COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC370	**Digital Image Processing**	**3-0-0-3**	**2016**

Prerequisite: EC301 Digital Signal Processing

Course objectives:

1. To study the image fundamentals and mathematical transforms necessary for image transform
2. To study the image processing techniques like image enhancement, image reconstruction, image compression, image segmentation and image representation.

Syllabus:

Digital image fundamentals, 2D Transforms, Image enhancement, Image restoration, Image segmentation, Image compression

Expected outcome:

The students will be able to:

1. Distinguish / Analyse the various concepts and mathematical transforms necessary for image processing
2. Differentiate and interpret the various image enhancement techniques
3. Illustrate image segmentation algorithm
4. Analyse basic image compression techniques

Text Books:

1. Gonzalez Rafel C, Digital Image Processing, Pearson Education, 2009
2. **S Jayaraman, S Esakkirajan, T Veerakumar,** Digital image processing ,Tata Mc Graw Hill, 2015

References:

1. Jain Anil K , Fundamentals of digital image processing: , PHI,1988
2. Kenneth R Castleman , Digital image processing:, Pearson Education,2/e,2003
3. Pratt William K , Digital Image Processing: , John Wiley,4/e,2007

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	**Digital Image Fundamentals:** Image representation, basic relationship between pixels, elements of DIP system, elements of visual perception-simple image formation model	3	15
	Vidicon and Digital Camera working principles	1	
	Brightness, contrast, hue, saturation, mach band effect,	1	
	Colour image fundamentals-RGB, CMY, HIS models	1	
	2D sampling, quantization.	1	
II	**Review of matrix theory**: row and column ordering- Toeplitz, Circulant and block matrix,	2	15
	2D Image transforms : DFT, its properties, Walsh transform, Hadamard transform, Haar transform,	3	
	DCT, KL transform and Singular Value Decomposition.	3	
FIRST INTERNAL EXAM			

III	**Image Enhancement:** Spatial domain methods: point processing- intensity transformations, histogram processing, image subtraction, image averaging	2	**15**
	Spatial filtering- smoothing filters, sharpening filters	1	
	Frequency domain methods: low pass filtering, high pass filtering, homomorphic filter.	2	
IV	**Image Restoration:** Degradation model, Unconstraint restoration- Lagrange multiplier and constraint restoration	2	**15**
	Inverse filtering- removal of blur caused by uniform linear motion, Weiner filtering,	2	
	Geometric transformations-spatial transformations	2	
SECOND INTERNAL EXAM			
V	**Image segmentation**: Classification of Image segmentation techniques, region approach, clustering techniques	2	**20**
	Segmentation based on thresholding, edge based segmentation	2	
	Classification of edges, edge detection, Hough transform, active contour	3	
VI	**Image Compression:** Need for compression, redundancy, classification of image compression schemes, Huffman coding, arithmetic coding, dictionary based compression, transform based compression,	5	**20**
	Image compression standards- JPEG& MPEG, vector quantization, wavelet based image compression.	3	
END SEMESTER EXAM			

Question Paper Pattern (End semester exam)

Maximum Marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50 % for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC362	Modelling & Simulation of Communication Systems	3-0-0-3	2016

Prerequisite: EC301 Digital Signal Processing

Course objectives:

- To impart the basic concepts of modeling and simulation of Communication Systems
- To study and evaluate the behavior and performance of the systems.

Syllabus:

Simulation and Modelling Methodology, Review of Random Processes, Random Number generation, Modelling of Transmitter and Receiver subsystems, Communication channels and models, Estimation of parameters in simulation, Estimation of performance measures from simulation, Analysis of simulation results.

Expected outcome:

The students will be able to apply modeling and computational techniques to problems in the communication field

Text Books:

1. M.C. Jeruchim, Philip Balaban , K.Sam Shanmugam, Simulation of communication systems, Kluwer Academic/Plenum Press, New York, 2000
2. Raj Jain. The Art of Computer Systems Performance Analysis, John Wiley and Sons, 1991 (Chapter 25)

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	Simulation and Modelling Methodology**:** Review of Random Processes, Univariate and multivariate models, Transformation of random variables	3	15
	Bounds and approximations, Random process models, Markov and ARMA Sequences, Poisson Process, Gaussian Process	3	
	Random Number Generation, Generation of Random sequences	1	
	Testing Random Number Generators	1	
II	Modelling of Transmitter and Receiver subsystems: Information sources	1	15
	Channel coding, Radio frequency and optical modulation	2	
	Demodulation and detection, Filtering	1	
	Multiple Access : Issues in the simulation of Multiple Access	1	
FIRST INTERNAL EXAM			
III	Communication channels and models: Fading and multipath channels, The Almost Free space channel	3	15
	Conducting and Guided wave media	1	
	Finite state channel models, Methodology for simulating Communication systems operating over Fading Channels.	4	
IV	Estimation of parameters in simulation: Quality of an estimator, Estimating the average level of a waveform,	3	15

