	3	3	3

B.TECH SECOND SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET205
Paper 5: Network Analysis and Synthesis

Total Lectures: 40

Unit 1: Network Graph Theory:

Review of Conventional Circuit Analysis Techniques, Analysis of Electrical Circuits using Laplace Transform, Basic definitions and properties of linear graphs, Matrices of graphs, Equilibrium equations, Generalized nodal and loop analysis

Unit 2: State Variable Techniques:

The concept of state variables of networks; Formulation of state equations and their solutions for linear time invariant networks.

Unit 3: Signal flow Graphs

Definition and properties of SFG; SFG models of linear circuits, Reduction of SFG, Mason's graph gain formula.

Unit 4: Network Functions:

Driving point and Transfer functions, Poles and Zeroes of network functions; Properties of Network functions and restrictions on pole and zero locations; Plots of Network functions; Relation between pole zero locations and time domain behavior; Parts of Network functions; Calculation of Network function from its given parts.

Unit 5: Network Synthesis:

Positive real functions; Definition, properties and testing of positive real functions; Herwitz polynomials; synthesis of Driving point functions of a two-element kind one-port network.

References:

1. Network Analysis and Synthesis: F. F. Kuo(Wiley)
2. Network Synthesis: Van Valkenburg (PHI)
3. Linear Network Theory: N. Balabanian (Matrix Publisher)
4. Circuit Theory: Ronald A. Rohrer (TMH)
5. Networks, Filters: Ruston and Bordogna

CO1	Explain the concepts of network graphs and matrices; analyze electrical circuits using Laplace transforms, generalized nodal and loop analysis, and equilibrium equations..
CO2	Define state variables for networks and formulate state equations; solve linear time-invariant

	networks using state variable approaches.
CO3	Apply the concepts of signal flow graphs (SFG) to model linear circuits; analyze system behavior using SFG reduction and Mason's Gain formula.
CO4	Determine driving point and transfer functions of networks; analyze poles and zeros and their relation to time-domain behavior; plot network function characteristics..
CO5	Explain positive real functions and their properties; synthesize driving point functions for one-port networks using techniques like Hurwitz polynomials.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	-	1	3	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	3	3	-	-	-	-	1	1	2	3	3	3
CO5	3	3	3	3	3	-	-	-	1	1	1	3	3	3	3

B.TECH SECOND SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET206
Paper 6: Communication Skill II

Total Lectures: 40

Unit1: Advance Communication

Objectives of communication: Information, Advice, Order, suggestion, Persuasion, Education, Warning, Raising morale, Motivation, Audio-visual communication: Use of audio visual aids for effective communication, Role of newspapers, Radio, Cinema and TV, Barrier to communication and overcoming barriers

Unit 2: Interactive Communication Skills

Group Discussions, Debates, Facing an interview, know your body language, confidence building, e-mail etiquette,

Unit 3: Personality Development

The art of listening: learning through listening, Hearing vs. Listening,

Unit 4: Speaking Skill

Preparing a report, technical report writing, Conversational skill, Telephonic Etiquettes

Unit 5: Writing Skill

Syllable and syllable stress, summarizing passage for official usage, Précis writing, Report writing-importance of reports,

References:

1. Essentials of Business Communication: Rajendra Pal and J S K orlahalli
2. Business Communication: Gyani
3. Effective Communication: Ludlow and Panton
4. A Practical English Grammar: Thomson and Martinet
5. English Conversation Practice: Grount Taylor
6. Developing Communication Skills: Krishna Mohanand Meera Banerji
7. Business Correspondence and Report Writing: R C Sharma and Krishna Mohan
8. Communication Skill: R Datta Royand K K Dhir

CO1	Explain the objectives of communication such as information, persuasion, motivation, and morale-raising; analyze the use of audio-visual aids, newspapers, radio, cinema, and TV to enhance communication and overcome barriers.
CO2	Demonstrate effective group discussion, debate, and interview skills; apply email etiquette and confidence-building techniques for professional communication.
CO3	Differentiate between hearing and active listening; apply effective listening strategies to enhance

	comprehension and learning.
CO4	Construct technical reports and conversational communication; present ideas clearly.
CO5	Summarize passages, write précis, and prepare formal reports using professional writing standards.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	-	-	-	1	3	-	2	1	1	1
CO2	2	2	1	-	2	-	-	-	1	3	1	2	1	1	1
CO3	2	2	1	-	1	-	-	-	3	3	2	2	1	1	1
CO4	1	1	1	-	1	1	1	1	3	3	2	2	1	1	1
CO5	1	1	1	-	1	2	1	3	2	3	2	3	1	1	1

B.TECH THIRD SEMESTER

(Electronics and Communication Engineering)

Paper Code: BET301

Paper 1: Electronic Instrumentation and Measurement

Total Lectures: 40

Unit 1: Measurement Fundamentals

Definition of measurement and instrument, Accuracy, Precision, Sensitivity, Resolution, Range, Stability, Dynamic response and repeatability of measuring instruments

Loading effect, loading effect due to shunt-connected instruments, loading effects due to series connected instruments.

Standards – International standards, Primary and secondary standards, Working or industry standards in measurements, Calibration, Calibration check and periodic calibration of instruments

Unit 2: Electronic Volt OHM Meters:

Analog type VOM – Principles of operation, working and construction; Bipolar transistor type electronic multi meter, FET bridge type multi meter; Comparison of analog, VOM and EMM, Chopper type Electronic DC voltmeter, MOSFET electrometer, Digital Multi meter Error in DMM measurement

Unit 3: Waveform Measurement Using CRO:

Block diagram of CRO, Construction and principle of operation, sensitivity, Trigger synchronization, special features of dual trace, Double beam delayed sweep and storage oscilloscopes, Front Panel controls, oscilloscope probes, Amplitude, Frequency, time period and phase measurement, Amplitude modulation measurement.

Unit 4: Time and Frequency Measurement:

Measurement of frequency by resonance and heterodyne methods, Digital frequency counter, Measurement of frequency, time period and time interval, Errors in frequency counters.

Unit 5: Frequency Spectrum, Distortion and Wave Measurement:

Spectrum analyzer, Harmonic distortion analyzer, Inter-modulation distortion analyzer, Wave analyzer and distortion factor meter- Tuned circuit wave meter for frequency measurements.

Transducers and Sensors:

Classification, Selecting a transducer and Sensing element, Strain gauge, Displacement transducers, temperature transducer, Photosensitive transducer, Flow meter

References:

1. Modern Electronics Instrumentation and Measurement Techniques: Helfric and Cooper.(PHI)
2. Instrumentation, Measurement and Analysis: Natra and Choudhary (TMH)

3. Instrumentation Devices and Systems: Rangan, Sarma and Mani(TMh)

4. Transducers and Instrumentation: D. V. S. Moorthy(PHI)

CO1	Explain the principles of measurement, types of errors, accuracy, precision, and significant figures; analyze the impact of measurement errors on electronic instruments.
CO2	Differentiate between analog and digital instruments; apply techniques to measure voltage, current, resistance, frequency, and phase using appropriate instruments such as multimeters, CROs, and LCR meters
CO3	Describe the working principles of various transducers (temperature, pressure, displacement, flow, and strain); analyze sensor outputs and implement signal conditioning techniques for accurate measurement.
CO4	Apply the concepts of data acquisition systems, ADC/DAC conversion, and interfacing techniques to collect, process, and display measurement data.
CO5	evaluate modern electronic measurement techniques, including digital storage oscilloscopes, spectrum analyzers, and instrumentation amplifiers, and select appropriate methods for practical applications

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	2	1	–	–	–	–	1	–	2	3	1	2
CO2	3	3	2	2	2	–	–	–	–	1	–	2	3	2	2
CO3	3	2	2	2	2	–	–	–	–	1	–	2	3	3	2
CO4	2	2	3	2	3	–	–	–	–	1	–	2	3	3	3
CO5	2	3	2	3	3	–	–	–	–	1	–	2	3	3	3

B.TECH THIRD SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET302
Paper 2: Signals and Systems

Total Lectures: 40

Unit 1: Representation and Specification of Signals:

Continuous time signals— Periodic vs Aperiodic, Symmetrical vs Asymmetrical, Continuous vs discrete. Elementary signals and associated wave forms- The unit-step, Unit Ramp, Unit-impulse and exponential signals. Periodic signals- Sinusoidal, Square, Sawtooth and impulse train, - Energy Vs Power signals,

Unit 2: Representation of Systems:

Classification of systems- Static vs dynamic, Time variant vs time-invariant, Linear vs non-linear, Casual vs non-casual and stable vs unstable. Linear time-invariant (LTI) systems- definitions and properties, impulse response and transfer function, Convolution, signal transmission through LTI systems, Filter characteristics of linear systems, Bandwidth and rise time, Spectral density, Parseval's theorem, Auto and cross-correlations

Unit 3: Probability

Random Experiments, Sample space, Events, Definitions of probability, Probability of union of events, Conditional Probability, Bayes' theorem, Independence of events,

Unit 4: Random Variables

Random Variables, Distribution functions, Probability Mass Function (PMF) of Discrete Random Variables, Probability Density Function (PDF) of continuous random variables, Mathematical expectation, Moments

Discrete uniform distributions, Bernoulli distribution, Poisson distribution, Binomial distribution, Continuous uniform distribution, Normal distribution, Exponential distribution, Rayleigh and Maxwell distributions.

Unit 5: Random Processes

Classification of random processes- Stationary, Ergodic and Stochastic processes, Auto Correlation and power spectral density. Sources of noise, Thermal noise and Shot noise, PDF of envelop of narrow band noise and narrowband noise plus sinusoidal signal.

References:

1. Principle of Digital Communication: J. Das (Wiley)
2. Network Analysis and Synthesis: F.F. Kuo (Wiley)
3. Signal and Systems: Simon Haykin (Wiley)
4. Communication Systems: Simon Haykin (Wiley)
5. Probability Random Variable and Stochastic Process: Papoulis (TMH)
6. Signals Systems and Communication: B. P . Lathi (Wiley)
7. Communication Systems: B.P. Lathi (Wiley)

CO1	Identify and classify continuous-time and discrete-time signals; analyze elementary and periodic signals, energy vs. power signals, and associated waveforms.
CO2	Classify systems based on properties (linear/non-linear, time-invariant/variant, causal/non-causal, stable/unstable); apply impulse response, convolution, and transfer functions to analyze LTI system behavior.
CO3	Explain basic probability concepts, including random experiments, sample spaces, conditional probability, Bayes' theorem, and independence of events; apply these concepts to model and analyze signals and systems with uncertainties.
CO4	Define discrete and continuous random variables, their PMF/PDF, expectation, and moments; analyze standard probability distributions (Bernoulli, Binomial, Poisson, Normal, Exponential, Rayleigh, Maxwell) in signal processing contexts.
CO5	Classify random processes (stationary, ergodic, stochastic); analyze auto-correlation, power spectral density, and noise sources (thermal, shot) in communication and signal systems.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	—	—	—	—	1	—	2	3	2	2
CO2	3	3	2	3	2	—	—	—	—	1	—	2	3	3	3
CO3	3	3	1	2	2	—	—	—	—	1	—	2	3	2	3
CO4	3	3	1	2	2	—	—	—	—	1	—	2	3	2	2
CO5	3	3	2	3	3	—	—	—	—	1	—	2	3	3	3

B.TECH THIRD SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET303
Paper 3: Analog Circuits and Systems

Total Lectures: 40

Unit 1: Linear ICs:

Linear IC design criteria, commonly used configurations and biasing techniques, current source; Current mirror; Differential amplifier circuits

Unit 2: Operational Amplifier:

Single supply and dual supply concept; Common mode input range; Output swing; Full power bandwidth; Slew rate and gain bandwidth product, Frequency compensation; Study of 741, OP-07, LM358 and LM393

Unit 3: Applications of Op-Amp:

Linear circuit Applications- Differential DC amplifier, Differentiators and Integrators; Voltage to current converters, Nonlinear circuits- Series and shunt limiters, feedback limiters, logarithmic amplifiers, Active filter circuits- LP, BP and HP filters; Sample and Hold circuits, Sine wave, Square wave Triangular wave and saw-tooth wave generator circuits and pulse circuits and their characteristics, Instrumentation Amplifier.

Unit 4: A/D and D/A Converters:

Functions and characterization of A/D and D/A converters; Different types of A/D and D/A converters; Study of 08xx series converters and their applications

Unit 5: Voltage Regulators:

Study of Commonly used 3 Terminal regulators (78xx, 79xx; LM 317); Techniques for current limit and thermal shut down; Precision voltage regulators and their characteristics.

References:

1. Op-Amps and Linear Integrated Circuits: R. A. Gayakward (Pearson)
2. Pulse digital and Switching Waveforms: Millman and Taub (TMH)
3. Operational Amplifiers and Integrated Circuits: Robert F. Coughlin Frederiek F. Discroll (PHI)
4. Operational Amplifiers and Integrated Circuits: James M. Fiore (Jaico)
5. Operational Amplifiers; Design and Applications: J.G. Graeme, G.E. Tobeyet.al. (McGraw-Hill)

CO1	Explain the design criteria, biasing techniques, and configurations of linear ICs; analyze current sources, current mirrors, and differential amplifier circuits.
CO2	Describe single and dual supply concepts, input/output ranges, bandwidth, slew rate, and frequency compensation; analyze characteristics of 741, OP-07, LM358, and LM393 op-amps..

