University of Diyala

College of Engineering

Department of Computer Engineering

Bachelor of Science (B.Sc.) Undergraduate Program

Fourth Year

And

Elective Courses

Fourth Year

First Semester					Second Semester				
Course Title	Credit Hours	Weekly Hours			Course Title	Credit Hours	Weekly Hours		
		The.	Lab.	Tut.			The.	Lab.	Tut.
Graduation Project	Continued	-	4	-	Graduation Project	2	-	4	-
Engineering Profession Ethics	2	2	-	-	Engineering Economy	2	2	-	-
Elective I (Computer Vision)	2	2	-	-	Elective II (Soft Computing)	2	2	-	-
Cryptography and Network Security I	4	3	2	-	Cryptography and Network Security II	4	3	2	-
GNSS Applications	3	2	2	-	Embedded Systems	3	2	3	-
Computer Networks II	3	2	2	-	Data Compression	2	2	-	1
Total	14	11	10	0	Total	15	11	9	1
		21					21		

- ## Fourth Year Courses Details

Course Number: E 401

Course Name: Engineering Profession Ethics

Credit Hours: (2-2-0-0)

Prerequisites: None

Course Contents: Introduction: Why Professional Ethics?, What Is A Profession?, Professions as Social Practices, Models Of Professionalism, The Business Model, The Professional Model, Types Of Ethics Or Morality, Responsibility in Engineering, Engineering Standards, Framing the Problems, Resolving Problems, The Social and Value Dimensions of Technology, Trust and Reliability, Risk and Liability in Engineering, Engineers in Organizations, Engineers and the Environment, Cases should be presented for use in conjunction with materials (over the world and local).

Course Number: E 404

Course Name: Engineering Economy

Credit Hours: (2-2-0-0)

Prerequisites: None

Course Contents: Principles of Engineering Economy, equivalence and compound interest formula Single payment model, Uniform payment model, gradient payment model. Decision criteria for single and multiple alternatives: Present worth, annual worth, future worth, annual rate of return, and benefit cost ratio, before and after tax analysis, economic laws. Comparison among projects, projects evaluation, replacement, inflation, cost estimation, cost control monitoring and accounting, strategic planning, stakeholder management, procurement management and risk management.

Note: This course is covered by two semesters

Course Number: E 402

Course Name: Engineering Project

Credit Hours: (2-4-0-0)

Prerequisites: None

Course Contents: This course encompasses analysis, design, experimental; synthesis, testing and evaluation work is carried out in accordance with a preapproved project plan under the supervision of faculty member(s). The students will use modern laboratory equipment's to achieve project objectives. Also, the students will be discussed in project teams about design, build, test and present results for realistic projects from university and industrial sponsors, Formulation of specifications, consideration of alternative solutions, feasibility considerations, detailed system descriptions, economic factors, safety, reliability, aesthetics, ethics and social impact.

Course Number: CPE 403

Course Name: Cryptography and Network Security I

Credit Hours: (4-3-0-2)

Prerequisites: None

Course Contents: Basic Definitions, Computer Security Concepts, Vulnerability- Threat - Control Model, classical and modern Security Attacks, Security Services and Mechanisms. Mathematical background: Numbers Theory, Complexity Theory, Finite Fields, Information Theory, Probability Theory, Abstract Algebra. Overview of Classical ciphers: Playfair, Hill and Vigenere Ciphers. Symmetric ciphers: Overview of Substitution Ciphers and Transposition Ciphers, Overview of Block Ciphers and Stream Ciphers , Operation Modes of Ciphers, block ciphers: DES, RC5, RC6, Blowfish, AES and Serpent algorithms, Stream Ciphers: RC4, SEAL, Stream Ciphers based on Feed Back Shift Register and Trivium Algorithms. Public-key cryptography: Basic Principles, RSA Public Key Encryption Rabin Public Key Encryption, ElGamal Public Key Encryption, Diffie Hellman Key Exchange, Elliptic Curve Crypto System, Digital Signatures, Hash Functions, Message Authentication Codes (MAC).

Course Number: CPE 405

Course Name: GNSS Applications

Credit Hours: (3-2-0-2)

Prerequisites: Mathematics II (E 102), Object Oriented Programming with Java (CPE 212), Digital Signal Processing I and II (CPE 303 and CPE 304)

Course Contents: Introduction to GNSS System, GPS Constellation, GLONASS Constellation, Galileo Constellation, Civilian GNSS signals, Modulation, Receiving and De-modulation Process, GPS - NMEA sentence information, Interpreted sentences, Garmin proprietary sentences, All $GPxxx sentence codes, Format of latitudes and longitudes, Navigation/Positioning onboard Smartphones (PoS), 1st PoS version, 2nd PoS version, Future PoS version, General GNSS Applications onboard Smartphones/Tablets, Location Based Service, Agriculture and Surveying, Civilian Application, Timing & Synchronization, Security, Overview of Personal Applications, Pedestrian Navigation, Outdoor Navigation, Photography Geocoding, Develop GNSS application (Android or other OS), Build Positioning Application, Build Timing Application, Encrypt the Header File of the geocoded photo.

