Ph.D. Electronics & Communication Engineering Scholars

All research scholars admitted to the Doctor of Philosophy (Ph.D.) program in Electronics & Communication Engineering under the Faculty of Engineering are required to select any one subject from the list of courses offered under PHD-102.

These subjects have been designed to strengthen the scholar's foundational and research-oriented understanding in specialized areas of Civil Engineering. The selected subject should align with the scholar's proposed area of research and must be approved by the Supervisor and the Departmental Research Committee (DRC).

The list of subjects offered under PHD-102 by the Department of Electronics & Communication Engineering is as follows:

S. No.	Faculty	Department / Branch	Subject Code	Name of Subject
1	Engineering & Technology	Electronics & Communication Engineering	PHD102EC01	Advanced Digital Signal Processing
2	Engineering & Technology	Electronics & Communication Engineering	PHD102EC02	Advanced Digital Communication
3	Engineering & Technology	Electronics & Communication Engineering	PHD102EC03	Digital Image Processing
4	Engineering & Technology	Electronics & Communication Engineering	PHD102EC04	Optical Integrated Networks
5	Engineering & Technology	Electronics & Communication Engineering	PHD102EC05	Advanced Computer Communication
6	Engineering & Technology	Electronics & Communication Engineering	PHD102EC06	Embedded Microcontroller
7	Engineering & Technology	Electronics & Communication Engineering	PHD102EC07	Wireless Networks
8	Engineering & Technology	Electronics & Communication Engineering	PHD102EC08	Advanced Wireless Communication
9	Engineering & Technology	Electronics & Communication Engineering	PHD102EC09	Low Power VLSI Circuits
10	Engineering & Technology	Electronics & Communication Engineering	PHD102EC10	Image and Video Processing

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Engineering & Technology	Electronics & Communication Engineering	Advanced Digital Signal Processing	PHD102EC01

Course Outcomes:

1. Analyze discrete-time systems using various realization structures and state-space representations.
2. Evaluate random processes and spectral estimation methods in digital signal analysis.
3. Apply parametric and non-parametric methods for power spectrum estimation.
4. Design and implement sampling rate converters and multirate signal processing systems.
5. Develop and simulate adaptive filters for applications like noise cancellation and echo suppression.

Unit-wise Content distribution

Unit	Contents
Unit-I	Structure for realization of discrete time system: Structure for IIR, state space system analysis and structures representation of numbers-fixed point representation, binary floating point representation, errors resulting from rounding and truncation, quantization of filter coefficient.
Unit-II	Discrete Random Process Expectations variance Co-Variance Scalar Product, Energy of Discrete Signals – Parsevals Theorem, Wiener Khintchine Relation, Power Spectral Density, periodogram- Sample Auto correlation Sum Decomposition Theorem, Spectral Factorization Theorem, Discrete Random Signal Processing by Linear Systems. Simulation of White Noise, Low Pass filtering of White Noise.
Unit-III	Non-Parametric methods-correlation Method, Co-Variance estimator, Performance analysis of Estimators Unbiased, Consistent Estimators Periodogram Estimator-Barlett Spectrum estimation Welch Estimation, a Model based Approach MA, ARMA Signal Modelling – Parameter Estimation using Yule Walker Method.
Unit-IV	Mathematical Description of change of sampling rate, interpolation and decimation continuous time model – Direct digital domain approach – decimation by an integer factor – interpolation by integer factor –single and multistage realization , poly phase realization, application to sub band coding –wavelet transform and filter bank implementation of wavelet expansion of signals.
Unit-V	Adaptive filters based on steepest descent method ,Window Hoff LMS adaptive algorithm – adaptive channel equalization , adaptive echo chancellor – adaptive noise cancellation ,RLS adaptive filters –exponentially weighted RLS-sliding window RLS simplified IIR LMS adaptive filter.

Textbooks/References:

1. *Proakis and Manolakis: Digital Signal Processing, Pearson Education.*
2. *Monson Hayes: Statistical Digital Signal Processing and Modeling, Wiley India Pvt. Ltd.*
3. *Spocles Orfandis: Optimum Signal Processing, TMH.*

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Engineering & Technology	Electronics & Communication Engineering	Advanced Digital Communication	PHD102EC02

Course Outcomes:

1. Compute and analyze power spectral density for various digital modulation schemes.
2. Design optimal signaling schemes for channels with ISI and AWGN.
3. Evaluate performance of coherent and non-coherent detection techniques.
4. Examine modulation techniques like QAM, QPSK, and continuous phase modulations.
5. Analyze block-coded communication systems and apply Shannon's channel coding principles.