CO3	Design and implement linear and nonlinear op-amp circuits such as differentiators, integrators, voltage-to-current converters, limiters, active filters, waveform generators, and instrumentation amplifiers.
CO4	Explain the functions and characteristics of analog-to-digital and digital-to-analog converters; analyze different types of converters and their applications using 08xx series ICs.
CO5	Describe 3-terminal and precision voltage regulators; analyze current limiting, thermal shutdown, and performance characteristics of voltage regulation circuits.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	–	–	–	–	1	–	2	3	2	2
CO2	3	2	2	2	3	–	–	–	–	1	–	2	3	3	2
CO3	3	3	3	3	3	–	–	–	2	2	1	2	3	3	3
CO4	3	2	2	3	3	–	–	–	–	1	–	2	3	3	3
CO5	3														

B.TECH THIRD SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET304
Paper 4: Electrical Engineering

Total Lectures: 40

Unit 1: D C Generators:

Principles and construction of DC machines; E.M.F Equation; Various types of losses occurring in DC Generators; its efficiency; Commutation; Armature reaction; Series, Shunt and Compound Generators; their characteristics and applications; Parallel operation of shunt generators.

Unit 2: D C Motors:

Types of DC Motors and their Basic characteristics; Torque Equation; Testing of DC motors; Separation of Losses; Need of starters for large motors and their working; Speed control of DC motors

Unit 3: A C Fundamentals and Poly phase Circuits:

Single phase alternating currents; Average R.M.S values; Form factor; Power factor; Power in AC circuits- Instantaneous power, Average power and Apparent power, Complex power- Active and Reactive power; Power factor in terms of Average and Apparent powers; Poly phase systems, Star and Delta connections, Relationship between line and phase values.

Unit 4: Transformers:

Construction and principles of working, losses in transformers, Equivalent circuit, Regulation and efficiency of Transformers, Autotransformers, Three phases transformers with different methods of connection using three single phase transformers, Scott connection and its application.

Alternators: Principle of operation, Salient pole and cylindrical rotor types of alternator, Rotating field and rotating armature types, Armature reaction, Parallel operation of Alternators.

Unit 5: Induction Motor:

General Principle and construction of three-phase induction motor; Phase wound and squirrel cage types of Induction motor; Production of rotating fields, Slip; Rotor emf and frequency; Starting and running torques; Relationship between torque and slip;

Synchronous Motors:

Working principles, Starting of synchronous motors, Motor on load, Effect of excitation on armature current and power factor, V-curves.

References:

1. Basic Electrical Engineering: I J Nagrath (TMH)
2. Electrical Technology: B.L. Theraja (S. Chand)

CO1	Explain the construction, working principles, and EMF equation of DC generators; analyze losses, efficiency, commutation, and armature reaction; differentiate between series, shunt, and compound generators and their characteristics.
CO2	Describe types of DC motors and their torque-speed characteristics; analyze performance using testing methods, separation of losses, and speed control techniques; explain the need and working of starters for large motors.
CO3	Explain single-phase AC quantities, power, and power factor; analyze polyphase systems, including star and delta connections, and relationships between line and phase values..
CO4	Explain the construction, working, losses, and efficiency of single-phase and three-phase transformers; analyze equivalent circuits, regulation, autotransformers, and parallel operation of alternators; differentiate alternator types and connections..
CO5	Describe construction and working principles of three-phase induction motors and synchronous motors; analyze slip, rotor EMF, torque-speed relationships, excitation effects, and V-curves; evaluate performance under load conditions..

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	3	2	2	2	2	—	—	—	—	1	—	2	3	2	2
CO2	3	3	3	3	2	—	—	—	—	1	—	2	3	3	3
CO3	3	2	2	2	2	—	—	—	—	1	—	2	3	2	2
CO4	3	3	2	3	2	—	—	—	—	1	—	2	3	3	3
CO5	3	3	3	3	3	—	—	—	—	1	—	2	3	3	3

B.TECH THIRD SEMESTER

(Electronics and Communication Engineering)

Paper Code: BET305

Paper 5: Computer Architecture and Organization

Total Lectures: 40

Unit 1: Processor Design Concepts

Review of Basic Computer Organization, Performance evaluation methods, Introduction to RISC processor, RISC impacts and drawbacks, Types of RISC processors. Design of Adders, Multipliers (Unsigned and Signed numbers (BOOTH'S Algorithm)), Dividers (Restoration and Non-restoration algorithm), concepts of floating point numbers and floating point arithmetic

Unit 2: Control Unit: Design and Operation

Micro-operations (Fetch Cycle), Design Issues, Methods of Implementation: Hardwired control unit, Microprogrammed Control unit and Nano-programming, Bus standards and Bus contention techniques.

Unit 3: Parallel Computing

In-order pipeline overview, Out-of-order pipelines, Branch prediction, Advanced branch prediction techniques, Flynn's and Feng's classifications, Threading and multi-core architecture.

Unit 4: Instruction level parallelism (ILP) and Memory Organisation

Pipeline data-path, data-dependence, Challenges in ILP realization. Pipeline hazards and their solutions, out-of-order execution, branch prediction. Compiler techniques to explore ILP, and Dynamic Scheduling to Explore ILP.

Virtual Memory and Address Translation, Paging and Segmentation, TLBs and Page Fault handling, Page replacement algorithms (FIFO, LRU, NRU), Interleaved Memory Organisation

Unit 5: Advanced Processor Organisation and Architecture

Introduction to embedded systems, design consideration of embedded systems, Pin diagram of Pentium, EFLAGS in Pentium, Addressing modes, Pipelining in Pentium and its Branch prediction logic, Pentium Cache Organisation

References:

1. Computer Architecture & Parallel processing – Hwang & Briggs
2. Computer Architecture – Jean Loop Bear
3. Introduction to Distributed and Parallel computing- Crichlow
4. Designing Efficient Algorithms for parallel Computers- M.J.Quinn
5. Introduction to Parallel Algorithms- Joseph JA
6. The Design and Analysis of Parallel Algorithms- S.G.Akl

CO1	Explain the fundamentals of computer organization, RISC processor design, and performance
-----	---

	evaluation; analyze arithmetic operations including adders, multipliers, and dividers; apply floating-point arithmetic concepts.
CO2	Describe the design and operation of control units, micro-operations, and bus standards; analyze hardwired and microprogrammed control units, including nano-programming techniques.
CO3	Explain in-order and out-of-order pipelines, branch prediction techniques, and classifications of parallel architectures; analyze threading, multi-core design, and performance impacts of parallel computing.
CO4	Analyze pipeline data paths, data dependencies, and hazards; apply compiler techniques and dynamic scheduling to exploit ILP; explain virtual memory, paging, segmentation, TLBs, and page replacement algorithms.
CO5	Describe embedded systems and advanced processor architecture concepts; analyze Pentium processor components, addressing modes, pipelining, branch prediction, and cache organization for efficient design.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	–	–	–	–	1	–	2	3	3	2
CO2	3	3	2	3	3	–	–	–	–	1	–	2	3	3	3
CO3	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3
CO4	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3
CO5	3	3	2	3	3	–	–	–	–	1	–	2	3	3	3

B.TECH THIRD SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET306
Paper 6: Industrial Management

Total Lectures: 40

Unit 1: Engineering Economics:

Nature and scope of economics, Wants and utility, Demand and supply, Elasticity of demand and supply, Four factors of production and their peculiarities, Function of Commercial and Central banks, Monetary policy of the Reserve Bank of India.

Unit 2: National Income-

Macro Economics approach, GNP, NNP, NI, DI, PI methods of calculation of national income.

Unit 3: Marketing Management:

Concept of marketing, Consumer behavior, Buying motives, Product design, New product distribution, Break even analysis and marginal costing in pricing, Sales promotion, Marketing research, Marketing of services, Advertising management-types of advertising, Choice of media, Economic and Psychological factors in advertising.

Unit 4: Finance Management:

Tasks, Evolution of corporate management, Long term financing, Equity, Preference and Debenture capitals, Term loans, Dividends and share valuation, Legal aspects of dividends, Short term financing, Working capital influencing factors,

Unit 5: Budgetary control

Cash budgeting, Budgets, Objectives of budgeting, classification, ratio analysis, Management Accounting: Fundamentals of Book-keeping, Journalizing, Subdivision of journal, Ledger Account Cash book, Trial balance, Preparation of trading, Profit and Loss account, and Balance sheet, Adjustments

References:

1. Industrial Organization and Management: Bethelet.al
2. Principles of Industrial Management: Kootnz and Donnel
3. Financial Management: Prasanna Chandra
4. Industrial Finance of India: S K Basu
5. Operation Management: Fabricky et al
6. Accountancy: SM Shukla

CO1	Explain the fundamentals of economics, demand-supply dynamics, elasticity, factors of production, and monetary policies; analyze the role of commercial and central banks in economic
-----	---

	regulation.
CO2	Describe macroeconomic concepts and national income components (GNP, NNP, NI, DI, PI); calculate national income using different approaches and methods.
CO3	Explain concepts of marketing, consumer behavior, product design, and promotion strategies; analyze pricing, advertising, and marketing research for products and services.
CO4	Describe corporate financing methods including equity, preference, debentures, and term loans; analyze working capital management, dividend policies, and short-term financing decisions.
CO5	Explain the concepts of budgeting, cash management, and budget classification; apply accounting principles to prepare journals, ledgers, trial balance, trading accounts, profit & loss accounts, and balance sheets.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	1	3	2	2	1	2	2	2	1	–	1
CO2	3	3	2	2	1	2	–	–	–	1	2	2	1	–	1
CO3	2	2	3	2	2	3	2	2	2	3	2	2	1	–	1
CO4	3	3	2	2	2	2	–	1	1	2	3	2	1	–	2
CO5	3	3	3	2	2	2	–	1	1	2	3	2	1	–	2

B.TECH FORTH SEMESTER
(Electronics and Communication Engineering)

Paper Code: BET401

Paper 1: EM Wave Theory

Total Lectures: 40

Unit 1: Static Electric Fields:

Electrostatics: Coulomb's law, Gauss's law, Electric field due to several charges, Potential function, Field due to continuous distribution of charge, Equi-potential surfaces, Divergence theorem, Poisson's and Laplace's equations, Capacitance, Energy stored in an Electric field

Unit 2: Magnetostatics:

Magnetic flux, Magnetic flux density Magnetic intensity, Energy stored in a magnetic field, Ampere's law for a Current element, Magnetic vector potential, Magnetic vector potential of a current element, Magnetic dipole

Unit 3: Maxwell's equations:

Ampere's law, Current continuity equations, Displacement current, Faradays law, Filled equations in vector and Integral forms, Boundary conditions at an interface

Unit 4: Plane EM Waves:

Solution of wave equations in rectangular, Cylindrical and spherical coordinates for Wave Equation free space, Conductors and dielectrics: Polarization, Isotropic and anisotropic media, Reflection and refraction, Skin effect and boundary, value problems, Poynting vector and power flow

Unit 5: Waveguides and Transmission Lines:

Electromagnetic wave in rectangular and cylindrical waveguides, TE and TH modes, Field and propagation characteristics, Formulation of differential equation and its solution, Wave and phase velocity, Characteristics impedance and propagation constant, Amplitude and phase distortion, Quarter wave and eighth wave impedance, Transformers, Impedance matching techniques, Single and double stub impedance matching, Smith chart.

References:

1. Electromagnetic Waves and Radiating Systems: Edward C. Jordan and Keith G. Balmain (PHI)
2. Electromagnetic Theory: K D Prasad (Khanna Pub.)
3. Electronic Communication Systems: George Kennedy (TMH)
4. Electromagnetic Theory and Wave Propagation: S N Ghosh (Narosa)

CO1	Understand and apply fundamental laws of electrostatics — Coulomb’s law and Gauss’s law — to calculate electric fields, potentials, and capacitance for different charge distributions, and analyze energy stored in electric fields.
CO2	Explain the concepts of magnetostatics including magnetic flux, intensity, vector potential, and dipole behavior, and calculate energy stored in magnetic fields using Ampere’s law.
CO3	Comprehend and derive Maxwell’s equations in differential and integral forms, and apply them to understand displacement current, current continuity, and electromagnetic boundary conditions.
CO4	Analyze plane electromagnetic wave propagation in free space, conductors, and dielectrics, including polarization, reflection, refraction, skin effect, and power flow using Poynting vector concepts.
CO5	Examine the propagation of electromagnetic waves in rectangular and cylindrical waveguides and transmission lines; derive TE and TM modes; determine propagation constants, impedance, and apply impedance matching techniques using Smith charts.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	—	—	—	—	1	—	2	3	2	2
CO2	3	3	2	2	2	—	—	—	—	1	—	2	3	2	2
CO3	3	3	2	3	2	—	—	—	—	1	—	2	3	3	2
CO4	3	3	2	3	3	—	—	—	—	1	—	2	3	3	3
CO5	3	3	3	3	3	—	—	—	—	1	—	2	3	3	3

B.TECH FORTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET402
Paper 2: Semiconductor Devices and Technology

Total Lectures: 40

Unit 1: Junctions and Contacts:

Current voltage characteristics of an ideal p-n Junction under zero bias condition; current-voltage characteristics of an ideal p-n junction (the diode equation); Generation and recombination currents; Depletion capacitance; Diffusion Capacitance and Equivalent circuit of a p-n diode; Junctions Breakdowns; Impact and Avalanche Breakdown; Schottky Barriers; Current-voltage characteristics of Schottky diodes: Thermionics emission and Thermionic-Field emission model ; small signal circuit Schottky diode; Ohmic contact ; Tunneling and Tunnel diodes; Hetero junctions .

Unit 2: Bipolar Junction Transistors:

Principle of operation; Ebers-Moll Model; Gummel-poon Model; Current Components and Current gain; Base Spreading Resistance; Graded base Transistors; Output Characteristics and early effect Operating point and Small signal equivalent circuits; Problems of BJT: Emitter current crowding

Unit 3: Field Effect Devices

JFET concepts- Basics JFET and MESFET operation, the device characteristics- Internal pinch-off voltage, Pinch-off voltage, and Drain to source saturation voltage, Ideal DC current-voltage relationship, Non-ideal effects channel length modulation; velocity saturation effects; Sub-threshold and gate current effects, small signal equivalent circuit and frequency limitations

Unit 4: MOSFET

Fundamentals of Metal-oxide semiconductor field effect transistor energy band diagrams, Depletion layer thickness, Work function differences, Flat band and threshold voltage, capacitance-voltage characteristics and it's comparison with ideal c-v characteristics, Frequency effects; The Basic MOSFET operation, Current Voltage relationship-concepts and its mathematical derivation.

