Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
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Choice Based Credit System (CBCS) in the Light of NEP-2020
M.Tech. in Embedded System
(2021-2023)

COURSE CODE	CATE-GORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTES201	DCC	Advanced Microcontroller	60	20	20	30	20	2	1	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To teach students how a microcontroller can be used as a computer within a single integrated circuit.
2. To teach programming for TM4C123 using assembly and C language.
3. To present the microcontrollers input/output interface capabilities for developing embedded systems with advanced microcontrollers.
4. To illustrate how a microcontroller is a component within embedded systems controlling the interaction of the environment with system hardware and software.

Course Outcomes (COs):

After successful completion of the course, student will be able:

1. To understand the architecture of advanced microcontroller TM4C123 and its programming.
2. To interface TM4C123 with analog peripherals and communication systems.
3. To design an embedded system using TM4C123 for specific application

Syllabus

UNIT I **9 Hrs.**

Introduction to Cortex-M Microcontroller: Architecture of Cortex-M4F (TM4C123) Microcontroller, ARM Instruction Set Architecture: Register Set, Processor Operating Modes, Interrupts and Processor Reset Sequence, Pipelined Architecture and Data Path, Memory Address Map; Nested Interrupt Vector Controller; Bus System and Bus Matrix; Memory and Peripherals: Memory Endian ness, Bit Banding, System Stack Architecture; Debug System.

UNIT II **8 Hrs.**

Introduction to ARM Instruction Sets: Cortex-M Assembly Programming Basics, Assembler Directives, Addressing modes, Instruction Encoding, Instruction Set, Data Processing Instructions; Shift, Rotate, and Logical Instructions, Arithmetic Instructions, Data Movement, Bitfield Instructions, Test and Compare Instructions, Saturating Instructions, Memory Access Instructions, Branch and Control Instructions.

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MTES201	DCC	Advanced Microcontroller	60	20	20	30	20	2	1	2	4

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UNIT III **8 Hrs.**

Interfacing: TM4C123 Microcontroller Peripherals, Configuring Microcontroller Pins as GPIOs, Interfacing for LED and Switch, Seven-Segment Interfacing, Interfacing of Keypad &LCD Module, analog interfacing.

UNIT IV **9 Hrs.**

I/O Synchronization and Interrupt Programming: Introduction to I/O Synchronization, Methods for I/O Synchronization, Types of Exceptions or Interrupts, Configuring Interrupts for Cortex-M Devices, Interrupt-Based Switch Interfacing.

Timing Interfaces: Basics of Timing Interfaces, Clocking, TM4C123 Clock and Frequency Configuration, Timer, TM4C123 Timing Interfaces and Systick Timer, General Purpose Timer Modules in TM4C123

UNIT V **8 Hrs.**

Serial Communication Interfaces on TM4C123 Microcontroller: Fundamentals of Serial Communication, UART Interface, I2C Interface, Serial Peripheral Interface (SPI), Controller Area Network (CAN), Comparison between MSP432 & TM4C123

Textbooks:

1. Muhammad Tahit and Kashif Javed , "ARM Microprocessor System", CRC press, 2017
2. Jonathan W. Valvano, "Embedded Systems: Real Time Operating System for ARM Cortex-M Microcontroller", Fourth Edition, 2017
3. Tammy Noergaard, "Embedded Systems Architecture", Elsevier Publisher, 2005

References:

1. Steve Heath, "Embedded System Design", Elsevier Publisher; 2006
2. Raj Kamal, "Embedded Systems", 4th Edition ,TMH, 2020

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTES201	DCC	Advanced Microcontroller	60	20	20	30	20	2	1	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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List of Experiments:

1. Blinking LED and switch handling.
2. Interrupt programming by GPIO's.
3. Handling Hibernation & Wakeup.
4. Interfacing of seven segment & LCD module.
5. Interfacing of potentiometer.
6. Waveform generation using PWM.
7. Velocity control of motor.
8. UART communication.
9. I2C Communication Interface.
10. SPI Communication.
11. Case Study: Weather monitoring / Traffic light controller.

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MTDC202	DCC	Advanced Digital Signal Processing	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

This course will introduce the concepts and techniques for processing of discrete time signals. To familiarize with the important methods in DSP, including digital filter design, transform-domain processes and Multirate processing, wavelet transform.