Unit-wise Content distribution

Unit	Contents
Unit-I	Power spectral density of digital modulations: Power spectral density of a synchronous data pulse stream generated by a binary, zero mean WSS sequence, cyclostationary sequence, power spectral density of a generalized M-ary markov source, NRZ baseband signaling, RZ baseband signaling, biphase baseband signaling, delay modulation or miller coding.
Unit-II	Digital signaling over a channel with intersymbol, interference and Additive White Gaussian Noise (AWGN) Signal design for band limited channels, optimum demodulation for ISI and additive white gaussian noise, linear equalization, feedback equalization.
Unit-III	Detection: Optimum demodulation for signals with random phase in AWGN, non-coherent detection of binary signal in an AWGN channel, non-coherent detection of M-ary orthogonal signal in an AWGN channel.
Unit-IV	Demodulation and detection of digital modulations 1-Q modulations: unbalanced QPSK, Quadrature Amplitude Modulation (QAM), Quadrature biorthogonal modulation, Continuous phase modulation (CPM): Continuous Phase Frequency Modulation (CPFM), Continuous Phase FSK Minimum Shift Keying (MSK), Sinusoidal Frequency Shift Keying (SFSK), Continuous Phase FPM and QFPM.
Unit-V	Block Coded digital communications: Block coded digital communication system architecture, performance of block coded communication systems, special types of binary block codes: orthogonal binary codes, bi-orthogonal block codes, trans-orthogonal block codes; ensemble of block coded modulation system: performance of the ensemble of binary coded system using BPSK modulation. Q-ary coded M-PSK, shannons channel coding theorem.

Textbooks/References:

1. *Proakis: Digital Communication, TMH*
2. *Taub and Schilling: Principles of Communication Systems, TMH.*
3. *Simon : Digital Communication Techniques, PHI Learning.*
4. *Skylar : Digital Communication, Pearson Education.*

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Engineering & Technology	Electronics & Communication Engineering	Digital Image Processing	PHD102EC03

Course Outcomes:

1. Apply mathematical models for image representation and 2D signal analysis.
2. Implement various image transformation techniques for enhancement and restoration.
3. Design algorithms for image enhancement, filtering, and edge detection.
4. Develop restoration algorithms using Wiener and inverse filtering methods.
5. Implement image compression techniques and reconstruction algorithms from projections.

Unit-wise Content distribution

Unit	Contents
Unit-I	Continuous and discrete images and systems : Light, Luminance, Brightness and Contrast, Eye, The Monochrome Vision Model, Image Processing Problems and Applications, Vision Camera, Digital Processing System, 2-D Sampling Theory, Aliasing, Image Quantization, Lloyd Max Quantizer, Dither, Color Images, Linear Systems and Shift Invariance, Fourier Transform, Z- Transform Matrix Theory Results, Block Matrices and Kronecker Products.
Unit-II	Image transforms : 2-D Orthogonal and Unitary transforms, 1-D and 2-D DFT, Cosine, Sine, Walsh, Hadamard, Haar, Slant, Karhunen- loeve, Singular Value Decomposition Transforms.
Unit-III	Image enhancement : Point Operations – contrast stretching, clipping and thresholding density slicing, Histogram equalization, modification and specification, Spatial operations- spatial averaging, low pass, high pass, band pass filtering, direction smoothing, median filtering, generalized cepstrum and homomorphic filtering, edge enhancement using 2-D IIR and FIR filters, color image enhancement.
Unit-IV	Image restoration : Image observation models, sources of degradation, inverse and Wiener filtering, geometric mean filter, non linear filters, smoothing splines and interpolation, constrained least squares restoration.
Unit-V	Image data compression and image reconstruction from projections : Image data rates, pixel coding, predictive, techniques transform coding and vector DPCM, Block truncation coding, wavelet transform coding of images, color image coding. Random transform, back projection operator, inverse random transform, back projection algorithm, fan beam and algebraic restoration techniques.