Unit 5: Organic Semiconductors

Basic Organic semiconductor materials and their classification; Basic concepts of OLEDs, Organic Photovoltaic devices and organic semiconductors for FET, White LED.

References

1. Physics of Semiconductor Devices: Michael Shur (Prentice Hall of India)
2. Semiconductor Physics and Devices: Basic Principles, Donald A. Neaman (Irwin Book Team)

CO1	Explain the current–voltage characteristics and physical behavior of semiconductor junctions, including p–n, Schottky, tunnel, and heterojunction diodes.
CO2	Analyze the operation and characteristics of Bipolar Junction Transistors (BJTs) using Ebers-Moll and Gummel-Poon models, and evaluate small-signal equivalent circuits.
CO3	Describe the operation and electrical characteristics of Field Effect Transistors (FETs), including JFETs and MESFETs, and interpret their non-ideal behaviors.
CO4	Explain the structure, characteristics, and current-voltage relationships of MOSFETs, including threshold voltage and capacitance–voltage behavior.
CO5	Discuss the basic concepts, materials, and applications of organic semiconductor devices such as OLEDs, organic photovoltaic cells, and organic FETs.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	–	–	–	–	1	–	2	3	2	2
CO2	3	3	2	3	2	–	–	–	–	1	–	2	3	3	2
CO3	3	3	2	2	2	–	–	–	–	1	–	2	3	3	2
CO4	3	3	2	3	2	–	–	–	–	1	–	2	3	3	3
CO5	3	2	2	2	3	–	1	1	–	1	–	2	3	3	3

B.TECH FORTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET403
Paper 3: Communication System

Total Lectures: 40

Unit 1: Amplitude Modulation and Detection:

AM equation analysis and its treatment with number of modulating signals, Square law modulator, Linear modulator schemes and circuits, DSB-SC modulators, Quadrature modulation, SSB-SC modulator, AM square law detector, Envelope detection, DSB-SC and SSB-SC detection, VSB modulation

Unit 2: Angle Modulation and Detection:

Frequency and Phase modulation equations and their spectrum; Narrow band modulation and wide band modulation and relationship with AM, FM, and PM, Direct methods of FM generation, Indirect Armstrong method of FM generation, FM slope Amplitude type of detection, Phase discriminator and Ratio detector, Pre- emphasis and De-emphasis, Comparison of AM and FM, Phase locked loops

Unit 3: AM, FM Transmitters and Receivers:

Blocks diagrams of standard AM and FM transmitters, Armstrong FM transmitter, AM and FMR a dio-receivers, Sensitivity, Selectivity, Fidelity, Stability, etc. TRF, receiver, Super heterodyne radio receiver- Block diagram and Principle of operation, Problems associated with it's successful operation, their solutions and analysis (selection of intermediate frequency and Local oscillator frequency, Tracking, Rejection of image signal and noise, AGC and AFC)

Unit 4: SNR Considerations in AM and FM Systems:

SNR calculations in DSB, DSB-SC and SSB AM receivers, SNR in FM receivers, Comparison of SNR.

Unit 5: Pulse Modulations:

Sampling theorem for LP and BP signals, Channel BW and for PAM signal, Natural and Flat-top sampling, Signal recovery, Pulse time modulations.

References:

1. Principles of Communication Systems: Tauband Schilling
2. Communication Systems: Simon Haykin
3. Modern Analog and Digital Communications: B. P. Lathi
4. Analog and Digital Communications: Samaugan
5. Electronic Communication System: George Kennedy

CO Code	Course Outcome (CO)
CO1	Explain the principles of amplitude modulation and detection, and analyze AM, DSB-SC, SSB-SC, and VSB systems and circuits.
CO2	Describe the concepts of angle modulation (FM and PM), compare narrowband and wideband systems, and analyze modulation and demodulation techniques.
CO3	Illustrate and analyze the block diagrams and working principles of AM and FM transmitters and receivers, including TRF and superheterodyne architectures.
CO4	Evaluate and compare signal-to-noise ratios (SNR) in AM and FM receivers and assess the effect of noise on system performance.
CO5	Explain pulse modulation techniques, apply sampling theorem to low-pass and band-pass signals, and analyze pulse amplitude and pulse time modulation schemes.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	–	–	–	–	1	–	2	3	2	2
CO2	3	3	2	2	2	–	–	–	–	1	–	2	3	2	2
CO3	3	3	2	3	3	–	–	–	–	1	–	2	3	3	2
CO4	3	3	2	3	3	–	–	–	–	1	–	2	3	3	3
CO5	3	3	2	3	3	–	–	–	–	1	–	2	3	3	3

B.TECH FORTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET404
Paper 4: Control Systems

Total Lectures: 40

Unit 1: Control System Concepts:

The Control Problem; Open-loop and closed-loop control system; Basic characteristics of Feedback Control Systems –Stability, Steady-state accuracy, transient accuracy, Disturbance rejection, Insensitivity and Robustness; Basic modes of feedback control- Proportional, Integral and Derivative.

Unit 2: Mathematical modeling of Dynamic systems:

Differential equation modeling; Analogous systems; Transfer function modeling; Block diagrams and their reduction; Signal flow graphs and Mason's graph gain formula; Modelling in State space; state diagrams.

Unit 3: Time-domain Analysis:

Standard test signals; Steady-state error constants and system types; Response of first and second order systems to standard test signals; Time-domain performance specifications; Derivative feedback control.

Stability Analysis: Concepts of stability; Routh-Hurwitz criterion; Stability analysis using Root-Locus plots

Unit 4: Frequency-Domain Analysis:

Frequency-response plots- Bode plots, Polar plots, log-magnitude vs phase plots; Performance specifications in frequency-domain; Evaluation of closed-loop frequency responses; Constant M and N circles; Nichols chart; Stability analysis using Nyquist stability criterion; Relative stability phase and Gain Margins.

Unit 5: Control System Design:

Preliminary Design consideration; Compensator design using Root-Locus plots- phase-lag, phase-lead and lag-lead compensation; Minor-loop feedback compensation; Compensator design using Frequency-response plots- phase-lag, phase-lead and lag-lead compensation; Minor-loop feedback compensation

References:

1. Modern Control Engineering: Katsuhiko Ogata (Pearson)
2. Control System Engineering: Nagrath and Gopal (NewAge)
3. Design of Feedback Control Systems: Stefani, Shahian, et al (Oxford)
4. Automatic Control System: B.C. Kuo. (PHI)

CO Code	Course Outcome (CO)
CO1	Explain the basic concepts of control systems, differentiate between open-loop and closed-loop systems, and understand feedback characteristics and control modes.
CO2	Develop mathematical models of dynamic systems using differential equations, transfer functions, block diagrams, signal flow graphs, and state-space representation.
CO3	Analyze time-domain response of first and second-order systems, evaluate steady-state errors, and determine system stability using Routh-Hurwitz and Root Locus techniques.
CO4	Analyze frequency-domain characteristics of control systems using Bode, Polar, and Nyquist plots, and assess system stability and performance parameters.
CO5	Design compensators and controllers using root-locus and frequency-response methods to meet desired performance specifications.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	–	–	–	–	1	–	2	3	2	2
CO2	3	3	2	3	2	–	–	–	–	1	–	2	3	3	3
CO3	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3
CO4	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3
CO5	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3

B.TECH FORTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET405
Paper 5: Fibre Optic Communication I

Total Lectures: 40

Unit 1: Basics of optical fibre communication:

Basic block diagram of an optical fiber communication. Advantages of optical fiber communication, Classifications of optical fiber. Propagation of light through multi- mode step index, multi-mode graded index fibers and single mode optical fibers. Numerical aperture for meridional and skew rays. Number of guided modes. Ray theory and mode theory analysis.

Unit 2: Transmission characteristics of optical fibers.

Degradation of optical signal due to attenuation in the fiber. Different types of losses in the fiber. Pulse broadening due to dispersion. Different types of dispersion. Intermodal and intramodal dispersion. Material and waveguide dispersion, overall dispersion.

Unit 3: Optical Sources:

Essential Requirements for lasing action, Direct and indirect energy gap materials, Homo and hetero junctions. Basic principles of semiconductor lasers and light emitting diodes. Different types of injection laser diodes and light emitting diodes and their characteristics. Rate equations, Internal quantum efficiency and external power efficiency.

Unit 4: Photo-detectors:

Basic principles, types of photo-detectors-PIN diode and Avalanche photo diodes, responsivity, quantum efficiency, Speed of photo diodes, Noises in detectors, signal to noise ratio, equivalent diagrams.

Unit 5: Link analysis:

Receiver structures, performance of receivers, Power budget and rise time budget equations. Splice and joint losses, mis-alignment losses. Source to fiber and fiber to detector coupling losses, Selection of wavelength, source and detectors.

References

1. Optical Fibre Communication: Gerd Keiser
2. Optical Fibre Communication: John M. Senior
3. Handbook of Fibre Optics: Chal Yen
4. Optical Fibre Telecommunication IIIA: Ivon P. Kaminow and Kock

CO Code	Course Outcome (CO)
CO1	Explain the basic structure, working principle, and classification of optical fibers, and analyze light propagation using ray and mode theory.
CO2	Analyze transmission characteristics of optical fibers and evaluate the effects of attenuation and dispersion on signal transmission.
CO3	Describe the working principles, characteristics, and performance parameters of optical sources such as LEDs and laser diodes.
CO4	Explain the operation and performance parameters of optical photo-detectors including PIN and avalanche photodiodes.
CO5	Perform optical link design by analyzing power budget, rise time budget, and various coupling and alignment losses.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	–	–	–	–	1	–	2	3	2	2
CO2	3	3	2	2	3	–	–	–	–	1	–	2	3	3	2
CO3	3	2	2	2	3	–	–	–	–	1	–	2	3	3	2
CO4	3	2	2	2	3	–	–	–	–	1	–	2	3	3	2
CO5	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3

B.TECH FORTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET406
Paper 6: Power Electronics

Total Lectures: 40

Unit 1: Power Semiconductor Devices

Introduction to power electronics; Scope and applications of power electronics; Characteristics and working of power semiconductor devices: Diodes, Transistors, SCRs, GTO, IGBT, etc.; Thyristors: Characteristics, types, protection, series and parallel operation, firing circuits.

Unit 2: Controlled Rectifiers

Principle of operation of phase-controlled converter; Single-phase Half-wave circuit with RL load; Single-phase Half-wave circuit with RL load and Freewheeling Diode; Single-phase Half-wave circuit with RLE load; Single-phase full-wave converters-Semi-converter, Full-converter; Dual Converters; Power factor improvement; Effect of load and source inductance.

Unit 3: DC Choppers

Principle of operation of Step-down and Step-up DC choppers; Constant Frequency system and Variable Frequency system; Types of chopper circuits; Performance parameters; Switching-mode regulators; Thyristor based chopper circuits.

Unit 4: Inverters

Principle of operation of inverters; Performance parameters; Single-phase bridge inverters; Voltage control of single-phase inverters: Single-Pulse-Width modulation, Multiple-Pulse-Width modulation, Sinusoidal Pulse-Width modulation.

Unit 5: Applications

Switched Mode Power Supply (SMPS)-Flyback converter, Push-pull converter, Half-bridge converter, Full-bridge converter; Uninterruptible Power Supply (UPS); Static Switches-Static AC switch, Static DC switch; Static Circuit Breakers-Static AC circuit breakers and static DC circuit breakers.

References:

1. Power Electronics: Circuits, Devices and Applications: M.H. Rashid Pearson Education.

2. Power Electronics: P.C. Sen, McGraw-Hill Education (India) Pvt. Ltd.
3. Power Electronic Circuits: I. Batarseh, John Wiley.
4. Power Electronics: P.S. Bhimbra, Khanna Publishers.

