MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electronics and Communication Engineering
Scheme of Instruction and Examination
(Choice Based Credit System)
Applicable from the AY 2022-23

I Semester

S.No	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1	MA101BS	Matrices and Calculus	3	1	0	40	60	3	4
2	PH101BS	Applied Physics	3	1	0	40	60	3	4
3	CS102ES	C Programming and Data Structures	3	0	0	40	60	3	3
4	EN101HS	English for Skill Enhancement	2	0	0	40	60	3	2
5	PH151BS	Applied Physics Laboratory	0	0	3	40	60	3	1.5
6	CS152ES	C Programming and Data Structures Laboratory	0	0	2	40	60	3	1
7	EN151HS	English Language and Communication Skills Laboratory	0	0	2	40	60	3	1
8	EC151PC	Elements of Electronics and Communication Engineering	0	0	2	50	-	-	1
9	ME151ES	Engineering Workshop	0	1	3	40	60	3	2.5
10		Induction Programme	-	-	-	-	-	-	-
		Total Hours/Marks/Credits	**11**	**3**	**12**	**370**	**480**	**-**	**20**

II Semester

S.No	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1	MA201BS	Ordinary Differential Equations and Vector Calculus	3	1	0	40	60	3	4
2	CH201BS	Engineering Chemistry	3	1	0	40	60	3	4
3	ME201ES	Engineering Graphics	1	0	4	40	60	3	3
4	EE201ES	Basic Electrical Engineering	2	0	0	40	60	3	2
5	EC201ES	Electronic Devices and Circuits	2	0	0	40	60	3	2
6	CH251BS	Engineering Chemistry Laboratory	0	0	2	40	60	3	1
7	CS251ES	Python Programming Laboratory	0	1	2	40	60	3	2
8	EE251ES	Basic Electrical Engineering Laboratory	0	0	2	40	60	3	1
9	EC251ES	Electronic Devices and Circuits Laboratory	0	0	2	40	60	3	1
10	MC201BS	Environmental Science	3	0	0	40	60	3	-
		Total Hours/Marks/Credits	**14**	**3**	**12**	**400**	**600**	**-**	**20**

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination

III Semester

S.No	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1	MA301BS	Numerical Methods and Complex Variables	3	1	0	40	60	3	4
2	EC301PC	Analog Circuits	3	0	0	40	60	3	3
3	EC302PC	Network Analysis and Synthesis	3	0	0	40	60	3	3
4	EC303PC	Digital Logic Design	3	0	0	40	60	3	3
5	EC304PC	Signals and Systems	3	1	0	40	60	3	4
6	EC351PC	Analog Circuits Laboratory	0	0	2	40	60	3	1
7	EC352PC	Digital Logic Design Laboratory	0	0	2	40	60	3	1
8	EC353PC	Basic Simulation Laboratory	0	0	2	40	60	3	1
9	MC301HS	Constitution of India	3	0	0	40	60	3	0
		Total Hours/Marks/Credits	**18**	**2**	**6**	**360**	**540**	**-**	**20**

IV Semester

S.No	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1	EC401PC	Electromagnetic Fields and Transmission Lines	3	0	0	40	60	3	3
2	EC402PC	Analog and Digital Communications	3	0	0	40	60	3	3
3	EC403PC	Linear and Digital IC Applications	3	0	0	40	60	3	3
4	EC404PC	Electronic Circuit Analysis	3	0	0	40	60	3	3
5	EC405PC	Probability Theory and Stochastic Processes	3	0	0	40	60	3	3
6	EC451PC	Analog and Digital Communications Laboratory	0	0	2	40	60	3	1
7	EC452PC	Linear and Digital IC Applications Laboratory	0	0	2	40	60	3	1
8	EC453PC	Electronic Circuit Analysis Laboratory	0	0	2	40	60	3	1
9	EC454PC	Real Time Research Project/ Field Based Project	0	0	4	50	-	-	2
10	MC451HS	Gender Sensitization Laboratory	0	0	2	50	50	3	0
		Total Hours/Marks/Credits	**15**	**0**	**12**	**420**	**530**		**20**

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination

V Semester

S.No	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1	EC501PC	Microcontrollers	3	1	0	40	60	3	4
2	EC502PC	Digital Signal Processing	3	0	0	40	60	3	3
3	EC503PC	Control Systems	3	1	0	40	60	3	4
4	MS501HS	Business Economics and Financial Analysis	3	0	0	40	60	3	3
5		**Professional Elective – I**	3	0	0	40	60	3	3
6	MC502ES	Artificial Intelligence	3	0	0	40	60	3	0
7	EC551PC	Microcontrollers Laboratory	0	0	2	40	60	3	1
8	EC552PC	Digital Signal Processing Laboratory	0	0	2	40	60	3	1
9	EC553PC	Advanced Communication Laboratory	0	0	2	40	60	3	1
Total Hours/Marks/Credits			**18**	**2**	**6**	**360**	**540**	**-**	**20**

VI Semester

S.No	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1	EC601PC	Antennas and Wave Propagation	3	0	0	40	60	3	3
2	EC602PC	IoT Architectures and Protocols	3	0	0	40	60	3	3
3	EC603PC	CMOS VLSI Design	3	0	0	40	60	3	3
4		**Professional Elective - II**	3	0	0	40	60	3	3
5		**Open Elective – I**	3	0	0	40	60	3	3
6	MC601HS	Intellectual Property Rights	3	0	0	40	60	3	0
7	MC602ES	Cyber Security	3	0	0	40	60	3	0
8	EC651PC	IoT Architectures and Protocols Laboratory	0	0	2	40	60	3	1
9	EC652PC	CMOS VLSI Design Laboratory	0	0	2	40	60	3	1
10	EN651HS	Advanced English Communication Skills Laboratory	0	0	2	40	60	3	1
11	EC653PC	Industry Oriented Mini Project/ Internship	0	0	4	-	100	-	2
12	MC601BS	Environmental Science	3	0	0	40	60	3	0
Total Hours/Marks/Credits			**24**	**0**	**10**	**440**	**760**		**20**

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination

VII Semester

S.No	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1	EC701PC	Microwave and Optical Communications	3	1	0	40	60	3	4
2		**Professional Elective – III**	3	0	0	40	60	3	3
3		**Professional Elective – IV**	3	0	0	40	60	3	3
4		**Open Elective – II**	3	0	0	40	60	3	3
5	MS701HS	Professional Practice, Law & Ethics	2	0	0	40	60	3	2
6	EC751PC	Microwave and Optical Communications Laboratory	0	0	2	40	60	3	1
7	EC752PC	Java Programming Laboratory	0	0	2	40	60	3	1
8	EC753PC	Project Stage – I	0	0	6	100	-	-	3
Total Hours/Marks/Credits			**14**	**1**	**10**	**380**	**420**	**-**	**20**

VIII Semester

S.No	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1		**Professional Elective – V**	3	0	0	40	60	3	3
2		**Professional Elective – VI**	3	0	0	40	60	3	3
3		**Open Elective – III**	3	0	0	40	60	3	3
4	EC851PC	Project Stage – II including Seminar	0	0	22	40	60	-	11
Total Hours/Marks/Credits			**9**	**0**	**22**	**160**	**240**		**20**

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination

List of Professional Electives

Professional Elective – I

EC511PE	Computer Organization & Operating Systems
EC512PE	Data Communications and Networking
EC513PE	Communication Technologies
EC514PE	Data Science

Professional Elective – II

EC611PE	Digital Image Processing
EC612PE	Mobile Communications and Networks
EC613PE	Embedded System Design
EC614PE	Python Programming
EC615PE	Railway Signaling

Professional Elective – III

EC711PE	Radar Systems
EC712PE	CMOS Analog IC Design
EC713PE	Artificial Neural Networks
EC714PE	Multimedia Database Management Systems

Professional Elective – IV

EC715PE	Network Security and Cryptography
EC716PE	Biomedical Instrumentation and Signal Processing
EC717PE	Natural Language Processing
EC718PE	Telecommunication Switching Systems and Networks
EC719PE	Automatic Train Protection (ATP) System - Kavach

Professional Elective – V

EC811PE	Satellite Communications
EC812PE	5G and Beyond
EC813PE	Speech and Video Processing
EC814PE	Deep learning

Professional Elective – VI

EC815PE	System on Chip Architecture
EC816PE	Wireless Sensor Networks
EC817PE	Pattern Recognition and Machine Learning
EC818PE	Low Power VLSI Design

List of Open Electives

Open Elective (OE – I)

EC621OE	Fundamentals of Internet of Things
EC622OE	Principles of Signal Processing
EC623OE	Railway Signaling

Open Elective (OE – II)

EC721OE	Computer Organization and Architecture
EC722OE	Data Communications and Networking
EC723OE	Automatic Train Protection (ATP) System - Kavach

Open Elective (OE – III)

EC821OE	Introduction to Embedded System Design
EC822OE	Digital Image Processing

L	T	P	C
3	1	0	4

B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
EC501PC: Microcontrollers

Prerequisites: Digital Electronics

Course Objectives:

1. To familiarize the architecture of microprocessors and micro controllers.
2. To provide the knowledge about interfacing techniques of bus & memory.
3. To understand the concepts of ARM architecture.
4. To study the basic concepts of Advanced ARM processors.

Course Outcomes: Upon completing this course, the student will be able to

1. Understands the internal architecture, organization and assembly language programming of 8086 processors.
2. Understands the internal architecture, organization and assembly language programming of 8051/controllers
3. Understands the interfacing techniques to 8086 and 8051 based systems.
4. Understand the internal architecture of ARM processors.
5. Understand the basic concepts of advanced ARM processors.

Course Articulation Matrix

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

Unit - I:

8086 Architecture: 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086.

Instruction Set and Assembly Language Programming of 8086: Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

Unit - II:

Introduction to Microcontrollers: Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters.

Unit - III:

I/O And Memory Interface: LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232,USB.

Unit - IV:

ARM Architecture: ARM Processor fundamentals, ARM Architecture – Registers,, Pipeline, exceptions and interrupts, interrupt vector table, ARM instruction set – Data processing, Branch instructions, load store instructions, Software interrupt instructions, Program status register instructions, loading constants, Conditional execution, Introduction to Thumb instructions.

Unit - V:

Advanced ARM Processors: Introduction to CORTEX Processor and its architecture, OMAP Processor and its Architecture.

TEXT BOOKS:

1. Advanced Microprocessors and Peripherals – A. K. Ray and K. M. Bhurchandani, TMH, 2nd Edition 2006.
2. The 8051 Microcontrollers, Architecture and Programming and Applications -K. Uma Rao, Andhe Pallavi, Pearson, 2009.
3. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012

REFERENCE BOOKS:

1. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed, 2004.
2. Microprocessors and Interfacing, D. V. Hall, TMGH, 2nd Edition 2006.
3. Digital Signal Processing and Applications with the OMAP- L138 Experimenter, Donald Reay, WILEY 2012.

L	T	P	C
3	0	0	3

B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
EC502PC: Digital Signal Processing

Prerequisite: Signals and Systems

Course Objectives:

1. To provide background and fundamental material for the analysis and processing of digital signals.
2. To understand the fast computation of DFT and appreciate the FFT processing.
3. To study the designs and structures of digital (IIR and FIR) filters and analyze and synthesize for given specifications.
4. To acquaint in Multi-rate signal processing techniques and finite word length effects**.**

Course Outcomes:

1. Understand the LTI system characteristics.
2. Understand the inter-relationship between DFT and various transforms.
3. Design a digital IIR filter for a given specification.
4. Design a digital FIR filter for a given specification.
5. Understand the multi rate signal processing and effects of round off errors.

Course Articulation Matrix

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

Unit I: Introduction

Introduction: Introduction to Digital Signal Processing: Discrete Time Signals & Sequences, conversion of continuous to discrete signal, Linear Shift Invariant Systems, Stability, and Causality, Time and Frequency Domain analysis on signals and systems, linear differential equation to difference equation**,** responses of first order FIR and IIR low and high pass filters, Resonator (Second order IIR filter), Significance of poles and zeros of first order FIR and IIR filters.

Applications of Z – Transforms, Solution of Difference Equations of Digital Filters, System Function, Stability Criterion, Frequency Response of Stable Systems,

Unit II: Discrete Fourier series, Fast Fourier Transforms Discrete Fourier series:

Fourier Series, Fourier Transform, Laplace Transform and Z-Transform relation**,** DFS Representation of Periodic Sequences, Properties of Discrete Series Fourier, Discrete Fourier Transforms: Properties of DFT, Computation of DFT: Linear and Circular Convolution of Sequences, Convolution using DFT, Over-Lap Add Method, Over-Lap Save Method, Relation between DTFT, DFS, DFT and Z- Transform.

Fast Fourier Transforms: Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT.

Unit III: IIR Digital Filters

Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital Filters from Analog Filters, Impulse Invariant Techniques, Bilinear Transformation Method, Spectral Transformations.

Realization of Digital Filters: Direct, Canonical, Cascade and Parallel Forms.

Unit IV: FIR Digital Filters

Characteristics of FIR Digital Filters, Frequency Response. Design of FIR Filters: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique, Comparison of IIR & FIR filters. Realization of FIR Filters.

Unit V: Multirate Signal Processing, Finite Word Length Effects

Multirate Signal Processing: Introduction, Down Sampling, Decimation, Up sampling, Interpolation, Sampling Rate Conversion and its applications

Finite Word Length Effects: Limit cycles, Overflow Oscillations, Round-off Noise in IIR Digital Filters, Computational Output Round Off Noise, Methods to Prevent Overflow, Trade-Off Between Round-Off and Overflow Noise, Measurement of Coefficient Quantization Effects through Pole-Zero Movement, Dead Band Effects.

TEXT BOOKS:

1. Oppenheim, A. V., and Schaffer, R.W. , Discrete Time Signal Processing, PHI, 2009
2. Proakis John G., Manolakis Dimitris G., Digital Signal Processing, Principles,
3. Algorithms, and Applications: Pearson Education / PHI, 2007.

REFERENCE BOOKS:

1. Li Tan, Digital Signal Processing – Fundamentals and Applications, Elsevier, 2008
2. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using MATLAB, Thomson, 2007
3. Salivahanan, S., Vallavaraj, A., and Gnanapriya, C., Digital Signal Processing, TMH, 2009
4. Emmanuel C. Ifeachor and Barrie W. Jervis, Digital Signal Processing - A Practical approach, Pearson Education, 2nd Edition, 2009

L	T	P	C
3	1	0	4

B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
EC503PC: Control Systems

Prerequisite: Electrical Engineering, Mathematics

Course Objectives:

1. To understand the different ways of system representations such as Transfer function representation.
2. To assess the system performance using time domain analysis and methods for improving it.
3. To assess the system performance using frequency domain analysis and techniques for improving the performance.
4. To design various controllers and compensators to improve system performance.
5. To assess the system dynamic response by state space representations.

Course Outcomes:

1. Understand the modelling of linear-time-invariant systems using transfer function.
2. Understand the concept of stability and its assessment for time response analysis.
3. Understand the concept of frequency response analysis.
4. Design simple feedback controllers.
5. Understand the modelling of linear-time-invariant systems using state- space representations.

Course Articulation Matrix

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

Unit - I: Introduction to Control Problem

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit - II: Time Response Analysis of Standard Test Signals

Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second- order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit - III: Frequency-Response Analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit - IV: Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Unit - V: State Variable Analysis and Concepts of State Variables

State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

TEXT BOOKS:

1. Gopal, M., Control Systems: Principles and Design, McGraw Hill Education, 1997.
2. Kuo, B. C., Automatic Control System, Prentice Hall, 1995.

REFERENCE BOOKS:

1. Ogata, K., Modern Control Engineering, Prentice Hall, 1991.
2. Nagrath, I. J., and Gopal, M., Control Systems Engineering, New Age International, 2009.

L	T	P	C
3	0	0	3

B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
MS501HS: Business Economics and Financial Analysis
(Common to CIVIL, EEE, MEC, ECE, MCT, MME & CSE (AI & ML))

Course Objectives: The Objective of the course are:

1. Students will understand various forms of Business and the impact of economic variables on the business, concepts of Business Economics and its significance.
2. Gain the knowledge on various market dynamics namely Demand, elasticity of demand, and demand forecasting.
3. To disseminate the knowledge on production function, Laws of production, Market structures, while dealing with the concept of cost and breakeven analysis.
4. To acquaint the students regarding Accounting and various books of accounts.
5. To enable the students to analyze a company's financial statements through ratios and come to a reasoned conclusion about the financial situation of the company.

Course Outcomes: After completion of the course the students will be able to:

1. Select a suitable business organization with available resources.
2. Analyze various aspects of Demand, Elasticity of demand and Demand Forecasting.
3. Gain knowledge on different market structures, production theories, cost variables and pricing methods.
4. Prepare Books of accounts and Financial Statements.
5. Analyze financial well-being of the business while using ratios.

UNIT – I: INTRODUCTION TO BUSINESS AND ECONOMICS

Economics: Significance of Economics, Micro and Macro Economic Concepts, National Income - Concepts and Importance, Inflation, Business Cycle - Features and Phases.

Business: Structure of Business Firm, Types of Business Entities – Sole Proprietorship – Partnership – Cooperative Societies - Limited Liability Companies, Sources of Capital – Conventional sources and Non - Conventional Sources of Finance.

Business Economics: Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT – II: DEMAND AND SUPPLY ANALYSIS

Demand Analysis: Demand - Meaning, Determinants of Demand, Law of Demand, Exceptions of Law of Demand, Demand Function, Changes in Demand – Increase and decrease in Demand - Extension and Contraction in Demand.