Textbooks/References:

1. *Anil Jain: Fundamentals of Digital Image Processing, PHI Learning.*
2. *Sid Ahmed: Image Processing, TMH.*
3. *Gonzalaz and Wintz: Digital Image Processing, Pearson Education.*
4. *William Pratt : Digital Image Processing.*

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Engineering & Technology	Electronics & Communication Engineering	Optical Integrated Networks	PHD102EC04

Course Outcomes:

1. Analyze fabrication and integration of micro-optical systems for photonic networks.
2. Design and evaluate various optical and fiber sensors for industrial applications.
3. Apply interferometric and holographic techniques in optical signal processing.
4. Assess theoretical limits of optical components in communication systems.
5. Examine ultrafast optical pulse processing and high-speed reflectometry techniques.

Unit-wise Content distribution

Unit	Contents
Unit-I	Components for information optics & photonics: Introduction, fabrication techniques for micro optical systems: fabrication methods for optical board level interconnect. Micro optical components for board level optical interconnect: Out-of-plane couplers for optical waveguides in standard FR4 PCBs, 2D single mode fiber array couplers, Intra MCM interconnect module. Fabry Perot model & photonic crystal cavities, recipes for high-Q Fabry perot resonators.
Unit-II	Optical sensors: Optical sensors without waveguide: optical speed sensor, optical shaft encoder, Laser based sensors, Laser for alignment of structures, distance measurement, Laser flaw detection system, Laser dimensional gauge, Laser Doppler velocimeter. Optical sensors with waveguides or optical fiber sensors (OFS): OFS based on intensity modulation: moving reflector type, moving mask type, refractive index modulation type, microbending type. OFS based on phase modulation, OFS based on wavelength modulation, OFS based on frequency modulation, OFS based on polarization modulation, voltage sensor based on Pockel's effect, OFS based on scattering modulation, OFS based on evanescent electric field modulation.
Unit-III	OFS requiring special processing: Interferometry, 2D optical imaging: Photography(basic triangulation method, passive triangulation method, active triangulation method, high speed photography) & Videography, Imaging & Image processing, Optical fiber imaging, optical signal processing- Optical wheatstone bridge, Ratiometric measurement, Interferometric technique, Holography & its mathematical analysis. Applications of Holography: spectroscopy, UV analyzer, IR analyzer, Near IR analyzer. Comparison of Absorption spectrometers, Introduction to integrated optics.
Unit-IV	Limits to optical components Mathematical approach: communication modes, new theorem for strong or multiple scattering, limit to the performance of linear optical components: Explicit limit for 1D systems, slow light limit, limit to dispersion of pulses.

Unit-V	Optical processing with longitudinally decomposed ultrashort optical pulses: Introduction, longitudinal spectral decomposition: theoretical description, practical realization, optical pulse shaping: operating principle, experimental demonstration, distortion from higher order dispersion, waveform detection. High speed optical reflectometry:Introduction, experimental demonstration.

Textbooks/References:

1. *Friberg & Dandliker: Advances in information optics & photonics, PHI Learning.*
2. *Kopeika: System engineering approach to imaging, PHI Learning.*
3. *Shamir: Optical systems & processes, PHI Learning*
4. *Jha: Fiber optic technology: applications to commercial, industrial, military, & space optical systems, PHI Learning.*

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Engineering & Technology	Electronics & Communication Engineering	Advanced Computer Communication	PHD102EC05

Course Outcomes:

1. Compare and analyze OSI and TCP/IP network architectures and protocols.
2. Design and evaluate performance of wired and wireless LAN systems.
3. Implement and secure network communication using IPv6 and VPN protocols.
4. Apply TCP, UDP, and related protocols for reliable and real-time communication.
5. Analyze multimedia networking and real-time data transfer over IP-based systems.