CO1	Explain the characteristics and operation of various power semiconductor devices and their triggering and protection circuits.
CO2	Analyze and design single-phase controlled rectifier circuits for different types of loads and power factors.
CO3	Explain the operation of DC choppers and evaluate performance parameters of various chopper configurations.
CO4	Describe the working of single-phase inverters and demonstrate control techniques such as PWM for voltage regulation.
CO5	Apply power electronic converters in practical applications such as SMPS, UPS, and static switches and circuit breakers.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	–	–	–	–	1	–	2	3	3	2
CO2	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3
CO3	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3
CO4	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3
CO5	3	3	3	3	3	–	–	–	–	1	–	2	3	3	3

B.TECH FIFTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET501
Paper 1: Antennas and Wave Propagation

Total Lectures: 40

Unit 1: Principles of Radiation:

Concept of radiation; Isotropic and Directional radiation; Basic Antenna Parameters– Radiation Pattern, Radiation Intensity, Power density, Gain, Directivity, Beam width, Polarization; Effective Height Concept

Unit 2: Thin Wire Antennas:

Linear wire antennas- Concept of Retarded potential; Radiation from current element and small dipole; Half-wavelength dipole; Long wire Antennas; Linear elements near or on infinite perfect conductors Image theory, Vertical and Horizontal Electric dipole. Loop Antenna- Equivalence of small loop to short Magnetic Dipole; Radiation from short Magnetic Dipole and equivalent small loop; Large circular loop with uniform in-phase current; Radiation resistance and Directing of circular loop with uniform current

Unit 3: Antenna Arrays:

Point sources; Arrays of two isotropic point sources; Non-isotropic but similar point sources; Principles of Pattern Multiplication; Broadside and End-Fire Arrays; Dolph-Tennenbaum-Scheff Distribution

Unit 4: Antenna Feedings and Antenna Impedance:

Location and Methods of feeding Antenna; End fed and centre-fed systems; Reciprocity Theorem; Arrays of Dipoles; Arrays with parasitic elements; Log-periodic dipole array antenna; Phased Arrays; Folded Dipole Antenna; Rhombic Antenna. Measurement of radiation pattern, Power gain, and directivity

Unit 5: Wave Propagation:

Ground wave, Surface wave and space wave propagation; Earth's atmosphere; Effective earth's radius; Tropospheric and duct propagation. Eccles Larmor theory of ionospheric wave propagation; Critical penetration frequency; Maximum usable frequency and Skip distance; Effects of earth's magnetic field on ionospheric propagation

References:

1. Antenna Theory: C.A. Balanis (Wiley)
2. Antennas: Kraus (TMH)
3. Antenna Engineering: Weeks (TMH)
4. Electromagnetic Waves and Radiating Systems: Jordan (PHI)
5. Antenna Theory and Practice: Rajeswari Chatterjee (New AGE)

CO1	Understand the fundamental concepts of electromagnetic radiation and explain basic antenna parameters
CO2	Analyze the radiation characteristics of thin wire antennas, including dipoles and loop

	antennas, and apply concepts like retarded potential and image theory in practical antenna design.
CO3	Design and evaluate antenna arrays using principles of pattern multiplication, and compare different array types such as broadside and end-fire arrays based on performance parameters.
CO4	Examine various antenna feeding techniques and calculate input impedance for different configurations, including folded dipoles and log-periodic antennas, using the reciprocity theorem and measurement
CO5	Explain and interpret different modes of wave propagation (ground, space, ionospheric) and determine key parameters like MUF, skip distance, and critical frequency in relation to atmospheric effects.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	1	-	2	3	2	1
CO2	3	3	2	2	2	-	-	-	-	1	-	2	3	3	2
CO3	3	2	3	2	3	-	-	-	-	1	1	2	2	3	3
CO4	2	2	3	3	3	-	-	-	-	1	1	2	2	3	3
CO5	2	2	1	1	2	1	2	-	-	2	-	2	2	2	2

B.TECH FIFTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET502
Paper 2: IC Technology

Total Lectures: 40

Unit 1: Introduction:

Fundamental Considerations for IC Processing, NMOS IC Technology, CMOS IC Technology, MOS Memory IC Technology, Outlines and properties of substrates, hybrid IC layout, Monolithic ICs

Unit 2: Crystal Growth and Wafer Preparation:

Introduction, Metallurgical Grade Silicon, Electronic grade Silicon, Czochralski Crystal Growing, Silicon Shaping, Processing Considerations, Clean Room

Unit 3: Oxidation:

Introduction, Growth Mechanism and Kinematics, Thin Oxides, Oxidation Techniques and Systems: Wet Oxidation and Dry Oxidation, Oxidation of Polysilicon. **Photolithography:** Introduction, Photoresist Materials and Masking, Optical Lithography, E-Beam Lithography, Ion Beam Lithography,

Unit 4: Antenna Feedings and Antenna Impedance:

Diffusion: Conventional Furnace Technique, Ion-Implantation Technique, Solid solubility, Role of Oxygen in diffusion, Ion Implantation: Low Current, High Current, Effects, Applications

Metallization: Single Level, Multi Level, Electromigration, PVD, Evaporation, Sputtering, Junction Spiking, Electromigration, CVD: Epitaxial Growth, Non-Epitaxial Growth

Etching: Introduction, Wet: Chemical, Dry: Physical, Plasma, Eutectic Temperature, Measurement: Thickness, resistivity

Unit 5: CMOS Fabrication:

Process Flow: NMOS and PMOS, n-well and p-well formation, CMOS Inverter Characteristics and fabrication

Thin Film Technology and Devices: Introduction to Thin Film Nanofabrication Technology, Thin film electronics, thin film Transistors, Optoelectronic and Energy devices, Introduction to thin film based Emerging nanoscale and quantum devices

References:

1. S. M. Sze, VLSI Technology, Second Edition, MH, 1988.
2. S. K. Gandhi, VLSI Fabrication Principles, Second Edition, Wiley, 1994.
3. D. Nagchoudhari, Principles of Microelectronics Technology, Wheeler, 1998

4. S. A. Campell, The Science and Engineering of Microelectronics Fabrication, OUP, 1996
5. P. Van Zant, Microchip Fabrication: A Practical Guide to Semiconductor Processing, Third Edition, MH, 1997.

CO1	Understand the fundamentals of integrated circuit (IC) processing technologies including NMOS, CMOS, and MOS memory IC fabrication, and distinguish between hybrid and monolithic IC layouts.
CO2	Explain and evaluate the crystal growth and wafer preparation processes, including the Czochralski method, silicon shaping techniques, and cleanroom requirements in semiconductor manufacturing.
CO3	Analyze the oxidation and photolithography processes used in IC fabrication, including wet and dry oxidation techniques, lithography types (optical, E-beam, ion beam), and photoresist materials.
CO4	Apply and compare diffusion, ion implantation, metallization, and etching techniques in IC processing, including the impact of parameters like solid solubility, electromigration, and deposition methods (PVD, CVD).
CO5	Interpret and design CMOS fabrication steps including n-well and p-well processes, and explore thin film nanofabrication technologies and their application in modern electronic and optoelectronic devices.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	1	-	-	1	-	2	3	2	1
CO2	3	3	1	1	2	-	1	-	-	1	-	2	3	2	1
CO3	3	3	2	2	3	-	1	-	-	2	-	3	3	3	2
CO4	3	3	3	2	3	-	1	-	-	2	1	3	3	3	3
CO5	3	2	3	2	3	1	2	1	-	2	1	3	2	3	3

B.TECH FIFTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET503
Paper 3: Fibre Optic Communication II

Total Lectures: 40

Unit 1: Advanced Fiber-Optic Devices:

Advanced lasers and advanced fibers, birefringence and polarization maintaining fibers, Special types of fibers, fibers. Optical Modulators: Types and principles of optical modulation techniques, Modulation bandwidth and limitations, internal and external modulation techniques.

Unit 2: Optical Fiber Measurements:

Attenuation measurement, Dispersion measurement, Index profile measurement, Cut-off wavelength measurement, Numerical aperture measurement, OTDR

Unit 3: Optical Fiber Couplers:

Fiber couplers- three port and four port couplers, Star couplers, their characteristics and description, Wavelength division multiplexing and couplers for it, Tunable sources, Fiber optic fixed wavelength and tunable filters

Unit 4: Coherent Optical Fiber Systems

Basic system configuration, Practical constraints, Modulation formats, Detection Principle and demodulation schemes, Receiver sensitivities and their comparison, Dual-detectors receivers

Unit 5: Applications:

Fiber optic sensors- Classification of fibre sensors, Intrinsic and extrinsic fiber sensors, Microbend sensors; Application of sensors; Applications of optical fiber in defence, medical and industries

References:

1. Optical Fiber Communication: Gerd Keiser
2. Optical Fiber Communication: John M. Senior
3. Handbook of Fiber Optics: Chal Yen
4. Optical Fiber Telecommunication IIIA: Ivon P. Kaminow and Kock

CO1	Understand and compare the principles of advanced optical fibers and lasers, including birefringence, polarization-maintaining fibers, and various optical modulation techniques and their limitations.
CO2	Apply standard optical fiber measurement techniques such as attenuation, dispersion, numerical aperture, and OTDR to evaluate fiber performance in communication systems.

CO3	Analyze the operation and characteristics of fiber couplers, including star and WDM couplers, and explain the use of tunable sources and filters in fiber optic networks.
CO4	Evaluate coherent optical fiber system configurations, including modulation formats, detection principles, and receiver sensitivities, and compare demodulation schemes for optimal system design.
CO5	Classify and explain different types of fiber optic sensors and their applications in defense, medical, and industrial fields, with emphasis on microbend and intrinsic/extrinsic sensors.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	-	1	-	-	1	-	2	3	2	1
CO2	3	3	2	2	3	-	1	-	-	1	-	2	3	3	2
CO3	3	3	3	2	3	-	1	-	-	1	1	3	3	3	3
CO4	3	3	3	3	3	-	1	-	-	1	1	3	3	3	3
CO5	2	2	1	1	2	1	2	1	-	2	-	3	2	3	3

B.TECH FIFTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET504
Paper 5: Computer Networks

Total Lectures: 40

Unit 1: Introduction: Application Presentation and Session Layer:

History of data communication, Advantages and Disadvantages of a Computer Networks; Classification of Computer Networks; Switching techniques: Circuit, Message, and Packet switching, Active and Passive Components used in a network design, Protocols and their role in computer network, ISO-OSI model, TCP/IP model, Client-Server concepts and application, DNS, HTTP, Email and web browsing, Introduction to WebSockets and REST APIs, Network Security and Management: SNMP

Unit 2: Transport Layer:

Process-to-process communication UDP and TCP: Headers, segmentation, flow and congestion control TCP connection management (3-way handshake), Adaptive retransmission.

Unit 3: Network Layer:

Store and forward, Next-Hop forwarding, Router and Routing Techniques, IP Addressing (IPv4 and IPv6), Subnetting, CIDR, ARP, ICMP, Routing algorithms: Distance Vector, Link State, Datagram encapsulation and fragmentation,

Unit 4: Data Link Layer:

Error detection and correction methods, Framing, Flow control: Stop-and-Wait, Sliding Window, MAC protocols: ALOHA, CSMA, CSMA/CD, CSMA/CA, Token passing rings, ATM LANs.

Unit 5: Physical Layer:

Physical layer communication, Media, Signals and Bits, Time division, Code Division and frequency division multiplexing, Encoding, Data Compression, Modulation, Delay, Bandwidth and noise; latency, throughput, Network Interconnections with repeaters, Switches, Bridges, Routers and gateways, DSU/CSU, XDSL and cable modems, Connection oriented and connectionless services, Comparative Study of various media used in Connection oriented networks and connectionless networks, Network topology, LAN wired/wireless, Ethernet, FDDI, ISDN, Broadband Multi-Service networks,

References:

1. Computer Networks: Tanenbum, A.S
2. Data and Computer Communication: Stallings, William
3. Inter Networking With TCP/IP Vol I, II, III: Comer, D.E. and Stevens D.L.

4. Computer Network and Distributed Data Processing: Martin. J.
5. Local Networks: Stalling, William
6. Data Communication and Networking: Forouzan, B.A
7. Telecommunication Switching Systems and Networks: Viswanathan Thiagarajan

CO1	Understand the functions of application, presentation, and session layers in the OSI and TCP/IP models, and analyze protocols like HTTP, DNS, and REST APIs, including their roles in modern network applications and management.
CO2	Explain the process-to-process communication provided by the transport layer, and analyze TCP and UDP mechanisms including segmentation, flow control, congestion control, and adaptive retransmission.
CO3	Identify and describe the function of active and passive components in network design, and understand the role of protocols in ensuring effective network communication.
CO4	Compare and contrast the ISO-OSI and TCP/IP models , and explain client-server architecture , including core application-layer protocols like DNS, HTTP, Email , and WebSockets .
CO5	Demonstrate understanding of network security and management concepts , including the role of SNMP and the importance of secure communication in application-layer protocols.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	1	-	-	2	-	2	3	2	2
CO2	3	3	3	2	3	-	1	-	-	2	1	2	3	3	2
CO3	3	2	3	2	3	-	1	-	-	1	1	2	3	3	3
CO4	3	3	3	2	3	-	1	-	-	2	1	3	3	3	3
CO5	2	2	2	1	3	2	2	2	-	2	1	3	2	3	3

B.TECH FIFTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET505
Paper 5: Machine Learning and Artificial Intelligence

Total Lectures: 40

Unit 1: Introduction to AI and ML:

Introduction to AI and ML, History and Evolution, Types of AI: Narrow, General, Super AI, Supervised, Unsupervised, Reinforcement Learning, Applications in ECE: Signal Processing, Communications, IoT, Robotics

Unit 2: Data Visualization and Preprocessing:

Data exploration and summary statistics, Data cleaning and preprocessing techniques Feature selection and dimensionality reduction (PCA), Visualization with Matplotlib, Seaborn, Handling missing values, encoding categorical variables, scaling

Unit 3: Supervised Learning:

Introduction to supervised learning, Linear regression, logistic regression, K-Nearest Neighbors (KNN), Decision Trees and Random Forest, Support Vector Machines (SVM) Model evaluation: confusion matrix, accuracy, precision, recall, F1-score

Unit 4: Unsupervised Learning:

Introduction to unsupervised learning, Clustering: K-Means, Hierarchical, DBSCAN, Dimensionality reduction: PCA

Unit 5: Model Optimization and Deep Learning Basics:

Model selection and validation techniques, Overfitting vs underfitting, Cross-validation, Grid Search, Random Search, Introduction to neural networks, Basics of TensorFlow / Keras, Building a simple neural network with Keras, Overview of Tools: Python, scikit-learn, TensorFlow, Jupyter

References:

1. Pattern Recognition and Machine Learning: Christopher Bishop
2. The Hundred-page Machine Learning Book: Andriy Burkov
3. Deep learning: Ian Goodfellow, Yoshua Bengio, and Aaron Courville
4. Computer Vision: Algorithms and Applications by Richard Szeliski
5. Computer vision: principles, algorithms, applications, learning: E.R. Davies

CO1	Explain the fundamentals of Artificial Intelligence and Machine Learning , their historical evolution, types (Narrow, General, Super AI), and identify key applications in ECE domains such as signal processing, communications, IoT, and robotics.
-----	--

CO2	Perform data preprocessing and visualization using tools like Matplotlib and Seaborn , including techniques such as handling missing data, encoding categorical variables, scaling, and dimensionality reduction (PCA) .
CO3	Apply supervised learning algorithms such as Linear/Logistic Regression, KNN, Decision Trees, Random Forest, and SVM , and evaluate models using performance metrics like accuracy, precision, recall, and F1-score .
CO4	Implement unsupervised learning techniques such as K-Means, Hierarchical Clustering, and DBSCAN , and apply PCA for dimensionality reduction to analyze unlabeled datasets.
CO5	Optimize ML models using techniques like cross-validation, grid/random search , and demonstrate an understanding of deep learning basics by building simple neural networks using TensorFlow/Keras .