Course Outcomes (COs):

1. Student will be able to represent discrete time signal analytically and visualize them in the time & frequency domain and also understand the different transforms techniques & their significance.
2. Student will be able to analyze and design the discrete time system and design different digital filters using the concept of digital signal processing.

Syllabus

UNIT I **8 Hrs.**

Introduction of DSP and Discrete Fourier transforms: Properties of the DFT Decimation in time and decimation in frequency FFT algorithms, discrete cosine transform. Linear filtering methods based on the DFT.

UNIT II **8 Hrs.**

Design of digital filters: IIR Filter design: Butterworth design, Bilinear Transformation. Low Pass, High Pass, Band Pass and Band Stop digital filters. Spectral transformation of IIR filters.
FIR filter design: Symmetric and Antisymmetric linear phase. FIR filter by rectangular, triangular and Hamming window functions.

UNIT III **9 Hrs.**

Finite word length effects in FIR and IIR digital filters: Quantization, round off errors and overflow errors. **Multi rate digital signal processing:** Concepts, design of practical sampling rate converters, Decimators, Interpolators, Polyphase decompositions. Applications of Multirate signal processing, Digital filter banks, two channel quadrature mirror filter banks, M-channel QMF bank.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTDC202	DCC	Advanced Digital Signal Processing	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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UNIT IV **8 Hrs.**

Adaptive filter: Applications of Adaptive filters, Adaptive direct form FIR filters, The LMS algorithm, Adaptive direct form filters, RLS algorithm.

UNIT V **8 Hrs.**

Wavelet Transform: Introduction to Wavelets, wavelets and wavelet expansion systems, Discrete Wavelet Transform, multi resolution formulation of wavelet systems, Haar Wavelet and other wavelet representations, scaling function, wavelet functions.

Text Books:

1. John. G Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Application", 4th Edition, Pearson Education, 2014.
2. S. K. Mitra, "Digital Signal Processing: A Computer Based Approach", 4th Edition, TMH, 2013.
3. S.Salivahanan, A Vallavaraj & C.Gnanapriya, "Digital Signal Processing", 2nd Edition TMH, 2009.
4. A.V. Oppenheim and R.W. Schaffer, "Digital Signal Processing", PHI.

References:

1. L. R. Rabiner and B. Gold, "Theory and application of Digital Signal Processing", PHI.
2. E.C. Ifeachor and B. W. Jarvis, " Digital Signal Processing: A Practitioner's approach", 2nd Edition, Pearson Education.
3. Thomas J. Cavicchi, "Digital Signal Processing", John Wiley & Sons.
4. Chi Tsong Chen, "Digital Signal Processing", Oxford.

List of Experiments:

1. Generation of basic signals with Proper Indexing.
2. Determine the Discrete Fourier Transform of the given sequence.
3. Determine circular convolution of given sequences.
4. Determine the DIT FFT of the given sequence.
5. Design of IIR and FIR filters.

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MTES202	DCC	Real Time Operating Systems	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Educational Objectives (CEOs):

1. To understand the concepts of Operating System.
2. To obtain hands-on experience in programming Real time OS.

Course Outcomes (COs):

After completion of the course student will be able to:

1. Explain the operating system concepts and types of operating system.
2. Demonstrate deadlock and memory management techniques.
3. Demonstrate concepts of real time operating system implementation.

Syllabus

UNIT I **8 Hrs.**

Introduction to Operating System, Goals of an OS, Operation of an OS, Computer Architecture, Classes of Operating Systems, Structure of an Operating System, Memory Management: Single User Contiguous Scheme, Dynamic Partitions, Best-Fit Versus First-Fit Allocation, Deallocation, Paged Memory Allocation, Demand Paging, Page Replacement Policies, Segmented Memory Allocation.

UNIT II **8 Hrs.**

Process Management: Processes and programs, Implementing processes, Threads, Process Synchronization, Semaphores, Monitors, Scheduling terminology and its concepts, Deadlock: Detection, Prevention and Avoidance.

UNIT III **8 Hrs.**

Introduction to RTOS, Cortex-M Processor Architecture, ARM Cortex-M Assembly Language, Pointers in C, Memory Management,MSP432 I/O programming, Interrupts, First in First Out (FIFO) Queues, Edge-triggered Interrupts, UART Interface, Basic principles of Input Capture, Pulse Width modulation on MSP432, OS Considerations for I/O Devices, Debugging.