Unit-wise Content distribution

Unit	Contents
Unit-I	Review of concepts of Data Communication and Networks. Review of the OSI model, features and functions of different layers, TCP/IP architecture, differences between two models.
Unit-II	Local Area Networks (LAN): Background, topologies and transmission media, LAN protocol architecture, bridges, switches, High speed LAN, Ethernet, Fast Ethernet, Gigabit Ethernet, Token Bus and Token Ring LAN, FDDI.
Unit-III	Wireless LAN (IEEE 802.11): Wireless LAN technology, IEEE 802.11: architecture and services, medium access control, physical layer, security considerations. Internetwork Protocols (IP) Basic protocol function, principles of internetworking, internet protocol IPv6 virtual private network and IP security, multicasting, routing protocols, integrated services architecture, differentiated services, service level agreements, IP performance metrics.
Unit-IV	Transport Protocols Connection oriented transport control mechanisms, Transport Control Protocol (TCP), TCP congestion control, User Datagram Protocol (UDP). Network Security: Security requirements and attacks, confidentiality with conventional encryption, message authentication and hash functions, public key encryption and digital signatures, secure socket layer and transport layer security, IPv4 and IPv6 security, Wi-Fi access.
Unit-V	Internet Applications Electronic Mail: SMTP and MIME, Network management: SNMP, Internet Directory Service: DNS, Web access: HTTP. Multimedia: audio and video compression, real time traffic, voice over IP and multimedia support, Real Time Transport Protocol (RTP).

Textbooks/References:

1. *Stallings: Data and Computer Communications, PHI learning.*
2. *Gupta: Data Communications and Computer Networks, PHI Learning.*
3. *Tannenbaum: Computer Networks, Pearson Education.*

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Engineering& Technology	Electronics & Communication Engineering	Embedded Microcontroller	PHD102EC06

Course Outcomes:

1. Distinguish between microprocessor, microcontroller, and embedded processor architectures.
2. Program and interface 8051/8031 microcontrollers for control applications.
3. Develop embedded control systems integrating sensors, actuators, and external devices.
4. Design applications using 16-bit and 32-bit ARM-based microcontrollers.
5. Utilize modern IDE tools for developing and debugging embedded applications.

Unit-wise Content distribution

Unit	Contents
Unit-I	Review of 16-bit microprocessor 8086, difference between microprocessor and microcontroller and embedded processor. Types of microcontrollers, examples of some popular microcontrollers, selection criteria of a microcontroller, applications of microcontrollers, basic processing units, microcontroller on-chip resources.
Unit-II	Intel 8051/8031 family microcontroller: Architecture and register organization of 8051, ATMEL 89c51, 8051 pins, 8051 ports, internal and external memory, counters and timers, serial communication, addressing modes, Internal and external interrupts, routine interrupt and interrupt service routine, interrupt handling structure of an MCU, interrupt latency and interrupt deadline, multiple sources of interrupts, enabling and disabling of the sources, polling.
Unit-III	Interfacing of 8051: Interfacing with keyboard, LCD, printer, external memory, automatic control applications, industrial process control system, measurement applications, robotics and embedded control, DSP and digital filters. Development tools for microcontroller applications: Development phases of a microcontroller based system, software development cycle and applications, software development tools IDE, examples of an IDE, emulator, target board, device programmer.
Unit-IV	16-bit microcontrollers: 8096/80196 Family Hardware, memory map, I/O ports, timers, high speed outputs and inputs, interrupts. 32 –bit ARM Family: ARM architecture, ARM7 ARM9, ARM based MCUs, ARM Cortex- M3, Instructions in ARM, exception handling in ARM, development tools.
Unit-V	Motorola MC68HC11/12 Family: Architecture, addressing modes, interfacing methods, interrupts, programmable timer, applications.

Textbooks/References:

1. Raj Kamal: Microcontrollers- architecture, programming, interfacing and system design, Pearson Education.
2. Greg Osborn: Embedded microcontrollers and processor design, Pearson Education.
3. Kanta Rao: Embedded Systems, PHI Learning.

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Engineering & Technology	Electronics & Communication Engineering	Wireless Networks	PHD102EC07

Course Outcomes:

1. Explain architecture and mobility management mechanisms in PCS and cellular networks.
2. Analyze network signaling methods and inter-system handoff mechanisms.
3. Evaluate GSM architecture, signaling, and mobility management procedures.
4. Assess third-generation (3G) and emerging mobile services for voice and data transmission.
5. Examine wireless protocols and enterprise network technologies such as Bluetooth and GPRS.