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	1	-	-	2	-	2	3	2	2
CO2	3	3	2	2	3	-	1	-	-	2	-	2	3	3	2
CO3	3	3	3	3	3	-	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	-	1	-	-	2	1	3	3	3	3
CO5	3	3	3	3	3	1	2	-	-	2	1	3	3	3	3

B.TECH FIFTH SEMESTER

(Electronics and Communication Engineering)

Paper Code: BET506

Paper 6: Digital Communication Systems

Total Lectures: 40

Unit 1: Fundamentals of Digital Communication Systems

Signals and Noise: Error-Performance Degradation in Communication Systems, Demodulation and Detection, A Vectorial View of Signals and Noise, The Basic SNR Parameter for Digital Communication Systems. Detection of Binary Signals in Gaussian Noise: Maximum Likelihood Receiver Structure, The Matched Filter, Correlation Realization of the Matched Filter, Error Probability Performance of Binary Signaling. Intersymbol Interference: Pulse Shaping to Reduce ISI, Two Types of Error-Performance Degradation, Demodulation/Detection of Shaped Pulses. Equalisation Channel Characterisation, Eye Pattern.

Unit 2: Bandpass Modulation and Demodulation/Detection

Digital Bandpass Modulation Techniques: Phasor Representation of a Sinusoid, Phase Shift Keying, Frequency Shift Keying, Amplitude Shift Keying, Amplitude Phase Keying. Detection of Signals in Gaussian Noise: Decision Regions, Correlation Receiver. Coherent Detection, Noncoherent Detection. Error Performance for Binary Systems. M-ary Signaling and Performance: M-ary Signaling, Vectorial View of MPSK Signaling. Symbol Error Performance for M-ary Systems ($M > 2$): Probability of Symbol Error for MPSK, Probability of Symbol Error for MFSK.

Unit 3: Basic Information Theory and Channel Capacity:

Mathematical models for information sources; Discrete memory-less source; Logarithmic measure of information; Entropy as a measure of Uncertainty; Interrelations between entropies; Conditional entropies; Average Mutual information, Properties of Mutual information; Binary Symmetric Channels, Discrete memoryless channels, Shannon- Hartley capacity theorem, Shannon's limit; Capacity of a channel of infinite Bandwidth.

Unit 4: Source Coding

Coding for discrete memory-less source; Fixed length code words; Source coding theorem; Variable length code-words; Unique decodability and prefix conditions; Kraft inequality; Significance of prefix condition; Shannon-Fano coding; Huffman Coding Technique.

Unit 5: Channel Coding

Linear block Codes- the Generator matrix and Parity check matrix; Construction of a standard array; Syndrome calculation; Hamming weight and Hamming distance. Cyclic codes, encoding in Systematic forms; Circuits for dividing polynomials; Systematic encoding with an $(n-k)$ stage shift register; Syndrome calculation and error detection with an $(n-k)$ stage shift register.

Convolutional Codes- Convolutional encoding; The state diagram; The tree diagram; The trellis diagram; Optimum decoding of the Convolutional codes- The Viterbi algorithm, Sequential decoding; Comparison and Limitations of Viterbi and Sequential decoding;

References:

1. Digital Communications: Fundamentals and Applications: B. Sklar (Prentice Hall P T R)
2. Modern Digital Communication System: B. Sklar (Addition Wesley)
3. Digital Communications: S. Haykin (Wiley)
4. Principle of Digital Comm: J. Das, S.K. Mullick, P.K. Chatterjee (Wiley)
5. Digital Communication: John G. Proakis (TMH)
6. An Introduction to Error-Correcting Codes: S. Lin (McGraw Hill)
7. Principles of Communication: Tauband Schilling (TMH)

CO1	Analyze the impact of noise and signal characteristics on the performance of digital communication systems, including binary signal detection in Gaussian noise , matched filters, and intersymbol interference (ISI) mitigation techniques such as pulse shaping and equalization .
CO2	Evaluate digital bandpass modulation schemes such as PSK, FSK, ASK, and M-ary signaling , and apply coherent and non-coherent detection techniques to determine the symbol error probability under Gaussian noise.
CO3	Apply the principles of information theory by calculating entropy, mutual information, and channel capacity for discrete memoryless channels using the Shannon-Hartley theorem and Shannon's limit .
CO4	Design efficient source coding schemes for discrete memoryless sources using Shannon-Fano and Huffman coding , while ensuring unique decodability and adherence to Kraft's inequality .
CO5	Implement channel coding techniques including linear block codes, cyclic codes, and convolutional codes , and demonstrate the use of decoding algorithms like the Viterbi algorithm for error detection and correction.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	1	-	-	2	-	2	3	3	2
CO2	3	3	3	2	3	-	1	-	-	2	1	2	3	3	3
CO3	3	3	2	2	3	-	1	-	-	1	-	2	3	3	2
CO4	3	2	3	2	3	-	1	-	-	2	1	3	3	3	3
CO5	3	3	3	3	3	-	1	-	-	2	1	3	3	3	3

B.TECH SIXTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET601
Paper 1: Microelectronics and VLSI Design

Total Lectures: 40

Unit 1: Introduction to VLSI Design

Overview of Microelectronics and VLSI, VLSI Design Methodologies: VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality, VLSI Design Styles
Degradation, Demodulation/Detection of Shaped Pulses. Equalisation: Channel Characterisation, Eye Pattern.

Unit 2: MOS Technology and Scaling

MOS Ideal I-V Characteristics, C-V Characteristics, MOS Small-signal Model, MOS Capacitance Models, MOS Gate Capacitance Model, MOSFET as a Switch, Scaling: Advantages and Disadvantages, Impact of Scaling on Different MOS Parameters, Non-ideal I-V Effects: Velocity Saturation and Mobility Degradation, Second Order Effects: Channel Length Modulation, Body Effect, Short-Channel Effects (SCEs): Sub-threshold Conduction, Vth-Roll off, Drain Induced Barrier Lowering, Junction Leakage, Hot Electron Effect, Velocity Saturation and Mobility Degradation

Unit 3: CMOS Technology Overview

CMOS Inverter, CMOS based NAND Gate and NOR Gate, CMOS Logic Implementation: Combinational Logic Pass Transistor and Transmission Gates, CMOS Inverter DC Characteristics, Beta Ratio Effects, CMOS Analysis: Noise Margin, CMOS Inverter Cross-section, Fabrication Process, Layout Design Rule, Discussion on Stick Diagrams.

Unit 4: Low Power Design

Delay Estimation using RC Delay Model and Linear Delay Model, Logical Effort, Parasitic, Delay. Logical Effort and Transistor Sizing: Delay in a Logic Gate, Delay in Multistage Logic, Networks, and Choosing the Best Number of Stages. Power Dissipation: Static Dissipation, Dynamic Dissipation, Low-Power Design. Interconnect: Resistance, Capacitance, Delay, and Crosstalk.

Unit 5: Circuit Families

Circuits, Cascade Voltage Switch Logic, Dynamic Circuits, Sense Amplifier Circuits, Bi-CMOS Circuits, Multiplexers, Sequential Static Circuits, Design of Latches and Flip-Flops.

References

1. Sung-Mo (Steve) Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design: 3rd Edition, McGraw Hill India, 2003
2. Neil H. E. Weste and David Money Harris, CMOS VLSI Design A Circuits and Systems Perspective: 4th Edition, Pearson 2015

3. S. M. Sze, VLSI Technology: 2nd Edition, McGraw-Hill, 2000.
4. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design: 3rd Edition, Prentice Hall, 199

CO1	Understand the fundamentals of microelectronics and VLSI design methodologies , including design flow, hierarchy, and various VLSI design styles.
CO2	Analyze the electrical characteristics and scaling behavior of MOS devices , including I–V and C–V characteristics, small-signal models, and short-channel effects.
CO3	Design and implement basic CMOS logic circuits , including inverters, NAND, and NOR gates, and understand fabrication processes, layout design rules , and stick diagrams.
CO4	Evaluate and optimize circuit performance in terms of delay and power , using delay models, logical effort, and low-power design techniques.
CO5	Examine and design advanced circuit families , including dynamic, Bi-CMOS, and sequential circuits such as latches and flip-flops for efficient VLSI implementations.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	-	1	-	-	1	-	2	3	2	2
CO2	3	3	2	2	3	-	1	-	-	1	-	2	3	3	2
CO3	3	3	3	2	3	-	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	-	1	-	-	2	1	3	3	3	3
CO5	3	3	3	3	3	-	1	-	-	2	1	3	3	3	3

B.TECH SIXTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET602
Paper 2: Satellite Communication

Total Lectures: 40

Unit 1: Elements of Satellite Communication

Satellite frequency bands, Satellite systems, Transmission and multiplexing, Modulation, Multiple Access, Advantages of digital satellite communication.

Unit 2: Orbits of Satellites

Orbital period and velocity; Effects of orbital inclination, Azimuth and elevation, Coverage angle and slant range, Eclipse, Placement of a satellite in geostationary orbit, Low, medium and polar orbits, Satellite description

Unit 3: Satellite Links

Earth station Antenna-Antenna gain and pointing loss, Effective isotropic radiated power antenna, Gain to noise temperature ratio, G/T measurement, Basic link analysis, Carrier to noise plus interference ratio

Unit 4: Frequency Division Multiple Access

Multiple Access- FDM- FM- FDMA; Single Channel per carrier, FM-FDMA Television, Inter-modulation Products

Unit 5: Time Division Multiple Access

TDMA Frame Structure, Reference burst, Traffic burst and guard time, TDMA burst structure, Carrier and lock recovery sequences, Unique word, Signaling channel, Traffic data, TDMA frame efficiency, TDMA super frame structure, Frame acquisition and synchronization, Satellite position determination, Single station ranging, Three station ranging, Errors in transmit frame delay, Burst time plan, Control and co-ordination by the reference station TDMA timing, Slip rate in digital terrestrial network, Advanced TDMA satellite systems

References

1. Digital Satellite Communication: Tri. T. Ha (T.M.H.)
2. Satellite Communication: Pratt (Wiley)

CO1	Understand the fundamental elements of satellite communication systems , including frequency bands, transmission, multiplexing, modulation, and multiple access techniques.
CO2	Explain the orbital mechanics of satellites , including orbital parameters, types of orbits, and the placement of satellites in geostationary orbit.
CO3	Analyze satellite link performance using parameters such as antenna gain, effective isotropic radiated power (EIRP), and carrier-to-noise ratio for reliable communication links.

CO4	Evaluate and compare Frequency Division Multiple Access (FDMA) techniques, including single-channel per carrier systems and intermodulation effects in satellite communication.
CO5	Describe and apply Time Division Multiple Access (TDMA) principles, including frame structure, synchronization, ranging methods, and control mechanisms for efficient satellite network operation.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	1	-	-	1	-	2	3	2	2
CO2	3	3	2	1	2	1	1	-	-	1	-	2	3	3	2
CO3	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO5	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3

B.TECH SIXTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET603
Paper 3: Radar Engineering & Navigational Aids

Total Lectures: 40

Unit 1: Radar Principles

Pulsed Radar- Components of radar set, Basic principles, Classification of radars, Radar frequencies, Derivation and significance of radar range equation, Minimum detectable signal, Limitations of pulse radar, Modulator, Duplexers; Displays, Radar antennas, Noise clutter.

Unit 2: CW and FM Radar

Doppler Effect, simple CW radar, FMCW radar, multiple frequency CW radar, Radio altimeter.

Unit 3: MTI and Tracking Radar

MTI Radar, Delay lines and cancellers, MTI using range gates and filters, Pulse Doppler radar, Non-coherent MTI, MTI from a moving platform.

Tracking with radar, Sequential lobing, Conical scan, Mono pulse radar, Tracking in range and Doppler effect, Electronic scanning radar, Satellite tracking

Unit 4: Radar Signal Processing

Evolution of radar signal processing, Detection of radar signal in noise, Pulse compression fundamentals, Matched filter pulse compression system, Matched filter receiver, Extraction of information from radar signal.

Unit 5: Navigational and Surveillance aids

Introduction, Types of navigation, Classification of radio navigational aids, Non-directional beacon (NDB), VHF Direction Finder, Very High Frequency Omni range, Doppler VOR, Distance Measuring Equipment, Application of DME, Instrument Landing system, Microwave Landing System; Application of Radar.

References

1. Introduction to Radar Systems: M.I. Skolnik (McGraw-Hill)
2. Microwave and Radar Engineering: G.S. Bhushana Rao (Pearson)

CO1	Understand the fundamental principles and components of radar systems , including pulsed radar operation, radar range equation, and factors affecting radar performance.
-----	---

CO2	Explain the working principles of Continuous Wave (CW) and Frequency Modulated (FM) radars , and their applications such as Doppler radar and radio altimeters.
CO3	Analyze the operation of Moving Target Indicator (MTI) and tracking radars , including techniques like sequential lobing, conical scan, monopulse, and electronic scanning systems.
CO4	Apply the concepts of radar signal processing , including signal detection in noise, pulse compression, and matched filter techniques for improving radar performance.
CO5	Describe the principles and applications of navigational and surveillance aids , such as VOR, DME, ILS, MLS, and radar-based navigation systems.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	-	-	1	-	2	3	2	2
CO2	3	3	2	2	3	1	1	-	-	1	-	2	3	3	2
CO3	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO5	3	2	2	2	3	1	1	-	-	2	1	3	3	3	3

B.TECH SIXTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET604
Paper 4: Mobile Ad Hoc Networks

Total Lectures: 40

Unit 1: Mobile Ad Hoc Network

Introduction, Wireless Networks, Mobile Ad Hoc Network- Definition, History. MANET Applications and Scenarios, Ad Hoc Network Characteristics, Classification of Ad Hoc Networks.