Course Number: CPE 407

Course Name: Computer Networks II

Credit Hours: (3-2-0-2)

Prerequisites: Computer Networks I (CPE 308), Digital Communications (CPE 307)

Course Contents: Introduction: General Review: Network Types (LAN, WAN, MAN, SAN, VPN, …), OSI and TCP/IP Model, IP addressing, Review, Wired LANs: Ethernet, IEEE Standards and Standard Ethernet, MAC Sublayer, Physical Layer, Bridged Ethernet, Switched Ethernet, Full-Duplex Ethernet, Wireless LANs, IEEE 802.11, Bluetooth, Connecting LANs, Backbone Networks, and Virtual LANs: Connecting Devices, Backbone Networks, and Virtual LANs , Wireless WANs, Cellular a view on: Telephone, Satellite Networks, Synchronous Optical Network (SONET/SDH), SONET Architecture, SONET layers, SONET Network, Virtual-Circuit Networks: Frame Relay, ATM.

Course Number: CPE 404

Course Name: Cryptography and Network Security II

Credit Hours: (4-3-0-2**)**

Prerequisites: Computer Networks I and II (CPE 308 and CPE 407), Operating Systems II (CPE 311), Cryptography and Network Security I (CPE 403)

Course Content: Transport Layer and Electronic mail Security: Browser Attacks, Web Attacks Targeting User Data and Web Site Data, Secure Socket Layer (SSL), Transport Layer Security (TLS), HTTPS and Secure Shell, Electronic Mail Security Pretty Good Privacy (PGP) and S/MIME Security Protocols, IEEE 802.11 Wireless LAN Overview and Security Wireless Application Protocol Overview, Wireless Transport Layer Security, WAP End-to-End Security WEP (Wired Equivalent Privacy) Protocol, WPA (WiFi Protected Access) Protocol , IP Security Overview and Security, Encapsulating Security Payload, Internet Key Exchange, Distributed Denial of Service. Emerging topics in information security: Internet of Things Security (IoT), Mobile Phones and Medical Devices Security, Cloud Computing Security, Cyber Warfare and Quantum Cryptography.

Course number: CPE 406

Course name: Embedded Systems

Credit Hours: (3-2-0-3)

Prerequisites: Programming and Problem Solving with C++ I and II (CPE 102 and CPE 103), Computer Architecture I and II (CPE 201 and CPE 202), Microprocessor Programming (CPE 206) and Computer Interfacing (CPE 312)

Course Contents: Embedded Systems Overview, What is an embedded system?, Embedded Systems Vs General Computing Systems, Embedded Systems Classification, Characteristics and Quality Attributes of Embedded Systems, Embedded System Design Process, Embedded system hardware, Typical Architecture, Input Components, Communication, Processing Units (Overview of Processors & Microcontrollers), Memories, Output Components, Secure hardware, System software, Embedded operating systems, ERIKA, Hardware abstraction layers, Middleware, Real-time databases, Complex Embedded Systems, Techniques for low-power operation, Mobile and networked embedded systems, and Applications of Embedded Systems in Modern Life.

Course Number: CPE 408

Course Name: Data Compression

Credit Hours: (2-2-1-0**)**

Prerequisites: Digital Image Processing (CPE 314)

Course Contents: Introduction to Compression Theory, Information Redundancy Types, Information Theory and Coding Concepts, Entropy Definition and Interpretation, Theoretical limits of compressibility, Fidelity Criteria and Kolmogorov–Chaitin Complexity Measure, Compression Models and standards, Overview of lossless Compression Theory, Burrows–Wheeler Transform, Context Tree Weighting Method, Dictionary Coders, Run Length Coding, Entropy Coders, Huffman Coding, Arithmetic Coding, Prediction By Partial Matching (PPM) Algorithm, Sequitur Algorithm, , Overview of lossy Compression Theory, Scalar and Vector Quantization, Still Image and Video Compression Methods, Block Transform Coding (BTC) Method Discrete Cosine Method, Discrete Wavelet Method, SPIHT Method, Fractal Method, Frame-by-Frame Video Compression, Audio and Speech Compression Methods, A-Low Algorithm, Code-Excited Linear prediction (CELP) Algorithm, Linear Predictive Coding (LPC) ,Warped Linear Predictive Coding (WLPC), Text Compression: Block Sorting. Introduction to the compression standards JPEG, JPEG2000, MPEG, MPEG2000 and H.264/AVC and HEVC.