Unit-wise Content distribution

Unit	Contents
Unit-I	Introduction: PCS architecture, Cellular Telephony, Cordless Telephony and Low-tier PCS, mobility Management: Handoff, Roaming Management, Roaming Management for SS7, Roaming Management for CT2,Handoff management: Detection and Assignment, strategies, channel assignment Handoff management: Radio Link Transfer: Hard and soft Hand off.
Unit-II	Network Signaling: IS-41 Network Signaling, Intersystem Handoff and Authentication in IS- 41:handoff measurement, handoff-forward and backward, adaptive algorithm, PACS Network Signaling: Network Elements, Interfaces, registration, intersystem hand off, call origination and termination, Cellular Digital Packet Data ,CDPD architecture, interface, radio resource allocation, roaming management.
Unit-III	GSM System overview: GSM architecture, data services, GSM Network signaling, GSM mobility management: GSM location update, failure restoration, VLR identification algorithm, GSM short message service: SMS architecture, SMS protocol hierarchy, mobile-originated and terminated messaging ,international roaming for GSM,GSM operation, administration and maintenance: call recording functions, performance measurement and management, subscriber and service data management.
Unit-IV	Mobile services Mobile number portability: Mechanisms, VOIP service for mobile Networks: iGSM wireless VoIP solution, iGSM procedures and message flows, mobile prepaid phone services: WIN approach, service node approach, Hot billing approach, hanset based approach, Third generation mobile services: W-CDMA AND CDMA2000.
Unit-V	Wireless Protocols: Wireless application protocol, Heterogeneous PCS, paging systems: network architecture, interfaces, Wireless Local Loop: architecture, technologies, Wireless enterprise networks: enterprise telephony, location systems, Bluetooth, enterprise PCS, GPRS: architecture, network nodes, interfaces, procedures,

Textbooks/References:

1. *Yi-Bing Lin: Wireless and Mobile Network Architectures, Wiley India Pvt Ltd.*
2. *Nicopolitidis: Wireless networks, Wiley India Pvt Ltd.*
3. *Haykin: Mordern Wireless Communication, Pearson Education.*
4. *Rappaport: Wireless Communications, Pearson Education.*

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Faculty of Engineering & Technology	Electronics & Communication Engineering	Advanced Wireless Communication	PHD102EC08

Course Outcomes:

1. Understand cellular concepts, frequency reuse, and capacity enhancement methods.
2. Compare and contrast multiple access techniques used in modern wireless systems.
3. Evaluate 3G, 4G, and 5G communication technologies and their performance metrics.
4. Analyze MANET and WSN protocols for routing, access control, and energy efficiency.
5. Implement cognitive radio and spectrum sensing methods for efficient spectrum utilization.

Unit-wise Content distribution

Unit	Contents
Unit-I	**MOBILE COMMUNICATION** Cellular Concept: Cell Area, Signals Strength and Cell Parameters, Capacity of a Cell, Frequency Reuse, Co channel Interference, Cell Splitting, Cell Sectoring.Multiple Radio Access: Multiple Radio Access Protocols, Contention Based Protocols. Multiple Division Techniques For traffic Channel: Concept and Model for Multiple Divisions, Modulation Techniques.
Unit-II	Traffic Channel Allocation, Mobile Communication Systems: Cellular System Infrastructure,Registration, Handoff Parameters and Underlying Support, Roaming Support, Multicasting.Existing Wireless Systems: AMPS- characteristics, Operation, General Working; GSM- GSM frequency Band, GSM LMN, Objectives, Services, Interfaces;IMT-2000 – International Spectrum Allocation, Services Provided By 3rd Generation Cellular Systems, Harmonized 3G Systems.Next Generation Cellular Technology 4G,5G: Evolution, Objectives, Advantages and Limitation Of 4G And 5G Network Technology Over 3G,Applications,4G Technologies,5G Technologies, Smart Antenna Technique.
Unit-III	**WIRELESS COMMUNICATION** Multiple Access and Channels: Orthogonal Frequency Division Multiplexing (OFDM), OFDMA, Fading channels, Multiple Input and Multiple Output (MIMO).
Unit-IV	Mobile Adhoc Network(MANet) : Infrastructure less network, Medium access Protocols for MANet, Routing Protocols, Wireless Sensor Networks: Distributed Sensing Nodes, Power saving medium access protocols, IEEE 808.15.4, Network attacks mitigation in MANet.