Unit 2: MAC Layer Protocols for Ad Hoc Wireless Networks:

Introduction, Important Issues and the Need for Medium Access Control (MAC) Protocols, Classification of MAC Protocols- Contention-Based MAC Protocols, MAC Protocols Using Directional Antennas, Multiple-Channel MAC Protocols, Power-Aware or Energy-Efficient MAC Protocols

Unit 3: Routing Protocols for Ad Hoc Wireless Networks:

Introduction, Design Issues of Routing Protocols for Ad Hoc Networks, Classification of Routing Protocols. Proactive Routing Protocols – Destination-Sequenced Distance Vector (DSDV), Optimised Link State Routing (OLSR) Protocol. Reactive Routing Protocols- Ad Hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR) Protocol. Hybrid Routing Protocols - Zone Routing Protocol (ZRP)

Unit 4: Transport Protocols for Ad Hoc Networks:

Introduction, Transmission Control Protocol's (TCP's) Challenges and Design Issues in Ad Hoc Networks, TCP Performance over That of Mobile Ad Hoc Networks (MANETs), Ad Hoc Transport Protocols, Application-Controlled Transport Protocol (ACTP)

Unit 5: Mobility Models for Ad Hoc Networks:

Introduction, Mobility Metrics, Impact of Mobility Models on MANET, Mobility Model Classifications, Random Walk Mobility, Random Way-point Mobility

References

1. Mobile Ad Hoc Networks – Current Status and Future Trends: Jonathan Loo, Jaime Lloret, and Jesus Hamilton Ortiz, CRC Press, Taylor & Francis Group 2012.
2. Ad Hoc Wireless Networks-Principles, Protocols and Applications: Subir Kumar Sarkar,T G Basavaraju and C Puttamadappa, Auerbach Publications, Taylor & Francis Group, New York London, 2008.
3. Handbook of Mobile Ad Hoc Networks for Mobility Models: Radhika Ranjan Roy, Springer 2011.

CO1	Understand the fundamental concepts, characteristics, and classifications of Mobile Ad Hoc Networks (MANETs), along with their applications and use-case scenarios.
CO2	Explain the design principles and operation of MAC layer protocols for ad hoc wireless networks, focusing on contention-based, multi-channel, and energy-efficient approaches.
CO3	Analyze various routing protocols for MANETs , including proactive (DSDV, OLSR), reactive (AODV, DSR), and hybrid (ZRP) methods, and evaluate their performance and suitability for different network conditions.
CO4	Examine the transport layer challenges in MANETs , understanding TCP limitations, performance issues, and the design of ad hoc transport protocols like ACTP.
CO5	Evaluate different mobility models and their impact on the performance of MANETs, including random walk and random waypoint mobility patterns.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	-	-	1	-	2	3	2	2
CO2	3	3	2	2	3	1	1	-	-	1	-	2	3	3	2
CO3	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO5	3	3	2	2	3	1	1	-	-	2	1	3	3	3	3

B.TECH SIXTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET605
Paper 5: Paper Title: Digital Signal Processing

Total Lectures: 40

Unit 1: Discrete Time Signal and Systems

Signal and system classifications, Time and frequency domain representation, Analysis of discrete time linear time invariant system, Discrete time system described by difference equation, Stability and Causality, Frequency domain & time domain stability criteria, frequency response of LTI system

Unit 2: Z-Transform & Discrete Fourier Transform (DFT)

Z-Transform and its properties, Z-Transform of simple functions, Inverse Z-Transform, Analysis of LTI system in Z-domain. Convergence of DFT, DFT of periodic signals; properties of DFT; DFT & convolution; Application of DFT to LTI system analysis, FFT algorithms and their applications

Unit 3: Realisation of Digital Systems

Recursive and non-recursive structure of digital system, Direct, cascaded, parallel, ladder and lattice realization

Unit 4: Design of Digital Filters

IIR Digital Filter- IIR filter designs by approximation of derivatives, impulse invariant and bilinear transformation methods, Frequency transformation, FIR digital Filter- Design of linear phase FIR filters by using windows and frequency sampling methods, Finite Word Length Effects-

Unit 5: Quantization errors

Quantization errors and their effects on the performance of digital signal processors

References

1. Digital Signal Processing: J.G. Proatais (PHI)
2. Discrete Time Signal Processing: Openheim& Shafer (PHI)
3. Signal Processing & Linear Systems: B.P. Lathi (Oxford)
4. Principles and Application of Signal Processing: Robiner Gold (PHI)

CO1	Understand and analyze discrete-time signals and systems , their classifications, time and frequency domain representations, and stability and causality characteristics of LTI systems.
CO2	Apply Z-transform and Discrete Fourier Transform (DFT) techniques to analyze discrete-time systems, and utilize FFT algorithms for efficient computation and system analysis.

CO3	Design and realize digital systems using various structures such as direct, cascade, parallel, ladder, and lattice realizations.
CO4	Design and implement IIR and FIR digital filters using techniques like bilinear transformation, impulse invariance, windowing, and frequency sampling methods, considering practical constraints such as finite word length.
CO5	Evaluate the impact of quantization errors on digital signal processing performance and understand methods to minimize their effects in digital systems.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	1	-	-	1	-	2	3	3	2
CO2	3	3	3	3	3	-	1	-	-	1	-	2	3	3	3
CO3	3	3	3	3	3	-	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	-	1	-	-	2	1	3	3	3	3
CO5	3	3	2	2	3	-	1	-	-	2	1	3	3	3	3

B.TECH SIXTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET606
Paper 6: Internet of Things

Total Lectures: 40

Unit 1: Introduction to the Internet of Things

Introduction, History of IoT, about objects/things in the IoT, the identifier in the IoT, Enabling technologies of IoT, About the Internet in IoT, IoT- Standards and Governance. Promoting ubiquitous networking: anywhere, any when, any what

Unit 2: IPv6

Importance of Addressing, Limitations of IPv4, Introduction to IPv6, IPv6 Address Structure and Prefixes, IPv6 Packet Format, Security and IPv6, Role of IPv6 in IoT

Unit 3: Radio Frequency Identification Technology (RFID)

Introduction, Principle of RFID, Components of an RFID system: RFID Reader, RFID Tags, Middleware, Different RFID applications: Logistics and supply chain, Production, Monitoring and Maintenance, Product Safety, Quality and Information, Access Control and Tracking and Tracing of Individuals, etc.,

RFID Deployment for Location: Localization, Multiple tags-to-reader collisions, Multiple readers-to-tag collisions, Reader-to-reader interference.

Unit 4: Wireless Sensor Networks (WSN)

History, the node: Communication, Computation, Sensing, Energy Connecting nodes: Radio Basics, Reliable Communication in practice, Networking nodes: Medium access control and Multi-hop routing, Securing communication. WSN application transport method: MQTT-S

Unit 5: Power Line Communication Technology (PLC)

Introduction, Overview of existing PLC technologies and standards, History of PLC technologies, Different types of in-home PLC technologies, Security, Performances of PLC technologies, Standards and normalization, Architectures for home network applications, Architecture for a high bit-rate home network application, Architecture for low bit-rate home network application, Internet of things using PLC technology, Connecting objects in the indoor environment, Interoperability of connecting objects in the home environment.

References

1. The Internet of Things: Connecting Objects to the Web – Hakima Chaouchi – Wiley
2. Designing the Internet of Things” by Adrian McEwen and Hakim Cassimall
3. RFID Handbook – Klaus Finkenzeller, Wiley.

4. Architecting the Internet of Things - Dieter Uckelmann, Mark Harrison; Florian Michahelles - (Eds.) – Springer 2011
5. Networks, Crowds, and Markets: Reasoning About a Highly Connected World - David Easley and Jon Kleinberg, Cambridge University Press – 2010

CO1	Understand the concepts, history, architecture, and enabling technologies of the Internet of Things (IoT), along with standards, governance, and the concept of ubiquitous connectivity.
CO2	Explain the importance of addressing in IoT , the need for IPv6, and describe IPv6 addressing structures, packet formats, and security features , emphasizing its integration within IoT systems.
CO3	Describe the working principles and components of RFID systems , analyze their applications in real-world domains such as logistics, monitoring, and access control, and identify challenges related to RFID deployment and interference.
CO4	Understand the design and functionality of Wireless Sensor Networks (WSNs) , including node architecture, communication, routing, energy efficiency, and secure data transmission using IoT protocols such as MQTT-S.
CO5	Explain the concept, architecture, and application of Power Line Communication (PLC) technologies in IoT, and evaluate their performance, standards, and interoperability for smart home and industrial environments.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	1	1	-	1	-	2	<u>3</u>	<u>2</u>	<u>2</u>
CO2	3	3	2	2	3	1	1	1	-	1	-	2	<u>3</u>	<u>3</u>	<u>2</u>
CO3	3	3	3	2	3	1	1	1	-	2	1	3	<u>3</u>	<u>3</u>	<u>3</u>
CO4	3	3	3	3	3	1	1	1	-	2	1	3	<u>3</u>	<u>3</u>	<u>3</u>
CO5	3	3	3	3	3	1	1	1	-	2	1	3	<u>3</u>	<u>3</u>	<u>3</u>

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET701
Paper 1: Microwave Technology

Total Lectures: 40

Unit 1: Microwave Sources

Microwave Tubes: High frequency effects in vacuum tubes, Velocity modulation; Two and multi-cavity klystrons; Reflex Klystrons, Magnetrons, Travelling wave tubes, Backwards wave oscillator

Unit 2: Microwave Semiconductor Devices:

Microwave transistor, Microwave oscillators using tunnel diode, Gunn diodes, IMPATT and TRAPATT, Parametric amplifiers, masers, Microwave integrated circuits

Unit 3: Microwave Passive Devices

Microwave transmission structures, Coaxial line, Strip-line, micro-strip and slotted line, Design procedures and design curves, Impedance transformation and matching
Terminations: Matched loads, Transition units, Attenuation, Phase shifters; Directional couplers, Hybrid junction, Microwave propagation in ferrites, Isolators and circulators

Unit 4: Microwave Circuits

Equivalent voltage and currents, Importance of waveguide elements and circuits, N-port circuits, Scattering and Transmission matrices, Microwave cavities, rectangular and cylindrical cavity resonators equivalent circuit Q and method of coupling resonators, Aperture coupled resonator, Co-axial resonator, Simple microwave filters

Unit 5: Microwave Measurements

Components of a typical test bench, Measurement of VSWR and guide wavelength, Measurement of impedance using slotted line and network analyzer, Measurement of power bolometric and calorimetric power meters, Measurement of frequency- wavemeter and heterodyne frequency meter, Measurement of scattering parameters using reflectometer and network analyzer, Spectrum analysis at UHF and microwave frequencies using spectrum analyzers

References

1. Microwave Devices & Circuits: Samuel Y. Liao (PHI)
2. Microwave Theory & Techniques: HJ Reich (East West Press Ltd.)
3. Microwave Devices: J T Coleman (Reston)
4. Microwave Engineering: D.M Pozar
5. Elements of Microwave Engineering: R Chatterjee (East West Press Ltd.)

CO1	Understand the principles and operation of microwave tubes , including klystrons, magnetrons, traveling wave tubes (TWTs), and backward wave oscillators (BWOs), used for
-----	--

	microwave signal generation and amplification.
CO2	Explain the working principles and characteristics of microwave semiconductor devices such as Gunn diodes, IMPATT, TRAPATT, tunnel diodes, and parametric amplifiers, and understand their applications in microwave circuits.
CO3	Analyze and design microwave passive devices including transmission lines, impedance matching networks, terminations, couplers, hybrid junctions, isolators, and circulators.
CO4	Apply the concepts of microwave circuit analysis using scattering parameters, transmission matrices, and resonator theory to design and evaluate microwave filters and cavity structures.
CO5	Perform and interpret microwave measurements , including VSWR, impedance, power, frequency, and scattering parameters, using standard microwave test benches and instruments like network and spectrum analyzers.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	1	-	-	1	-	2	3	2	2
CO2	3	3	2	2	3	1	1	-	-	1	-	2	3	3	2
CO3	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO5	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET702
Paper 2: Mobile Communication

Total Lectures: 40

Unit 1:

Introduction, History of wireless communication, Telecommunication and Standard Organisations, Evolution of Mobile Communication, Mobile and Wireless Devices, A Simplified Reference Model for Mobile Communication, Wireless Transmission, Frequency For Radio Transmission, Signal Propagation, Multiplexing, Modulation, Spread Spectrum.

Unit 2:

Introduction to Switching and Traffic, Cellular Analog Switching Equipment, Cellular Digital Switching Equipment, Special Features of Handling Traffic, MTSO Interconnection, Traffic Analysis, Traffic Characterisation, Loss systems, Network Blocking Probabilities, Delay Systems

Unit 3:

Introduction to SDMA, FDMA, TDMA and CDMA, Elements Of Cellular Radio System Design, Introduction To Cellular Mobile Systems, A Basic Cellular System, Elements Of Cellular Radio System Design, Concept Of Frequency Reuse Channels, Hands Off, Cell Splitting.

Unit 4:

Mobile Transport Layer, Congestion Control, Slow Start, Fast Retransmit/ Fast Recovery, Implications of Mobility, Classical TCP Improvements, TCP Over 2.5/ 3G Wireless Networks, Performance Enhancing Proxies.

Unit 5:

GSM, Mobile Services, System Architecture, Radio Interface, Protocols, Localisation and Calling, Handover, Security, New Data Services.

References

1. Mobile Cellular Telecommunication: Analogue and Digital Systems by W.C.Y Lee, McGraw-Hill.
2. Mobile Communications: Jochen Schiller, Pearson Education.