Elective Courses

Course Number: CPE 401 or CPE 402

Course Name: Soft Computing

Credit Hours: (2-2-0-0)

Prerequisites: None

Course Contents: Introduction to soft computing: Introduction , Fuzzy computing, Neural computing ,Genetic algorithms ,Associative memory , Adaptive resonance theory, Application Fundamentals neural networks, Introduction, Model of artificial neuron, Architectures learning methods , taxonomy of NN Systems , Single-layer NN system , Applications, Back propagation network: Background, Back-propagation learning , Back –propagation algorithm, Associative memory , Discretion, Auto-associative memory, Bi-directional metro-associative memory. Adaptive resonance theory : Recap-supervised, Unsupervised, Back prop algorithms, Competitive learning , Stability-plasticity dilemma (SPD), ART networks iterative Clustering ,unsupervised ART clustering ,Fuzzy set theory: Introduction, Fuzzy set: membership, operations, propertied ; fuzzy relation ,Fuzz systems: Introduction ,Fuzzy logic, Fuzzification, Fuzzy inference ,Fuzzy rule, Based system , Defuzzification, Fundamentals of genetic algorithms: Introduction, Encoding, Operators of genetic algorithm, Basic genetic, Algorithm., Hybrid systems: Integration of neural networks, Fuzzy logic and genetic algorithms, Ga based back propagation networks, Fuzzy back propagation networks, Fuzzy associative memories Simplified fuzzy ARTMP.

Course Number: CPE 401 or CPE 402

Course Name: Computer Vision

Credit Hours: (2-2-0-0)

Prerequisites: Digital Image Processing (CPE 314)

Course Contents: Introduction to Computer Vision, Cameras and Optics, Light and Color, Image Pyramids and Applications, Model Fitting and Frequency Domain Analysis, Computer Vision Applications. Edge, Interest Points, Line and Corners Detection, Invariant Local Image Features, Feature Matching and Hough Transform, Model fitting and RANSAC, Feature Detectors: SURF, SIFT and others. Overview of Morphology, Segmentation and Clustering Techniques, Erosion, Dilation, opening and Closing Morphological Operations, Some Basic Morphological Algorithms, Threshold based Segmentation Methods, Region based Segmentation Methods, Segmentation using Morphological Watersheds, The use of Motion in segmentation, Some Clustering Algorithms. Basic Concepts in Classification and Recognition, Classification: Generative and Discriminative Models, introduction to the Object Recognition, Multiple views, Motion and Tracking.

Course Number: CPE 401 or CPE 402

Course Name: Digital Multimedia

Credit Hours: (2-2-0-0)

Prerequisites: Digital Image Processing (CPE 314), Programming and Problem Solving with C++ I and II (CPE 102 and CPE 103)

Course Contents: Introduction to Multimedia, What is multimedia, Components of multimedia, Web and Internet multimedia applications, Transition from conventional media to digital media, Issues in multimedia (Authoring and Design), Computer Fonts and Hypertext, Families and faces of fonts, outline fonts, bitmap fonts, International character sets and hypertext, Digital fonts techniques, Audio fundamentals and representations, Digitization of sound, frequency and bandwidth, decibel system, data rate, Sound synthesis, MIDI, wavetable, Compression and transmission of audio on Internet, Audio software and hardware, Graphics and image representations, Graphics/Image data types measurements, Digital graphics and image formats, Vector graphics and Vector based animation on Internet, Color science, color gamut, Color models, RGB, HSV, CMYK, LUVLAB, Output devices and their characteristics, Graphics and image software and hardware, Video theory and representations, Analogue video, PAL, NTSC standard, Digital video, AVI, MPEG, Video software and hardware, Multimedia Network Communications and Applications, Quality of Multimedia Data Transmission , Quality of Service (QoS) , QoS for IP Protocols, Prioritized Delivery, Multimedia over IP.

Course Number: CPE 401 or CPE 402
Course Name: Computer Simulation and Modelling
Credit Hours: (2-2-0-0)
Prerequisites: None
Course Contents: What Is Simulation, Modelling, Computer Simulation, How Simulation Get Done, When Simulation Are Used, Fundamental Simulation Concepts, The System, Analysis Options, Pieces of a Simulation Model, Event-Driven Hand Simulation, Event and Process-Oriented Simulation, Randomness in Simulation, A Guided Tour through Arena, Exploring the Arena Window, Browsing Through an Existing Model, Build It Yourself, More on Menus, Toolbars, Drawing and Printing, Modelling Basic Operations and Inputs, An Electronic Assembly and Test System, The Enhanced Electronic Assembly and Test System, Input Analysis: Specifying Model Parameters and Distributions, Modelling Detailed Operations, , Modelling Approach, Building the Model, Finding and Fixing Model Errors, Statistical Analysis of Output from Terminating Simulations, Continuous and Combined Discrete/Continuous Model, Modelling Simple Discrete/Contiguous System, Continuous State-Change System, Conducting Simulation Studies, A Successful Simulation Study, Problem Formulation, Solution Methodology, Verification and Validation, Experimentation and Analysis.

