

**DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING
JADAVPUR UNIVERSITY
PG EVENING COURSE (M.E.TELE.)**

CORE PAPERS

MECE511	Distributed Computing
MECE512	Electromagnetic Theory and Practice
MECE513	Advanced Circuits and Systems
MECE514	Telecommunication Switching
MECE515	Computational Intelligence
MECE516	Advanced Digital Signal Processing
MECE517	Advanced Instrumentation and Systems Design
MECE518	Embedded and Real-Time Systems
MECE519	Digital Communication Network
MECE 520	Electronic and Photonic Devices
MECE521	Digital Image and Speech Processing

SPECIALIZATION PAPERS

MECE 614	Microelectronics Technology
MECE 615	Micro and Nanoelectromechanical Systems
MECE 616	Advanced Analog Integrated Circuit Design
MECE 617	Advanced Digital Integrated Circuit Design
MECE 618	Quantum and Nanoelectronic Devices and Systems
MECE 619	VLSI Architecture and Design Methodologies
MECE 627	Advanced Digital Control Systems
MECE 628	Fuzzy Control Systems
MECE 629	Optimal Control
MECE 630	Stochastic and Adaptive Control
MECE 631	Intelligent Systems
MECE 632	Intelligent Robots
MECE 633	Computer Graphics and Visualization

ANNEXURE-2

Existing and Redesigned Labs for the proposed course
Sessional Papers: (two labs in each of the four semesters)
Total sessional papers: $2 \times 4 = 8$.

MECE 531	Microwave Laboratory
MECE 532	Development of Applications Using Software Lab.
MECE 533	Embedded System Lab.
MECE 534	Communication Networks Lab.
MECE 535	Device Fabrication and testing Laboratory
MECE 536	Analysis & Design Using MATLAB, VHDL and Spice
MECE 537	Development & Implementation of Communication Software
MECE 538	Digital Communication Lab.
MECE 539	Optical Communication
MECE 540	DSP Lab
MECE 541	AI & Robotics Lab.
MECE 542	Digital Control Lab
MECE 543	VLSI Design Lab
MECE 544	MEMS and Sensor Lab
MECE 545	Circuit & Systems Lab.

DETAILED CURRICULUM FOR THE PROPOSE M.TECH (ECE) COURSE

CORE PAPERS

MECE511 Distributed Computing

Concept of Distributed Systems: Definition, Enslow's model, Motivation and Objectives, Application areas.

Inter Process Communication: Building Blocks, Client Server Communication, Case Studies.

Remote Procedure Call (RPC): Design Issues and Implementation, Case Studies -SUN, ANSA, Asynchronous RPC.

Distributed Operating System: Kernel definition of Process and Threads, Naming and Protection, Communication and Invocation, File Server, SNS Name Service Model.

Timing and Coordination: Synchronization, Physical Clocks, Concept of Logical Time and Logical Clocks, Distributed Coordination.

Replication: Basic Architectural Model, Consistency and Request Ordering, Gossip Architecture, Process Group and ISIS.

Shared Data Transaction: Conversation between Client and Server, Simple Distributed Transaction and Nested Transactions, Automatic Commit Protocol, Concurrency Control, Distributed Deadlocks, Transactions with replicated data

Recovery and Fault Tolerance: Transaction Recovery, Hierarchical and Group Masking of Faults, Security Issues.

BOOK: George Coulouris, Jean Dollimore and Tim KinDberg, "Distributed Systems Concept and Design", Addison-Wesley, 1994.

MECE512 Electromagnetic Theory and Practice

The Wave Equation, Waves in Dielectric and Lossy Media

Duality, Source Concept, Uniqueness, Image Theory, Equivalence, Principle, Induction Theorem, Reciprocity, Green's Function - Scalar and Tensor, Plane Wave Functions.

Equivalent Circuit Theory for Guided Wave Systems, Microwave and Millimeter Wave Networks, Network Matrices and Their Properties.

Concepts of EMI and EMC.

Planar and Quasiplanar Transmission Structures - Analysis and Design, Their Applications to MICs and MMICs.

BOOK:

Time Harmonic Electromagnetic Fields by RF Harrington (McGraw Hill)

Microwave Engineering by DM Pozar (Wiley Eastern).

MECE513 Advanced Circuits and Systems

Laplace and Z-transform techniques, system transfer functions, convolution and deconvolution, feedback stability analysis, system analysis techniques and their application to circuit and filter design.