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTES202	DCC	Real Time Operating Systems	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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UNIT IV **8 Hrs.**

Thread Management: Parallel, distributed and concurrent programming, Introduction to threads, States of a main thread, Two types of threads, Thread Control Block, Creation of threads, Switching threads, Profiling the OS, Semaphores, Thread Synchronization, Process Management, Dynamic loading and linking

UNIT V **8 Hrs.**

Time Management: Cooperation, Blocking semaphores, First in First out Queue, Thread Sleeping, Deadlocks, Monitors, Fixed Scheduling.
Real-time Systems: Data Acquisition Systems, Priority scheduler, Debouncing a switch, Texas Instruments RTOS, FreeRTOS

Text Books:

1. Dhananjay M. Dhamdhere, "Operating Systems: A Concept-Based Approach", McGraw Hill Education; Third Edition,2017
2. Ann Mciver Mchoes ,Ida M. Flynn , "Understanding Operating Systems"., Cengage Learning Sixth Edition
3. Jonathan W. Valvano, "Real-Time Operating Systems for ARM Cortex-M Microcontrollers", Volume 3, Fourth Edition, 2017

References:

1. Rob Williams, "Real Time Systems Development"., First Edition, Elsevier 2006
2. Phillip A. Laplante, Seppo J. Ovaska, "Real Time Systems Design And Analysis: Tools for the Practitioner", Fourth Edition IEEE Press, 2012
3. Andrew S. Tanenbaum, Herbert Bos "Modern Operating Systems", Pearson, Fourth Edition, 2012

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COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTRM301	Common for all Engineering branches	Research Methodology in Engineering	3	1	0	4	60	20	20	0	0

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Course Educational Objectives (CEOs):

1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. To analyze and evaluate research works and to formulate a research problem to pursue research.
3. To develop skills related to professional communication and technical report writing.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

1. Understanding and formulation of research problem.
2. Apply quantitative and qualitative methods used in engineering research.
3. Analyze interpret and evaluate data that relate to engineering problems.
4. Develop skills related to professional communication, technical report writing and publishing papers.
5. Act professionally, autonomously, ethically and in teams to produce a professional product.

Syllabus

Unit-I

Introduction to Research Methodology: - An overview of Research process, Types of research; Approaches to research, Importance of criticism in Literature review, identifying research gaps; Formulation of research problem; Research design,

Data: Primary and secondary data-sources, advantages/disadvantages; Sampling and primary data collection, sampling size, random and structured sampling

Unit-II

Measurement and Scaling Techniques: - Types of scales, Criteria for good measurement, Attitude measurement - Likert's scale, Semantic differential scale, Thurstone-equal appearing interval scale.

Statistical Tools for Data Analysis: - Measure of central tendency, Measures of dispersion, Correlation and Regression, Formulation of hypothesis, Type I & Type II error, Parametric test, non-parametric test.

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Unit-III

Research Methods I - Use of computer software in research and understanding the limitations. Multi-attribute decision making methods, Data envelopment analysis, Grey relational analysis etc., Multidisciplinary research problems, Synthesis of disciplinary research findings; Reliability and sensitivity analysis.

Unit-IV

Research Methods II - Modeling and simulation of engineering problem; Mathematical modeling-formulation, calibration, validation, application; measurement design – validity, reliability, scaling and sources of error. Mathematical programming methods, Numerical analysis, Optimization techniques, Design of laboratory experiments and field tests.

Unit-V

Academic Writing Skills and Presentation - Layout of a Research paper, research report, Thesis structure, Impact factor of Journals, Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Reference Management Software like Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism. Guidelines on how to write research papers. Content of Poster presentation, Power point presentation, Oral presentation

Books:

Text Books -

1. C.R. Kothari, 2012. Research Methodology Methods and Techniques, 3/e, Vishwa Prakashan,
2. Montgomary, Douglas C., 2007. Design and Analysis of Experiments (Wiley India).
3. Chawla, D. and Sodhi, N., 2011. Research methodology: Concepts and cases. Vikas Publishing House.