Elasticity of Demand: Elasticity – Meaning, Types of Elasticity – Price Elasticity – Income Elasticity – Cross Elasticity– Advertising Elasticity of Demand, Factors affecting Elasticity of Demand, Measurement and Significance of Elasticity of Demand, Elasticity of Demand in decision making.

Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting – Survey methods, Statistical methods.

Supply Analysis: Supply – Meaning, Determinants of Supply, Supply Function & Law of Supply.

Unit III: PRODUCTION, COST, MARKET STRUCTURES & PRICING

Production Analysis: Production – Meaning, Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Cobb-Douglas production function.

Cost analysis: Cost–Meaning, Types of Costs, Short run and Long run Cost Functions.

Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition.

Pricing: Pricing -Meaning, Objectives of pricing, pricing methods – Cost based pricing methods – Demand based pricing methods – Competition based pricing methods – Strategy based pricing methods - Product Life Cycle based Pricing, Break Even Analysis (simple problems), Cost Volume Profit Analysis.

Unit IV: FINANCIAL ACCOUNTING

Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts along with adjustments– Trading account – Profit and loss account – Balance sheet (simple problems).

UNIT – V: FINANCIAL ANALYSIS THROUGH RATIOS

Concept of Ratio Analysis, Importance, Liquidity Ratios- Current Ratio – Quick Ratio – Absolute Liquid Ratio, Profitability Ratios – Gross Profit Ratio – Net Profit Ratio – Operating Ratio, Turnover Ratios – Stock Turnover Ratio – Debtors Turnover Ratio – Creditors Turnover Ratio, Leverage Ratios – Debt-to-Assets Ratio - Debt-Equity Ratio - Proprietary Ratios and interpretation (simple problems).

TEXT BOOKS:

1. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury,"Managerial Economics", 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.
2. Dhanesh K Khatri, "Financial Accounting", Tata McGraw Hill, 2011.
3. Ramachandra Aryasri. A, "Business Economics and Financial Analysis", McGraw Hill Education India Pvt. Ltd. 2020.

REFERENCE BOOKS:

1. P. L. Mehta, Managerial Economics, Analysis, Problems & Cases, 8th Edition, Sultan Chand & Sons, 2001.
2. S.N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.
3. D.D. Chaturvedi, S.L. Gupta, "Business Economics - Theory and Applications", International Book House Pvt. Ltd. 2013.

L	T	P	C
3	0	0	3

B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
Professional Elective-I
EC511PE: Computer Organization & Operating Systems

Prerequisite: Digital Logic Design

Course Objectives:

1. To understand the structure of a computer and its operations.
2. To understand the RTL and Micro-level operations and control in a computer.
3. Understanding the concepts of I/O and memory organization and operating systems.

Course Outcomes:

1. Able to visualize the organization of different blocks in a computer.
2. Able to visualize the compatibility of different memories.
3. Know the functioning of priority interrupt and various Data transfer modes.
4. Able to use Operating systems in a computer.
5. Know the File concepts and implementation of File system.

Course Articulation Matrix

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

Unit - I:

Basic Structure of Computers: Computer Types, Functional Unit, Basic OPERATIONAL Concepts, Bus Structures, Software, Performance, Multiprocessors and Multi Computers, Data Representation, Fixed Point Representation, Floating – Point Representation.

Register Transfer Language and Micro Operations: Register Transfer Language, Register Transfer Bus and Memory Transfers, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit, Instruction Codes, Computer Registers Computer Instructions

Unit - II:

Instruction Cycle, Memory – Reference Instructions, Input – Output and Interrupt, STACK Organization, Instruction Formats, Addressing Modes, DATA Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

The Memory System: Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Cache Memories Performance Considerations, Virtual Memories Secondary Storage, Introduction to RAID.

Unit - III:

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer Modes, Priority Interrupt, Direct Memory Access, Input –Output Processor (IOP), Serial Communication; Introduction to Peripheral Components, Interconnect (PCI) Bus, Introduction to Standard Serial Communication Protocols like RS232, USB, IEEE 1394.

Unit - IV:

Operating Systems Overview: Overview of Computer Operating Systems Functions, Protection and Security, Distributed Systems, Special Purpose Systems, Operating Systems Structures-Operating System Services and Systems Calls, System Programs, Operating Systems Generation

Memory Management: Swapping, Contiguous Memory Allocation, Paging, Structure of The Page Table, Segmentation, Virtual Memory, Demand Paging, Page-Replacement Algorithms, Allocation of Frames, Thrashing Case Studies - UNIX, Linux, Windows

Principles of Deadlock: System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

Unit - V:

File System Interface: The Concept of a File, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection.

File System Implementation: File system Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

TEXT BOOKS:

1. Computer Organization – Carl Hamacher, Zvonks Vranesic, Safea Zaky, Vth Edition, McGraw Hill.
2. Computer Systems Architecture – M. Moris Mano, IIIrd Edition, Pearson
3. Operating System Concepts- Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 8th Edition, John Wiley.

REFERENCE BOOKS:

1. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson
2. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition PHI
3. Fundamentals of Computer Organization and Design - Sivaraama Dandamudi Springer Int. Edition.
4. Operating Systems – Internals and Design Principles, Stallings, sixth Edition–2009, Pearson Education.
5. Modern Operating Systems, Andrew S Tanenbaum 2nd Edition, PHI.
6. Principles of Operating Systems, B.L. Stuart, Cengage Learning, India Edition.

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B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
Professional Elective - I
EC512PE: Data Communications and Networking

Prerequisites: Principles of Communication systems, Signals and Systems

Course Objectives:

1. To introduce the Fundamentals of data communication networks.
2. To demonstrate the Functions of various protocols of Data link layer.
3. To demonstrate Functioning of various Routing protocols.
4. To introduce the Functions of various Transport layer protocols.
5. To understand the significance of application layer protocols.

Course Outcomes:

1. Know the Categories and functions of various Data communication Networks.
2. Design and analyze various error detection techniques.
3. Demonstrate the mechanism of routing the data in network layer.
4. Know the significance of various Flow control and Congestion control Mechanisms.
5. Know the Functioning of various Application layer Protocols.

Course Articulation Matrix

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

Unit I: Introduction to Data Communications

Components, Data Representation, Data Flow, Networks- Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture.

Unit II: Data Link Layer

Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noisy less Channels and Noisy Channels, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols. 802.11 MAC Protocol, IEEE 802.11 Frame.

Unit III: The Network Layer

Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol(IP):Forwarding and Addressing in the Internet- Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6.

Unit IV: Transport Layer

Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go- Back-N(GBN), Selective Repeat(SR), Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow

Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control, TCP Congestion Control.

Unit V: Application Layer

Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Web and HTTP, File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.

TEXT BOOKS:

1. James, Kurose F., Keith W., Computer Networking A Top-Down Approach, Pearson 6th Edition.
2. Behrouz A. Forouzan, Data Communications and Networking, McGraw-Hill Education, 4th Edition.

REFERENCE BOOKS:

1. Trivedi, Bhusan, Data communication and Networks, Oxford university press, 2016
2. Andrew S. Tanenbaum, Computer Networks, Pearson Education, 4th Edition.
3. William A. Shay, Understanding Communications and Networks, Cengage Learning, 3rd Edition.

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B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
Professional Elective-I
EC513PE: Communication Technologies

Course Objectives:

1. To give an overview of Source-Destination communication.
2. To provide the different modes of communication technologies like wireless and cellular mobile networks.
3. To make familiar with the generations of communications like 1G, 2G, 3G, 4G and 5G.
4. To give brief explanation on security of network and its management.

Course Outcomes:

1. Understand the information theory and its coding styles.
2. Acquire knowledge on satellite communication and broadcasting services.
3. Know GSM, LTE and 5G mobile networks.
4. Know about free space optical communications.
5. Know about network security through encryption and decryption.

Course Articulation Matrix

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

Unit - I:
Information Theory: Shanon Capacity, Multimedia Data, Data Processing, Boolean Logics, Information Content, Entropy, Source Coding, Channel Coding, Modulation Schemes, Internet.

Unit - II:
Wireless Communication Technologies: WLAN, Wifi, Bluetooth, Other Wireless PAN And WAN Technologies, Satellite Communications, Broadcast Services.

Unit - III:
Cellular Mobile Networks: GSM(2G), UMTS (3G), LTE(4G), 5G Mobile Networks, Mobile Network Planning Aspects.

Unit - IV:
Free Space Optical Communications: Optical Fiber, FTTC, FTTH, FTTBS, Free Space Optical Link, Channel Model with Different Factors, Deep Space Optical Communications.

Unit - V:
Network Security and Management: Symmetrical Encryption, Asymmetrical Encryption, Authentication, Hash-Value, Integrity Check, Telecommunications Management Network, SNMP, Functionalities of Network Management, Trends and Future Development.

TEXT BOOKS:

1. Shun-Ping Chen, “Fundamentals of Information and Communication Technologies” 2020
2. B.P. Lathi, “Communication systems”- BS Publications, 2006.

REFERENCE BOOKS:

1. Simon Haykin, John Wiley “Digital Communications” 2005.
2. Herbert Taub, Donald L Schilling Gautham Saha “Principles of Communication systems” 3rd edition McGraw-Hill 2008.

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B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
Professional Elective-I
EC514PE: Data Science

Prerequisite: Ordinary Differential Equations and Vector Calculus, Numerical methods and Complex variables.

Course Objectives:

1. Learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration.
2. Understand the basic types of data and basic statistics.
3. Identify the importance of data reduction and data visualization techniques.

Course Outcomes:

1. Implementation of R programming concepts.
2. Understand basic terms of statistical modeling and data science.
3. Understand the accessing methods of lists.
4. Utilize R elements for data visualization and prediction.
5. Understand Regression models.

Course Articulation Matrix

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

Unit – I:

Introduction

Definition of Data Science- Big Data and Data Science hype – and getting past the hype - Datafication- Current landscape of perspectives - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model – Over fitting.

Basics of R: Introduction, R-Environment Setup, Programming with R, Basic Data Types.

Unit – II: Data Types & Statistical Description

Types of Data: Attributes and Measurement, Attribute, The Type of an Attribute, The Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes. Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range, Graphic Displays of Basic Statistical Descriptions of Data.

Unit – III:

Vectors: Creating and Naming Vectors, Vector Arithmetic, Vector sub setting,

Matrices: Creating and Naming Matrices, Matrix Sub setting, Arrays, Class.

Factors and Data Frames: Introduction to Factors: Factor Levels, Summarizing a Factor, Ordered Factors, Comparing Ordered Factors, Introduction to Data Frame, subsetting of Data Frames, Extending Data Frames, Sorting Data Frames.

Lists: Introduction, creating a List: Creating a Named List, Accessing List Elements, Manipulating List Elements, Merging Lists, Converting Lists to Vectors.

Unit – IV:

Conditionals and Control Flow: Relational Operators, Relational Operators and Vectors, Logical Operators, Logical Operators and Vectors, Conditional Statements.

Iterative Programming in R: Introduction, While Loop, For Loop, Looping Over List.

Functions in R: Introduction, writing a Function in R, Nested Functions, Function Scoping, Recursion, Loading an R Package, Mathematical Functions in R.

Unit – V:
Charts and Graphs: Introduction, Pie Chart: Chart Legend, Bar Chart, Box Plot, Histogram, Line Graph: Multiple Lines in Line Graph, Scatter Plot.
Regression: Linear Regression Analysis, Multiple Linear regression.

TEXT BOOKS:

1. Doing Data Science, Straight Talk from The Frontline. Cathy O'Neil and Rachel Schutt, O'Reilly, 2014.
2. K G Srinivas, G M Siddesh, "Statistical programming in R", Oxford Publications.

REFERENCE BOOKS:

1. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, 3rd ed. The Morgan Kaufmann Series in Data Management Systems.
2. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.
3. Brain S. Everitt, "A Handbook of Statistical Analysis Using R", Second Edition, 4 LLC, 2014.
4. Dalgaard, Peter, "Introductory statistics with R", Springer Science & Business Media, 2008.
5. Paul Teetor, "R Cookbook", O'Reilly, 2011.

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B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
MC502ES: Artificial Intelligence
(Common to all branches except CSE, IT, CSBS, CSE(AI&ML))

Course Objectives:

- To train the students to understand different types of AI agents, various AI search algorithms, fundamentals of knowledge representation, building of simple knowledge-based systems and to apply knowledge representation, reasoning.
- Study of Markov Models enable the student readyto step into applied AI.

UNIT - I

Introduction: AI problems, Agents and Environments, Structure of Agents, Problem Solving Agents **Basic Search Strategies**: Problem Spaces, Uninformed Search (Breadth-First, Depth-First Search, Depth-first with Iterative Deepening), Heuristic Search (Hill Climbing, Generic Best-First, A*), Constraint Satisfaction (Backtracking, Local Search)

UNIT - II

Advanced Search: Constructing Search Trees, Stochastic Search, A* Search Implementation,Minimax Search, Alpha-Beta Pruning

Basic Knowledge Representation and Reasoning: Propositional Logic, First-Order Logic, Forward Chaining and Backward Chaining, Introduction to Probabilistic Reasoning, Bayes Theorem.

UNIT - III

Advanced Knowledge Representation and Reasoning: Knowledge Representation Issues, Non- monotonic Reasoning, Other Knowledge Representation Schemes

Reasoning Under Uncertainty: Basic probability, Acting Under Uncertainty, Bayes' Rule,Representing Knowledge in an Uncertain Domain, Bayesian Networks.

UNIT - IV

Learning: What Is Learning? Rote Learning, Learning by Taking Advice, Learning in Problem Solving,Learning from Examples, Winston's Learning Program, Decision Trees.

UNIT - V

Expert Systems: Representing and Using Domain Knowledge, Shell, Explanation, KnowledgeAcquisition.

TEXT BOOK:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hill publications, Third Edition, 2009

REFERENCE BOOKS:

1. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, Prentice-Hall, 2010.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.

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B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
EC551PC: Microcontrollers Laboratory

Course Objectives:

1. Introduce ALP concepts and features.
2. Write ALP for arithmetic and logical operations in 8086 and 8051.
3. Differentiate Serial and Parallel Interface.
4. Interface different I/Os with Microprocessors.
5. Basic ARM programming.

Course Outcomes:

1. Acquire the knowledge 0f 8086 architecture and its programming.
2. Work on 8051 and ARM microcontrollers programming using some simulation tools.
3. Hands-on experience to interface various peripherals with microcontrollers.
4. Able to understand the difference between programming of microprocessor and microcontroller.
5. Able to develop programs for simple real time applications.

Course Articulation Matrix

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

Task 1: Using 8086 Processor Kits and/or Assembler, Assembly Language Programs to perform

1. Arithmetic, Logical, String Operations, sorting on 16/32 bit numbers.
2. Bit level Logical Operations, Rotate, Shift, Swap and Branch Operations.

Task 2: 8051 Microcontroller programming using Keil IDE

1. 8051 Assembly Language Programs for Arithmetic and Logical Operations.
2. Time delay Generation Using Timers of 8051.
3. 8051 Serial Communication.
4. Program Using Interrupts to Generate Square Wave 10 KHZ Frequency on P2.1 Using Timer 0 8051 in 8 bit Auto reload Mode and Connect a 1 HZ Pulse to INT1 pin and Display on Port 0. Assume Crystal Frequency as 11.0592 MHZ
5. ARM Basic Programming in KEIL

Task 3: Interfacing I/O Devices to 8051

1. LEDs and Switches
2. LCD display
3. Matrix Keypad to 8051
4. 8 bit-ADC /DAC Interface to 8051

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B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
EC552PC: Digital Signal Processing Laboratory

Course Objectives:

1. To interpret the differences between Fourier, Laplace and Z-transforms.
2. To study the effects of noise added to the signal.
3. To understand the concepts of multirate sampling techniques.
4. To design digital filters for given specifications.

Course Outcomes: Upon completing of this course, the student will be able to:

1. Understand the mathematical operations on discrete signals.
2. Analyze IIR and FIR digital filters in time and frequency domain.
3. Interpret discrete time signals using DFT and apply FFT algorithms.
4. To design digital IIR and FIR filters for real time signals.
5. Process the signals using multi-rate sampling techniques.

Course Articulation Matrix

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

The Programs shall be implemented in Software (Using Octave / MATLAB / Lab View / C Programming/ Python / Equivalent).

Note: - Minimum of 12 experiments has to be conducted.

List of Experiments:

1. Generate a discrete sequence and perform different types of operations on it. Determine Power and Energy of given signals.
2. Plot the spectra of a 50Hz signal with and without adding noise to it. Prove any three properties of Fourier transform.
3. Analyze first order difference equations of FIR low and high pass filters in time and frequency domains with and without in-built functions.
4. Analyze first order difference equations of IIR low and high pass filters in time and frequency domains with and without in-built functions.
5. Impulse and step responses of first order and second order systems.
6. Analyze second order IIR filter (Resonator). Plot its poles and zeros for different radii and angle of oscillations.
7. Obtain the Discrete Fourier Series coefficients for a sequence
8. To find DFT / IDFT of a given DT Signal. Also prove that DFT is Periodic.
9. Find FFT and IFFT of a given Sequence with and without in-built functions.
10. Generation of DTMF Signals.
11. Perform Decimation and Interpolation processes on a discrete time signal. Also perform and I/D sampling rate conversion.
12. Design Butterworth low and high pass IIR filters for the given specifications. Plot the frequency response and filter a given signal through them.
13. Design Chebyshev Type-1 and Type-2 low and high pass IIR filters for the given specifications. Plot the frequency response and filter a given signal through them.
14. Design low and high pass FIR filters for the given specifications using different windows. Plot the frequency response and filter a given signal through them.