	Estimating the average power of a waveform, Estimating the power spectral density of a process	2	
	Estimating Delay and Phase.	2	
SECOND INTERNAL EXAM			
V	Estimation of performance measures from simulation: Estimation of SNR	3	**20**
	Estimating Performance measures for digital systems-The Monte Carlo Method	2	
	Importance sampling method	2	
VI	Analysis of simulation results: Model Verification Techniques, Model Validation Techniques	3	**20**
	Transient Removal, Terminating Simulations	2	
	Stopping Criteria, Variance Reduction	2	
END SEMESTER EXAM			

Question Paper Pattern (end semester exam)

Maximum marks : 100 **Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 30% for theory and 70% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC366	Real Time Operating Systems	3-0-0-3	2016

Prerequisite: EC206 Computer Organization

Course objectives:

- To understand the basics of operating systems tasks and basic OS architectures and develop these to RTOS
- To understand concepts of task scheduling
- To understand problems and issues related with multitasking
- To learn strategies to interface memory and I/O with RTOS kernels
- To impart skills necessary to develop software for embedded computer systems using a real-time operating system.

Syllabus:

Introduction to OS and RTOS, Process management of OS/RTOS, Process Synchronization, Memory and I/O management, Applications of RTOS

Expected outcome:

The students will be familiar with operating systems, the real time operating systems and its applications.

Text Books:

1. C.M. Krishna and G.Shin, Real Time Systems, McGraw-Hill International Edition, 1997.
2. William Stallings, Operating Systems: Internals and Design Principles, 7/e, Prentice Hall

References:

1. Micro C/OS-II, The Real Time Kernel, CMP Books, Jean J Labrosse, 2011
2. Qiung Li and Caroline Yoa, Realtime Concepts for Embedded Systems, CRCPress
3. Real-Time Embedded Components and Systems: With Linux and RTOS (Engineering) by Sam Siewert, John Pratt, 2015
4. Tanenbaum, Modern Operating Systems, 3/e, Pearson Edition, 2007.
5. VxWorks: Programmer's Guide 5.4, Windriver, 1999
6. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, 2/e, Kindle Publishers, 2005.

Course Plan

Module	Course content	Hours	End Sem. Exam Marks
I	Operating system objectives and functions, Virtual Computers, Interaction of O. S. & hardware architecture, Evolution of operating systems	2	15
	Architecture of OS (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures)	3	
	Batch, Multi programming, Multitasking, Multiuser, parallel, distributed & real –time O.S.	3	
II	Uniprocessor Scheduling: Types of scheduling	2	15
	Scheduling algorithms: FCFS, SJF, Priority, Round Robin	3	
	UNIX Multi-level feedback queue scheduling, Thread Scheduling, Multiprocessor Scheduling concept	3	
FIRST INTERNAL EXAM			

III	Concurrency: Principles of Concurrency, Mutual Exclusion H/W Support, software approaches, Semaphores and Mutex, Message Passing techniques	2	**15**
	Classical Problems of Synchronization: Readers-Writers Problem, Producer Consumer Problem, Dining Philosopher problem.	3	
	Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategies.	3	
IV	Memory Management requirements, Memory partitioning: Fixed, dynamic, partitioning	3	**15**
	Memory allocation Strategies (First Fit, Best Fit, Worst Fit, Next Fit), Fragmentation, Swapping, Segmentation, Paging, Virtual Memory, Demand paging	2	
	Page Replacement Policies (FIFO, LRU, Optimal, clock), Thrashing, Working Set Model	3	
SECOND INTERNAL EXAM			
V	I/O Management and Disk Scheduling: I/O Devices, Organization of I/O functions	2	**20**
	Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), Disk Caches	3	
VI	Comparison and study of RTOS: Vxworks and µCOS	3	**20**
	Case studies: RTOS for Control Systems.	3	
END SEMESTER EXAM			

Question Paper

The question paper shall consist of three parts. Part A covers I and II module, Part B covers III and IV module, Part C covers V and VI module. Each part has three questions, which may have maximum four subdivisions. Among the three questions, one will be a compulsory question covering both modules and the remaining from each module, of which one to be answered. Mark patterns are as per the syllabus with 50 % for theory and 50% for logical/numerical problems, derivation and proof.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC368	**Robotics**	**3-0-0-3**	**2016**

Prerequisite: EC 307 Power Electronics & Instrumentation, EC 305 Microprocessors & Microcontrollers

Course objectives:

- To impart knowledge about the engineering aspects of Robots and their applications.