Reference Books -

1. Donald H.McBurney, 2006. Research Methods, 5th Edition, Thomson Learning, ISBN: 81-315-0047.
2. Donald R. Cooper, Pamela S. Schindler, 2006. Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd.,
3. Timothy J. Ross 2002. Fuzzy Logic with Engg Applications, , Wiley Publications, 2nd Ed[d]
4. Thiel D.V. 2014. Research Methods for Engineering; Published by Cambridge University Press, UK
5. P.J. van Laarhoven & E.H. Aarts, Simulated Annealing: Theory and Applications (Mathematics and Its Applications).

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MTES113	DSE	HDL Fundamentals	60	20	20	0	0	3	0	0	3

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Course Educational Objectives(CEOs):
The objective of this course is to:
1. Introduce basic concepts of hardware description language.
2. Describe FPGA implementation of digital systems.

Course Outcomes(COs):
After completion of this course the students will be able to:
1. Describe digital hardware in terms of its structure or behavior using HDL.
2. Configure FPGA boards for specific design need.

Syllabus

UNIT I **8 Hrs.**
Programmable Logic Devices and Computer Aided Design Tools
Introduction to design of digital hardware, Programmable Logic Devices- PAL, PLA, CPLD and FPGA.CAD Tools: Introduction, Design flow, Synthesis, RTL Synthesis, Overview of Synthesis Steps, Net List Generation, Gate Optimization, Technology Mapping, Simulation, Functional and Timing Simulation, Physical Design Steps- Placement , Routing and Static Timing Analysis.

UNIT II **8 Hrs.**
Verilog HDL Basics
Introduction of HDL, Verilog, Top Down and Bottom Up design, Data Flow modeling , Structure and Behavioral Modeling, Verilog Basic Constructs, White space, Comments, Nets and Variables, Data Types, Identifiers, Signal Values, Numbers, Parameters. Module and Ports- Module Declaration, List of Ports, Port Types, Port Declaration, Port Connection Rules.

UNIT III **8 Hrs.**
Concurrent Statements
Verilog Operators: Arithmetic,Bitwise, Logical, Reduction, Relational,Shift,Conditional, Concatenate, Replication. Operator Precedence, Gate Instantiation, Signal Assignments, Continuous Assignment, Delays, Data Flow Modeling and Structure Modeling, Module Instantiation,Design of various Combinational Logic Circuits i.e. Adders, Multiplexers, Encoders and Decoders.

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MTES113	DSE	HDL Fundamentals	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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UNIT IV **8 Hrs.**

Procedural Statements

Always and Initial Block, Sensitivity List, Blocking and Non Blocking Assignments, If-else Statements, Case Statements, For Loop, While Loop, Repeat and Forever Loop, Generate statement, Verilog Function and Task, Finite State Machines- Melay and Moore Models, Behavioral Modeling of Various Combinational Circuits. Behavioral Modeling of Various Sequential Circuits- Latches and Flip Flops, Shift Registers and Counters, Mealy and Moore Machines.

UNIT V **7 Hrs.**

Introduction to VHDL

Language Constructs, Modeling Style, Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators, Structural Description, Organization of the Structural Descriptions.

Text Books:

1. Stephen Brown I Zvanko Vranesic, "Fundamentals of Digital Logic with Verilog Design", The Mc Graw Hill, Third Edition 2014.

References:

1. Peter Wilson, "Design Recipes for FPGA using Verilog and VHDL", Newnes Publication, Second Edition 2016.
2. M. Morris Mano, Michael D. Cilletti, "Digital Design With An Introduction to The Verilog HDL", Pearson, Fifth Edition 2012.

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MTES123	DSE	Robotics and Machine Vision	60	20	20	0	0	3	0	0	3

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Course Educational Objectives(CEOs):
Students will be able to:
1. Gain knowledge of Robotics and its applications.
2. Understand the working methodology of robotics and automation.
3. To understand the fundamentals of digital image processing

Course Outcomes (COs):
On completion of course students will be able to:
1. Understand Robotics, automation, robotics motion, sensors and control, machine vision, and roles of robots in industry
2. Understand the working methodology of motion and control and application of robots in industry.
3. Apply the image fundamentals and mathematical transforms for image processing.
4. Apply the image enhancement, compression, and restoration techniques.

Syllabus

UNIT I **7 Hrs.**
Basic Concepts of Robotics, Classification and Structure of Robotic Systems, Architecture of Robotic systems, Law of Robotics, History and Terminology of Robotics, Speed of Robot, Robot joints and links, Robot classifications, Industrial Applications of Robots and Programming.

