Rajiv Gandhi ProudyogikiVishwavidyalaya Bhopal
M.Tech (IoT)
First Semester Syllabus

MTIO 101-OPERATING SYSTEM AND REAL TIME OS

Unit I

Operating System Introduction, Structures - Simple Batch, Multi programmed, time-shared, Parallel, Distributed Systems, Real-Time Systems, System components, Operating-System services, System Calls, Virtual Machines, System Design and Implementation, Process and CPU Scheduling - Process concepts and scheduling, Operation on processes, Cooperating Processes, Threads, IPC.

Unit II

Memory Management and Virtual Memory - Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging, Demand Paging, Performance of Demanding Paging, Page Replacement Algorithm, Allocation of Frames, Thrashing

Unit III

Deadlocks - System Model, Dead locks Characterization, Methods for Handling Dead locks Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock, Process Management and Synchronization - The Critical Section Problem, Synchronization Hardware, Semaphores, and Classical Problems of Synchronization, Critical Regions, Monitors.

Unit IV

Operating System Security Issues and File System- Introduction to the topic of Security in Operating Systems, Principles of Information Security, Access Control Fundamentals, and Generalized Security Architectures.
File System Interface and Implementation -Access methods, Directory Structure, Protection, File System Structure, Allocation methods, Free-space Management, Directory Management, Directory Implementation, Disk scheduling.

Unit V

Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS, Basic architecture of an RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Interrupt management in RTOS environment, Memory management, File systems, I/O Systems, Advantage and disadvantage of RTOS, RTOS for IoT
Case Studies of RTOS: RT Linux, Micro C/OS-II, Vx Works, Embedded Linux, and Tiny OS, Embedded Operating System

Reference Books:

1. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley
2. Operating System a Design Approach-Crowley, TMH.
3. Operating Systems – Internals and Design Principles Stallings, Fifth Edition–2005, Pearson Education/PHI
4. Jane W. S. Liu, “Real-time systems”, Prentice Hall, 2000.

Course Outcomes:

On successful completion of this course the students will be able to-

1. Explain about operating systems, what they are, and what are their major components and functions
2. Describe and analyze the memory management and its allocation policies
3. Evaluate the requirement for process synchronization and coordination handled by operating system
4. Understand various security issues in Operating systems
5. Evaluate the need for real-time operating system

MTIO 102- EMBEDDED SYSTEM AND MICROCONTROLLERS

Unit I

Fundamentals of Embedded System: Embedded systems vs General Computing systems, Classification, Applications, Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware (RTOS, Drivers, Application programs), Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Ethical practice. Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net, UML

Unit II

8051 Microcontroller Basics: Microcontrollers Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins Of 8051. Memory Address Decoding, 8031/51 Interfacing With External ROM And RAM. 8051 Addressing Modes

UnitIII

Assembly programming and instruction of 8051: Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming. Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051. Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in assembly, serial port programming in 8051. 8051 interrupts, Programming timer, external hardware, serial communication interrupt, Interrupt priority in 8051/52

UnitIV

Interfacing: LCD interfacing, Keyboard interfacing. ADC, DAC and sensor interfacing**:** ADC 0808 interfacing to 8051, Serial ADC Max1112 ADC interfacing to 8051, DAC interfacing, Sensor interfacing and signal conditioning. Motor control: Relay, PWM, DC and stepper motor: Relays and opt isolators, stepper motor interfacing, DC motor interfacing and PWM. 8051 interfacing with 8255: Programming the 8255, 8255 interfacing

UnitV

Introduction to PIC, AVR family of microprocessors & ARM processors:Introduction, Salient features and Architecture of 8 bit PIC and AVR microcontroller s and 32 bit ARM processor

Reference Books:

1. Ayala J.K., The 8051 Microcontroller: Architecture, programming and applications, Penram International (2005) 3rd ed.
2. Mazidi,E. and Mazidi,F., The 8051 Microcontroller and Embedded Systems, Prentice-Hall of India (2004) 2nd ed.
3. Peatman J., Embedded system Design using PIC18Fxxx, Prentice Hall, 2003.
4. Raj Kamal, "Microcontroller - Architecture Programming Interfacing and System Design" 2nd Edition, Pearson Education, 2011
5. Joseph Yiu," The Definitive Guide to the ARM Cortex-M3", Second Edition, Elsevier Inc. 2010.
6. Dr. K.V.K. Prasad, "Embedded / Real-Time Systems: Concepts, Design and Programming Black Book" , New ed (MISL-DT) Paperback – 12 Nov 2003
7. Ajay Deshmukh, "Microcontroller - Theory & Applications", Tata McGraw Hill, 2005 .
8. Shibu K.V, Introduction to embedded systems, Tata McGraw Hill