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B.Tech. in Electronics and Communication Engineering
V Semester Syllabus
EC553PC: Advanced Communication Laboratory

Note: Minimum Eight experiments should be conducted.

Course Outcomes: Upon completing this course the students will be able to:

1. Simulate and analyze Digital signals.
2. Simulate and analyze the M-ary modulation techniques.
3. Simulate and study radiation pattern of different antennas.
4. Analyze the multiple access techniques.
5. Analyze the wireless standards for cellular networks like 3G (CDMA), 4G (OFDM)

Course Articulation Matrix

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

List of experiments:

1. Study the features of spectrum analyzer
2. Obtain the Radiation pattern for different antennas using Antenna advanced Trainer kit.
   i. Dipole Antenna
   ii. Yagi Uda Antenna
   iii. Horn Antenna, etc.
3. Time division multiplexing and de-multiplexing.
4. Plotting eye diagram for baseband signal using MATLAB and verify using hardware.
5. Plotting Constellation Diagram of QAM using MATLAB and verify using hardware.
6. Generation of different types of signals using MATLAB.
7. Modulation analysis on digital modulated single carrier signals using MATLAB.
8. Simulation of CDMA system using MATLAB and verify using hardware.
9. DQPSK Modulation and demodulation technique
10. OFDM generation and detection

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
EC601PC: Antennas and Wave Propagation

Pre-requisites: EM Field theory, Ray theory, Transmission Lines

Course Objectives:

1. To understand the concept of radiation, antenna definitions and significance of antenna parameters, to derive and analyze the radiation characteristics of thin wire dipole antennas and solve numerical problems.
2. To identify the antenna array requirements, to determine the characteristics of ULAs and estimate the patterns of BSA, EFA, and Binomial Arrays.
3. To analyze the characteristics and design relations of UHF, VHF and Microwave Antennas.
4. To understand the concepts and set-up requirements for microwave measurements, and familiarize with the procedure to enable antenna measurements.
5. To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.

Course Outcomes:

1. Explain the mechanism of radiation, field from Dipoles, definitions of different antenna parameters and establish their mathematical relations.
2. Design Broadside and Endfire arrays for given specifications.
3. Characterize the antennas based on frequency, configure the geometry and establish the radiation patterns of VHF and UHF antennas.
4. Configure the geometry and establish the radiation patterns of Microwave antennas and specify the requirements for microwave measurements and arrange a setup to carry out the antenna far zone pattern and gain measurements in the laboratory.
5. Classify the different wave propagation mechanisms, determine the characteristic features of different wave propagations, and estimate the parameters involved.

Course Articulation Matrix

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

Unit I: Antenna Basics, Thin Linear Wire Antennas

Antenna Basics: Antenna Parameters – Patterns, Beam area, Radiation intensity, Beam efficiency, Directivity-Gain-Resolution, Antenna apertures, Effective height. Radiation: Helmholtz Theorem, Retarded Potentials

Thin Linear Wire Antennas – Fields from Oscillating Dipole, Radiated power, Field Zones, Short Dipole, Quarter Wave Monopole/Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Antenna Theorems, Natural Current Distributions, Far Field plots and Patterns of Thin Linear Centre-fed Antennas of Different Lengths.

Loop Antennas - Small Loop, Comparison of Far Fields of Small Loop and Short Dipole, Radiation Resistances and Directivities of Small Loops (Qualitative Treatment).

Unit II: Antenna Arrays

Antenna Arrays: Point sources, **A**rrays of two Isotropic Sources - Different cases, Principle of pattern multiplication, n-element Uniform linear arrays - Phase and array factors, Broadside array, Endfire array, EFA with increased Directivity, Derivation of their characteristics and comparison, BSAs with non-uniform amplitude distributions– General considerations and Binomial arrays.

Unit III: VHF and UHF Antennas
Arrays with Parasitic Elements, Yagi-Uda array, Folded Dipoles and their Characteristics, Helical Antennas – Helical geometry, Helix modes, Normal mode, of operation, Practical design considerations for monofilar axial mode Helical antenna.

Unit IV: Microwave Antennas, Antenna Measurements
Microwave Antennas: Horn antennas – Types, Design considerations of pyramidal Horns, Optimum horns. Microstrip antennas – Introduction, Advantages and limitations, Rectangular patch antenna – Geometry, Design parameters, Radiation characteristics of Microstrip antennas, Various feed techniques.

Reflector antennas – Introduction, Flat Sheet and corner reflectors, Paraboloidal reflectors – Geometry, Operation, Characteristics, Feed methods

Antenna measurements: Introduction, Coordinate System, Reciprocity, Near and far fields, Sources of error. Antenna ranges, Radiation pattern measurement, Directivity/Gain measurement (Direct comparison, Absolute Gain and 3-Antenna methods)

Unit V: Wave Propagation, Ground wave, Space wave and Sky wave propagation modes
Wave Propagation: Definitions, Categorizations and general classifications, Different modes of wave propagation, Ray/Mode Concepts.

Ground Wave Propagation: Plane Earth reflections, Space and surface waves, Wave tilt, Curved Earth reflections.

Space Wave Propagation: Field strength variation with distance and height, Effect of Earth's curvature, Absorption, Super refraction, M-Curves and Duct propagation, Scattering phenomena, Tropospheric propagation.

Sky Wave Propagation: Structure of Ionosphere, Refraction of sky waves by Ionosphere, Ray path, Critical frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip distance, Multi-hop propagation.

TEXT BOOKS:
1. Kraus, J. D., Marhefka R.J. and Khan, Ahmad S., Antennas and Wave Propagation – TMH, New Delhi, 4th ed., (Special Indian Edition), 2010.
2. Jordan E.C., and Balmain, K.G., Electromagnetic Waves and Radiating Systems – PHI, 2nd ed., 2000.

REFERENCE BOOKS:
1. Balanis, C.A., Antenna Theory - John Wiley & Sons, 3rd Ed., 2005.
2. Prasad, K.D., Satya Prakashan, Antennas and Wave Propagation – Tech India Publications, New Delhi, 2001.
3. Henney, Keith, Radio Engineering Handbook, TMH, 3rd edition.
4. John Leonidas Volakis, Antenna Engineering Handbook – 3rd edition, 2007.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
EC602PC: IoT Architectures and Protocols

Prerequisite: Embedded System Design

Course Objectives:

1. To provide the basic knowledge on IoT.
2. To explain the different components and Architectures from M2M to IoT.
3. To provide knowledge on different protocols of IoT.
4. To impart knowledge on implementations of different protocols of IoT.

Course Outcomes: After completion of this course the student will able to

1. Explore the Evolution of IoT, its Growth and Applications.
2. Know the components of IoT and Compare the various architectures of IoT.
3. Acquire the knowledge on data management of IoT.
4. Establish the knowledge on various IoT protocols like Data link, Network, Transport, Session, Service layers.
5. Understand the issues of Security in IoT.

Course Articulation Matrix

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

Unit - I:

IOT introduction:

Introduction and definition of IoT, Evolution of IoT, IoT growth, Application areas of IoT, Characteristics of IoT, IoT stack, Enabling technologies, IoT levels, IoT sensing and actuation, Sensing types, Actuator types.

Unit – II:

IOT and M2M:

M2M to IoT – A Basic Perspective– Introduction, Differences and similarities between M2M and IoT, SDN and NFV for IoT, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, international driven global value chain and global information monopolies.

IOT Architecture:

IoT Architecture components, Comparing IoT Architectures, A simplified IoT Architecture, core IoT functional stack, IoT data management and compute stack.

Unit – III:

IOT Data link layer and Network layer protocols:

PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP,ICMP, RPL, CORPL, CARP.

Unit – IV:

Transport and Session layer protocols:

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer HTTP, CoAP, XMPP, AMQP, MQTT.

Unit – V:

Service layer protocols and Security:

Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 6LoWPAN, RPL, Application Layer.

TEXT BOOKS:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy -Introduction to IOT, Cambridge University Press.
2. David Hanes, Gonzalo salgueiro, Patrick Grossetete, Rob barton, Jerome henry-IoT Fundamentals
3. Networking Technologies, Protocols and Use cases for IoT", Cisco Press.

REFERENCE BOOKS:

1. Cunopfister-Getting started with the internet of things, O Reilly Media, 2011
2. Francis daCosta,-Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications.
3. Arshdeep Bahga, Vijay Madisetti -Internet of Things A Hands-on approach, Universities Press
4. Shriram K Vasudevan, RMD Sundaram, Abhishek S Nagarajan-Internet of things, John Wiley and Sons.

Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
EC603PC: CMOS VLSI Design

Prerequisite: Digital Logic Design

Course Objectives:

1. Give exposure to different steps involved in the fabrication of ICs.
2. Explain electrical properties of MOS and BiCMOS devices to analyze the behavior of inverters designed with various loads.
3. Give exposure to the design rules to be followed to draw the layout of any logic circuit.
4. Provide design concepts to design building blocks of data path of any system using gates.
5. Understand basic programmable logic devices and testing of CMOS circuits.

Course Outcomes:

1. Acquire qualitative knowledge about the fabrication process of integrated circuits using MOS transistors.
2. Draw the layout of any logic circuit which helps to understand and estimate parasitic effect of any logic circuit.
3. Acquire knowledge in gate level design of basic and complex logic circuits.
4. Design building blocks of data path systems, memories and simple logic circuits using PLA, PAL, FPGA and CPLD.
5. Explore different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system.

Course Articulation Matrix

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

Unit - I:

Introduction: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS &BiCMOS.

Basic Electrical Properties: Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, Figure of merit; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

Unit – II:

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.

Unit – III:

Gate Level Design: Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out.

Unit – IV:

Data Path Subsystems: Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters.

Array Subsystems: SRAM, DRAM, ROM, Serial Access Memories.

Unit – V:
Programmable Logic Devices: Design Approach – PLA, PAL, Standard Cells FPGAs, CPLDs.
CMOS Testing: CMOS Testing, Test Principles, Design Strategies for test, Chip level Test Techniques.

TEXT BOOKS:

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, PHI, 2005 Edition
2. CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris, Ayan Banerjee, 3rd Ed, Pearson, 2009.

REFERENCE BOOKS:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011
2. CMOS logic circuit Design - John. P. Uyemura, Springer, 2007.
3. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.
4. VLSI Design- K. Lal Kishore, V. S. V. Prabhakar, I.K International, 2009

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
Professional Elective - II
EC611PE: Digital Image Processing

Prerequisite: Digital Signal Processing

Course Objectives:

1. To provide a approach towards image processing and introduction about 2D transforms.
2. To expertise about enhancement methods in time and frequency domain.
3. To expertise about segmentation Techniques.
4. To understand the Morphological operations on an image.
5. To expertise about compression techniques.

Course Outcomes: Upon completing this course, the student will be able to

1. Explore the fundamental relations between pixels and utility of 2-D transforms in image processer.
2. Articulate the enhancement processes on an image.
3. Articulate the segmentation and restoration processes on an image.
4. Implement the various Morphological operations on an image.
5. Utilize basic compression algorithms.

Course Articulation Matrix

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

Unit – I:

Digital Image Fundamentals & Image Transforms: Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels.

Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling Transform.

Unit – II:

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighborhood criterion, Median Filter, Spatial Domain High-Pass Filtering.

Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

Unit – III:

Image Restoration: Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

Unit – IV:

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, thresholding, Region Oriented Segmentation.

Morphological Image Processing: Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

Unit – V:

Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image Compression, Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods -Digital Image Processing, 3rd Edition, Pearson, 2008.
2. S Jayaraman, S Esakkirajan, T Veerakumar - Digital Image Processing- - TMH, 2010.

REFERENCE BOOKS:

1. Scotte Umbaugh- Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools, 2nd Ed, CRC Press, 2011
2. Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings - Digital Image Processing using MATLAB, 2nd Edition, TMH, 2010.
3. Somka, Hlavac, Boyle-Digital Image Processing and Computer Vision –Cengage Learning (Indian edition) 2008.
4. Adrian low- Introductory Computer Vision Imaging Techniques and Solutions-,2nd Edition, BS Publication, 2008.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
Professional Elective - II
EC612PE: Mobile Communications and Networks

Prerequisite: Analog and Digital Communications

Course Objectives:

1. To provide the student with an understanding of the cellular concept, frequency reuse, hand- off strategies.
2. To provide the student with an understanding of Co-channel and Non-Co-Channel interferences.
3. To give the student an understanding of cell coverage for signal and traffic, diversity techniques and channel assignment.
4. To give the student an understanding types of handoff.
5. To understand challenges and application of Adhoc wireless Networks.

Course Outcomes: Upon completing this course, the student will be able to:

1. Known the evolution of cellular and mobile communication system.
2. The student will be able to understand Co-Channel and Non-Co-Channel interferences.
3. Understand impairments due to multipath fading channel and how to overcome the different fading effects.
4. Familiar with cell coverage for signal and traffic, diversity, techniques, frequency management, Channel assignment and types of handoff.
5. Know the difference between cellular and Adhoc Networks and design goals of MAC Layer protocol.

Course Articulation Matrix

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

Unit – I:

Introduction to Cellular Mobile Radio Systems: Limitations of Conventional Mobile Telephone Systems. Basic Cellular Mobile System, First, Second, Third and Fourth Generation Cellular Wireless Systems. Uniqueness of Mobile Radio Environment-Fading-Tie Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time.

Fundamentals of Cellular Radio System Design: Concept of Frequency Reuse, Co-Channel Interference, Co-Channel Interference Reduction Factor, Desired C/I from a Normal Case in a Omni Directional Antenna System, System Capacity Improving Coverage and Capacity in Cellular Systems- Cell Splitting, Sectoring, Microcell Zone Concept.

Unit – II:

Co-Channel Interference: Measurement of Real Time Co-Channel Interference, Design of Antenna System, Antenna Parameters and their effects, diversity techniques-space diversity, polarization diversity, frequency diversity, time diversity.

Non Co-Channel Interference: Adjacent Channel Interference, Near end far end interference, cross talk, effects on coverage and interference by power decrease, antenna height decrease, effects of cell site components.

Unit – III:

Cell Coverage for Signal and Traffic: Signal Reflections in flat and Hilly Terrain, effects of Human Made Structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long-distance propagation, path loss from a point to point prediction model in different conditions, merits of lee model.

Frequency Management and Channel Assignment: Numbering and Grouping, Setup Access andPaging Channels, Channel Assignments to Cell Sites and Mobile Units.

Unit – IV:

Handoffs and Dropped Calls: Handoff Initiation, types of Handoff, Delaying Handoff, advantages of Handoff, Power Difference Handoff, Forced Handoff, Mobile Assisted and Soft Handoff, Intersystem handoff, Introduction to Dropped Call Rates and their Evaluation.

Unit – V:

Ad Hoc Wireless Networks: Introduction, Cellular and Ad Hoc wireless Networks, Applications and Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks, Ad Hoc Wireless Internet, MAC Protocols for Ad Hoc Wireless, Introduction, issues in designing AMAC Protocol for Ad Hoc wireless Networks, Design Goals of AMAC protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols.

TEXT BOOKS:

1. Mobile Cellular Telecommunications-W.C.Y. Lee, Mc Graw Hill, 2nd Edn., 1989.
2. Wireless Communications-Theodore. S. Rapport, Pearson Education, 2nd Edn., 2002.

REFERENCE BOOKS:

1. Ad Hoc Wireless Networks: Architectures and Protocols-C. Siva ram Murthy and B.S. Manoj, 2004, PHI.
2. Modern Wireless Communications-Simon Haykin, Michael Moher, Pearson Education, 2005.
3. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.
4. Wireless Communications-Andrea Goldsmith, Cambridge University Press, 2005.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
Professional Elective - II
EC613PE: Embedded System Design

Prerequisites: Microprocessors and Microcontrollers.

Course Objectives:

1. To provide an overview of principles of Embedded System.
2. To provide an overview of 8051 microcontroller.
3. To provide a clear understanding of role of firmware, operating systems in correlation with hardware systems.

Course Outcomes:

1. Expected to understand the selection procedure of processors in the embedded domain.
2. Understand programming of 8051 microcontroller.
3. Design procedure of embedded firm ware.
4. Expected to visualize the role of real-time operating systems in embedded systems.
5. Expected to evaluate the correlation between task synchronization and latency issues.

Course Articulation Matrix

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

Unit – I: Introduction to Embedded Systems

Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit – II: Typical Embedded System

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators- Light Dependent Resistor, Thermistor, Photo Transistor, Light Emitting Diode, Relays, Stepper Motor. Communication Interfaces: SPI, I2C, UART, Onboard and External Communication Interfaces: WiFi, Bluetooth, ZigBee, USB.

Unit – III: Other System Components of Embedded system:

Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches: Super Loop Based Approach and OS based Approach, Development Languages: Assembly Language and High level Language.

Unit – IV: RTOS Based Embedded System Design:

Operating System Basics, Types of Operating Systems-GPOS, RTOS, Tasks, Task States, Task Control Block, Process and Threads, Multiprocessing and Multitasking, Task Scheduling- Non-Preemptive Scheduling (FCFS, LCFS, SJF, Priority Based), Preemptive Scheduling(FCFS, LCFS, SJF, Priority Based, Round-Robin).

Unit – V: Task Communication:

Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Communication/Synchronization Issues: Racing, Deadlock, Livelock, Starvation, Task Synchronization Techniques: Mutual exclusion through busy waiting/ Spin lock, Mutual exclusion through Sleep and Wakeup, Semaphores, Device Drivers, Methods to Choose an RTOS.

