DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DIGITAL IMAGE PROCESSING
290711(DE)

COURSE OBJECTIVES:

- To understand the fundamentals of image acquisition, image processing in spatial and frequency domain.
- To understand image transforms used in digital image processing.
- To know about the image restoration techniques and methods used in image processing**.**

Unit – I:

Introduction and Fundamental: Introduction to Image Processing Systems, Digital Image fundamentals: Components of Digital Image Processing Systems, Image Model, Image Geometry, Sampling and Quantization of Images, Classification of Digital Images, Zooming and Shrinking, Relationship between pixels.

Unit – II:

Image Enhancement in spatial Domain: Introduction, Basic Gray Level Function, Piecewise Linear Transformation, Contrast Stretching, Histogram Specification, Histogram Equalization, Local Enhancement using arithmetic and logical operation- Image Subtraction, Image averaging, Image Smoothing: Smoothing Spatial Filters, Smoothing Linear Filters, Image Sharpening.

Unit – III:

Image Enhancement in Frequency Domain: Introduction to Fourier Transform, Filters: Low Pass and High Pass, Gaussian Filters, Homomorphic Filtering, Image Restoration: Model of Image Degradation/Restoration process, Noise Models, Noise Reduction in Spatial and Frequency Domain, Inverse Filtering, Mean Filters, Least Mean Square (Wiener) Filtering, FIR Wiener Filter.

Unit – IV:

Morphological Image Processing: Logic operation involving binary images, Dilation and Erosion, Opening and Closing, Morphological Algorithms: Boundary Extraction, Region filling, Extraction of connected components, Convex Hull, Thinning and Thickening.

Unit –V:

Image Registration: Introduction, Geometric Transformation, Plane to plane Transformation, Mapping, Image Segmentation: Introduction, Region Extraction, Pixel based approach, Multilevel Thresholding, Local Thresholding, Region based approach, Region growing, Splitting and Merging, Edge and line detection, Corner Detection, Detection of Discontinuities, Edge and boundary detection.

RECOMMENDED BOOKS:

1. Digital Image processing, Rafael C Gonzalez, Richard E Woods, Pearson Education.
2. Fundamental of Digital Image processing, K. Jain, Pearson education.
3. Digital Image Processing, S. Esakkirajan, S. Jayaraman, T. Veerakumar, Tata McGraw- Hill Education.

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

CO1: Explain different modalities and current techniques in image acquisition.

CO2: Classify spatial and frequency domain techniques used in image processing.

CO3: Apply image processing techniques to enhance visual images

CO4: Analyze the constraints in image processing when dealing with real problems.

CO5: Evaluate various enhancement, restoration and retrieval techniques of image processing.

Course Articulation Matrix

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

1 - Slightly; 2 - Moderately; 3 – Substantially

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Parallel Processing
290712(DE)

COURSE OBJECTIVES

- To introduce the fundamentals of parallel processing architectures and paradigms.
- To understand the technologies, system architecture, and communication architecture that propelled the growth of parallel processing systems.
- To develop and execute basic parallel processing applications using basic programming models and tools.

Unit-1

Introduction: Introduction to Parallel Computing, Key Concepts and Challenges, Flynn's Classification, System Attributes to Performance, Parallel computer models Multiprocessors and multicomputer, Multi-vector and SIMD Computers. Data and resource dependencies, Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Control flow, data flow, and Demand-driven mechanisms. Static interconnection networks, Dynamic interconnection Networks: Bus Systems, Crossbar Switch, Multiport Memory, Multistage and Combining Networks.

Unit-2

Instruction Architectures and Memory Hierarchy: Instruction set architecture, CISC Scalar Processors, RISC Scalar Processors, VLIW architecture, Memory Hierarchy, Inclusion, Coherence and Locality, and Memory capacity planning. Interleaved memory organization, memory interleaving, pipelined memory access, Bandwidth, and Fault Tolerance. Backplane Bus System: Backplane bus specification, Addressing and timing protocols, Arbitration transaction, and interrupt.

Unit-3

Pipeline Processing: Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, pipeline hazards, Dynamic instruction scheduling -score boarding and Tomasulo's algorithm, Branch handling techniques, Arithmetic Pipeline Design, Static arithmetic pipeline, Multifunctional arithmetic pipelines. Superscalar pipeline design, Super pipeline processor design.

Unit-4

Parallel Computing communication: Cache coherence, Snoopy protocols, Directory-based protocols. Message routing schemes in multicomputer networks, deadlock, and virtual channels. Vector Processing Principles, Vector instruction types, Vector-access memory schemes. Vector supercomputer architecture, SIMD organization: distributed memory model and shared memory model. Principles of Multithreading: Multithreading Issues and Solutions, Multiple-Context Processors.