CO1	Understand the fundamentals and evolution of wireless communication systems , including frequency spectrum, signal propagation, multiplexing, modulation, and spread spectrum techniques.
CO2	Explain the concepts of switching and traffic management in mobile networks, including analog and digital switching systems, traffic characterization, and analysis of network

	performance metrics like blocking and delay.
CO3	Analyze the multiple access techniques (SDMA, FDMA, TDMA, CDMA) and the principles of cellular system design , including frequency reuse, handoff mechanisms, and cell splitting for network optimization.
CO4	Examine the mobile transport layer protocols , addressing issues like congestion control, TCP enhancements for mobile and wireless networks, and performance improvement using proxies.
CO5	Describe the architecture and operation of GSM systems , including mobile services, radio interfaces, protocols, handover procedures, security features, and emerging data services.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	1	-	-	1	-	2	3	2	2
CO2	3	3	2	2	3	1	1	-	-	2	-	2	3	3	2
CO3	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO5	3	2	3	2	3	1	1	-	-	2	1	3	3	3	3

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET703

Paper 3: Microcontroller and Microprocessor Interfacing

Total Lectures: 40

Unit 1: Overview of Computer Architecture

Princeton and Harvard Architecture, Overview of microprocessor and microcontroller, Intel Pentium, I (i3, i5, i7 Series) and other recent processors. Applications of microcontrollers.

Unit 2: Microcontroller Architecture: Intel 8051

Microcontroller 8051 - Organization and Architecture, PIN diagram, RAM-ROM Organization, Machine Cycle, Instruction set: Addressing modes, Data Processing - Stack, Arithmetic, Logical; Branching – Unconditional and Conditional, Assembly programming.

Unit 3: Interfacing with Microcontroller 8051

I/O Ports, Timers-Counters, Serial Communication, and Interrupts.
LCD, LED, Keypad, Analog-to-Digital Convertors, Digital-to-Analog Convertors, Sensor with Signal Conditioning Interface.

Unit 4: Input & output Organization

Synchronous and Asynchronous Data Transfer, Basic Input-output methods and transfer modes. Priority Interrupt systems. Functions and study of 8255A(Programmable Peripheral Interface), 8259A (Programmable Interrupt Controller), Programmable Timer Controller (8254).

Unit 5: ARM Processor Architecture and Instruction set

ARM Design Philosophy; Overview of ARM architecture; States [ARM, Thumb, Jazelle]; Registers, Modes; Conditional Execution; Pipelining; Vector Tables; Exception handling, ARM Instruction- data processing instructions, branch instructions, load store instructions

References

1. Advanced Microprocessor and Peripherals, 2012, 2nd Edition, Tata McGraw-Hill, India: A.K. Ray, K.M. Bhurchandi
2. The 8051: Mohammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay.
3. Microcontroller and Embedded Systems, 2014, 2nd Edition, Pearson, India
4. 8086 Microprocessors and its Applications: NagoorKani, 2017, Second Edition, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, India.

CO1	Understand the fundamentals of computer architecture , including Princeton and Harvard
-----	---

	architectures, and gain knowledge of modern processors such as Intel Pentium and Core series, along with their applications in embedded systems.
CO2	Explain the architecture, organization, and instruction set of the Intel 8051 microcontroller , including memory organization, machine cycles, and assembly language programming techniques.
CO3	Design and interface peripheral devices with the 8051 microcontroller , such as LCDs, LEDs, keypads, ADCs, DACs, and sensors, using timers, counters, serial communication, and interrupt mechanisms.
CO4	Understand the input/output organization and peripheral interfaces , including synchronous/asynchronous data transfer, interrupt systems, and the operation of devices such as 8255A (PPI), 8259A (PIC), and 8254 (PTC).
CO5	Explain the ARM processor architecture and instruction set , including design philosophy, pipeline structure, operating modes, exception handling, and data processing instructions for embedded applications.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	1	-	-	1	-	2	3	2	2
CO2	3	3	2	2	3	1	1	-	-	1	-	2	3	3	2
CO3	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO5	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET751
Paper 4: Image Processing (Elective I-A)

Total Lectures: 40

Unit 1: Introduction

Image representation and modeling, 2-D linear system, Luminance, Contrast and Brightness, Color representation, Visibility functions, Monochrome and color vision model.

Unit 2: Image Quantization and Image Transforms

Sampling theorem, Anti-aliasing, image quantization, Orthogonal and unitary transforms, DFT, Cosine transform, Hadamard transform, Haar transform, KL transform.

Unit 3: Image Enhancement

Point operation, Histogram modeling, Filtering and spatial operations, Transform operations, Multispectral Image Enhancement

Unit 4: Image Restoration

Image formation models, Noise models, Inverse and Wiener filtering, Least square filters, Recursive filters, Maximum entropy method, Blind deconvolution, Bayesian method of noise removal, Image reconstruction, Tomography, Radan transform, Back-projection, Reconstruction algorithm, Algebraic method of reconstruction, Fan-beam reconstruction.

Unit 5: Data Compression

Data compression vs. Bandwidth, Pixel coding, Predictive coding, Transform coding, Coding of two-tone images

References:

1. Fundamentals of Digital Image Processing: Anil K. Jain
2. Digital Image Processing: R. Chellappa
3. Image Processing for Scientific Applications: Bernd Jahne
4. Digital Image Processing: R.C. Gonzalez & R.E. Woods
5. The Image Processing Handbook: J.C. Russ
6. Digital Image Processing: W.K. Pratt
7. Digital Image Restoration: Andrews & Hunt

CO1	Understand the fundamentals of digital image representation and modeling , including 2D systems, color and brightness perception, and human visual models.
-----	---

CO2	Apply the concepts of image sampling, quantization, and transformation techniques such as DFT, DCT, Hadamard, Haar, and KL transforms for image analysis and processing.
CO3	Implement image enhancement techniques in spatial and transform domains using point operations, histogram methods, filtering, and multispectral enhancement approaches.
CO4	Analyze and apply image restoration and reconstruction techniques , including noise modeling, Wiener and inverse filtering, Bayesian methods, and tomographic reconstruction algorithms.
CO5	Understand and apply image data compression techniques , including pixel coding, predictive and transform coding, and compression methods for binary (two-tone) images to optimize storage and transmission efficiency.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	1	-	2	3	2	1
CO2	3	3	2	2	3	1	-	-	-	2	-	2	3	3	2
CO3	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO5	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET752
Paper 4: Technology of Digital Vision (Elective I-B)

Total Lectures: 40

Unit 1: Fundamentals of Imaging Systems

Light and optics basics: reflection, refraction, lenses, Image formation and pinhole camera model, Types of image sensors: CCD vs CMOS, Sensor electronics: pixel structure, readout circuits, noise

Unit 2: Digital Image Representation and Processing

Sampling, quantization, and resolution, Image file formats and color models (RGB, YUV, Grayscale), Image histograms and basic transformations, Filtering: smoothing, sharpening, edge detection (Sobel, Laplacian), Histogram equalization and contrast enhancement

Unit 3: Image Sensing and Camera Models

Camera geometry and intrinsic/extrinsic parameters, Lens distortions and correction, Stereo vision basics and depth perception, Sensor calibration techniques, Exposure, gain, dynamic range, and auto-exposure algorithms

Unit 4: Introduction to Computer Vision

Feature detection, descriptors, Image matching, Object detection basics (bounding boxes, sliding window), Motion estimation and optical flow

Unit 5: Real-World Applications and Trends

Vision in embedded systems and IoT cameras, Applications: surveillance, medical imaging, robotics, AR/VR, Vision hardware: camera modules, interfaces (MIPI CSI, USB, etc.)

References:

1. Computer Vision: Algorithms and Applications: Richard Szeliski
2. Multiple View Geometry in Computer Vision: Richard Hartley and Andrew Zisserman
3. Deep learning: Ian Goodfellow, YoshuaBengio, and Aaron Courville
4. Computer vision: principles, algorithms, applications, learning: E.R. Davies

CO1	Understand the fundamental principles of imaging systems , including light behavior, lens optics, image formation, and the working of image sensors such as CCD and CMOS.
CO2	Apply the concepts of digital image representation and processing , including sampling, quantization, filtering, and histogram-based contrast enhancement for improving image quality.
CO3	Analyze camera models and image sensing mechanisms , including intrinsic and extrinsic

	parameters, distortion correction, depth perception, and sensor calibration techniques.
CO4	Understand the basics of computer vision techniques , such as feature detection, image matching, object detection, and motion estimation using optical flow.
CO5	Explore real-world applications of imaging and vision systems in fields like embedded systems, IoT, surveillance, robotics, AR/VR, and understand the associated vision hardware and communication interfaces .

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	1	-	2	3	2	2
CO2	3	3	2	2	3	1	-	-	-	2	-	2	3	3	2
CO3	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO5	3	3	3	2	3	1	1	-	-	2	1	3	3	3	3

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET753

Paper 4: Operating System for Smart Devices (Elective I-C)

Total Lectures: 40

Unit 1: Fundamentals of Imaging Systems

Light and optics basics: reflection, refraction, lenses, Image formation and pinhole camera model, Types of image sensors: CCD vs CMOS, Sensor electronics: pixel structure, readout circuits, noise

Unit 2: Digital Image Representation and Processing

Sampling, quantization, and resolution, Image file formats and color models (RGB, YUV, Grayscale), Image histograms and basic transformations, Filtering: smoothing, sharpening, edge detection (Sobel, Laplacian), Histogram equalization and contrast enhancement

Unit 3: Image Sensing and Camera Models

Camera geometry and intrinsic/extrinsic parameters, Lens distortions and correction, Stereo vision basics and depth perception, Sensor calibration techniques, Exposure, gain, dynamic range, and auto-exposure algorithms

Unit 4: Introduction to Computer Vision

Feature detection, descriptors, Image matching, Object detection basics (bounding boxes, sliding window), Motion estimation and optical flow

Unit 5: Real-World Applications and Trends

Vision in embedded systems and IoT cameras, Applications: surveillance, medical imaging, robotics, AR/VR, Vision hardware: camera modules, interfaces (MIPI CSI, USB, etc.)

References:

1. Computer Vision: Algorithms and Applications: Richard Szeliski
2. Multiple View Geometry in Computer Vision: Richard Hartley and Andrew Zisserman
3. Deep learning: Ian Goodfellow, Yoshua Bengio, and Aaron Courville
4. Computer vision: principles, algorithms, applications, learning: E.R. Davies

CO1	Understand the principles of imaging systems including light propagation, optics, image formation models, and the working mechanisms of image sensors such as CCD and CMOS.
CO2	Apply the concepts of digital image representation and processing , including sampling, quantization, color models, and enhancement techniques like filtering and histogram equalization.

CO3	Analyze camera models and image sensing parameters , including intrinsic and extrinsic geometry, distortion correction, stereo vision, calibration, and exposure control mechanisms.
CO4	Explain and implement fundamental computer vision techniques , such as feature detection, image matching, object detection, and motion estimation through optical flow analysis.
CO5	Evaluate and explore real-world applications of imaging and computer vision systems in embedded devices, IoT cameras, robotics, AR/VR, and medical imaging, along with knowledge of camera hardware interfaces.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	1	-	2	3	2	2
CO2	3	3	2	2	3	1	-	-	-	2	-	2	3	3	2
CO3	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO4	3	3	3	3	3	1	1	-	-	2	1	3	3	3	3
CO5	3	3	3	2	3	1	1	-	-	2	1	3	3	3	3

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET754
Paper 4: Data Structure with C (Elective I-D)

Total Lectures: 40

Unit 1: Introduction

Data Abstraction and Algorithm, Analysis, Data types/objects/structures, Abstract definition of data structures, Representation and implementation, Time requirements of algorithms, Space requirements of algorithms.

Unit 2: Arrays and Linked list

Array implementation and addressing with examples. Array applications and representation, Polynomials, Sparse matrices, String-pattern Matching, Singly linked lists, list heads, circular list, doubly linked lists, orthogonal lists, generalised (recursive) lists, applications and Implementation of Arrays and Linked lists with C.

Unit 3: Stacks and Queues

Basic ideas, array and linked representation. Prefix/infix/postfix expressions and their inter-conversion for evaluation, Priority, queues and simulation, Recursion, Applications and Implementation of Stacks and Queues with C

Unit 4: Trees and Graphs

Definition, terminologies and properties, Binary tree representation traversals and applications, Threaded binary trees, Binary Search trees, AVL Trees, Definition, terminologies and properties, Graph representations, Minimum spanning trees, Depth-first search, Breadth-first search, Networks, Applications and Implementation of Trees and Graphs concepts with C.

Unit 5: Sort and Search Algorithms

Internal and External Sorting algorithms, Symbol tables, sequential search, Binary search, Interpolation search, Applications and Implementation of Sort and Search Algorithms with C.

References

1. Data Structures and Program Design- Robert Kruse.
2. Data Structures: Horowitz and Sahni
3. Data Structures through C: A. Tennenbaum

CO1	Understand the concepts of data abstraction, data types, and algorithm analysis , including time and space complexity for efficient problem-solving.
CO2	Implement and apply arrays and linked lists (singly, doubly, and circular) to solve problems such as polynomial operations, sparse matrix handling, and string manipulation using C.