Syllabus:

Robots: Introduction, anatomy, Robot specifications, Robot characteristics, Areas of application, classification of robots. Robotic arm, Sensors, Encoders, Tachometers, Robotic drive systems and actuators, Specification, principle of operation and areas of application of: DC motor, Stepper motor, Servo motor and brushless DC motor, Microprocessor control of electric motors, speed control using PWM and direction control using H- Bridge, Robotic vision systems, Image processing techniques, kinematics, inverse kinematics, Velocity kinematics, Application of velocity kinematics for all serial manipulators, Digital and Programmable Logic (PLC) controllers. Robot Programming, Industrial applications of Robots, Mobile robots, Micro robots, Recent developments in Robotics.

Expected outcome:

i. The students will have a thorough understanding about Robots and their applications
ii. The students will be able to analyse and design robotic structures.

Text Books:

1. Mikell and Groover, Industrial Robotics – Technology, Programming and Applications, McGraw Hill, 2/e, 2012
2. Saeed B. Niku Introduction to Robotics. Analysis and control, applications- Wiley student edition, 2010
3. Spong and Vidyasagar, Robot Dynamics and Control, John Wiley & Sons, 1990.

References:

1. Ashitava Ghosal, Robotics, Fundamental concepts and analysis, OXFORD University Press, 2006
2. Fu, K.S,Gonzalez,R.C,Lee, C.S.G.,Robotics, Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
3. John. J.Craig, Introduction to Robotics: Mechanics and Control, PHI, 2005.
4. Klafter, R.D., Chmielewski, T.A, Negin, M, Robotic Engineering An Integrated Approach, PHI, 2007
5. Robert J. Schilling, Fundamentals of Robotics: Analysis & Control, Pearson Education, 2000
6. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi, 1994.

Course Plan			
Module	**Course content**	**Hours**	**End Sem. Exam Marks**
I	Introduction – Definition and origin of robotics, Robot Anatomy, Robot specifications, Robot characteristics – accuracy, precision, and repeatability, Areas of application, classification of robots. Robotic arm – Components and structure, Types of joints and workspace, Common kinematic arrangements, Wrists, End effectors.	7	**15**
II	Sensors: Types and applications of sensors in Robotics, position and displacement sensors, Strain gauge based force-torque sensors, Tachometers. Robotic drive systems and actuators: Hydraulic, Pneumatic and Electric drives. Specification, principle of operation and areas of application of: Stepper motor, Servo motor and brushless DC motor. Microprocessor control of electric motors, speed control using PWM and direction control using H- Bridge	6	**15**
FIRST INTERNAL EXAM			
III	Robotic vision systems: Imaging, Sensing and Digitization, Image processing techniques, Areas of application in robotics. Introduction to kinematics: Position and orientation of objects, Rotation, Euler angles, Rigid motion representation using Homogenous Transformation matrix.	7	**15**
IV	Forward kinematics: Link coordinates, Denavit-Hartenberg Representation, Application of DH convention to different serial kinematic arrangements fitted with spherical wrist. Inverse kinematics – General properties of solutions, Kinematic Decoupling, Inverse kinematic solutions for all basic types of three-link robotic arms fitted with a spherical wrist.	9	**15**
SECOND INTERNAL EXAM			
V	Velocity kinematics – Derivation of the Jacobian, Application of velocity kinematics for serial manipulators, importance of Singularities. Manipulator Dynamics. Introduction to Legrangian mechanics and Dynamic equation for 2 DOF robots, Introduction to position control and force control of robotic manipulators, Robot actuation and control using PID controllers.	6	**20**
VI	Robot Programming – Programming methods, Robot language classification, Robot language structure, elements and its functions. Motion, End-effecter and Sensor commands in VAL programming language. Simple programs. Industrial applications of Robots in material handling and assembly. Mobile robots, Recent developments in Robotics.	7	**20**
END SEMESTER EXAM			

Question Paper Pattern (End Semester Examk Pattern)

Max. Marks : 100 **Time : 3 Hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 70 % for theory and 30% for logical/numerical problems, derivation and proof.