Course Outcomes:

On successful completion of this course the students will be able to-

1. Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.
2. Understand the basics of Microcontrollers and describe the internal architecture of microcontroller systems, including counters, timers, ports, and memory.
3. Do programming for microcontrollers
4. Interface a microcontroller system to user controls and other electronic systems
5. Demonstrate knowledge of ARM and AVR microcontrollers

MTIO 103 - PRINCIPLES OF SENSORS AND SIGNAL CONDITIONING

UNIT I

Sensor Classification, Sensor Characteristics, Physical Principles of Sensing, Optical Components of Sensors
Interface Electronic Circuits: Signal Conditioners, Sensor Connections, Excitation Circuits, Analog-to-Digital Converters, Integrated Interfaces, Data Transmission, Noise in Sensors and Circuits, Batteries for Low-Power Sensors, Energy Harvesting

UNIT II

Sensor Materials and Technologies; Occupancy and Motion Detectors: Ultrasonic Detectors, Microwave Motion Detectors, Micropower Impulse Radars, Ground Penetrating Radars, Capacitive Occupancy Detectors, Triboelectric Detectors, Optoelectronic Motion Detectors, Sensor Structures, Visible and Near IR Light Motion Detectors, Far-Infrared Motion Detectors, Optical Presence Sensors, Pressure-Gradient Sensors, 2D Pointing Devices, Gesture Sensing, Tactile Sensors

UNIT III

Position, Displacement and Level: Potentiometric Sensors, Piezoresistive Sensors, Capacitive Sensors, Inductive and Magnetic Sensors, Optical Sensors, Thickness and Level Sensors
Velocity and Acceleration: Stationary Velocity Sensors, Inertial Rotary Sensors, Inertial Linear Sensors (Accelerometers)

UNIT IV

Force, Strain, and Tactile Sensors: Strain Gauges, Pressure-Sensitive Films, Piezoelectric Force Sensors, Piezoelectric Cables, Optical Force Sensors
Pressure Sensors: Concepts and units of pressure, Mercury Pressure Sensor, Bellows, Membranes, and Thin Plates, Piezoresistive Sensors, Capacitive Sensors, Optoelectronic Pressure Sensors, Indirect Pressure Sensor, and Vacuum Sensors
Flow Sensors: Basics of Flow Dynamics, Pressure Gradient Technique, Thermal Transport Sensors, Ultrasonic Sensors, Electromagnetic Sensors, Drag Force Sensors, Dust and Smoke Detectors,

UNIT V

Microphones: Microphone characteristics, Microphone Types
Humidity and Moisture Sensors: Concept of Humidity, Capacitive and Resistive humidity Sensors, Electrical Conductivity Sensors, Thermal Conductivity Sensor, Optical Hygrometer, Oscillating Hygrometer
Light Detectors: Image Sensors, UV Detectors, Thermal Radiation Detectors, Detectors of Ionizing Radiation, Temperature Sensors, Chemical and Biological Sensors

Reference Books:

1. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 5th edition, Springer, New York.
2. Jon. S. Wilson, “Sensor Technology Hand Book”, 1st edition, Elsevier, Netherland.

Course Outcomes:

On successful completion of this course the students will be able to-

1. Use concepts and common methods for converting a physical parameter into an electrical quantity
2. Know about the Sensor Materials and Technologies
3. Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.
4. Evaluate performance characteristics of different types of sensors
5. Compete in the design, construction, and execution of systems for measuring physical quantities

MTIO 104 - ADVANCE COMPUTER NETWORKS

UNIT I

Importance of computer networks, broadcast and point to point networks, Local area networks and Wide area networks , ISO-OSI reference model, TCP/IP model , interfaces and services, Protocol data unit, connection oriented and connectionless services, service primitives, Binding Protocol Address- ARP & RARP, packet format, Encapsulation, Data link layer and its functions, MAC and LLC Sub layer

UNIT II

Network layer- IP Addressing: Address space, Notations, Classfull addressing, Network Address Translation (NAT); Internet Protocol (IP): Datagram Format, Fragmentation, Options; $ICMP_V4$: Messages, Debugging, Tools, ICMP, Checksum; IP_V6 Addressing: Representation, address space, address space allocation, Autoconfiguration, Renumbering; Transition from IP_V4 to IP_v6: Dual Stack, Tunneling, Header Translation; IPv6 Protocol: Packet format, Extension Header

UNIT III

Network layer- Introduction toInter–domain, Intra-domain Routing; Routing Algorithms: Distance Vector Routing, Bellman Ford algorithm, Link State Routing, Path Vector Routing, Unicast Routing Protocols: Internet Structure, Routing Information Protocol(RIP), Open Shortest Path First(OSPF), Border Gateway Protocol Version 4(BGP4), Introduction: Unicast, Multicast and Broadcast; Intradomain Multicast Protocols:Mulicast Distance vector(DVMRP), Multicast Link State(MOSPF), Protocol Independent Multicast(PIM)

UNIT IV

Transport Layer-User Datagram Protocol: User Datagram, UDP Services, UDP Applications; Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP Connection, State Transition Diagram, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers, Options; SCTP: SCTP Services, SCTP Features, Packet Format, An SCTP Association, Flow Control, Error Control

UNIT V

Application layer- World Wide Web and HTTP; File Transfer: FTP and TFTP; Electronic Mail: Architecture, Web- Based Mail, Email Security, SMTP, POP, IMAP and MIME, SNMP; DNS – Concept of Domain Name space, DNS Operation; DHCP- Static and Dynamic Allocation, DHCP Operation; Remote Login: TELNET, and SSH; Mobile IP: Addressing, Agents, Three Phases, Inefficiency in Mobile IP; Virtual Private Network: VPN Technology.

Reference Books:

1. Forouzan Behrouz A., “Internetworking with TCP/IP”, McGraw Hill Education
2. Comer Douglas E., “Internetworking with TCP/IP”, Volume I,II Fourth Edition, Prentice Hall of India Private Limited
3. Tanenbaum Andrew S., “Computer Networks”, PHI Learning

Course Outcomes:

On successful completion of this course the students will be able to-

1. Enumerate the layers of the OSI model and TCP/IP model and explain the function(s) of each layer
2. Acquire the skills of subnetting and routing mechanisms
3. Understand the protocols of computer networks, Design and implement networking protocols
4. Understand the applications of transport layer protocols
5. Identify core networking and infrastructure components, and the roles they serve

MTIO 105 (A) SOFTWARE ENGINEERING

Unit I

Nature of Software, Software Engineering, Software Development Life Cycle, Software Process, Software Engineering Practice, Software Process Models: Linear, RAD, Incremental, Spiral, Component-based development, Fourth Generation Techniques, CMM

Unit II

Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements, Software Requirement Specification, Design within the context of Software Engineering, Design Process, Design Concepts, and Design Model-Software Architecture

Unit III

Strategic Approach to Software Testing, Testing Principles, Strategic Issues, Test Strategies for Conventional Software, Software Testing Fundamentals, Testing Techniques: Black box Testing, White box Testing and their types, Testing Strategy: Unit, Testing, Integration Testing, Validation Testing, System Testing, Regression Testing, Code walkthrough and reviews, Reliability models

Unit IV

Software Measures and Metrics, Product and Process Metrics, Metrics for the Requirements Model, Metrics for the Design Model - Architectural Design Metrics, Object-Oriented Design, Software Measurement, Metrics for Software Quality,Software cost estimation, COCOMO model, Software Quality Assurance

Unit V

Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring and Management, RMMM Plan, Software Maintenance, Software Supportability, Reengineering, Reverse Engineering.

Reference Books:

1. Roger Pressman, Software Engineering: A Practitioner's Approach, 7th Edition, McGrawHill,
2. Ian Sommerville, Software Engineering, 9th Edition, Addison-Wesley
3. Pankaj Jalote, A Concise Introduction to Software Engineering, Springer

Course Outcomes:

On successful completion of this course the students will be able to-

1. Understand the fundamental concepts of Software Engineering and software development life cycle
2. Analyze a problem, identify and define the user and system requirements and design a software system and its process to meet user needs
3. Evaluate and select and software systems considering user needs
4. Evaluate processes and products against the applicable standards and metrics
5. Assist in the creation of an effective software project plan and analyze software risks and identify mitigation strategies

MTIO 105 (B) DATABASE MANAGEMENT SYSTEM

Unit I

Structure of relational databases, Relational Algebra, Functional Dependency, Different anomalies in designing a database., Normalization using functional dependencies, Lossless Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF

Unit II

Transaction processing, Concurrency control and Recovery management, Conflict and View serializability, Lock based protocols, Two phase locking

Unit III

Distributed DBMS features and needs. Reference architecture. Levels of distribution transparency, replication. Distributed database design - fragmentation, allocation criteria. Distributed deadlocks. Time based and quorum-based protocols. Comparison. Reliability- non-blocking commitment protocols

Unit IV

Partitioned networks, Checkpoints and cold starts, Management of distributed transactions- 2 phase unit protocols, Architectural aspects, Node and link failure recoveries, Distributed data dictionary management, Distributed database administration, Heterogeneous databases-federated database, reference architecture, loosely and tightly coupled

Unit V

Case Study of Oracle RDBMS and PostgreSQL

Reference Books:

1. Leon & Leon, Essentials of DBMS, McGraw Hill
2. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, McGraw Hill.
3. Saeed K. Rahimi, Frank S. Haug, “Distributed Database Management Systems: A Practical Approach”, Wiley

Course Outcomes:

On successful completion of this course the students will be able to-

1. Describe the fundamental elements of relational database management systems
2. Understand the principles of storage structure and recovery management
3. Explain the need for distributed database technology to tackle deficiencies of the centralized database systems
4. Understand transaction management, concurrency control techniques
5. Create a relational database schema

MTIO 105 (C) ADVANCE DISTRIBUTED SYSTEM

Unit I

Characterization of Distributed Systems:Introduction, Examples of Distributed Systems, Trends in Distributed Systems, Challenges, System Models, Interprocess Communication, Network Protocols, Naming, Remote Procedure Call, Remote Method Invocation, Models for Communication, Distributed File Systems

Unit II

Time in a Distributed System:Introduction, Logical Clocks, Vector Clocks, Events and Process States, Clock Synchronization, Algorithms for Internal and External Synchronization; Distributed Mutual Exclusion: Introduction, Solutions on Message Passing Systems, Token Passing Algorithms; Distributed Snapshot: Chandy-Lamport Algorithm; Distributed Debugging

Unit III

Global State Collection: Termination Detection Algorithms, Distributed Deadlock Detection; Coordination Algorithms: Introduction, Leader election, Bully Algorithm; Distributed Consensus: Introduction, Consensus in asynchronous and synchronous systems, Distributed Shared Memory

Unit IV

Transactions and Concurrency Control: Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering, Distributed Transactions, Flat and Nested Transactions, Atomic Commit Protocols, Concurrency Control and serializability in Distributed Systems, Transaction Recovery, Checkpointing and Rollback Recovery; Group Communication

Unit V

Architecture of replicated data management; Security in Distributed Systems:Security Mechanisms, Common Security Attacks, Encryption, Secret key and public key Cryptosystems, Hashing, Digital signature and Digital certificate, Authentication in Distributed Systems; Self Stabilizing Systems

Reference Books:

1. Sukumar Ghosh, Distributed Systems: An Algorithmic Approach, Second Edition
2. A.D. Kshemkalyani, M. Singhal, Distributed Computing: Principles, Algorithms, and Systems, ISBN: 9780521189842, Cambridge University Press, March 2011.
3. George Coulouris, Jean Dollimore, Tim Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education Asia
4. Gerard Tel. Introduction to Distributed Algorithms
5. Nancy A. Lynch. Distributed Algorithms

Course Outcomes:

On successful completion of this course the students will be able to-

1. Identify the advantages and challenges in designing distributed algorithms for different primitives like mutual exclusion, deadlock detection, agreement, etc.
2. Design and develop distributed programs using sockets and RPC/RMI
3. Analyze different algorithms and techniques for the design and development of distributed systems
4. Understand Distributed File Systems and Distributed Shared Memory
5. Understand the importance of security in distributed systems