CO3	Develop and implement stacks and queues using arrays and linked lists, and apply them in applications such as expression evaluation, recursion, and process scheduling.
CO4	Understand and apply tree and graph data structures , including binary trees, BSTs, AVL trees, and graph traversal algorithms (DFS, BFS, MST) for network and hierarchical data processing using C.
CO5	Analyze and implement various sorting and searching algorithms , including internal/external sorting, sequential, binary, and interpolation searches, and apply them for efficient data management using C.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	1	-	2	3	2	2
CO2	3	3	3	2	3	-	-	-	-	2	-	2	3	3	2
CO3	3	3	3	2	3	-	-	-	-	2	-	2	3	3	2
CO4	3	3	3	3	3	-	-	-	-	2	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	2	-	3	3	3	3

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET771

Paper 5: Application Specific Integrated Circuits (Elective II-A)

Total Lectures: 40

Unit 1: Introduction

Types of ASICs, Full Custom ASICs, Standard Cell based ASICs, Gate Array based ASICs, Channelled gate array, Channel less gate array, Structured gate array, PLDs and FPGA

Unit 2: ASIC Design Methodology

ASIC library design, Transistor Parasitic capacitances, turn-around-time (TAT), Price of the die, Power consumption, Miscellaneous aspects, Design methodology: Design Views, Design Entry, Design Analysis, Technology Optimization, Logic Synthesis, Test Insertion Clock Planning and Insertion, Floor planning Design Verification

Unit 3: ASIC Methodology Flow

Model Development, Process development, Tool Development, Library development
DESIGN USING PLDS: Classification, Design of circuits using ROM, PLA, PAL, PROM, EEPROM etc., Antifuse Technology, Programmable ASIC Logic Cells, Programmable ASIC interconnects

Unit 4: ASIC Design and Packaging

ASIC pad selection, placement, and package type, About trace port signal quality, PCB design guidelines: Physical Trace Port Signal Guidelines

Unit 5: ASIC Design in Nanometer Era:

High level interconnect, design productivity, flat and hierarchical design methods, packaging priorities, design quality, power management noise and signal integrity
SOCs: SOC Design challenges Methodology and design, FPGA to ASIC conversion, Design for integration, SOC verification

References

1. Application Specific Integrated Circuits: M.J.S. Smith, Pearson Education, 2008
2. FPGA-Based System Design: Wayne Wolf, Prentice Hall PTR, 2009.
3. From ASICs to SOCs: A Practical Approach: Farzad Nekoogar and Faranak Nekoogar, Prentice Hall PTR, 2003.

CO1	Understand the types and architectures of ASICs , including Full Custom, Standard Cell, and Gate Array-based designs, as well as PLDs and FPGAs, and their relative advantages and applications.
-----	---

CO2	Explain the ASIC design methodology , including library design, logic synthesis, power and area optimization, clock planning, floor planning, and design verification techniques.
CO3	Apply the ASIC design flow and development process , including model, process, tool, and library development, and design circuits using PLDs, ROMs, PLAs, PALs, and PROMs .
CO4	Understand ASIC packaging and pad design considerations , including signal integrity, trace port quality, and PCB design guidelines for reliable high-speed interconnections.
CO5	Analyze advanced ASIC design concepts in the nanometer era , including SoC design methodologies, power management, signal integrity, FPGA-to-ASIC conversion, and verification challenges in complex systems.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	-	-	-	-	1	-	2	3	2	2
CO2	3	3	3	2	3	-	-	-	-	2	-	2	3	3	3
CO3	3	3	3	2	3	-	-	-	-	2	-	3	3	3	3
CO4	3	2	2	2	3	-	1	-	-	2	-	3	3	3	3
CO5													3	3	3

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET772

Paper No. 5: Paper Title: Wireless Communication (Elective II-B)

Total Lectures: 40

Unit 1: The Wireless Channel:

Physical modeling for wireless channels, Input /output model of the wireless channel, Time and frequency coherence: Doppler spread and coherence time, Delay spread and coherence bandwidth, Statistical channel models: Rayleigh and Rician fading. Bit Error Rate (BER) of AWGN Channels.

Unit 2: Point-to-Point Communication: Detection, Diversity and Channel Uncertainty

Detection in a Rayleigh fading channel: Non-coherent detection, Coherent detection, Bit Error Rate of Rayleigh Fading Wireless Channel, Diversity: Time diversity, Antenna diversity, Frequency diversity, Impact of channel uncertainty.

Unit 3: Spread Spectrum Systems:

Frequency Hopping Multiple Access (FHMA), Code Division Multiple Access: Rake receiver, Cellular Code-Division-Multiple-Access Systems, Multiuser Detection, Time Hopping Impulse Radio.

Unit 4: Orthogonal Frequency Division Multiplexing (OFDM):

Principle of Orthogonal Frequency Division Multiplexing, Implementation of Transceivers, Frequency-Selective Channels, Channel Estimation, Peak-to-Average Power Ratio, Inter Carrier Interference, Adaptive Modulation and Capacity, Multiple Access – OFDMA, Multicarrier Code Division Multiple Access, Single-Carrier Modulation with Frequency Domain Equalization

Unit 5: Multiple Input Multiple Output (MIMO) Systems:

Introduction, System Model, Channel State Information, Capacity in Nonfading Channels, Capacity in Flat-Fading Channels, Impact of the Channel, Diversity, Tradeoffs between Diversity, Beam forming Gain, and Spatial Multiplexing, Multiuser MIMO.

References

1. Fundamentals of Wireless Communication: D. Tse and P. Viswanath
2. Wireless Communications: Andreas F. Molisch

CO1	Understand the characteristics and modeling of wireless channels , including fading phenomena (Rayleigh and Rician), coherence properties, and evaluate Bit Error Rate (BER)
-----	--

	performance in AWGN and fading environments.
CO2	Analyze point-to-point wireless communication systems , including coherent and non-coherent detection, and apply diversity techniques (time, frequency, and antenna) to improve communication reliability under channel uncertainty.
CO3	Explain the principles of spread spectrum systems , including Frequency Hopping (FHMA) and Code Division Multiple Access (CDMA), and analyze receiver structures such as the Rake receiver and multiuser detection techniques.
CO4	Understand and evaluate Orthogonal Frequency Division Multiplexing (OFDM) systems, including transceiver design, frequency-selective fading mitigation, channel estimation, and multiple access schemes such as OFDMA and MC-CDMA .
CO5	Analyze Multiple Input Multiple Output (MIMO) systems, their capacity in fading and non-fading channels, and the trade-offs among diversity, beamforming gain, and spatial multiplexing in single and multiuser MIMO environments.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	1	-	2	3	2	2
CO2	3	3	3	2	3	-	-	-	-	2	-	3	3	3	3
CO3	3	3	3	2	3	-	-	-	-	2	-	3	3	3	3
CO4	3	3	3	3	3	-	-	-	-	2	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	2	-	3	3	3	3

B.TECH SEVENTH SEMESTER
(Electronics and Communication Engineering)
Paper Code: BET773
Paper 5: Introduction to Robotics (Elective II-C)

Total Lectures: 40

Unit 1: Kinematics

History of the development of robots, basic components of robotic systems, Anatomy and structural design of robot, manipulation, arm geometry, Drives and control (hardware) for motions, End effectors and grippers. Translation, orientation of rigid bodies, Representation of links and joints, workspace, velocities, manipulator jacobian, singularities of robots and mechanisms, Kinematics for serial and parallel manipulators, election of coordinate frames, Homogeneous transformation, DH parameters, Direct and Inverse kinematics: Two link planner.

Unit 2: Dynamics of Robots

Introduction to robot dynamics, Forward and inverse dynamics of robot manipulators, Rigid link Recursive Acceleration, Lagrange- Euler Dynamic formulation

Unit 3: Trajectory Planning and Control

Path planning, trajectory planning, Joint space trajectory planning, Cartesian space trajectory, planning, Continuous trajectory recording (Trajectory following), position, velocity and force control.

Unit 4: Mobile Robotics

Wheeled mobile robots, bipeds, swarm robotics, Military mobile robots, Underwater robots, Surveillance robots, Nano robots.

Unit 5: SLAM (Simultaneous Localization and Mapping)

Localization, Planning, Segmented Ste, Fun with Parameters, SLAM, Graph SLAM, Implementing Constraints, Adding Landmarks, Matrix Modification, Untouched Fields, Landmark Position, Confident Measurements, Implementing SLAM

References

1. Robotics: Control Sensing. Vision and Intelligence: Fu, King Sun, Ralph Gonzalez, and CS George Lee, Tata McGraw-Hill Education,
2. Introduction to robotics: mechanics and control: Craig, John J, Pearson Education India.
3. Robot dynamics and control.: Spong, Mark W., and Mathukumalli Vidyasagar, John Wiley and Sons
4. Control of robot manipulators: Lewis, Frank L., D. M. Dawson, and Chaouki T. Abdallah, Prentice Hall PTR
5. Robot grippers: Pham, Duc Truong, and Wilfred B. Heginbotham, IFS (Publications) Ltd, UK,
6. Introduction to Robotics: S. K. Saha, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
7. Robotics and Control: R. K. Mittal, I. J. Nagrath, Tata McGraw-Hill Publishing Company Ltd.

CO1	Understand the basic components, structure, and kinematic modeling of robotic systems,
-----	---

	including link representations, coordinate frames, Denavit–Hartenberg (DH) parameters, and perform direct and inverse kinematic analysis for serial and parallel manipulators.
CO2	Analyze the dynamics of robotic manipulators using forward and inverse dynamic formulations, including Lagrange–Euler and Newton–Euler approaches , and understand joint torques, forces, and motion behavior.
CO3	Design and implement trajectory planning and motion control in both joint and Cartesian spaces , applying path planning, position, velocity, and force control strategies for smooth and accurate robot movements.
CO4	Describe the concepts, design, and applications of mobile robots , including wheeled, legged, underwater, swarm, and nano robots, and understand their motion mechanisms and control systems.
CO5	Explain and apply the principles of Simultaneous Localization and Mapping (SLAM) , including localization, landmark detection, mapping, and Graph SLAM methods for autonomous navigation and environmental awareness.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	1	-	2	3	3	2
CO2	3	3	2	3	2	-	-	-	-	2	-	3	3	3	3
CO3	3	3	3	3	3	-	-	-	-	2	-	3	3	3	3
CO4	3	2	3	2	3	-	1	-	-	2	-	3	3	3	3
CO5	3	3	3	3	3	-	1	-	-	2	-	3	3	3	3

B.TECH SEVENTH SEMESTER

(Electronics and Communication Engineering)

Paper Code: BET774

Paper 5: Organic Electronic Devices and Circuits (Elective II-D)

Total Lectures: 40

Unit 1: Organic Materials and Device Physics

Introduction; Organic Materials: Conducting Polymers and Small molecules, Organic Semiconductors: p-type and n type semiconductors, Source, Drain and Gate Electrodes, Gate Dielectrics, Substrate; Concept of Charge Transport in Organic Semiconductors; Energy Band Diagram; Comparison between Organic and Inorganic Semiconductors including the Merits, Demerits and Limitations

Unit 2: Organic Thin Film Transistors (OTFTs) and Modeling of Organic Devices

Introduction; Operating Principle; Classification of Various OTFT Structures; Output and Transfer Characteristics; Performance Parameters; Extraction of Performance Parameters, Impact of Structural Parameters on Behavior of OTFT; Merits, Demerits and Limitations of Organic Devices; Effect of Self Assemble Monolayer (SAM); Different OTFT Models; Stability Issues, Future Scope. Various Defects and Effects in Organic Devices

Unit 3: Design and Modeling of Organic Devices

Modeling of OTFT Structures; Concept of Contact Resistance: Origin of Contact Resistance, Contact Resistance Extraction, Analysis and Performance Parameters Comparison of OTFT structures; Single Gate (SG) and Dual Gate (DG) OTFT Performance Comparison

Unit 4: Organic Light Emitting Diodes (OLEDs) and Organic Solar Cells

OLED: Introduction; Organic Materials for OLEDs; Classification of OLEDs, Operating Principle; Output and Transfer Characteristics; Analysis of OLED Performance: Optical, Electrical and Thermal properties, Merits and Demerits; Stability Issues; OLEDs as display Applications. Organic Solar Cell: Introduction; Materials for organic Solar Cells; Operating Principle; Characteristics, Applications and Future Scope

Unit 5: OTFT Applications

Organic Digital Circuits: All p-Type, Hybrid Complementary Inverters, Fully Organic Complementary Inverter Circuits and Their Comparison; Logic Circuit Implementation. Organic Memory: Organic Static Random Access Memory (OSRAM) and other Important Organic Memory Designs.

References

1. Organic Electronics: Materials, Manufacturing and Applications: Hagen Klauk, Wiley-VCH Verlag Gmbh & Co. KGaA, Germany, 2006
2. Organic Light Emitting Devices: Synthesis, Properties and Applications: Klaus Mullen, Ullrich Scherf, Wiley-VCH Verlag Gmbh & Co. KGaA, Germany, 2005
3. Organic Electronics II: More Materials and Applications: Hagen Klauk, Wiley-VCH Verlag Gmbh & Co. KGaA, Weinheim, Germany, 2012
4. Organic Thin Film Transistor Integration: A Hybrid Approach: Flora Li, Arokia Nathan, Yiliang Wu, Beng S.

Ong, Wiley-VCH, Germany; 1st Ed., 2011

5. Physics of Organic Semiconductors: Wolfgang Brütting, Wiley-VCH Verlag GmbH & Co. KGaA.

CO1	Understand the fundamentals of organic materials and their electronic properties, including charge transport mechanisms, energy band structures, and differences between organic and inorganic semiconductors .
CO2	Analyze the structure, operation, and characteristics of Organic Thin Film Transistors (OTFTs) , interpret their performance parameters, and assess the influence of structural parameters, defects, and stability issues on device performance.
CO3	Design and model organic device structures by studying contact resistance effects , parameter extraction methods, and performance comparison of Single Gate (SG) and Dual Gate (DG) OTFT configurations.
CO4	Explain the working principles, materials, and performance characteristics of Organic Light Emitting Diodes (OLEDs) and Organic Solar Cells , along with their applications, advantages, and stability considerations .
CO5	Explore the applications of organic devices in digital circuits and memory, including organic inverters, complementary logic circuits, and organic memory architectures such as Organic Static Random Access Memory (OSRAM) .

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	1	-	-	1	-	2	3	2	2
CO2	3	3	2	2	3	-	1	-	-	2	-	2	3	3	3
CO3	3	3	3	2	3	-	1	-	-	2	-	3	3	3	3
CO4	3	2	2	2	3	-	1	-	-	2	-	3	3	3	3
CO5	3	3	3	2	3	-	1	-	-	2	-	3	3	3	3