Architecture of digital systems, structural principles, multilevel implementation strategies, primitives (e.g. gates, instructions, procedures and processes) and their implementation using lower-level elements.

Analysis of concurrency, precedence constraints. Pipelined and multidimensional systems. Instruction set design issues.

Applications of rule chaining, heuristic search, constraint propagation, constrained search, inheritance.

Applications of neural nets, genetic algorithms and other learning paradigms.

Two-level logic synthesis, prime implicants, heuristic minimization, binary decision diagrams, finite-state machine synthesis, multi-level logic synthesis.

MECE514 Telecommunication Switching

Circuit Switching: Analog 3-stage matrix space switch, Digital time slot interchange switch, Digital space switch, Digital time-space time switch, Signaling techniques, ISDN and SS7 signaling architecture.

Packet Switching: Basic Banyan architecture, Batcher sorting network, Knockout switch architecture, Staiite switch architecture, Sunshine switch architecture, Large 3-stage ATM switch architecture, Associated hardware design considerations, Associated signaling architecture. Ethernet and router switches, Multicast and Multi-protocol router switches, Digital cross-connects.

Optical Switching: Basic of MEMS, Optical cross-connects, Re-configurable wavelength add-drop multiplexing using MEMS, Optical burst switching node architecture, MPAS/LOBS/variable length packet switches, Photonic GMPLS router characteristics and architecture.

Traffic engineering concepts

BOOK: Digital Switching Systems Reliability and Analyze - Syed Ali, Aug. 1997 McGraw Hill.

MECE515 Computational Intelligence

General principles of reasoning; Fuzzy sets and logic; Fuzzy reasoning; Fuzzy control; Fuzzy databases; Fuzzy classification; Introduction to machine learning; Supervised, Unsupervised, Reinforcement and Competitive learning paradigms; Genetic algorithms and its application in learning, optimization and intelligent search; Belief networks and evidential reasoning; Pearl's model; Dempster-Shafer theory; Introduction to Rough Set theory, Chaos theory and Inductive logic programming; Some case studies with reference to Object Recognition, Robot motion planning, Engineering system design and optimization. Prerequisites: Nil.

BOOK :

Fuzzy logic and Neural nets by Bart Kosko, Prentice-Hall, 1998.

Computational Intelligence: Principles, Techniques and Applications by A. Konar, Springer - Verlag, 2002 (to appear).

MECE516 Advanced Digital Signal Processing

Brief recapitulation of linear & circular convolutions, linear filtering, DFT, Goertzel and chirp-z transform algorithms, Radix-4 FFT algorithms, Quantization errors in FET algorithms.

Linear Phase FIR filters, realizations, design using Rectangular window, Bartlett window, Hanning window, Hamming window, Kaiser window, FIR filter design using MATLAB.

Multirate signal processing, decimation, interpolations, sampling rate conversion, Filters in sampling rate alternation systems, MATLAB examples, Polyphase decomposition.

Filter banks, decimation & inverse decimation, M-band filter banks, reconstruction, transmultiplexers, QMF & CQF filter banks, Cosine-modulated filter banks, Lapped Orthogonal Transforms, wavelet transforms.

Programmable Digital Signal Processors, Multiplier Accumulator, Modified bus structures, VLIW architecture, pipelining, Addressing Modes, On-chip peripherals.

TMS320C5X DSP, architecture, Assembly Language instructions & programming, Instruction pipelining, Analog interfacing circuits & applications, introduction to FPGA based DSP system design.

MECE517 Advanced Instrumentation and Systems Design

Accuracy of measurement systems in the steady state, Dynamic characteristics of measurement systems. Loading effects in measurement systems. Signals & Noise in measurement systems. Measurement system Elements. Sensing elements: Review of electrical, electromagnetic, piezoelectric, electro-chemical sensing elements. Semiconductor sensors, fiber optic sensors, Digital transducers. Signal conditioning elements. Signal Processing elements and software.

Intrinsically Safe Measurement systems (a) Electronic systems (b) Fiber optic systems.

Ultrasonic measurement systems, spectro-photometric & Gas chromatographic measurement systems.

Data Acquisition Systems.

Communication systems for Measurement.

Distributed sensing Mechanism and Multiplexing technique.

Modern Industrial Instrumentation System design for process control.

Marine instrumentation, Nuclear instrumentation, Aero-space instrumentation, semiconductor instrumentation, Geo-scientific instrumentation - concepts.

BOOK:

Measurement Systems Applications & Design by - Doebelin, McGraw Hill.

Principles of Measurement Systems - by J.P. Bentley - Longman.

Instrumentation Technology- E.B. Jones, Butterworth, London.

Optical Fiber Sensors - J. Dakin & B. Culshaw, Artech House.

MECE518 Embedded and Real-Time Systems

Methodologies and technologies for behavioral synthesis, system synthesis and real-time issues in embedded systems. Topics include behavioral synthesis, hardware/software codesign, interface synthesis, scheduling, real-time constraints, real-time specification and modeling, transformation and estimations during synthesis and design optimization, concurrency, real-time OS and embedded processors. Design for low power, verification and debugging.

BOOK: An introduction to the design of small-scale embedded systems by T. Wilmshurst, Palgrave Publisher. Intel, "Embedded Controller Handbook, Vol.1 8-bit", Intel Corporation Santa Clara, CA, 1998.

MECE519 Digital Communication Network

Physical layer. Wired connectivity issues. Wireless connectivity issues: Worldwide frequency allocation, Fading and mobility related propagation models. Multiple Access and multiplexing technique: CSMA-CD, Token Ring, CSMA-CA, CDMA, OFDM, WDM, Network Adapters and drivers.

Date Link Layer : Error detection coding techniques: Parity, Checksum, CRC. Framing technique: PPP, HDLC, SDH/SONET. Reliable Transmission: ARQ techniques (S&W, GBN, SR Protocols), Protocol Engineering, Concurrent Logical Channels.

Network Layer: Simple internetworking: Service model, Global IP address, ARP, DHCP, ICMP, VPN and tunnels. Networking Devices: Repeaters, Bridges, Routers, Gateways, Multi Protocol Routers. Routing Algorithms: Network as a graph, Spanning Tree algorithm, Distance Vector (RIP), Link State (OSPF) and Dijkstra Algorithm, Link costs Metrics, Routing for mobile hosts Congestion control Algorithms. Pre-allocation of buffers, Flow control, Deadlocks. Global Internet: Subletting, Classless Routing, Inter Domain Routing (BGP, IP v6). Multicast: Link State Multicast, Distance Vector Multicast. Transport Layer: UDP, TCP, Remote Procedure call, Performance, Queuing Disciplines, Congestion control, Congestion avoidance, Quality of Service, Integrated services (RSVP), Differentiated services, ATM QoS. Session layer: Session and transport interaction, Synchronisation points, Dialog and activity management, Remote procedure call, Client server model.

Presentation Layer: Translation. Data Compression: Lossless compression algorithms, JPEG, MPEG, MP3. Data security: Cryptographic algorithms, Security Mechanisms, Authentication protocols, Public key distribution, Firewalls.

Application Layer: DNS, SMTP/POP, www, SNMP, Multimedia Applications, RTP, H.323, VoIP.

Performance Analysis and Design of Telecommunication Network and Multiple Access Communication Systems. Architectural Issues. Microwave Digital Radio, Link Calculations. Spread Spectrum and Ultra Wide Band Techniques.

Bluetooth. Network Management - System Tools and Applications.

BOOK: R. Horak Aug. 2002, Wiley.

MECE520 Electronic and Photonic Devices and Components

Electronic processes in semiconductors : Semiconductor under non-equilibrium condition; kinetics of bulk recombination-generation processes; surface recombination.

Surface effects and surface controlled devices - MOS structures and their characteristics; surface space charge regions and their characteristics; properties of silicon-silicon dioxide systems, MIS diodes and CCDs.

Microwave and Millimeter wave Devices: Tunnel diode, Impatt diodes, Transferred-Electron Devices.

Quantum Devices - HEMT, RTD devices.

Photonic Devices: LEDs and semiconductor Lasers; photodiodes and photodetectors, Liquid Crystal; Optical Sensors; Integrated optics, optical waveguide components, acousto-optical and electro-optical devices, optical radar.

BOOKS

Physics of Semiconductor Devices - S.M. Sze, Wiley Eastern.

Physics & Technology of Semiconductor Devices - A.S. Grove - John Wiley's Sons.

Optoelectronics - Pallab Bhattacharya, PrenticeHall India,

Semiconductor optoelectronics - Chuang, Academic Press.

MECE521: Digital Image and Speech Processing

Digitized image and its properties, Data structures for image analysis, image preprocessing, geometric transformations, local preprocessing, image restoration;

Segmentation: Thresholding, edge-based segmentation, border detection, Region-based segmentation, shape representation and description: region-based shape representation and description.

Object recognition and classification: Image detection and Registration

Knowledge representation: Statistical pattern recognition, neural nets, fuzzy system

3D vision geometry and radiometry: Geometry for 3D vision, projective geometry, Camera calibration, Stereo vision, 3D object models and related issues, 3D model-based vision. Mathematical Morphology, Linear discrete image transforms, Image data compression, Motion Analysis. Invariant Transforms.

Acoustic characteristic of speech: Formants, consonants, vowels, auditory perception, loudness estimation, pitch, speech perception.

Speech analysis: Time domain, frequency domain, data reduction, coding, speech synthesis, text to speech, speech recognition; speaker recognition system.

Specialization: Microelectronics Technology and VLSI Design

MECE614 Microelectronics Technology

Clean room concept, Growth of Single crystal silicon - Czochralski and Float zone method, wafer processing, cleaning and etching.

Physical vapour deposition ; Vacuum evaporation sputtering. **Chemical vapour deposition** - APCVD, Plasma CVD, MOCVD.

Epitaxial growth : Liquid phase epitaxy, vapour phase epitaxy, Molecular beam epitaxy; Heteroepitaxy.

Oxidation - Growth mechanism and Kinetics of oxidation, oxidation techniques and systems, oxide properties, oxide-induced defects.

Diffusion - Fick's equations; Atomic Diffusion mechanisms, Measurement techniques, Diffusion in Polysilicon and SiO₂, Diffusion Systems.

Ion Implantation : Range Theory, Equipments, Annealing, Shallow junction, High energy implantation.

Lithography: Optical lithography; optical mask printing and making techniques, electron lithography, X-ray lithography.

Plasma Deposition and Etching: Plasma properties, plasma assisted depositions of Polysilicon, silicon dioxide and silicon nitrides; Reactive plasma Etching techniques and equipment; specific etch processes.

Metallisation : Metallisation Application, Patterning Interconnects, Multilayer metallisation, Measurement.

VLSI Process Integration : Fundamental considerations of IC technology, NMOS and CMOS IC processing; MOS Memory IC processing, Bi CMOS processing.

BOOKS:

VLSI Technology: S.M. Sze, McGraw-Hill Int. Ed. Principles of Microelectronics Technology - D. Nagchowdhury Wheeler Publishing.

MECE615: Micro and Nanoelectromechanical Systems

Fundamentals of microelectromechanical systems (MEMS) microsensors and microinstruments. Advanced discussion of micromachining processes used to construct MEMS. Coverage of many lithographic, deposition and etching processes, as well as their combination in process integration. Materials issues such as chemical resistance, corrosion, mechanical properties and residual/intrinsic stress. Introduction to MEMS design. Design methods, design rules, sensing and actuation mechanisms, microsensors and microactuators. MEMS for pressure sensors, Accelerators Gyroscopes etc.

Measurement principles for MEMS transducers. Design methods and design constraints for sensitivity and stability.

Implementation of control methods for improving measurement sensitivity, linearity and reproducibility.

Nano Electromechanical systems; nanofabrication and measurement techniques applications.

BOOK: RE MEMS Circuits Design for wireless Application - H. J. De Los Santos, June 2002, Artech House.

MECE616 Advanced Analog Integrated Circuit Design

Basic MOS device and model. CMOS inverter, characteristics, transient response and delay analysis, power considerations.

MOS resistor, MOS current source, current mirror circuits: design and performance enhancement issues, MOS voltage source, design and improvement considerations. Linear voltage and current converters.

CMOS operational amplifier (OP AMP) design, differential amplifier, level shifter, source follower, output stage voltage and power amplifiers. Compensation techniques.

BiCMOS circuit techniques: BiCMOS device and technology, basic analog subcircuits, low-voltage BiCMOS operational amplifier design.

Analog Filters: Switched capacitor (SC) fundamentals, first order and higher, second-order SC circuits and cascade design, analytical techniques for SC circuits; SC ladder filters, switched current filters.

Analog VLSI Interconnects: Physics of interconnects in VLSI, scaling of interconnects, distributed RC model, transmission line model. Improvements in interconnect performance, future interconnect technologies.

BOOK:

"Analog VLSI Signal and Information Processing", M. Ismail and T. Fietz.

"VLSI Design Techniques for Analog and Digital Circuits", R.L. Geiger, P.E. Allen and N.R. Strader.

"CMOS Analog VLSI Design", P.E. Allen and D.R. Holberg.

MECE617 Advanced Digital Integrated Circuit Design

Review of MOSFET characteristics, scaling and small-geometry effects, MOSFET capacitances. MOS inverters, CMOS inverter, static characteristics, switching characteristics, power dissipation issues. Combinational MOS Logic Circuits: MOS logic circuits with depletion loads, CMOS logic gates, complex logic gates, CMOS transmission gates, pseudo-nMOS, domino logic gates. Multilevel gate circuits and design. Sequential MOS Logic Circuits: The SR latch circuit, clocked latch and flip-flop, CMOS D-latch and edge-triggered circuits, Schmitt trigger circuit.

Dynamic Logic Circuits: Pass transistor logic, synchronous dynamic circuit techniques, high-performance dynamic CMOS circuits.

Semiconductor Memories: ROM circuits, SRAM circuits, DRAM circuits, drivers and buffers, design issues in memory and array structures.

Low-Power CMOS Logic Circuits: Overview of power consumption, low-power design through voltage scaling, estimation and optimization of switching activity, quasi-adiabatic logic circuits, Multi-threshold CMOS, SOI-MOSFET design issues.

BiCMOS Logic Circuits: Basic BiCMOS circuits, static behavior, switching characteristics in BiCMOS logic circuits, BiCMOS applications.

Input-Output Circuits: ESD protection, input and output buffer design, on-chip clock generation and distribution, latch-up and its prevention.

BOOK:

CMOS Digital Integrated Circuits", S.M. Kang and Y. Leblebici.

VLSI Design Techniques for Analog and Digital Circuits, R.L. Geiger, P.E. Allen and N.R. Strader. Digital Integrated Circuits, J.M. Rabaey. Introduction to Digital Systems, M. Ercegovac, T. Land and J. H. Moreno.

MECE618 Quantum and Nanoelectronic Devices and Systems

Foundation: Wave mechanics and the Schrodinger Eq., Free particles, Bound particles : Quantum well, Charge and current densities, Operators and Measurements, Math properties of Eigenstates, Counting states, Occupation of states

Electrons and Phonons in crystal : Band structures in 1D, Motion of electrons in Band, Density of states, Band structures in two and three dimensions, Band structure of the common semicond., Phonons. **Heterostructures (HS):** General properties of Heterostructures, Growth of HS, Bandgap Engineering, Layered structures: Quantum well and barriers, Doped Heterostructures, Strained layers, Si-Ge Heterostructures, Wires and Dots, Optical confinements, Effective mass then in HS.

Quantum wells and Low dimensional systems: Infinite deep square well finite depth well parabolic well, Low dimensional systems, Quantum well in HS, Superlattice and Miniband, Tunnelling in HS, The Quantum Hall effect, Optical absorption in QW, Band diagram Modulation doped, Scattering mechanisms in QW.

Optical properties in Low dimensions: Valence band structure, Bands in QW, Intersubband transitions in QW, Optical gain and laser, Excitons,

Quantum effect nanoelectronic devices: Resonant tunneling diode, HEMT, QW Laser, QW detector, Modulator and Switch.

Single electron devices: Coulomb Block Phenomenon, Single electron effect & its application in transistor & memory devices. Fabrication of Single Electron Devices, Binary Decision Diagram circuits, Digital single-electronics. (Quantum computer). Single electron simulators for high and low level analysis, Turnstile based single-electron logic devices.

Spin electronic devices

Quantum computation and communications

MECE619 VLSI Architecture and Design Methodologies

The Impact of VLSI on Computer Architecture

VLSI Technology Overview and Trends

VLSI design methodologies: Custom, semi-custom, synthesis, simulation and verification at the system, behavior, logic, circuit and layout levels. (Datapath: synthesis, bit slice approach, ad hoc logic, structured logic-control: ad hoc, finite state machines, use of PLAs.)

Advanced Microprocessor Architecture and Memory Systems in VLSI

Multi-Processor Arrays and Interconnect Topologies: Architectures and algorithms, systolic arrays methods.

Timing Design of VLSI systems: Asynchronous schemes, Timing and clocking-asynchronous versus synchronous, single and two-phase clocking schemes, clock generation, buffering and clock distribution.

FPGA Architecture: FPGA Structure, CPLD Structure, Programming Techniques, Device Dependent/Independent Technologies, Tips & Tricks Rules.

Low-Power VLSI Design: Design methods, estimation techniques.

Applications: Digital signal and image processing, numerical linear algebra, robotics, real-time computing, telecommunications, super-computing.

PREREQUISITES: VLSI circuits and Introduction to Computer Architecture (or equivalent courses).

Specialization: Intelligent Automation And Robotics

MECE627: Advanced Digital Control Systems

Review of representation and analysis of discrete systems. Discretization of continuous systems, solutions of difference equations by state transition matrix, controllability and observability of linear systems; Stability of discrete systems-review of frequency domain method; Lyapunov's direct method for linear systems, Root locus and parameter sensitivity; Performance specifications of closed loop systems, design of compensators, Pole assignment design; Current and predictive state estimators; Regulating and tracking systems. Implementation of digital controllers in finite bit computers - quantization effects, Propagation of errors; Choice of sampling rate; Selection of A/D, memory, CPU and memory word length, overflow characteristics and its avoidance; case studies of microcomputer based control system.

MECE628: Fuzzy Control Systems

Fuzzy set, operation on Fuzzy sets, Fuzzy arithmetic, Fuzzy logic and extension principle, Fuzzy relations, Possibility Theory, Approximate reasoning, Fuzzy control systems, Fuzzy rule base, Fuzzifier, Defuzzifier, Inference Engine, Mamdani and Sugeno scheme, Design Methodology of Fuzzy control systems, stability of Fuzzy controller, Fuzzy Rule extraction from Numerical training data, case studies: Inverted pendulum, aircraft landing system, Metro rail control system, Truck backer system, Ball and beam system.

MECE629: Optimal Control

Performance index, the principle of optimality, minimum time and minimum control-effort problems, LQ problem, illustrative examples, Riccati equation, discrete optimal principle, Optimal estimator, LQG control, Kalman filtering, necessary and sufficient condition. Theorems for optimal control, design of the optimal controller, illustrative examples. Applications of variational methods. Pontryagin maximum principle, Hamilton-Jacobi-Bellman Equation, dynamic programming, Optimal control of nonlinear ordinary differential equations.

MECE630 : Stochastic and Adaptive Control

State-space solutions of time-invariant and time varying nonlinear systems, Stability of nonlinear systems by Liapunov's direct method, Instability Theorems, invariance, center manifold theorem, input-to-state stability and small-gain theorem. Estimation and control of linear discrete-time and continuous-time stochastic systems; separation theorem and applications; Kalman filtering. Introduction to Adaptive control, Model reference and Self-tuning Adaptive control. Adaptive controller using neural nets, Neuro-Fuzzy adaptive control system.

MECE631 Intelligent Systems

Production systems; Heuristic search; Game playing; Propositional and predicate logic; Structured objects; Logic programming; Non-monotonic and default reasoning; Intelligent planning; Natural language understanding; Application of the above tools and techniques in VLSI design, Networking,. Adaptive antenna systems, Flowshop and Jobshop scheduling, Image understanding and others.

Prerequisites: Nil.

BOOK:

Artificial Intelligence: A Modern Approach by Russel and Norvig, Prentice-Hall, 1995.

Artificial Intelligence and Soft Computing by A. Konar, CRC Press, 1999.

MECE632 Intelligent Robots

Co-ordinate transformation; Robot arm kinematics; Robot arm dynamics; Planning of manipulator trajectories; Control of robot manipulators; Sensing; Low, Medium and high Level vision; Intelligent task planning; Introduction to Mobile Robotics; Neuro-Fuzzy control and path planning of mobile robots; Target tracking using 2 robots; Introduction to multi-agent robotics.

Prerequisites: (i) Computational Intelligence and (ii) Intelligent systems.

BOOK:

Robotics by Fu, Gonzalez and Lee, McGraw-Hill, 1987. Intelligent Robotics by A. Konar, World Scientific, 2002 (to appear).

MECE633 Computer Graphics and Visualization

Geometry and line generation; Graphics primitives; Polygons; Transformations; Segments; Windowing and Clipping; Interaction; Three dimensional geometry; Three dimensional clipping; Hidden surfaces and lines; Illumination and shading; Curves and fractals; Graphic kernel system; Three dimensional rendering; Animation; Graphic user interface; Application in computer aided design of machines.

Prerequisites: Nil.

BOOK:

Computer graphics: A programming approach by Steven Harrington, McGraw Hill, 2000.

Comprehensive computer graphics by V.K. Pachghare, Laxmi publications, 2002.