UNIT II **8 Hrs.**
Accuracy and repeatability of Robotics, Simple problems Specifications of Robot, Robot Drive systems, Principles of Machine Vision, Vision and factory automation, Human Vision Vs. Machine Vision, Economic Considerations, Machine Vision: System Overview.

UNIT III **7 Hrs.**
Image acquisition, Illumination, Image formation and Focusing, Image Detection-Introduction, Types of Cameras; Image Processing and Presentation, Discretization, Neighbours of a pixel, connectivity, Distance measures, preprocessing, Neighbourhood averaging.

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COURSE CODE	CATE-GORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTES123	**DSE**	**Robotics and Machine Vision**	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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UNIT IV **7 Hrs.**

Median filtering, smoothening of binary Images, Image Enhancement, Histogram Equalization, Histogram Specification, Local Enhancement, Edge detection, Gradient operator, Laplace operators, Thresholding, Morphological image processing.

UNIT V **8 Hrs.**

Case study-Automated Navigation guidance by vision system, Vision based depalletizing, line tracking, Automatic part Recognition, Image processing techniques implementation through Image Processing software MATLAB/OPENCV.

Text books:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, "Industrial Robotics: Technology, Programming and Applications", 2 nd Edition, Tata McGraw Hill, 2012.
2. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd., 2003

References:

1. Roland Siegwart, Illah R. Nourbakhsh, an d Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", 2 nd Edition, PHI, 2011
2. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, "Robotics Engineering an Integrated Approach", Phi Learning., 2009.

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MTDC215	DSE	Digital Image Processing	60	20	20	0	0	3	0	0	3

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Course Outcomes (COs):

After completion of this course the students are expected to be able to:

1. Describe image fundamentals and mathematical transforms necessary for image processing.
2. Use the image enhancement techniques.
3. Apply image restoration procedures & compression procedures.
4. Implement the image segmentation and representation techniques.

Syllabus

UNIT I **8 Hrs.**

Digital Image Fundamentals

Introduction: Digital Image- Steps of Digital Image Processing Systems-Elements of Visual Perception -Connectivity and Relations between Pixels. Simple Operations- Arithmetic, Logical, Geometric Operations. Mathematical Preliminaries - 2D Linear Space Invariant Systems - 2D Convolution - Correlation 2D Random Sequence - 2D Spectrum.

UNIT II **8 Hrs.**

Image Transforms and Enhancement

Image Transforms: 2D Orthogonal and Unitary Transforms-Properties and Examples. 2D DFT, FFT, DCT, Hadamard Transform, Haar Transform, Slant Transform, KL Transform, Image Enhancement: - Histogram Equalization Technique, Point Processing.

UNIT III **8 Hrs.**

Image Restoration and Construction

Image Restoration: Image Observation And Degradation Model, Circulant And Block Circulant Matrices and Its Application In Degradation Model - Algebraic Approach to Restoration, Inverse By Wiener Filtering, Generalized Inverse, SVD And Interactive Methods, Blind Deconvolution, Image Reconstruction From Projections.

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UNIT IV **7 Hrs.**

Image Compression and Segmentation

Image Compression: Redundancy and Compression Models, Loss Less And Lossy. Loss Less, Variable Length, Huffman, Arithmetic Coding, Bit-Plane Coding, Loss Less Predictive Coding, Lossy Transform (DCT) Based Coding, JPEG Standard - Sub Band Coding.

UNIT V **8 Hrs.**

Image Segmentation: Edge Detection, Line Detection, Curve Detection, Edge Linking And Boundary Extraction, Boundary Representation, Region Representation and Segmentation, Morphology-Dilation, Erosion.

Color and Multispectral Image Processing

Color Image-Processing Fundamentals, RGB Models, HSI Models, Relationship Between Different Models. Multispectral Image Analysis - Color Image Processing Three Dimensional Image Processing,

Text Books:

1. Rafael C. Gonza Lez and Richard E. Woods, "Digital Image Processing" 4th Edition, Pearson publication, 2018.
2. Kenneth R Castleman, "Digital Image Processing", Pearson Education,2007.

References:

1. S. Jayaraman, S. Esakkirajan; T. Veerakumar, "Digital Image Procesing", McGraw Hill Education, 2009.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.

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