Unit- 5

Parallel Programming models and tools: Parallel Programming Models, Shared-Variable Model, Message-Passing Model, Data-Parallel Model, Object-Oriented Model, Functional and Logic Models, Parallel Languages and Compilers, Language Features for Parallelism, Parallel Programming Environment, Software Tools and Environments.

RECOMMENDED BOOKS

- V. Rajaranam & C. S. R. Murthy, “Parallel computer”; PHI Learning.
- Hwang and Briggs, “Computer Architecture and Parallel Processing”; MGH.
- Kai Hwang, “Advanced computer architecture”, TMH.
- M.J Flynn, “Computer Architecture, Pipelined and Parallel Processor Design”; Narosa Publishing.
- J. P. Hayes, “Computer Architecture and Organization”; MGH.
- Parallel Programming in C with MPI and OpenMP by M.J. Quinn, McGraw-Hill Science/Engineering/Math, 1st edition, 2003, ISBN: 0072822562.

COURSE OUTCOMES

After completion of this course, the students would be able to:

CO1. Define classes of computers and new trends and developments in computer architecture.

CO2. Explain the advanced performance enhancement techniques such as pipelines, dynamic scheduling branch predictions, and caches.

CO3. Compare and contrast the modern computer architectures such as RISC, Scalar, and multi-CPU systems.

CO4. Critically evaluate the performance of different CPU architectures and improve the performance of applications running on different CPU architectures.

CO5. Develop and implement parallel processing models in the applications for high-performance computing systems.

Course Articulation Matrix

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

1 - Slightly; 2 - Moderately; 3 – Substantially

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

WIRELESS NETWORKS
290713 (DE)

COURSE OBJECTIVES

- Understand the fundamentals of wireless communication.
- Describe and differentiate between various wireless network architectures.
- Analyze wireless protocols and standards.
- Design and implement basic wireless networks.
- Evaluate the performance and security of wireless networks.
- Explore emerging trends and technologies in wireless networking.

Unit-I

Introduction to Wireless Communication: Overview of wireless communication, History and evolution of wireless networks, Applications of wireless networks, Fundamentals of Wireless Communication, Radio wave propagation, Modulation techniques, Signal encoding techniques, Propagation models: free space, two-ray ground, and log-distance path loss models, Channel models: Rayleigh fading, Rician fading, and shadowing models, Link budget analysis and system design considerations.

Unit-II

Wireless Network Architectures and Standards: Wireless Network Architectures, Infrastructure-based networks, Ad-hoc networks, Hybrid networks, Wireless Communication Standards, IEEE 802.11 (Wi-Fi), IEEE 802.15 (Bluetooth, Zigbee), Cellular networks (3G, 4G, 5G).

Unit- III

Protocols and Security: Medium Access Control (MAC) Protocols, Carrier Sense Multiple Access (CSMA),MACA (Multiple Access with Collision Avoidance),TDMA, FDMA, and CDMA, Network Layer Issues, Routing in wireless networks, Mobile IP, Ad-hoc routing protocols (AODV, DSR) Transport Layer Protocols, TCP over wireless networks, Performance issues and solutions, QoS (Quality of Service) in wireless networks, Wireless Network Security, Security threats and vulnerabilities, Encryption and authentication techniques, Security protocols (WPA, WPA2, WPA3).

Unit-IV

Performance Analysis and Specialized Networks Performance Analysis and

Optimization Metrics for performance evaluation Network simulation tools, Case studies and optimization techniques, Wireless Sensor Networks (WSNs), Architecture and design of WSNs, Energy-efficient protocols, Applications of WSNs, Mobile and Pervasive Computing, Concepts of mobility, Mobile IP and Mobile TCP, Context-aware computing.

Unit-V

Emerging Trends and Practical Applications: Internet of Things (IoT),5G and beyond, Cognitive radio networks, Practical Applications and Case Studies, Real-world applications of wireless networks, Industry case studies

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RECOMMENDED BOOKS

- "Wireless Communications & Networks" by William Stallings
- "Wireless Networking Technology: Principles, Protocols, and Applications" by Xianbin Wang, Honggang Zhang, and Min Chen
- "Wireless Communications: Principles and Practice" by Theodore S. Rappaport
- "Mobile Communications" by Jochen H. Schiller

COURSE OUTCOMES

After completion of course students will be able to:

CO1: **Understand** the fundamentals of wireless communication.
CO2: **Describe** different wireless network architectures, such as infrastructure-based, ad-hoc, and hybrid networks, and analyze their respective advantages and limitations.
CO3: **Analyze** wireless protocols, standards and emerging trends and technologies in wireless networking.
CO4: **Evaluate** the performance and security of wireless networks.
CO5: **Investigate** the architecture and design principles of wireless sensor networks (WSNs) and evaluate energy-efficient protocols for data communication in resource-constrained environments.

Course Articulation Matrix

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

1 - Slightly; 2 - Moderately; 3 – Substantially