Unit-V	Cognitive Radio Network (CRN): Spectrum Sensing Techniques: Energy Detector, Cyclostationary Detector, Marched Filter Detector, Radio Identification Detector, Cyclo- Energy Detector etc. Cooperative spectrum Sensing: Data and Decision cooperative spectrum sensing, Fusion Center, Spectrum Allocation Techniques, Network attacks mitigation in CRN, IEEE 802.22 (WRAN). Wireless Access Networks: WLAN, IEEE 802.11, WiMAX, IEEE 802.16, LTE, Ultra Wide-Band (UWB).

Textbooks/References:

1. Theodore S. Rappaport, *Wireless Communications: Principles and Practice*, 2nd Edition, Pearson Education / Prentice Hall.
2. Dharma Prakash Agrawal and Qing-An Zeng, *Introduction to Wireless and Mobile Systems*, 4th Edition, Cengage Learning.
3. Andrea Goldsmith, *Wireless Communications*, Cambridge University Press.
4. William Stallings, *Wireless Communications and Networks*, 2nd Edition, Pearson Education.
5. Huseyin Arslan (Ed.), *Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems*, Springer.

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Engineering & Technology	Electronics & Communication Engineering	Low Power VLSI Circuits	PHD102EC09

Course Outcomes:

1. Identify sources of power dissipation and apply scaling techniques for low power design.
2. Perform circuit and logic-level power analysis using simulation tools.
3. Design low-power circuits using probabilistic and architectural optimization techniques.
4. Develop power-efficient logic and clock distribution architectures.
5. Apply modern CMOS techniques for reducing dynamic and static power consumption.

Unit-wise Content distribution

Unit	Contents
Unit-I	Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches. Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing& gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.
Unit-II	Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.
Unit-III	Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy. Low Power Circuit's: Transistor and gate sizing, network restructuring and Reorganization. Special Flip Flops & Latches design, high capacitance nodes, low power digital cells library.
Unit-IV	Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre- computation logic. Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components.
Unit-V	Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network. Special Techniques: Power Reduction in Clock networks, CMOS Floating Node, Low Power Bus Delay balancing, and Low Power Techniques for SRAM.

Textbooks/References:

1. Kaushik Roy and Sharat C. Prasad, *Low-Power CMOS VLSI Circuit Design*, Wiley, 2nd Edition, 2009.
2. Jan M. Rabaey and Massoud Pedram (Eds.), *Low Power Design Methodologies*, Springer/Kluwer Academic Publishers, 1996.

3. Gary K. Yeap, *Practical Low Power Digital VLSI Design*, Springer/Kluwer Academic Publishers, 1998.
4. Etienne Sicard and Sonia Delmas Bendhia, *Basics of CMOS Cell Design*, Tata McGraw-Hill Education, 2005.
5. A. P. Chandrakasan, W. J. Bowhill, and F. Fox (Eds.), *Design of High-Performance Microprocessor Circuits*, IEEE Press, 2001.
6. B. Nikolić & R. W. Brodersen, *Digital Integrated Circuits: A Design Perspective*, 2nd Edition, Pearson.
7. K. Eshraghian et al., *Essentials of VLSI Circuits and Systems*, PHI Learning.

Program	Faculty	Branch/Specialization	Name of Subject	Subject Code
Ph.D	Engineering & Technology	Electronics & Communication Engineering	Image And Video Processing	PHD102EC10

Course Outcomes:

1. Analyze and process images using spatial and frequency domain techniques.
2. Apply various image enhancement and segmentation algorithms.
3. Implement compression techniques such as transform coding, JPEG, and wavelet coding.
4. Understand digital video formation models and temporal image processing.
5. Design motion estimation and video coding algorithms for multimedia applications.

Unit-wise Content distribution

Unit	Contents
Unit-I	Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.
Unit-II	Image Processing Techniques: Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.
Unit-III	Image Compression Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards.
Unit-IV	Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations.
Unit-V	2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

Textbooks/References:

1. Gonzalez and Woods , “Digital Image Processing”, 3rd edition , Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, “Video processing and communication”, 1st edition, PHI.

3. M. Tekalp, “Digital video Processing”, Prentice Hall International
4. Relf, Christopher G.,"Image acquisition and processing with LabVIEW", CRC press
5. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", John Wiley & Sons.
6. Chris Solomon, Toby Breckon ,"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons.