University of Baghdad/ College of Engineering

M.Sc. Computer Engineering

Courses Syllabus (2016-2017)

1.Advanced **Computer** Architecture: ( 2 Units / Week , 30 Hours/Sem.)

-Technological Advances and new era in Measuring, and reporting performance from Moore’s law and beyond.

-Advanced Pipelining Topics: Static and Dynamic Pipelining.

-Superscalar pipelining, multiple issue pipelining.

-Advanced topics in loop unrolling and branch prediction.

-Hyper-threading, Multi-cores architecture, and thread level parallelism.

 -Review of Memory organization and cache coherency protocols.

-Micro and Macro Fusion mechanisms. Vector, SIMD, and Many cores GPU architectures.

- Overview of Dual-Core, Core-Due, Core I3, Core I5, Core I7, Nvidia, -Radeon Architectures. Granularity in Fine Grained and Coarse Grained Processors.

2.Advanced Digital Control Systems:

 ( 2 Units / Week , 30 Hours/Sem. )

* Introduction to Digital Control

 Discrete-Time Systems: The z-Transform

* z-Transforms of Standard Discrete-Time Signals
* The Modified z-Transform
* The Closed-Loop Transfer Function
* Z-Transform of Discrete Time State Space Systems
* Jury’s Stability Rule

 Digital Control System Design

* Direct Design Method
* Design Digital Controller via Continuous Controller: (pole-zero matching method, bilinear transformation, Zero order hold).
* Dead-beat Design method
* Digital PID Controller Tuning
* z-Domain Root Locus
* Frequency Response Design
* Proportional Control Design in the z-Domain

 Discrete-Time State–Space Equations

* Stability o f State–Space Realizations
* Controllability and Stabilizability
* Observability and Detectability
* Poles and Zeros o f Multivariable Systems

 State Feedback Control

* Pole Placement
* Pole Placement Using a Matrix Polynomial
* Choice of the Closed-Loop Eigen-values
* State Estimation
* Full-Order Observer
* Reduced-Order Observer
* Observer State Feedback

3. Digital Signal Processing ( 2 Units / Week , 30 Hours/Sem. )

* Digital filter design (IIR filter, FIR filter).
* Multirate signal processing (Decimation, Interpolation, Multistages frequency sampling convertor).
* Applications of multirate signal processing.
* Digital filter bank.
* Adaptive signal processing.
* Least-mean square error (LMS) algorithm.
* Recursive least square (RLS) and Kalman filter.
* Application of adaptive filters, System identification, System inverse modeling, Equalization, Adaptive prediction, Adaptive noise and interference cancelling.

4. Image Processing:

 (2 Units / Week , 30 Hours/Sem.)

- Image compression: subband coding and wavelets; fractals; 3D model-based coding.

- Image enhancement and restoration: order-statistics filters; projection on convex sets; EM; reconstruction from incomplete data.

- 3D motion analysis: rigid objects; articulate objects; non-rigid motion.

- Texture analysis; Morphology: Image enhancement; edge detection; shape analysis.

- Optical image processing: 2D Fourier transform; linear filtering; nonlinear processing.

* Human stereo vision; motion perception in humans; motion estimation from optical flow and motion stereo; human texture perception and surface shape from texture gradient; surface shape from contours; active vision.
* Three-dimensional model generation; object recognition; relaxation processes
* Computer architectures for vision: model of computer vision; planar array and hierarchial multiprocessor architectures for image analysis and processing.

5. Advanced Mathematics : (2 Units / Week , 30 Hours/Sem.)

* Numerical Integration and Differentiation.
* Solution of Equations.
* Matrices and related topics.
* System of Equations: Gaussian Elimination, Jacobi Iterative Method, Gauss-Seidal Iterative Method.
* Approximation of Solution of Ordinary Differential Equations.
* Approximation of the solution of partial differential equations.
* Statistical Methods.
* Turing machines, Nondeterminism, hierarchy and simulation theorems.
* Circuit complexity, parallel complexity.
* Relativized computational complexity.
* Time-space trade-offs.

6. Computer Vision: (2 Units / Week , 30 Hours/Sem.)

* Interpreting Intensity Light, shading, and color
* • Image filters, template matching, and image pyramids
* • Edge detection
* Correspondence and Alignment Interest point detection and feature tracking
* • Fitting and registration of objects and images
* 3D Geometry Camera models
* • Single-view and multi-view geometry
* • Stereo and structure-from-motion
* Grouping and Segmentation Clustering, EM
* • Segmentation
* Recognition Face recognition
* • Image features and categorization
* • Object category recognition
* • Statistical templates and part-based recognition
* Special Topics Action recognition
* • Convolutional neural networks
* • 3D scene interpretation

7. **Computer and Network Security**:( 2 Units / Week , 30 Hours/Sem.)

**Introduction**

**Cryptography**

Symmetric Encryption

Asymmetric Encryption

Message Authentication

Digital Signature

**Mutual Trust**

Key Management and Distribution

User Authentication (Kerberos)

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| **Network and Internet Security** |

Network Access Control

Cloud Security

Transport Layer Security

Wireless Network Security

Email Security

IP Security

**System Security**

Malicious Software

Intruders

Firewalls

**8. Internet Protocols and Services**: ( 2 Units/Week, 30 Hours/Sem.)

* Overview: Computer Networks and the Internet, Protocols Layers and Their Services; Layered Architecture, Encapsulation. Delay, Loss, and Throughput in Packet-Switched Networks.
* Protocols Flow/Processing in a Web Page Request: 1- DHCP, UDP, IP, CIDR, Routers, IP Forwarding Table, Ethernet, Switches, Multiplexing and Demultiplexing . 2- DNS, ARP, TCP Socket, HTTP Request. 3- Client-Server Interaction TCP and HTTP; Non-Persistent and Persistent Connections, Round-Trip-Time. Related Topics: ICMP, NAT, Self-Learning Switch, VLANs.
* Transport Layer Protocols: Overview of the Transport Layer in the Internet, connectionless and connection-oriented protocols, Building Reliable Data Transfer protocol. The TCP Connection: TCP Segment Structure, Round-Trip Time Estimation and Timeout, Flow Control, TCP Connection Management, Congestion Control, Cause and Cost of Congestion. TCP Congestion Control: Slow start, Congestion Avoidance, Fast Recovery.
* Routing in the Internet: Intra-Domain Routing; RIP, OSPF. Inter-Domain Routing; BGP. Broadcast and Multicast Routing. IGMP. IP6: IP6 Datagram Format, Transitioning from IP4 to IP6.
* WiFi 802.11 Wireless LANS: The 802.11 Architecture, The 802.11 MAC Protocol, The IEEE 802.11 Frame, Mobility Management, Mobile IP.
* Multimedia Networking: Streaming Stored Audio/Video, Streaming Live Audio/Video, Voice-over-IP, Real-Time Interactive Audio/Video, Protocols for Real-Time Conversational Applications: RTP, SIP. Network Support for Multimedia

9.Soft Computing : (2 Units / Week , 30 Hours/Sem.)

* Introduction to soft computing
* Technologies for study the details of Brain (EEG, MRI, MEG, ..etc.)
* ANN and supervised learning
* Factors affecting the performance of ANN Moedels
* Introduction to fuzzy logic
* Operations on fuzzy set
* De-fuzzification methods
* Application of fuzzy rule based system
* Introduction to genetic algorithm
* Application of genetic algorithm

10.Robotics systems: (2 Units / Week , 30 Hours/Sem.)

Introduction of Robotics

* History of Robotics
* Components and Structure of Robots
* Rigid Motions and homogenous transformations.

 Forward Kinematics: The Denavit Hartenberg Convention

* Kinematic Chains
* Denavit Hartenberg Representation
* Assigning the coordinate frames
* Examples.

 Inverse Kinematics

* The General Inverse Kinematics Problem
* Kinematic Decoupling
* Inverse Position: A Geometric Approach
* Inverse Orientation

 Velocity Kinematics – The Manipulator Jacobian

* Angular Velocity: The Fixed Axis Case
* Skew Symmetric Matrices
* Angular Velocity: The General Case
* Linear Velocity of a Point Attached to a Moving Frame
* Derivation of the Jacobian
* The Analytical Jacobian
* Inverse Velocity and Acceleration
* Programming the robot using MATLAB

**11. Cloud Computing** : (2 Units / Week , 30 Hours/Sem.)

Cloud Architecture and Model

– System Models for Distributed and Cloud Computing

 –Cloud Computing Architecture

– Cloud Services

– Cloud models (IaaS, PaaS, SaaS)

 – Public vs Private Cloud

Virtualization

– Basics of Virtualization

– Types of Virtualization

– Implementation Levels of Virtualization

– Virtualization Structures

Cloud Infrastructure

– Architectural Design of Compute and Storage Clouds

 – Layered Cloud Architecture Development

 – Design Challenges

– Inter Cloud Resource Management

 – Resource Provisioning and Platform Deployment

– Global Exchange of Cloud Resources.

Security in the Cloud

– Security Overview

– Cloud Security Challenges and Risks

 – Software-as-a-Service Security

– Risk Management

– Security Monitoring

 – Security Architecture Design

 – Data Security

**12.** **VLSI System Design :** (2 Units / Week , 30 Hours/Sem.)

* Introduction to VLSI: CMOS, interconnects, scaling
* Performance parameters: power, delay, area
* Design to fabrication flow
* ASIC design
* FPGA design
* Static time analysis
* Low power design techniques
* Testing and reliability
* Emerging technologies

Internet of Things ( 2 Units / Week , 30 Hours/Sem. )

# Overview of IoT, Industrial versus enterprise network architecture. Things as Element: IoT devices, Sensors, Actuators, Intelligent sensors, WSN. Connecting traditional computers, connecting non-traditional computer things. Data as Element: Management, transportation, analytics, virtualization, cloud computing. People as element: behavior adapts to information, organization adapts to behavior. The role of the process, M2M connection, M2P connection, P2P connection. Current and Future trends in IoE: Support IoT in industry, converged network, challenges to connect things, industrial IoT devices, Fog Computing, cyber and physical security issues, IoT System management and automation. Non-IP enabled device communication, IP enabled device configuration, Configuring infrastructure device. IoT: programming, modeling, simulating, and prototyping. Transition to IoE: Converged Information Technology (IT) and Operational Technology (OT): simple, smart, secure trends.

# Case studies: Smart building, Smart Cities, Smart Transportation, Smart Health, Smart Energy, Smart Industry.