TEXT BOOKS:

1. Shibu K.V, "Introduction to Embedded Systems", McGrawHill.
2. RajKamal, "Embedded Systems", TMH.

REFERENCE BOOKS:

1. Frank Vahid, Tony Givargis, "Embedded Systems Design: A Unified Hardware / Software Introduction", John & Wiley Publications, 2002.
2. Lyla B. Das, "Embedded Systems", Pearson, 2013.
3. David E. Simon, "An Embedded Software Primer", Pearson Education

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
Professional Elective - II
EC614PE: Python Programming

Prerequisite: C Programming and Data Structures

Course Objectives:

1. To learn about Python programming language syntax, semantics, and the runtime environment.
2. To be familiarized with universal computer programming concepts like data types, containers.
3. To be familiarized with general computer programming concepts like conditional execution, loops & functions.
4. To be familiarized with general coding techniques and object-oriented programming.

Course Outcomes:

1. Develop essential programming skills in computer programming concepts like data types, containers.
2. Apply the basics of programming in the Python language.
3. Solve coding tasks related Exceptions and Functions.
4. Solve coding tasks related to the fundamental notions and techniques used in object- oriented programming.
5. Solve coding tasks related to GUI Programming.

Course Articulation Matrix

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

Unit – I:

Introduction: Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators, Type conversions, Expressions.

Data Types and Expression: Strings Assignment, and Comment, Numeric Data Types and Character Sets, Using functions and Modules.

Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.

Repetition Structures: Introduction, while loop, for loop, Input Validation Loops, Nested Loops.

Unit – II:

Sequences: Introduction to Sequences: Strings, Lists, and Tuples, Mapping, Set Types and Dictionaries

String: Strings and Operators, Built-in Methods and Special Features of String.

Lists: Operators, Built-in Functions, List Type Built in Methods, Special Features of List.

Tuples: Built-in Functions, Tuple Type Built in Methods, Special Features of Tuples.

Mapping and Set Type: Dictionaries, Dictionary Keys, Operators and Built-in Methods. Set type, Operator and Built in Methods.

Unit – III:
Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Redefined Clean-up Actions.

Functions: What are Functions, Defining and Creating functions, Function Arguments: Formal and Variable length, Calling functions, Recursive Functions and Variable Scope.
Modules: Modules, Standard Modules, Importing Modules, Namespaces and Packages.

Unit – IV:
File Operations: Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations

Object Oriented Programming: Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, Structuring Classes with Inheritance and Polymorphism.

Unit – V:
GUI Programming: Introduction, Tkinter and Python Programming, Brief Tour of Other GUIs, Related Modules and Other GUIs.
Introduction to Plotting in Python – Basic Plots- Line and Scatter Plot, box plot, bar plots, Histograms and plotting data contained in files.

TEXT BOOKS:
1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage, 2016.
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson, 2018.

REFERENCE BOOKS:
1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press, 2019.
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson, 2017.
3. Core Python Programming, Wesley J.Chun, Second Edition. Pearson 2007.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
Professional Elective-II
EC615PE: Railway Signaling

Prerequisite: Signals and Systems, Analog & Digital Communications

Course Objectives:

1. To introduce general railway signaling principles.
2. To understand the principles of railway traction system.
3. To understand various systems of train working, interlocking features.
4. To know the knowledge on monitoring and control of Railway safety equipment.
5. To understand supervisory aspects of safety equipment.

Course Outcomes:

After completion of the course, students will be able to:

1. Acquire knowledge on general signaling principles.
2. Acquire knowledge on principles of railway traction system.
3. Understand various systems of train working, interlocking features.
4. Acquire the knowledge on monitoring and control of Railway safety equipment.
5. Acquire the knowledge on supervisory aspects of safety equipment.

Course Articulation Matrix

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

Unit 1: General Signaling - I

Opening of Railways: Introduction to Railway signaling, Duties of Commissioners, Sanction to Open Railway for Public Carriage of Passengers, Requirements & Recommendations for Signaling and Interlocking Installations, Catechism for Signaling and Interlocking Installations, for 25KV AC, layouts : Isolation, Ruling gradients, Slip, Catch sidings.

Unit II: General Signaling - II

Schedule of Dimensions: General, Station Yards, Electric Traction 25KV AC 50 Cycles, Clearances required for 25KV single phase AC Electric Traction, Standard and Moving Dimension Diagrams.

General Rules: Definitions, Type of Signals; Adequate Distance, System of Working, Absolute Block system, Automatic Block System, Block Working, Level Crossings, Station Working Rules.

Unit III: Railway Signaling

Station Layouts: MACLS, Signal Aspects, Location of Signals; Station Layouts: Single Line, Double Line, 2-Road, 3-Road, 4-Road.

Signaling Elements: Level Crossings, Cables, Power Supply Arrangements, Track Circuits & Axle Counters, Block Instruments, Point machines, Relays, Relay Interlocking; and Electronic Interlocking, Requirement of Signaling in 25KV AC Electrified Area.

Signaling Interlocking Plan: Essentials of Interlocking, Train Detection, Level Crossing Gate, Point Switching, Signal, Block Control, Aspect Control Chart.

Unit IV: Signaling Equipment-I

Details of relays, Signal Cables, Signals, Control Panel & Operation – Safety features, Working, Details of Point Machines – Components, Working, Circuit Progression, Testing, Safety features, Level Crossing Gates – Working, Circuit Progression, Safety features Details of Track Circuits, Axle Counters – Single section, Multi-section, Subsystems; Working and Application.

Unit V: Signaling Equipment-II

Details about Block Instruments - Types, Working, Circuit Progression safety features, Data Acquisition System - Interfaces, Fault Logic. Details of Integrated Power Supply, CLS Panel, Lightning and Surge Protection.

Interactive experiential sessions will be conducted at IRISET on the following aspects.

- Relays, Signal Cables. Signals, Control Panel & Operation,
- Point Machines - Components, Working, Circuit Progression, Testing.
- Level Crossing Gates - Working, Circuit Progression.
- Track Circuits, Axle Counters - Single section, Multi-section, Subsystems;
- Working and Application.
- Block Instruments - Types, Working, Circuit Progression.
- Data Acquisition System - Interfaces, Fault Logic.
- Integrated Power Supply, CLS Panel, Lightning and Surge Protection.

Text Books:

1. KAVACH - Cab Signalling & Automatic Train Protection System for Digital Railways by Lalit Kumar Mansukhani, Chandra Kishore Prasad, et al. | 1 January 2023.
2. Signal Engineering by Kavach.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
MC601HS: Intellectual Property Rights

(Common to CIVIL, MECH, ECE, MCT & MME)

Course Objectives: The objectives of the course are:

1. To enable the students to have an overview of Intellectual Property Rights.
2. To provide comprehensive knowledge to the students regarding Trademarks Registration process and law related to it.
3. To disseminate knowledge on Copyrights, its related rights and recent developments.
4. To make the students understand Patent Regime in India and abroad.
5. To understand the framework of Trade secrets.

Course Outcomes: By the end of the course students shall:

1. Gain knowledge on Intellectual property rights and their importance.
2. Understand Indian and International Trademark Law and procedure for registration of Trademarks.
3. Acquire knowledge on Copyright Law, and the privileges awarded to the copyright owners.
4. Familiarized with the process of acquiring the patent and relevant laws.
5. Learn the importance of trade secrets for business sustainability.

UNIT – I: INTRODUCTION TO INTELLECTUAL PROPERTY

Introduction of IPR-Meaning of intellectual property, types of intellectual property-trademarks, copyrights, patents, trade secrets, importance of intellectual property rights, International organizations-WTO-WIPO-USPTO-INTA, International Conventions, agencies and treaties- Paris Convention-Berne Convention- Madrid Protocol-NAFTA-PCT-GATT-TRIPS.

UNIT – II: TRADEMARKS

Trademarks: Purpose and functions of Trademarks-Categories of marks, acquisition of trademark rights - Protectable matter - Selecting and evaluating Trademark- Trademark registration process – Trademark Infringement - Remedies for infringement of Trademarks-New developments in Trademark Law- International Trademarks Law.

UNIT III: COPYRIGHT

Copyrights-Fundamentals of Copyright Law - Requirements of Copyrightability - Originality of material, fixation of material, Authorship works, exclusions from copyright protection- Rights of Copyright Owner-Right of reproduction of copyrighted work, right to do derivative works ,right to distribute copies of the copyrighted work, right to perform the work publicly, right to display the copyrighted work, – Copyright Ownership issues – Joint Works, Works made for Hire, Specially commissioned works, Copyright Registration - Notice of Copyright – Copyright Infringement - Remedies for infringement in Copyrights- New developments in Copyright Law- International Copyright Law.

UNIT IV: PATENTS

Concept of Patent - Classification – Utility Patents – Design Patents and Plant Patents, Patent searching process-Types of Patent Applications-Patent Registration Process, Ownership, Transfer, Assignment and Licensing of Patent-Patent Infringement, Remedies for Infringement of Patents, New developments in Patent Law- International Patent Law.

UNIT – V: TRADE SECRETS & LAW OF UNFAIR COMPETITION

Trade Secrets: Trade secret law, determination of trade secret status, measures for protecting trade secret - Liability for misappropriation of trade secrets, protection for submissions, trade secret litigation. New developments in Trade secrets Law - International Trade Secret law.

Law of Unfair Competition: Passing off, Misappropriation, Right of publicity, Dilution of trademarks, Product disparagement, False advertising, Internet Piracy.

TEXT BOOKS:

1. Deborah. E.Bouchoux, Intellectual property, Cengage learning India Pvt.Ltd., 4th edition, 2013.
2. Prabuddha Ganguli, Intellectual Property Right, Tata McGraw Hill Publishing Company, 8th edition, 2016.

REFERENCES

1. Richard Stim, Intellectual Property, Cengage learning India Pvt. Ltd. 3rd edition, 2017.
2. Vinod.V. Sope, Managing Intellectual Property, Asoka K. Ghosh, 2nd edition, 2010.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
MC602ES – Cyber Security
(Common to all branches except CSE, IT, CSBS)

Course objectives:

- To familiarize various types of cyber-attacks and cyber-crimes
- To give an overview of the cyber laws
- To study the defensive techniques against these attacks

Course Outcomes:

- The students will be able to understand cyber-attacks, types of cybercrimes, cyber laws and how to protect them self and ultimately the entire Internet community from such attacks.

UNIT - I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defence, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT- IV

Cyber Security: Organizational Implications: Introduction cost of cybercrimes and IPR issues, web Threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing, and the associated challenges for organizations.

Cybercrime and Cyber terrorism: Introduction, intellectual property in cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

UNIT - V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

Cybercrime: Examples and Mini-Cases Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCES:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
EC651PC: IoT Architecture and Protocols Laboratory

Course Outcomes: Upon completing this course the students will be able to:

1. Understand the basics of sensors and actuators.
2. Interface the sensors and processor for transmission of data.
3. Capture the images and process it on Arduino/NodeMCU/Raspberry Pi.
4. Know the utilization of various protocols like I2c, UART communication etc.
5. Explore the concepts of cloud storage models in IoT.

Course Articulation Matrix

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

List of Experiments:

1. Demonstrate blinking of an LED at every 5 seconds and to control the brightness of an LED.
2. Read Humidity and Room Temperature using DHT sensor and display the readings.
3. Send the recorded values of Temperature/Humidity to the Internet via GSM module using Arduino/ NodeMCU/ Raspberry Pi.
4. Demonstrate Interfacing NodeMCU/Raspberry Pi with the Cloud using REST API and MQTT protocol.
5. Demonstrate Switching lights on /off remotely using Arduino/NodeMCU/Raspberry Pi.
6. Voice-based Home Automation for switching lights on/off using Google Assistant, IFTTT and MQTT.
7. Interfacing DHT11 sensor with Raspberry pi/equivalent and upload temperature and humidity values to the cloud.
8. Design an obstacle detection unit using ultrasonic sensor.
9. Capture images from web camera using Raspberry Pi/equivalent and apply filters in increase image quality.
10. Access a remote computer from Raspberry Pi and display the remote screen.
11. Design an automatic water sprinkler based on soil moisture using Arduino/NodeMCU/Raspberry Pi.
12. Design an RFID based attendance system using Arduino/NodeMCU/Raspberry Pi.
13. Write an arduino program to demonstrate interrupts.
14. Write an arduino program to demonstrate UART communication protocol.
15. Write an arduino program to demonstrate I2C communication protocol.
16. Write an arduino program to demonstrate SPI communication protocol.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
EC652PC: CMOS VLSI Design Laboratory

Course Outcomes:

1. Simulate various digital circuits.
2. Simulate and synthesize various CMOS circuits.
3. Understand the layout design rules for both static & dynamic CMOS circuits.
4. Develop an ability of designing analog CMOS circuits.
5. Develop an ability of designing digital CMOS circuits.

Course Articulation Matrix

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

Note: Any **SIX of** the following experiments from each part are to be conducted (Total 12)

Part - I
All the following experiments have to be implemented using HDL

1. Realize all the logic gates
2. Design of 8-to-3 encoder (without and with priority) and 2-to-4 decoder
3. Design of 8-to-1 multiplexer and 1-to-8 demultiplexer
4. Design of 4 bit binary to gray code converter
5. Design of 4 bit comparator
6. Design of Full adder using 3 modeling styles
7. Design of flip flops: SR, D, JK, T
8. Design of 4-bit binary, BCD counters (synchronous/ asynchronous reset) or any sequence counter
9. Finite State Machine Design

Part-II
Layout, physical verification, placement & route for complex design, static timing analysis, Transient & DC analysis for the following:

1. Basic logic gates
2. CMOS inverter
3. CMOS NOR/ NAND gates
4. CMOS XOR and MUX gates
5. Static / Dynamic logic circuit (register cell)
6. Latch
7. Pass transistor
8. Layout of any combinational circuit (complex CMOS logic gate).

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
EN651HS: Advanced Communication Skills Laboratory
[Common CE, EEE, ECE, ME/MCT & MMT]

Introduction:
The introduction of the Advanced English Communication Skills Lab is considered essential at the B.Tech 3rd year level. At this stage, the students need to prepare themselves for their career which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.
The proposed course should be a laboratory course to enable students to use appropriate English and perform the following:

1. Gathering ideas and information to organize ideas relevantly and coherently.
2. Making oral presentations.
3. Writing formal letters.
4. Transferring information from non-verbal to verbal texts and vice-versa.
5. Writing project/research reports/technical reports.
6. Participating in group discussions.
7. Engaging in debates.
8. Facing interviews.
9. Taking part in social and professional communication.

Course Objectives:
This Lab focuses on using multi-media instruction for language development to meet the following targets:

1. Improve the students' fluency in English, with a focus on vocabulary.
2. Enable them to listen to English spoken at normal conversational speed by educated English speakers.
3. Respond appropriately in different socio-cultural and professional contexts.
4. Communicate their ideas relevantly and coherently in writing.
5. Prepare the students for placements.

Course Outcomes:
Students will be able to:

1. Enhance listening proficiency and reading comprehension and cultivate critical thinking ability.
2. Acquire essential vocabulary and develop strategic planning skills for effective technical writing and gain expertise in E-Correspondence and (N) etiquette.
3. Understand the nuances of oral skills (Speaking skills), gain competence in delivering effective presentations, employing suitable language and body language.
4. Communicate confidently in group discussions and enhance the employability skills of students.
5. Apply effective techniques and strategies for successful job interviews.

Syllabus:
The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Listening and Reading Comprehension:** Active Listening – Development of Listening Skills Through Audio clips - Benefits of Reading – Methods and Techniques of Reading – Basic Steps to Effective Reading – Common Obstacles – Discourse Markers or Linkers - Sub-skills of reading - Reading for facts, negative facts and Specific Details- Guessing Meanings from Context, Inferring Meaning - Critical Reading — Reading Comprehension – Exercises for Practice.
2. **Activities on Writing Skills**: Vocabulary for Competitive Examinations - Planning for Writing – Improving Writing Skills - Structure and presentation of different types of writing – Free Writing and Structured Writing - Letter Writing –Writing a Letter of Application –Resume vs. Curriculum Vitae – Writing a Résumé **–** Styles of Résumé - e-Correspondence – Emails – Blog Writing - (N)etiquette – Report Writing – Importance of Reports – Types and Formats of Reports– Technical Report Writing– Exercises for Practice.

3. **Activities on Presentation Skills –** Dealing with Glossophobia or stage fear, starting a conversation – responding appropriately and relevantly – using the right language and body language – Role Play in different situations including Seeking Clarification, Making a Request, Asking for and Refusing Permission, Participating in a Small Talk – Oral presentations (individual and group) through JAM sessions- PPTs – Importance of Presentation Skills – Planning, Preparing, Rehearsing and Making a Presentation - Understanding Nuances of Delivery - Presentations through Posters/Projects/Reports – Checklist for Making a Presentation and Rubrics of Evaluation.
4. **Activities on Group Discussion (GD):** Types of GD and GD as a part of a Selection Procedure - Dynamics of Group Discussion - myths and facts (Dos and Don'ts) of GD - Intervention, Summarizing - Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas - GD Strategies – Exercises for Practice.
5. **Activities on Interview Skills**: Concept and Process - Interview Preparation Techniques - Types of Interview Questions – Pre-interview Planning, Opening Strategies, Answering Strategies - Interview Through Tele-conference & Video-conference - Mock Interviews.

Suggested Books:

1. Effective Technical Communication by M Ashraf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition.
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

Reference Books:

1. Rizvi, M. Ashraf (2018). *Effective Technical Communication.* (2nded). McGraw Hill Education (India) Pvt. Ltd.
2. Suresh Kumar, E. (2015). *Engineering English.* Orient BlackSwan Pvt. Ltd.
3. Bailey, Stephen. (2018). Academic *Writing: A Handbook for International Students.* (5th Edition). Routledge.
4. Koneru, Aruna. (2016). *Professional Communication*. McGraw Hill Education (India) Pvt. Ltd.
5. Raman, Meenakshi & Sharma, Sangeeta. (2015). *Technical Communication, 3E: Principles and Practice.*Oxford University Press.
6. Anderson, Paul V. (2007). *Technical Communication***.** Cengage Learning Pvt. Ltd. New Delhi.
7. McCarthy, Michael; O'Dell, Felicity & Redman, Stuart. (2017). *English Vocabulary in Use* Series. Cambridge University Press.
8. Sen, Leela. (2009). *Communication Skills.* PHI Learning Pvt Ltd., New Delhi.
9. Elbow, Peter. (1998). *Writing with Power.* Oxford University Press.
10. Goleman, Daniel. (2013). *Emotional Intelligence*: *Why it can matter more than IQ.* Bloomsbury Publishing.
11. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
12. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
13. How to Write and Speak Better, Reader's Digest, 2003.
14. TOEFL Reading & Writing Workout, The Princeton Review.
15. How to prepare for Group Discussions and Interviews by Harimohan Prasad and Rajneesh Prasad,TataMcgrawHill.
16. Keep Talking, Frederick Klippel, Cambridge University Press, South Asian edition (6 May 2010).
17. Objective English, Edgar Thorpe & Showick Thorpe, Pearson; 5th edition (1 August 2013).

Communication Skills for Engineers, Sunitha Mishra, C.Murali Krishna, Pearson; 4th Edition.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
MC601BS: Environmental Science

Course Objectives:

1. To understand the natural resources and their conservation.
2. To understand the importance of ecosystem, biodiversity and ecological balance for sustainable development.
3. To gain knowledge about environmental pollution, effects and controlling measures.
4. To study about global environmental problems and global issues.
5. To understand the environmental policies, regulations and sustainable development.

Course Outcomes:

After completing the course, the student will be able to:

1. Learn about different types of natural resources and take up the measures to protect the resources.
2. Get the information about ecosystem, biodiversity and their usage and conservation.
3. Get the information about the types of pollution, understand their effects and controlling measures.
4. Gain the knowledge about current global environmental issues and initiations to be taken to protect the environment.
5. Gain the knowledge about environmental acts, EIA, sustainable development and follow the rules and regulations

Unit - I:

Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Bio-magnification, ecosystem value, services and carrying capacity.

Unit – II: Natural Resources:

Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefitsand problems. **Mineral resources:** use and exploitation, environmental effects of extracting and usingmineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

Unit – III:

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In- Situ and Ex-situ conservation. National Biodiversity act.

Unit – IV:

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, causes and effects, Ambient air quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

Global Environmental Issues and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). International conventions /Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

Unit – V:

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, biomedical waste management and handling rules, hazardous waste management and handling rules.

Environmental Impact of Assessment (EIA): structure, methods of baseline data acquisition. Concepts of Environmental Management Plan (EMP).

Towards Sustainable Future: Concept of Sustainable Development Goals, Population and its explosion, Environmental Education, Human health, Environmental Ethics, Concept of Green Building, Green chemistry principles, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHILearning Pvt. Ltd.
3. Environmental Studies by R. Rajagopalan, Oxford University Press.
4. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BSPublications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
EC701PC: Microwave and Optical Communications

Prerequisites: Antennas, Waveguides, EM field boundary conditions

Course Objectives:

1. To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
2. To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
3. To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S- Matrix for various types of microwave junctions.
4. Understand the utility of Optical Fibres in Communications.

Course Outcomes:

1. Known power generation at microwave frequencies and derive the performance characteristics.
2. Realize the need for solid state microwave sources and understand the principles of solid state devices.
3. Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications.
4. Understand the utility of S-parameters in microwave component design and learn the measurement procedure of various microwave parameters.
5. Understand the mechanism of light propagation through Optical Fibres.

Course Articulation Matrix

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

Unit I: Microwave Tubes, Helix TWTs

Microwave Tubes: Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes – O Type and M Type Classifications, O-type Tubes: 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics.

Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

Unit II: M-Type Tubes, Microwave Solid State Devices

M-Type Tubes: Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical - Traveling Wave Magnetron – Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PI- Mode, o/p characteristics,

Microwave Solid State Devices: Introduction, Classification, Applications. TEDs – Introduction, Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

Unit III: Waveguide Components

Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities– Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators– Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters- Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees. Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components – Gyrator, Isolator,

Unit IV: Scattering matrix, Microwave Measurements

Scattering matrix : Scattering Matrix Properties, Directional Couplers – 2 Hole, Bethe Hole, [s] matrix of Magic Tee and Circulator.

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, measurement of Low and High VSWR, Cavity Q, Impedance Measurements.

Unit V: Optical Fiber Transmission Media

Optical Fiber types, Light Propagation, Optical fiber Configurations, Optical fiber classifications, Losses in Optical Fiber cables, Light Sources, Optical Sources, Light Detectors, LASERS, WDM Concepts, Optical Fiber System link budget.

TEXT BOOKS:

1. Liao, Samuel Y., Microwave Devices and Circuits, Pearson, 3rd Edition, 2003.
2. Tomasi Wayne, Electronic Communications Systems, Pearson, 5th Edition

Reference Books:

1. Keiser Gerd, Optical Fiber Communication, TMH, 4th Ed., 2008.
2. David M. Pozar, Microwave Engineering, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3rd ed., 2011.
3. Raghuvanshi, G.S., Microwave Engineering - Cengage Learning India Pvt. Ltd., 2012.
4. Kennedy George, Electronic Communication System, McGrawHill, 6th Ed.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Professional Elective - III
EC711PE: Radar Systems

Prerequisite: Analog and Digital Communications

Course Objectives:

1. To explore the concepts of radar and its frequency bands.
2. To understand Doppler Effect and get acquainted with the working principles of CW radar, FM- CW radar.
3. To impart the knowledge of functioning of MTI and Tracking Radars.
4. To explain the deigning of a Matched Filter in radar receivers.

Course Outcomes: Upon completing this course, the student will be able to

1. Derive the complete radar range equation.
2. Understand the need and functioning of CW and FM-CW radars.
3. Understand the need and functioning of MTI and Pulse Doppler radars.
4. Known various Tracking methods.
5. Derive the matched filter response characteristics for radar receivers.

Course Articulation Matrix

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

Unit – I:

Basics of Radar: Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation.

Radar Equation: SNR, Envelope Detector – False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment).

Unit – II:

CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar.

FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter.

Unit – III:

MTI and Pulse Doppler Radar: Principle, MTI Radar - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

Unit – IV:

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

Unit – V:

Detection of Radar Signals in Noise Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise.

Radar Receivers – Noise Figure and Noise Temperature, Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Applications, Advantages and Limitations.

TEXT BOOKS:

1. Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2nd Ed., 2007.

REFERENCE BOOKS:

1. Radar: Principles, Technology, Applications – Byron Edde, Pearson Education, 2004.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Professional Elective - III
EC712PE: CMOS Analog IC Design

Prerequisite: Digital Logic Design

Course Objectives: Analog circuits play a very crucial role in all electronic systems and due to continued miniaturization, many of the analog blocks are not getting realized in CMOS technology.

1. To understand most important building blocks of all CMOS Analog ICs.
2. To study the basic principle of operation, the circuit choices and the trade-offs involved in the MOS transistor level design common to all Analog CMOS ICs.
3. To understand specific design issues related to single and multistage voltage, current and differential amplifiers, their output and impedance issues, bandwidth, feedback and stability.
4. To understand the design of differential amplifiers, current amplifiers and OPAMPs.
5. To understand design of various comparators.

Course Outcomes: After studying the course, each student is expected to be able to

1. Design basic building blocks of CMOS Analog ICs.
2. Carryout the design of single and two stage operational amplifiers and voltage references.
3. Determine the device dimensions of each MOSFETs involved.
4. Design various amplifiers like differential, current and operational amplifiers.
5. Design of various comparators for CMOS analog IC design.

Course Articulation Matrix

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

Unit – I:
MOS Devices and Modelling
The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

Unit – II:
Analog CMOS Sub-Circuits
MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Bandgap Reference.

Unit – III:
CMOS Amplifiers
Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

Unit – IV:
CMOS Operational Amplifiers
Design of CMOS OpAmps, Compensation of OpAmps, Design of Two-Stage Op Amps, Power-Supply Rejection Ratio of Two-Stage OpAmps, Cascode OpAmps, Measurement Techniques of OPAmp.

Unit – V:

Comparators

Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

TEXT BOOKS:

1. Philip E. Allenand Douglas, R. Holberg – CMOS Analog Circuit Design, Oxford University Press, International Second Edition/Indian Edition, 2010.
2. Paul R. Gray, Paul J. Hurst, S. Lewis and R.G. Meyer -Analysis and Design of Analog Integrated Circuits, 5th edition, Wiley India, 2010.

REFERENCE BOOKS:

1. David A. Johns, Ken Martin- Analog Integrated Circuit Design, Wiley Student Edn, 2013.
2. Behzad Razavi – Design of Analog CMOS Integrated Circuits, TMH.
3. Baker, Liand Boyce - CMOS: Circuit Design, Layout and Simulation, PHI.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Professional Elective - III
EC713PE: Artificial Neural Networks

Prerequisite: Digital Logic Design

Course Objectives:

1. To understand the biological neural network and to model equivalent neuron models.
2. To understand the architecture, learning algorithms.
3. To know the issues of various feed forward and feedback neural networks.
4. To explore the Neuro dynamic models for various problems.

Course Outcomes: Upon completing this course, the student will be able to

1. Understand the similarity of Biological networks and Neural networks.
2. Perform the training of neural networks using various learning rules.
3. Understanding the concepts of forward and backward propagations.
4. To design and analyze Self Organizing Maps.
5. Understand and Construct the Hopfield models.

Course Articulation Matrix

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

Unit – I:

Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

Unit – II:

Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment

Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

Unit – III:

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

Unit – IV:

Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

Unit – V:

Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

Hopfield Models – Hopfield Models, restricted boltzmen machine.

TEXT BOOKS:

1. Neural Networks a Comprehensive Foundations, Simon S Haykin, PHI Ed.,.
2. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

REFERENCE BOOKS:

1. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
2. Neural Networks -James A Freeman David M S Kapura Pearson Ed., 2004.
3. Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd 2005

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Professional Elective - III
EC714PE: Multimedia Database Management Systems

Prerequisite: Computer Organization.

Course Objectives:

1. To understand the basic concepts and the applications of database systems.
2. To master the basics of SQL and construct queries using SQL.
3. Topics include data models, database design, relational model, relational algebra, transaction control, concurrency control, storage structures and access techniques.

Course Outcomes:

1. Gain knowledge of fundamentals of DBMS, database design and normal forms
2. Explore the relational and logical data.
3. Master the basics of SQL for retrieval and management of data.
4. Be acquainted with the basics of transaction processing and concurrency control.
5. Familiarity with database storage structures and access techniques

Course Articulation Matrix

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

Unit – I:

Database System Applications: A Historical Perspective, File Systems versus a DBMS, the Data Model, Levels of Abstraction in a DBMS, Data Independence, Structure of a DBMS.

Introduction to Database Design: Database Design and ER Diagrams, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design With the ER Model.

Unit – II:

Introduction to the Relational Model: Integrity constraint over relations, enforcing integrity constraints, querying relational data, logical data base design, introduction to views, destroying/altering tables and views. Relational Algebra, Tuple relational Calculus, Domain relational calculus.

Unit – III:

SQL: Queries, Constraints, Triggers: form of basic SQL query, UNION, INTERSECT, and EXCEPT, Nested Queries, aggregation operators, NULL values, complex integrity constraints in SQL, triggers and active data bases. Schema Refinement: Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, FIRST, SECOND, THIRD normal forms, BCNF, lossless join decomposition, multi-valued dependencies, FOURTH normal form, FIFTH normal form.

Unit – IV:

Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for serializability, Lock Based Protocols, Timestamp Based Protocols, Validation- Based Protocols, Multiple Granularity, Recovery and Atomicity, Log–Based Recovery, Recovery with Concurrent Transactions.

Unit – V:

Data on External Storage, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing, Tree base Indexing, Comparison of File Organizations, Indexes and Performance Tuning, Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM), B+ Trees: A Dynamic Index Structure.

TEXT BOOKS:

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata Mc Graw Hill 3rd Edition
2. Database System Concepts, Silberschatz, Korth, Mc Graw hill, V edition.

REFERENCE BOOKS:

1. Database Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate, Pearson Education
3. Introduction to Database Systems, C. J. Date, Pearson Education
4. Oracle for Professionals, The X Team, S.Shah and V. Shah, SPD.
5. Database Systems Using Oracle: A Simplified guide to SQL and PL/SQL, Shah, PHI.
6. Fundamentals of Database Management Systems, M. L. Gillenson, Wiley Student Edition.

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Professional Elective - IV
EC715PE: Network Security and Cryptography

Prerequisite: Data Communication and Computer Networks

Course Objectives:

Students undergoing this course are expected to
1. Understand the basic concept of Cryptography and Network Security, their mathematical models.
2. To understand the necessity of network security, threats/vulnerabilities to networks and countermeasures.
3. To understand Authentication functions with Message Authentication Codes and Hash Functions.
4. To provide familiarity in Intrusion detection and Firewall Design Principles.

Course Outcomes:

1. Describe network security fundamental concepts and principles.
2. Encrypt and decrypt messages using block ciphers and network security technology and protocols.
3. Analyze key agreement algorithms to identify their weaknesses.
4. Analyze authentication applications.
5. Identify and assess different types of threats, malware, spyware, viruses, vulnerabilities.

Course Articulation Matrix

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

UNIT - I

Security Services, Mechanisms and Attacks, A Model for Internetwork security, Classical Techniques: Conventional Encryption model, Classical Encryption Techniques. Modern Techniques: Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Block Cipher Design Principles.

UNIT - II

Encryption: Triple DES, International Data Encryption algorithm, Blowfish, RC5, Characteristics of Advanced Symmetric block Ciphers. Placement of Encryption function, Key distribution.

UNIT - III

Public Key Cryptography: Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography. Number Theory: Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete Algorithms.

UNIT - IV

Message Authentication and Hash Functions: Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs. Hash and Mac Algorithms: MD-5, Message digest Algorithm, Secure Hash Algorithm.

Digital signatures and Authentication protocols: Digital signatures, Digital signature standards. Authentication Applications: Kerberos, Electronic Mail Security: Pretty Good Privacy, SIME/ MIME.

UNIT - V

IP Security: Overview, Architecture, Authentication, Encapsulating Security Payload. Web Security: Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction. Intruders, Viruses and Worms: Intruders, Viruses and Related threats. Fire Walls: Fire wall Design Principles.

TEXT BOOKS:

1. William Stallings-Cryptography and Network Security: Principles and Practice, Pearson Education.
2. Robert Bragg, Mark Rhodes -Network Security: The complete reference, TMH, 2004.

REFERENCE BOOKS:

1. William Stallings - Network Security Essentials (Applications and Standards), Pearson Education.
2. Eric Maiwald - Fundamentals of Network Security, Dreamtech press
3. Whitman - Principles of Information Security, Thomson.
4. Buchmann - Introduction to Cryptography, Springer.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Professional Elective - IV
EC716PE: Biomedical Instrumentation and Signal Processing

Prerequisites: Signals and Systems, Digital Image Processing

Course Objectives

1. Identify significant biological variables at cellular level and ways to acquire different bio-signals.
2. Elucidate the methods to monitor the activity of the heart, brain, eyes and muscles.
3. Introduce therapeutic equipment for intensive and critical care.
4. Outline medical imaging techniques and equipment for certain diagnosis and therapies.

Course Outcomes: After completion of the course the student is able to:

1. Understand Biosystems and medical systems from an engineering perspective.
2. Identify the techniques to acquire record and primarily understand physiological activity of the human body through cell potential, and ECG.
3. Identify the techniques to acquire record and primarily understand physiological activity of the human body through EEG, BP and blood flow measurement and EMG.
4. Understand the working of various medical instruments and critical care equipment.
5. Know the imaging techniques including CT, PET, SPECT and MRI used in diagnosis of various medical conditions.

Course Articulation Matrix

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

UNIT - I:

Bio-Potential Signals and Electrodes: Bio-signals and their characteristics, Organization of cell, Nernst equation of membrane, Resting and Action potentials. Bio-amplifiers, characteristics of medical instruments, problems encountered with measurements from living systems. Bio-potential electrodes – Body surface recording electrodes, Internal electrodes, micro electrodes. Bio-chemical transducers – reference electrode, the pH electrodes, Blood gas electrodes.

UNIT - II:

Cardiovascular Instrumentation: Heart and cardiovascular system Heart electrical activity, blood pressure and heart sounds. Cardiovascular measurements electro cardiography – electrocardiogram, ECG Amplifier, Electrodes and leads, ECG recorder principles. Types of ECG recorders. Principles of blood pressure and blood flow measurement.

UNIT - III:

Neurological Instrumentation: Neuronal communication, electro encephalogram (EEG), EEG Measurements EEG electrode-placement system, interpretation of EEG, EEG system Block diagram, preamplifiers and amplifiers. EMG block diagram and Stimulators

UNIT - IV:

Equipment for Critical Care: Therapeutic equipment - Pacemaker, Defibrillator, Shortwave diathermy, Hemodialysis machine. Respiratory Instrumentation - Mechanism of respiration, Spirometry, Pneumotachograph, Ventilators.

UNIT - V:

Principles of Medical Imaging: Radiography, computed Radiography, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear Medicine, Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET), Ultrasonography, Introduction to Telemedicine.

TEXT BOOKS:

1. Hand-book of Biomedical Instrumentation – by R.S. Khandpur, McGraw-Hill, 2003.
2. Medical Instrumentation, Application and Design – by John G. Webster, John Wiley.

REFERENCE BOOKS:

1. Biomedical Instrumentation and Measurements – by Leslie Cromwell, F.J. Weibell, E.A. Pfeiffer, PHI.
2. Principles of Applied Biomedical Instrumentation – by L.A. Geoddes and L.E. Baker, John Wiley and Sons.
3. Introduction to Biomedical equipment technology-by Joseph Carr and Brown.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Professional Elective - IV
EC717PE: Natural Language Processing

Prerequisite: Data structures and compiler design

Course Objectives:

1. Introduction to some of the problems and solutions of NLP and their relation to linguistics and statistics.

Course Outcomes:

1. Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2. Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems.
3. Manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
4. Design, implement, and analyze NLP algorithms.
5. Design different language modeling Techniques.

Course Articulation Matrix

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

Unit – I:
Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models

Finding the Structure of Documents: Introduction, Methods, Complexity of the Approaches, Performances of the Approaches, Features

Unit – II:
Syntax I: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms

UNIT – III
Syntax II: Models for Ambiguity Resolution in Parsing, Multilingual Issues
Semantic Parsing I: Introduction, Semantic Interpretation, System Paradigms, Word Sense

Unit – IV:
Semantic Parsing II: Predicate-Argument Structure, Meaning Representation Systems

Unit – V:
Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Bayesian parameter estimation, Language Model Adaptation, Language Models- class based, variable length, Bayesian topic based, Multilingual and Cross Lingual Language Modeling

TEXT BOOKS:

1. Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M. Bikel and Imed Zitouni, Pearson Publication.

REFERENCE BOOK:

1. Speech and Natural Language Processing - Daniel Jurafsky & James H Martin, Pearson Publications.
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Professional Elective - IV
EC718PE: Telecommunication Switching Systems and Networks

Prerequisite: Switching Theory

Course Objectives: The Course is designed

1. To provide students with a balanced blend of theoretical and practical aspects regarding Telecommunication Switching System.
2. To expose through the evolution of switching systems from manual and Electromechanical systems to stored-program-controlled digital systems.
3. To provide knowledge to the students regarding design and performance analysis of various switching systems.
4. To train the students about basic Telephone Networks structures and traffic engineering concepts
5. To inculcate students on various internet concepts like OSI reference model, LAN, WAN, WAN, Repeaters, bridges, routers & gateways.
6. To provide a comprehensive coverage of data communication networks and ISDN.

Course outcomes:

1. Students will be able to analyze different switching methodologies.
2. Students will be able to differentiate between signaling methods used in Telecommunication Networks.
3. Students will exhibit a good knowledge on data communication networks and ISDN and be able to differentiate LAN, MAN, WAN.
4. Students will demonstrate an ability to work on various Telecommunication Network concepts.
5. Students will demonstrate knowledge on modern telecommunication concepts like ISDN.

Course Articulation Matrix

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

Unit - I: Telecommunication Switching Systems: Introduction, Elements of switching systems, switching network configuration, Rotary switches, Uniselector, Two motion selector, Trunking principle ,principles of cross bar switching, Crossbar Switch Configuration, Cross point Technology, Crossbar Exchange Organization.

Unit – II:

Electronic Space Division Switching: Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced services, Two-Stage Networks, Three-Stage Networks, n-Stage Networks.

Time Division Switching: Basic Time Division Space Switching, Basic Time Division Time Switching, Time Multiplexed Space Switching, Time Multiplexed Time Switching, Combination Switching, Three Stage Combination Switching, n - Stage Combinational Switching.

Unit – III:

Telecommunications Traffic: Introduction; The Unit of Traffic, Congestion; Traffic Measurement, A Mathematical Model, Lost-Call Systems-Theory, Traffic Performance, Loss Systems in Tandem, Use of Traffic Tables, Queuing Systems-The Second Erlang Distribution, Probability of Delay, Finite Queue Capacity, Some Other Useful Results, Systems with a Single Server, Queues in Tandem, Delay Tables, Applications of Delay Formulae.

Unit – IV:

Telephone Networks: Subscriber loop systems, switching hierarchy and routing, transmission plan, transmission systems, numbering plan, charging plan, Signaling techniques: In channel signaling, common channel signaling, Cellular mobile telephony.

Data Networks: Data transmission in PSTNs, Switching techniques for data transmission, data communication architecture, link to link layers, end to end layers, satellite based data networks, LAN, MAN, Internetworking.

Unit – V:

Integrated Services Digital Network (ISDN): Introduction, motivation, new services, Network and protocol architecture, Transmission channels, User-Network interfaces, functional grouping, reference points, signaling, numbering, addressing, BISDN.

TEXT BOOKS:

1. Tele communication switching system and networks – Thyagarajan Viswanath, PHI, 2000.
2. J. E Flood, "Telecommunications Switching and Traffic Networks," Pearson Education, 2006.
3. Data Communication & Networking - B.A. Forouzan, TMH, 4th Edition, 2004.

REFERENCES:

1. Digital telephony - J. Bellamy, John Wiley, 2nd edition, 2001.
2. Data Communications & Networks - Achyut. S. Godbole, TMH, 2004.
3. Principles of Communication Systems – H. Taub & D. Schilling, TMH, 2nd Edition, 2003.
4. An Engineering approach to computer networking - S. Keshav, Addison W.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Professional Elective - IV
EC719PE: Automatic Train Protection (ATP) System - Kavach

Prerequisites: Railway Signaling, Control Systems.

Course Objectives:

1. To understand fundamentals about the Train Protection Systems.
2. To understand the subsystems of Kavach.
3. To understand the speed profile of Locomotive.
4. To understand the design aspects of Kavach.
5. To familiarize about deployment of Kavach.

Course Outcomes:

After completion of the course, students will be able to:

1. Identify fundamental aspects of Train Protection Systems.
2. Articulate the subsystems of Kavach.
3. Illustrate the speed profile of Locomotive.
4. Analyze the design aspects of Kavach.
5. Explore the precepts of deployment of Kavach.

Course Articulation Matrix

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

Unit I: Introduction to Train Protection Systems - I

Train Protection Systems: Auxiliary Warning Systems, European Train Control Systems Communication Based Interlocking System, Spot and Continuous Relay of Information

Working: Overview of Kavach and its Working, Features, Subsystems, Communication Interfaces, Signaling Interfaces.

Unit II: Introduction to Train Protection Systems - II

Subsystem; Onboard Kavach: Driver Machine Interlocking, Braking Interface, Radio Equipment, Onboard Computer, Transponder Receiver, Odometry, GNSS, GPRS, GSM.

Subsystem; Stationary Kavach: Station Kavach, Track Side Equipment, Signaling Interface, Radio & Tower, GNSS, Transponders, Network Monitoring System.

Unit III: Speed Profiles of Locomotive

Location Referencing – Train position, Modes of Onboard subsystem, Train Characteristics, Mode Transitions, Braking Curves, Speed Profiles, Speed Limits, Speed Monitoring, Target Speed, Target Distance, Movement Authority, Communication Protocols, Key Management System (KMS), Messages & Language.

Unit IV: Design - Kavach

Survey, Assessment & Estimation: Station Layout, Radio Signal Strength, Tower Location, Power Requirement, Cable Survey, Loco Fitment Survey.

Station Design: Kavach Scheme Plan, Kavach Control Table, Signaling Interface Diagram, Connectivity Plans for Remote Interface Units (RIUs), Power Supply Plan.

Tower Design: Soil Testing, Foundation design, Super Structure Design.

Unit V: Installation, Deployment & Testing

Stationary Kavach: Interlocking Interface, RFID Tags, Station Master Operation Console Indication Panel (SM_OCIP), GPS/GSM Antennas, Pre-commissioning Checklist, Testing.

Onboard Kavach: DMI, Speed Sensors, RFID Reader, Onboard Computer, Brake Interface Unit. Pre-commissioning Checklist, Testing.

Interactive experiential sessions will be conducted at IRISET on the following aspects.

1. Test bench, Preparation and deployment of Stationary Kavach Data: Configuration involving Topographical Information – Arrangement of Signals/Markers, Transponders, Inter-signal Distances, Signal Routes, Gradients, Speed Restrictions
2. Verification and Validation of Onboard Data – Ceiling.

Text Book:

1. KAVACH - Cab Signalling & Automatic Train Protection System for Digital Railways by Lalit Kumar Mansukhani, Chandra Kishore Prasad, et al. | 1 January 2023.
2. KAVACH INDIAN RAILWAY AUTOMATIC TRAIN PROTECTION SYSTEM by Kavach.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
MS701HS: Professional Practice, Law & Ethics
(Common to ECE & CSE (AI&ML))

Course Objectives: The objectives of the course are:

1. To create awareness on professional ethics, professional responsibility, whistle blowing, GST.
2. To learn the basics of Law of Contract.
3. To discuss the Alternative Dispute Resolution mechanisms.
4. To familiarize with Industrial relations and Labour laws in India
5. To introduce different types of IPRs and laws relating to copyrights and patents in India.

Course Outcomes: After completion of the course the students will be able to:

1. Understand the importance of professional practice, Law and Ethics in their personal lives and professional careers.
2. Analyze the law of Contracts and special contracts
3. Evaluate the alternative dispute resolution systems in India
4. Gain knowledge about the Industrial relations and Labour laws in India
5. Appreciate about the types of IPRs and laws relating to copyrights and patents in India.

UNIT I: PROFESSIONAL PRACTICE AND ETHICS

Definition of Ethics, Professional Ethics - Engineering Ethics, Personal Ethics; Code of Ethics - Profession, Professionalism, Professional Responsibility, Conflict of Interest, Gift vs Bribery, Environmental breaches, Professional negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing and protected disclosures. Introduction to GST - Roles of Various Stake holders.

UNIT II: LAW OF CONTRACT

Nature of Contract Essential elements of valid contract: Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object. Unlawful and illegal agreements, Contingent Contracts, Performance and Discharge of Contracts and Remedies for breach of contract. Contracts-II: Indemnity and Guarantee, Contract of Agency, Bailment and Pledge.

UNIT III: ARBITRATION, CONCILIATION AND ALTERNATIVE DISPUTE RESOLUTION (ADR) SYSTEM

Arbitration – meaning and scope. Arbitration and Conciliation Act, 1996;UNCITRAL model law–Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements–essential and kinds, validity, reference and interim measuresbycourt;Arbitrationtribunal–appointment,challenge,jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and Court assistance; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.

UNIT IV: LABOUR LAWS AND CYBER LAW

Industrial Disputes Act,1947;Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Minimum Wages Act 1948; RERA Act 2017; IT Act, 2000.

UNIT V: LAW RELATING TO INTELLECTUAL PROPERTY

Introduction – meaning of intellectual property, Main forms of IP - Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyrights under Copyrights Act,1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970.

TEXT BOOKS:

1. R. Subramanian, Professional Ethics, Oxford University Press, 2nd Edition, 2017.
2. Ravinder Kaur, Legal Aspects of Business, Cengage Learning, 4th Edition, 2016.
3. Anupam Kurlwal, An Introduction to Alternative Dispute Resolution System (ADR), 4thEdition, Central Law Publications,2022.
4. T.Ramappa, Intellectual Property Rights Law in India, 1stEdition, Asia Law House, 2010.

REFERENCE BOOKS:

1. Wadhera, Intellectual Property Rights, 5thEdition,Universal Law Publishing Co, 2004
2. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers.
3. S C Srivastava, Industrial Relations and Labor Laws, 7thEdition,Vikas Publications, 2020.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
EC751PC: Microwave and Optical Communications Laboratory

Course Objectives:

1. Analyze and verify the characteristics of Reflex klystron, Gunn diode, Directional coupler, horn antenna, Circulator, attenuators and Isolator.
2. To verify the characteristics of optical sources.
3. To measure attenuation and distortions in optical fiber link.
4. Calculate the numerical aperture, losses in fibers and analyze the characteristics of LED, LASER sources and PIN detector experimentally.

Course Outcomes:

1. Verify characteristics of Reflex Klystron and Gunn Diode.
2. Estimate the power measurements of RF Components such as directional Couplers.
3. Analyze various parameters of Waveguide Components.
4. Demonstrate characteristics of various optical sources.
5. Measure data Rate, Numerical Aperture and Losses in Optical Link.

Course Articulation Matrix

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

Note: Any **twelve** of the following experiments

LIST OF EXPERIMENTS:

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Attenuation measurement
4. Directional coupler Characteristics.
5. Scattering parameters of wave guide components
6. Frequency measurement.
7. Impedance measurement
8. VSWR measurement
9. Characterization of LED.
10. Characterization of Laser Diode.
11. Intensity modulation of Laser output through an optical fiber.
12. Measurement of Data rate for Digital Optical link.
13. Measurement of Numerical Aperture of fiber cable.
14. Measurement of losses for Optical link

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
EC752PC: Java Programming Laboratory

Prerequisites: C Programming, Python Programming

Course Objectives:

1. Gain knowledge about basic Java language syntax and semantics to write Java programs and use concepts such as variables, conditional and iterative execution methods etc.
2. Understand the principles of inheritance, packages and interfaces Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
3. Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
4. Be aware of the important topics and principles of software development and ability to write a computer program to solve specified problems.
5. Create database connectivity in java and implement GUI applications.

Course Outcomes:

1. Implement OOP paradigm using Java.
2. Demonstrate the concepts of polymorphism, and inheritance.
3. Demonstrate the concepts of method overloading, overriding.
4. Implement inheritance and exception handling.
5. Develop GUI application using Swings package.

Course Articulation Matrix

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

Task-1 Write java programs that implement the following
a) Constructor
b) Parameterized constructor
c) Method overloading
d) Constructor overloading.

Task-2
a) Write a Java program that checks whether a given string is a palindrome or not.
b) Write a Java program for sorting a given list of names in ascending order.

Task-3
Write java programs that uses the following keywords
a) this b) super c) static d) final

Task-4
a) Write a java program to implement method overriding
b) Write a java program to implement dynamic method dispatch.
c) Write a Java program to implement multiple inheritance.
d) Write a java program that uses access specifiers.

Task-5
a) Write a Java program that reads a file name from the user, and then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.
b) Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
c) Write a Java program that displays the number of characters, lines and words in a text file

Task-6
a) Write a Java program for handling Checked Exceptions.
b) Write a Java program for handling Unchecked Exceptions.

Task-7
Write a Java program that creates three threads. First thread displays Good Morning every one second, the second thread displays “Hello” every two seconds and the third thread displays “Welcome” every three seconds.

Task-8
Write a Java program that works as a simple calculator. Use a grid layout to arrange button for the digits and for the +, -,*, % operations. Add a text field to display the result.

Task-9
a) Write a Java program for handling mouse events.
b) Write a Java program for handling key events.

Task-10
Write a program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields Num1 and Num 2. The division of Num1 and. Num2 is displayed in the Result field when the Divide button is clicked. If Num1or Num2 were not an integer, the program would throw Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception and display the exception in a message dialog box.

Task -11
a) Write a java program that simulates traffic light. The program lets the user select one of three lights: red, yellow or green. When a radio button is selected, the light is turned on, and only one light can be on at a time No l Light is on when the program starts.
b) Write a Java program that allows the user to draw lines, rectangles and ovals.

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Professional Elective - V
EC811PE: Satellite Communications

Prerequisite: Analog & Digital Communications

Course Objectives:

1. To acquired foundation in orbital mechanics and launch vehicles for the satellites.
2. To provide basic knowledge of link design of satellite.
3. To understand multiple access systems and earth station technology.
4. To understand concepts of earth station technologies.
5. To understand the concepts of satellite navigation and GPS.

Course Outcomes:

1. Understand basic concepts and frequency allocations for satellite communication, orbital mechanics and launch vehicles.
2. Envision the satellite sub systems and design satellite links for specified C/N.
3. Understand the various multiple access techniques for satellite communication systems.
4. Understand basic concepts of earth station technologies.
5. Known the concepts of Satellite navigation & Global Positioning Systems.

Course Articulation Matrix

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

Unit - I: Introduction, Orbital Mechanics and Launchers

Introduction: Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Satellite Frequency Bands, Frequency Allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

Orbital Mechanics and Launchers: Orbital Mechanics, Kepler's Three Laws of Planetary Motion, Look Angle determination, Elevation Angle Calculation, Azimuth Angle Calculation, Orbital Perturbations, Orbit determination, Launches and Launch vehicles, Placing Satellites into Geostationary Orbit, Orbital Effects in Communication Systems Performance, Solar Eclipse.

Unit - II: Satellite Subsystems

Attitude and Orbit Control System, Telemetry, Tracking, Command And Monitoring, Power Systems, Communication Subsystems, Transponders, Satellite Antennas, Equipment Reliability and Space Qualification.

Unit - III: Satellite Link Design, Multiple Access

Satellite Link Design: Basic Transmission Theory, System Noise Temperature and G/T Ratio, Noise Figure and Noise Temperature, Design of Down Links, Link Budgets, Up Link Design, Design Of Satellite Links For Specified C/N, Uplink Attenuation and (C/N)up, Downlink Attenuation and (C/N)dn, System Design Examples, Ku Band Uplink Design, Ku Band Downlink Design.

Multiple Access: Frequency Division Multiple Access (FDMA), Inter modulation, Calculation of C/N, Time Division Multiple Access (TDMA), Frame Structure, Examples, Satellite Switched TDMA, Onboard Processing, Baseband Processing Transponders, DAMA, Code Division Multiple Access (CDMA), Spread Spectrum Transmission and Reception.

Unit - IV: Earth Station Technology
Introduction, Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Primary Power, Test Methods, Noise Power Ratio, Measurement of G/T.

Unit - V: Satellite Navigation & Global Positioning System:
Radio and Satellite Navigation, GPS Position Location Principles, GPS Time, GPS Receivers and Codes, The C/A Code, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, GPS Receiver Operation, GPS C/A Code Accuracy, Dilution of Precision: HDOP, VDOP, and GDOP, Differential GPS.

TEXT BOOKS:

1. Pratt Timothy, Bostian Charles and Allnutt Jeremy, WSE, Satellite Communications, Wiley Publications, 2nd Edition, 2003.
2. Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud, Satellite Communications Engineering, 2nd Edition, Pearson Publications, 2003.

REFERENCE BOOKS:

1. Richharia, M., Satellite Communications: Design Principles, BS Publications, 2nd Edition, 2003.
2. Agarwal, D.C., Satellite Communication, Khanna Publications, 5th Ed.
3. Raja Rao, K. N., Fundamentals of Satellite Communications, PHI, 2004
4. Roddy Dennis, Satellite Communications, McGraw Hill, 4th Edition, 2009.

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Professional Elective - V
EC812PE: 5G and Beyond

Prerequisites: Analog and Digital Communications, Mobile Communications and Networks

Course Objectives:

1. To understand the basics of wireless networks and its services from 1G to 5G.
2. To acquaint with the operation of LTE network architecture and protocols.
3. To teach the significance of mobility management in next generation networks.
4. To address the 5G spectrum requirements.
5. To know the various Modulation techniques in 5G environment.

Course Outcomes:

1. Understand the different types of wireless standards and its services.
2. Comprehend the architecture of LTE network, protocol architecture and inter working with other RATs.
3. Attain the knowledge about multi-carrier modulations schemes for next generation networks.
4. Analyze the spatial multiplexing schemes and low-complexity receivers to maximize the spectral efficiency.
5. Understand the usage of small cells as tools for network densification.

Course Articulation Matrix

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

Unit - I: Multiple Input Multiple Output (MIMO) Communications:
Spatial Multiplexing, Spatial Diversity, Beamforming in MIMO systems, Hybrid Precoding, 5G Communication Landscape, Related work on 5G.

Unit - II:
Introduction to Mobile Wireless Technology Generations:
5G, WISDOM, GIMVC, Requirements of 5G, standardization of WISDOM, Vision of 5G, WISDOM Concept and Challenges, Cellular D2D Communication, D2D Using Physical Layer Network Coding,
Using FFR and Using Cognitive Radio.

SMNAT: Introduction, Network Architecture and the Process, Implementation of SMNAT for In-Band-D2D and Interoperability with WISDOM, Description of Network elements of SMNAT and Call Flow for Session Establishment.

Unit - III: Radio Wave Propagation for Mm Wave:
Introduction, Large-scale Propagation Channel Effects, Small-Scale Channel Effects, Spatial Characterization of Multipath and Beam Combing, Outdoor Channel Models, Indoor Channel Models.

Unit - IV: Higher layer Design Considerations for Mm Wave:
Challenges when Networking Mm Wave Devices, Beam Adaptation Protocols, Relaying for Coverage Extension, Support for Multimedia Transmission, Multiband considerations, Performance of Cellular networks, Mm Wave Standardization: ECMA-387, IEEE 802.11ad.

Unit - V: BEYOND 2020

Major Challenges Surrounding Future Cyber Security, Users Awareness, Spectrum Related Security Issues in CRNs. Challenges for 2020 and beyond, Future Mobile Technologies, High Altitude Stratospheric Platform Station Systems, Human Bond Communications, CONASENSE.

TEXT BOOKS:

1. Ramjee Prasad, 5G: 2020 and Beyond, River Publishers
2. T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock, Millimetre Wave Wireless Communication, Pearson Education, 2015.

REFERENCE BOOKS:

1. M. Manish, G. Devendra, P. Pattanayak, and N. Ha, 5G and Beyond Wireless Systems PHY Layer Perspective, Springer Series in Wireless Technology
2. M. Vaezi, Z. Ding, and H. V. Poor, Multiple Access techniques for 5G Wireless Networks and Beyond, Springer Nature, Switzerland, 2019.

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Professional Elective - V
EC813PE: Speech and Video Processing

Prerequisite: Digital Image Processing

Course Objectives:

1. Knowledge on speech and video processing techniques
2. Understand basic algorithms of speech analysis and speech recognition.
3. Understand the speech production and perception process.

Course Outcomes:

1. Describe the mechanisms of human speech production systems.
2. Extract the different features from speech signals using MFCC and LFCC methods.
3. Explain basic techniques in digital video processing, including imaging characteristics and sensors.
4. Apply motion estimation on video sequence.
5. Apply object tracking algorithms on video sequence.

Course Articulation Matrix

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

Unit - I:
Speech processing concepts: The speech production mechanism, Discrete time speech signals, Pole-Zero modeling of speech, relevant properties of the fast Fourier transform for speech recognition, convolution, linear and nonlinear filter banks, spectral estimation of speech using DFT. Linear Prediction analysis of speech.

Unit - II:
Speech recognition: Real and Complex Cepstrum, application of cepstral analysis to speech signal, feature extraction for speech, static and dynamic feature for speech recognition, robustness issues, discrimination in the feature space, feature selection, MFCC, LPCC, Distance measures, vector quantization models. Gaussian Mixture model, HMM.

Unit - III:
Basics of Video Processing: Video formation, perception and representation: Principle of color video, video cameras, video display, pinhole model, CAHV model, Camera motion, Shape model, motion model, Scene model, two-dimensional motion models. Three-Dimensional Rigid Motion, Approximation of projective mapping.

Unit - IV:
Motion estimation Techniques: Optical flow, motion representation, motion estimation criteria, optimization methods, pixel-based motion estimation, Block matching algorithm, gradient Based, Intensity matching, feature matching, frequency domain motion estimation, Depth from motion. Motion analysis applications: Video Summarization, video surveillance.

Unit - V:

Object tracking and segmentation: 2D and 3D video tracking, blob tracking, kernel based counter tracking, feature matching, filtering Mosaicing, video segmentation, mean shift based, active shape model, video shot boundary detection. Interframe compression, Motion compensation

TEXT BOOKS:

1. L. Rabiner and B. Juang, Fundamentals of Speech recognition, Prentice Hall signal processing series.
2. A Murat Tekalp, Digital Video processing, Prentice Hall.
3. Thomas F. Quatieri, Coth, Discrete-time speech signal processing: principles and practice.
4. Yao Wang, J. Osternann and Qin Zhang, Video Processing and Communications, Pearson Education.

REFERENCE BOOKS:

1. B.Gold and N. Morgan, “Speech and Audio Signal Processing”, Wiley.
2. Todd R. Reed, “Digital image sequence processing, Compression, and analysis”, CRC Press.
3. Al Bovik, “Handbook of Image and Video processing”, Academic press, second Edition

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Professional Elective - V
CS814PE: Deep Learning

Prerequisite: Artificial Neural Networks

Course Objectives:

1. To introduce the foundations of Artificial Neural Networks.
2. To acquire the knowledge on Deep Learning Concepts.
3. To learn various types of Artificial Neural Networks.
4. To gain knowledge to apply optimization strategies.

Course Outcomes:

1. Ability to understand the concepts of Neural Networks.
2. Ability to select the Learning Networks in modeling real world systems.
3. Ability to use an efficient algorithm for Deep Models.
4. Ability to work on different regularization techniques.
5. Ability to apply optimization strategies for large scale applications.

Course Articulation Matrix

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

Unit – I:
Artificial Neural Networks Introduction, Basic models of ANN, important terminologies, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Back-propagation Network. Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks.

Unit – II:
Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks. Special Networks-Introduction to various networks.

Unit – III:
Introduction to Deep Learning, Historical Trends in Deep learning, Deep Feedforward networks, Gradient-based learning, Hidden Units, Architecture Design, Back-Propagation, and Other Differentiation Algorithms.

Unit – IV:
Regularization for Deep Learning: Parameter norm Penalties, Norm Penalties as Constrained Optimization, Regularization, and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised learning, Multi-task learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, tangent Prop and Manifold, Tangent Classifier.

UNIT – V:
Optimization for Train Deep Models: Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Optimization Strategies and Meta-algorithms.
Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing.

TEXTBOOKS:
1. Deep Learning: An MIT Press Book By Ian Good fellow and Yoshua Bengio and Aaron Courville
2. Neural Networks and Learning Machines, Simon Haykin, 3rd Edition, Pearson Prentice Hall

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Professional Elective - VI
EC815PE: System on Chip Architecture

Prerequisite: Embedded System Design

Course Objectives:

1. To introduce the architectural features of system on chip.
2. To imbibe the knowledge of customization using case studies.

Course Outcomes:

1. Expected to understand SOC Architectural features.
2. To acquire the knowledge on processor selection criteria and limitations.
3. To acquires the knowledge of memory architectures on SOC.
4. To understands the interconnection strategies on SOC.
5. To understand the customization strategies on SOC.

Course Articulation Matrix

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

Unit – I:

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

Unit – II:

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

Unit – III:

Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I , and D – Caches , Multilevel Caches, Virtual to real translation SOC Memory System, Models of Simple Processor – memory interaction.

Unit - IV:

Interconnect Customization: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization:

Unit – V:

Configuration: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

TEXT BOOKS:

1. Computer System Design System-on-Chip by Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
2. ARM System on Chip Architecture – Steve Furber –2nd Ed., 2000, Addison Wesley Professional.

REFERENCE BOOKS:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM
3. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.
4. Radar Principles – Peebles, Jr., P.Z., Wiley, New York, 1998.
5. Principles of Modern Radar: Basic Principles – Mark A. Richards, James A. Scheer, William A. Holm, Yesdee, 2013
6. Radar Handbook - Merrill I. Skolnik, 3rd Ed., McGraw Hill Education, 2008.

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Professional Elective - VI
EC816PE: Wireless Sensor Networks

Prerequisite: Mobile Communications and Networks

Course Objectives

The objectives of this course are to make the student

1. To acquire the knowledge about various architectures and applications of Sensor Networks.
2. To understand issues, challenges and emerging technologies for wireless sensor networks.
3. To learn about various routing protocols and MAC Protocols.
4. To understand various data gathering and data dissemination methods.
5. To Study about design principals, node architectures, hardware and software required for implementation of wireless sensor networks.

Course Outcomes

On completion of this course student will be able to

1. Understand the fundamentals of standard Wireless protocols.
2. Analyze and compare various architectures of Wireless Sensor Networks.
3. Understand Design issues and challenges in wireless sensor networks.
4. Analyze and compare various data gathering and data dissemination methods.
5. Design, Simulate and Compare the performance of various routing and MAC protocol.

Course Articulation Matrix

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

Unit – I:

Wireless LANs and PANs: Introduction, Fundamentals of WLANS, IEEE 802.11 Standards, HIPERLAN Standard, Bluetooth, Home RF.

AD HOC WIRELESS NETWORKS: Introduction, Issues in Ad Hoc Wireless Networks.

Unit – II:

MAC Protocols: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

Unit – III:

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.

Unit – IV:

Transport Layer Protocols: Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

Unit – V:

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

TEXT BOOKS:

1. Siva Ram Murthy. C and Manoj B. S, Ad Hoc Wireless Networks: Architectures and Protocols, PHI, 2004.
2. Jagannathan Sarangapani, Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control, CRC Press.

REFERENCE BOOKS:

1. Toh C. K, Ad-Hoc Mobile Wireless Networks: Protocols & Systems, 1st Ed. Pearson Education.
2. Raghavendra C. S and Krishna M. Sivalingam, Wireless Sensor Networks, Springer, 2004.

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Professional Elective - VI
EC817PE: Pattern Recognition and Machine Learning

Prerequisite: Probability Theory and Linear Algebra

Course Objectives:

The student will be able to
1. Understand the mathematical formulation of patterns.
2. To study the various linear models.
3. Understand the basic classifiers.
4. Can able to distinguish different models.

Course Outcomes:

1. Learn the basics of pattern classes and functionality.
2. Construct the various linear models.
3. Understand the importance kernel methods.
4. Learn the graphical models.
5. Learn the Markov and Mixed models.

Course Articulation Matrix

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

Unit - I: Introduction to Pattern recognition

Mathematical Formulation and Basic Functional Equation, Reduction of Dimensionality, Experiments in Pattern Classification, Backward Procedure for Both Feature Ordering- and Pattern Classification, Suboptimal Sequential Pattern Recognition, Nonparametric Design of Sequential Pattern Classifiers, Analysis of Optimal Performance and a Multiclass Generalization.

Unit - II: Linear Models

Linear Basis Function Models -Maximum likelihood and least squares, Geometry of least squares , Sequential learning, Regularized least squares, Multiple outputs , The Bias-Variance Decomposition, Bayesian Linear Regression -Parameter distribution, Predictive, Equivalent, Bayesian Model Comparison, Probabilistic Generative Models-Continuous inputs , Maximum likelihood solution, Discrete features, Exponential family, Probabilistic Discriminative Models -Fixed basis functions, Logistic regression, Iterative reweighted least squares, Multiclass logistic regression, Probit regression, Canonical link functions.

Unit - III: Kernel Methods

Constructing Kernels, Radial Basis Function Networks - Nadaraya-Watson model, Gaussian Processes -Linear regression revisited, Gaussian processes for regression, Learning the hyper parameters, Automatic relevance determination, Gaussian processes for classification, Laplace approximation, Connection to neural networks, Sparse Kernel Machines-Maximum Margin.

Classifiers, Overlapping class distributions, Relation to logistic regression, Multiclass SVMs, SVMs for regression, Computational learning theory, Relevance Vector Machines- RVM for regression, Analysis of sparsity, RVM for classification.

Unit - IV: Graphical Models

Bayesian Networks, Example: Polynomial regression, Generative models, Discrete variables, Linear-Gaussian models, Conditional Independence- Three example graphs, Desperation, Markov Random Fields -Conditional independence properties, Factorization properties, Illustration: Image de-noising, Relation to directed graphs, Inference in Graphical Models- Inference on a chain, Trees, Factor graphs, The sum-product algorithm, The max-sum algorithm, Exact inference in general graphs, Loopy belief propagation, Learning the graph structure.

Unit - V: Mixture Models and EM algorithm

K-means Clustering-Image segmentation and compression, Mixtures of Gaussians-Maximum likelihood, EM for Gaussian mixtures, An Alternative View of EM- Gaussian mixtures revisited, Relation to K-means, Mixtures of Bernoulli distributions, EM for Bayesian linear regression, The EM Algorithm in General, Combining Models- Tree-based Models, Conditional Mixture Models- Mixtures of linear regression models, Mixtures of logistic models, Mixtures of experts.

TEXT BOOKS:

1. Fu, K. S., Sequential methods in Pattern Recognition and Machine Learning- Academic Press, volume no.52.
2. Bishop, C., Pattern Recognition and Machine Learning, Springer, 2006.

REFERENCE BOOKS:

1. Richard O. Duda. Peter E. Hart. David G. Stork, Pattern Classification, John Wiley & Sons, 2nd Ed., 2001.
2. Hastie, Trevor, The elements of Statistical Learning- Robert Tibshirani, Jerome H. Friedman, Springer, 2nd Ed., 2009.

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Professional Elective - VI
EC818PE: Low Power VLSI Design

Prerequisite: CMOS VLSI Design

Course Objectives:

1. The student will be able to understand the Fundamentals of Low Power VLSI Design.
2. In this course, students can study low-Power Design Approaches, Power estimation and analysis.
3. Another main object of this course is to motivate the graduate students to study and to analyze the Low-Voltage Low-Power Adders, Multipliers.
4. The concepts of Low-Voltage Low-Power Memories and Future Trend and Development of DRAM.

Course Outcomes:

1. Understand the concepts of low power.
2. Apply different circuit techniques to manage the leakage currents.
3. Apply the knowledge of architectural approaches.
4. Analyze and Design Low-Voltage Low-Power combinational circuits.
5. Analyze the functionality of Low- voltage low -power memories.

Course Articulation Matrix

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

Unit – I:

Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

Unit – II:

Low-Power Design Approaches: Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures and Mask level Measures.

Unit – III:

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles.

Unit – IV:

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

Unit – V:

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

TEXT BOOKS:

1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011.
2. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering.

REFERENCE BOOKS:

1. Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press
2. Anantha Chandrakasan, "Low Power CMOS Design", IEEE Press, /Wiley International, 1998.
3. Kaushik Roy, Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", John Wiley, & Sons, 2000.
4. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002.
5. Bellamour, M. I. Elamasri, "Low Power CMOS VLSI Circuit Design", A Kluwer Academic Press.
6. Siva G. Narendran, Anatha Chandrakasan, "Leakage in Nanometer CMOS Technologies", Springer, 2005.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
Open Elective -I
EC621OE: Fundamentals of Internet of Things

Prerequisite: Embedded System Design

Course Objectives:

1. Understand the concepts of Internet of Things and able to build IoT applications
2. Learn the programming and use of Arduino and Raspberry Pi boards.
3. Known about data handling and analytics in SDN

Course Outcomes:

1. Understand the role of IoT and its components.
2. Known basic protocols in sensor networks.
3. Program and configure Arduino boards for various designs.
4. Python programming and interfacing for Raspberry Pi.
5. Design IoT applications in different domains.

Course Articulation Matrix

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

Unit – I:
Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.

Unit – II:
Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.

Unit – III:
Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi.

Unit – IV:
Implementation of IoT with Raspberry Pi, Introduction to Software defined Network (SDN), SDN for IoT, Data Handling and Analytics.

Unit – V:
Cloud Computing, Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT. Case Study: Agriculture, Healthcare, Activity Monitoring.

TEXT BOOKS:

1. Madisetti, Vijay and Bahga, Arshdeep, Internet of Things (A Hands-on-Approach), VPT, 1st Edition, 2014.
2. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Apress Publications, 1st Edition, 2013.
3. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011.

REFERENCE BOOKS:

1. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks:Theory and Practice"
2. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress, 2013.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
Open Elective - I
EC622OE: Principles of Signal Processing

Prerequisite: Vector Calculus

Course Objectives:

1. To give the basics of Signals and Systems required for all Engineering related courses.
2. To provide the basic characteristics of LTI systems.
3. To provide knowledge on signal transmission requirements.
4. To give basic understanding of signal statistical properties and noise source concepts.

Course Outcomes:

1. Differentiate various signal functions.
2. Understand the characteristics of linear time invariant systems.
3. Understand the concepts of sampling theorem and signal to noise ratios.
4. Determine the Spectral and temporal characteristics of Signals.
5. Understand the different sources of Noise.

Course Articulation Matrix

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

Unit – I: Signal Analysis: Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

Unit – II: Signal Transmission through Linear Systems Linear System: Impulse response, Response of a Linear System, Linear Time Invariant(LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Convolution and Correlation of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution.

Unit – III: Sampling theorem: Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to Band Pass Sampling.

Unit – IV: Temporal characteristics of signals: Concept of Stationarity and Statistical Independence, First-Order Stationary Processes, Time Averages and Ergodicity, Cross Correlation and Auto Correlation of Functions, Properties of Correlation Functions, Cross-Correlation Function and Its Properties, Power Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function.

Unit – V: Noise sources: Resistive/Thermal Noise Source, Arbitrary Noise Sources, Effective Noise Temperature, Noise equivalent bandwidth, Average Noise Figures, Average Noise Figure of cascaded networks, Narrow Band noise, Quadrature representation of narrow band noise & its properties.

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, B.S. Publications, 2013.
2. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, TMH, 4 th Ed., 2001.

REFERENCE BOOKS:

1. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.
2. Fundamentals of Signals and Systems - Michel J. Robert, MGH, 2008.
3. Random Processes for Engineers-Bruce Hajck, Cambridge unipress, 2015
4. Statistical Theory of Communication – S.P Eugene Xavier, New Age Publications, 2003.

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B.Tech. in Electronics and Communication Engineering
VI Semester Syllabus
Open Elective - I
EC623OE: Railway Signaling

Prerequisite: Signals and Systems, Analog & Digital Communications

Course Objectives:

1. To introduce general railway signaling principles.
2. To understand the principles of railway traction system.
3. To understand various systems of train working, interlocking features.
4. To know the knowledge on monitoring and control of Railway safety equipment.
5. To understand supervisory aspects of safety equipment.

Course Outcomes:

After completion of the course, students will be able to:

1. Acquire knowledge on general signaling principles.
2. Acquire knowledge on principles of railway traction system.
3. Understand various systems of train working, interlocking features.
4. Acquire the knowledge on monitoring and control of Railway safety equipment.
5. Acquire the knowledge on supervisory aspects of safety equipment.

Course Articulation Matrix

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

Unit 1: General Signaling - I

Opening of Railways: Introduction to Railway signaling, Duties of Commissioners, Sanction to Open Railway for Public Carriage of Passengers, Requirements & Recommendations for Signaling and Interlocking Installations, Catechism for Signaling and Interlocking Installations, for 25KV AC, layouts : Isolation, Ruling gradients, Slip, Catch sidings.

Unit II: General Signaling - II

Schedule of Dimensions: General, Station Yards, Electric Traction 25KV AC 50 Cycles, Clearances required for 25KV single phase AC Electric Traction, Standard and Moving Dimension Diagrams.

General Rules: Definitions, Type of Signals; Adequate Distance, System of Working, Absolute Block system, Automatic Block System, Block Working, Level Crossings, Station Working Rules.

Unit III: Railway Signaling

Station Layouts: MACLS, Signal Aspects, Location of Signals; Station Layouts: Single Line, Double Line, 2-Road, 3-Road, 4-Road.

Signaling Elements: Level Crossings, Cables, Power Supply Arrangements, Track Circuits & Axle Counters, Block Instruments, Point machines, Relays, Relay Interlocking; and Electronic Interlocking, Requirement of Signaling in 25KV AC Electrified Area.

Signaling Interlocking Plan: Essentials of Interlocking, Train Detection, Level Crossing Gate, Point Switching, Signal, Block Control, Aspect Control Chart.

Unit IV: Signaling Equipment-I

Details of relays, Signal Cables, Signals, Control Panel & Operation – Safety features, Working, Details of Point Machines – Components, Working, Circuit Progression, Testing, Safety features, Level Crossing Gates – Working, Circuit Progression, Safety features Details of Track Circuits, Axle Counters – Single section, Multi-section, Subsystems; Working and Application.

Unit V: Signaling Equipment-II

Details about Block Instruments - Types, Working, Circuit Progression safety features, Data Acquisition System - Interfaces, Fault Logic. Details of Integrated Power Supply, CLS Panel, Lightning and Surge Protection.

Interactive experiential sessions will be conducted at IRISET on the following aspects.

- Relays, Signal Cables. Signals, Control Panel & Operation,
- Point Machines - Components, Working, Circuit Progression, Testing.
- Level Crossing Gates - Working, Circuit Progression.
- Track Circuits, Axle Counters - Single section, Multi-section, Subsystems;
- Working and Application.
- Block Instruments - Types, Working, Circuit Progression.
- Data Acquisition System - Interfaces, Fault Logic.
- Integrated Power Supply, CLS Panel, Lightning and Surge Protection.

Text Books:

1. KAVACH - Cab Signalling & Automatic Train Protection System for Digital Railways by Lalit Kumar Mansukhani, Chandra Kishore Prasad, et al. | 1 January 2023.
2. Signal Engineering by Kavach.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Open Elective - II
EC721OE: Computer Organization and Architecture

Prerequisite: Digital Logic Design

Course Objectives:

1. The purpose of the course is to introduce principles of computer organization and the basic architectural concepts.
2. It begins with basic organization, introduces simple register transfer language to specify various computer operations, design and programming of a simple digital computer.
3. Topics include computer arithmetic, instruction set design, microprogrammed control unit, pipelining and vector processing, memory organization and I/O systems, and multiprocessors.

Course Outcomes:

1. Explain the computer organization components, instructions and addressing modes.
2. Demonstrate arithmetic operations.
3. Interpret the basic of MIPS implementation and pipelining.
4. Outline the concept of parallelism and multi-core processor.
5. Classify the memory technologies and I/O systems.

Course Articulation Matrix

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

Unit - I: Digital Computers, Basic Computer Organization and Design

Digital Computers: Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture. Register Transfer Language and Micro operations: Register Transfer language, Register Transfer, Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.

Unit - II: Central Processing Unit

General Register Organization, Instruction codes, Computer Registers, Instruction cycle, Addressing Modes, Computer instructions: Data Transfer and Manipulation, Program Control.

Unit - III: Data Representation, Computer Arithmetic

Data Representation: Data Types, Complements, Fixed Point Representation, Floating Point Representation. Computer Arithmetic: Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating – Point Arithmetic Operations. Decimal Arithmetic Unit, Decimal Arithmetic Operations.

Unit - IV: Input-Output Organization

Input-Output Organization: Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer: Programmed-controlled I/O, Interrupt-initiated I/O, Direct memory Access, Priority Interrupt.

Unit - V: Memory Organization

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory, Virtual memory.

TEXT BOOKS:

1. Moris Mano, Computer System Architecture, Pearson/PHI, Third Edition.

REFERENCE BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, McGraw Hill, 5th Edition, 2014.
2. William Stallings, Computer Organization and Architecture, Pearson/PHI, Sixth Edition.
3. Andrew, S. Tanenbaum, Structured Computer Organization, PHI/Pearson, 4th Edition.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Open Elective - II
EC722OE: Data Communications and Networking

Prerequisites: Principles of Communication systems, Digital logic design

Course Objectives:

1. To introduce the Fundamentals of data communication networks.
2. To demonstrate the Functions of various protocols of Data link layer.
3. To demonstrate Functioning of various Routing protocols.
4. To introduce the Functions of various Transport layer protocols.
5. To understand the significance of application layer protocols.

Course Outcomes:

1. Know the Categories and functions of various Data communication Networks.
2. Design and analyze various error detection techniques.
3. Demonstrate the mechanism of routing the data in network layer.
4. Know the significance of various Flow control and Congestion control Mechanisms.
5. Know the Functioning of various Application layer Protocols.

Course Articulation Matrix

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

Unit - I: Introduction to Data Communications

Components, Data Representation, Data Flow, Networks- Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture,

Unit - II: Data Link Layer

Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noisy less Channels and Noisy Channels, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols. 802.11 MAC Protocol, IEEE 802.11 Frame.

Unit - III: The Network Layer

Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol (IP): Forwarding and Addressing in the Internet- Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6

Unit - IV: Transport Layer

Introduction and Transport Layer Services: Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined

Reliable Data Transfer Protocols, Go- Back-N(GBN), Selective Repeat(SR), Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control, TCP Congestion Control

Unit - V: Application Layer

Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Web and HTTP, File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.

TEXT BOOKS:

1. James, Kurose F., Keith W., Computer Networking A Top-Down Approach, Pearson 6th Edition.
2. Behrouz A. Forouzan, Data Communications and Networking, McGraw-Hill Education, 4th Edition.

REFERENCE BOOKS:

1. Trivedi, Bhusan, Data communication and Networks, Oxford university press, 2016
2. Andrew S. Tanenbaum, Computer Networks, Pearson Education, 4th Edition.
3. William A. Shay, Understanding Communications and Networks, Cengage Learning, 3rd Edition.

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B.Tech. in Electronics and Communication Engineering
VII Semester Syllabus
Open Elective - II
EC723OE: Automatic Train Protection (ATP) System - Kavach

Prerequisites: Railway Signaling, Control Systems.

Course Objectives:

1. To understand fundamentals about the Train Protection Systems.
2. To understand the subsystems of Kavach.
3. To understand the speed profile of Locomotive.
4. To understand the design aspects of Kavach.
5. To familiarize about deployment of Kavach.

Course Outcomes:

After completion of the course, students will be able to:

1. Identify fundamental aspects of Train Protection Systems.
2. Articulate the subsystems of Kavach.
3. Illustrate the speed profile of Locomotive.
4. Analyze the design aspects of Kavach.
5. Explore the precepts of deployment of Kavach.

Course Articulation Matrix

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

Unit I: Introduction to Train Protection Systems - I

Train Protection Systems: Auxiliary Warning Systems, European Train Control Systems Communication Based Interlocking System, Spot and Continuous Relay of Information

Working: Overview of Kavach and its Working, Features, Subsystems, Communication Interfaces, Signaling Interfaces.

Unit II: Introduction to Train Protection Systems - II

Subsystem; Onboard Kavach: Driver Machine Interlocking, Braking Interface, Radio Equipment, Onboard Computer, Transponder Receiver, Odometry, GNSS, GPRS, GSM.

Subsystem; Stationary Kavach: Station Kavach, Track Side Equipment, Signaling Interface, Radio & Tower, GNSS, Transponders, Network Monitoring System.

Unit III: Speed Profiles of Locomotive

Location Referencing – Train position, Modes of Onboard subsystem, Train Characteristics, Mode Transitions, Braking Curves, Speed Profiles, Speed Limits, Speed Monitoring, Target Speed, Target Distance, Movement Authority, Communication Protocols, Key Management System (KMS), Messages & Language.

Unit IV: Design - Kavach

Survey, Assessment & Estimation: Station Layout, Radio Signal Strength, Tower Location, Power Requirement, Cable Survey, Loco Fitment Survey.

Station Design: Kavach Scheme Plan, Kavach Control Table, Signaling Interface Diagram, Connectivity Plans for Remote Interface Units (RIUs), Power Supply Plan.

Tower Design: Soil Testing, Foundation design, Super Structure Design.

Unit V: Installation, Deployment & Testing

Stationary Kavach: Interlocking Interface, RFID Tags, Station Master Operation Console Indication Panel (SM_OCIP), GPS/GSM Antennas, Pre-commissioning Checklist, Testing.

Onboard Kavach: DMI, Speed Sensors, RFID Reader, Onboard Computer, Brake Interface Unit. Pre-commissioning Checklist, Testing.

Interactive experiential sessions will be conducted at IRISET on the following aspects.

1. Test bench, Preparation and deployment of Stationary Kavach Data: Configuration involving Topographical Information – Arrangement of Signals/Markers, Transponders, Inter-signal Distances, Signal Routes, Gradients, Speed Restrictions
2. Verification and Validation of Onboard Data – Ceiling.

Text Book:

1. KAVACH - Cab Signalling & Automatic Train Protection System for Digital Railways by Lalit Kumar Mansukhani, Chandra Kishore Prasad, et al. | 1 January 2023.
2. KAVACH INDIAN RAILWAY AUTOMATIC TRAIN PROTECTION SYSTEM by Kavach.

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Open Elective - III
EC821OE: Introduction to Embedded System Design

Prerequisite: Microprocessors and Microcontrollers.

Course Objectives:

1. To provide an overview of principles of Embedded System.
2. To provide an overview of components of Embedded System
3. To provide a clear understanding of role of firmware, operating systems in correlation with hardware systems.

Course Outcomes:

1. Expected to understand the selection procedure of processors in the embedded domain.
2. Understand programming of 8051 microcontroller.
3. Design procedure of embedded firm ware.
4. Expected to visualize the role of real-time operating systems in embedded systems.
5. Expected to evaluate the correlation between task synchronization and latency issues

Course Articulation Matrix

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

Unit – I: Introduction to Embedded Systems

Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit – II: Typical Embedded System

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators- Light Dependent Resistor, Thermistor, Photo Transistor, Light Emitting Diode, Relays, Stepper Motor. Communication Interfaces: SPI, I2C, UART, Onboard and External Communication Interfaces: WiFi, Bluetooth, ZigBee, USB.

Unit – III: Other System Components of Embedded system :

Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches: Super Loop Based Approach and OS based Approach, Development Languages: Assembly Language and High level Language.

Unit – IV: RTOS Based Embedded System Design :

Operating System Basics, Types of Operating Systems-GPOS, RTOS, Tasks, Task States, Task Control Block, Process and Threads, Multiprocessing and Multitasking, Task Scheduling- Non-Preemptive Scheduling (FCFS, LCFS, SJF, Priority Based), Preemptive Scheduling (FCFS, LCFS, SJF, Priority Based, Round-Robin).

Unit – V: Task Communication:
Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Communication/Synchronization Issues: Racing, Deadlock, Livelock, Starvation, Task Synchronization Techniques: Mutual exclusion through busy waiting/ Spin lock, Mutual exclusion through Sleep and Wakeup, Semaphores, Device Drivers, Methods to Choose an RTOS.

TEXT BOOKS:

1. Shibu K.V, "Introduction to Embedded Systems", McGrawHill.
2. RajKamal, "Embedded Systems", TMH.

REFERENCE BOOKS:

1. Frank Vahid, Tony Givargis, "Embedded Systems Design: A Unified Hardware / Software Introduction", John & Wiley Publications, 2002.
2. Lyla B. Das, "Embedded Systems", Pearson, 2013.
3. David E. Simon, "An Embedded Software Primer", Pearson Education

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B.Tech. in Electronics and Communication Engineering
VIII Semester Syllabus
Open Elective - III
EC822OE: Digital Image Processing

Prerequisite: Digital Signal Processing

Course Objectives:

1. To provide a approach towards image processing and introduction about 2D transforms.
2. To expertise about enhancement methods in time and frequency domain.
3. To expertise about segmentation and compression techniques.
4. To understand the Morphological operations on an image.

Course Outcomes:

1. Explore the fundamental relations between pixels and utility of 2-D transforms in image processer.
2. Understand the enhancement processes on an image.
3. Understand the segmentation and restoration processes on an image.
4. Implement the various Morphological operations on an image.
5. Understand the need of compression and evaluation of basic compression algorithms.

Course Articulation Matrix

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

Unit - I:

Digital Image Fundamentals & Image Transforms: Digital Image fundamentals, Sampling and quantization. Relationship between pixels, Image Transforms: 2-D FFT. Properties, Walsh transform, Hadamard Transform, Discrete Cosine Transform, Haar transform, Slant transform, Hotelling transform.

Unit - II:

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighbourhood criterion, Median Filter, Spatial Domain High-Pass Filtering.

Image Enhancement (Frequency Domain): Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

Unit - III:

Image Restoration: Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

Unit - IV:

Image Segmentation: Detection of Discontinuities, Edge Linking and boundary detection, thresholding, Region oriented segmentation.

Morphological Image Processing: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

Unit - V:

Image Compression: Types of redundancies, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 3rd Edition, Pearson, 2008.
2. S Jayaraman, S Esakkirajan, T Veerakumar, Digital Image Processing, TMH, 2010.

REFERENCE BOOKS:

1. ScotteUmbaugh, Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools , 2nd Ed, CRC Press, 2011.
2. Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, Digital Image Processing using MATLAB, 2nd Edition, TMH, 2010.
3. Somka, Hlavac, Boyle, Digital Image Processing and Computer Vision, Cengage Learning (Indian edition) 2008.