Course Number: CPE 402

Course Name: Cloud Computing

Credit Hours: (2-2-0-0)

Prerequisites: Operating Systems I and II (CPE 209 and CPE 311), Computer Networks I and II (CPE 308 and CPE 407)

Course Contents: Introduction: What is the cloud?, The Emergence of cloud computing, Cloud-Based Service Offering and Benefits, The Evolution of Cloud Computing: Hardware and Internet Software Evolution, Server Virtualization, Web Services Delivered from the Cloud: Communication-as-a-Service (CaaS), Infrastructure as a Service (IaaS), Monitoring-as-a-Service (MaaS), Platform as a Service (PaaS), Software-as-a-Service (SaaS), Building Cloud Networks: The Evolution from the MSP Model to Cloud Computing and Software-as-a-Service, The Cloud Data Centre, The Role of Open Source Software in Data Centres, Virtualization Practicum (Practice Projects):Downloading and Installing Sun xVM VirtualBox, Adding a Guest Operating System to VirtualBox, End-User Access to Cloud Computing: YouTube, Zimbra, Facebook, etc.., Mobile Internet Devices and the Cloud: Mobile Operating Systems for Smartphones, IPhone, Google (Android), Blackberry, Windows Mobile, Ubuntu Mobile Internet Device (MID), Mobile Platform Virtualization: KVM, VMWare.

Course Number: CPE 402

Course name: Mobile Computing

Credit Hours: (2-2-0-0**)**

Prerequisites: Computer Network I and II (CPE 308 and CPE 407)

Course Contents: Introduction: Mobile Computing,, Mobile Computing Vs. wireless Networking , Mobile Computing Applications ,Characteristics of Mobile computing ,Structure of Mobile Computing, Application. MAC Protocols, Wireless MAC Issues ,Fixed Assignment Schemes, Random Assignment Schemes , Reservation Based Schemes, Mobile internet protocol and transport layer : Overview of Mobile IP , Features of Mobile IP ,Key Mechanism in Mobile IP , Route Optimization, Mobile telecommunication system : Global System for Mobile Communication (GSM) , General Packet Radio Service, (GPRS) – Universal Mobile Telecommunication System (UMTS), Mobile managements: Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations. Mobile Agents computing, security and fault tolerance, transaction processing in mobile Computing environment.

Course Number: CPE 402

Course Name: Wireless Sensor Networks

Credit Hours: (2-2-0-0)

Prerequisites: Digital Communications (CPE 307), Computer Networks I and II (CPE 308 and CPE 407), Computer Control (CPE 310)

Course Contents: Introduction and Overview of Wireless Sensor Networks, Basic Wireless Sensor Technology, Wireless Transmission Technology and Systems , Medium Access Control Protocols for Wireless Sensor Networks, Routing Protocols for Wireless Sensor Networks, Transport Control Protocols for Wireless Sensor Networks, Network Management for Wireless Sensor Networks.

Course Number: CPE 401 or CPE 402

Course Name: Data Mining and Warehousing

Credit Hours: (2-2-0-0)

Prerequisites: Database Systems (CPE 208)

Course Contents: Introduction to data mining, Visual data mining, Statistical primer, parameter estimation, quality metrics of parameter estimation, hypothesis testing, Bayes theorem, histograms, scatter plots, egression , Classification algorithms , Clustering algorithms , Association rules , Data warehousing , SQL OLAP extensions, Multi-dimensional Join , Data warehouse performance.

Course Number: CPE 401 or CPE 402

Course Name: Distributed Systems

Credit Hours: (2-2-0-0)

Prerequisites: Computer Architecture I and II (CPE 201 and CPE 202)

Course Contents: Introduction to Distributed Systems (DS) , Theories evolve DS, Sequence and Parallel Computers, Model Properties, Computing organization for parallel and distributed ,Distributed of computing, master-slave, client server. DS and Parallelism: Architecture Classification, Flynn Taxonomy: SISD, SIMD, MISD, and MIMD vs. SIMD, Multiprocessors DS: Types of Multiprocessors: Dual and Multi Core, Hyper-Threading Shared Memory, Architecture, Access to Share Memory: UMA, NUMA, COMA, and ccNUMA ,Characteristics of Share Memory in DS Communication: Fundamentals, Remote procedure call, Synchronization, Mutual execution, central algorithm, decentralized algorithm, Distributed algorithm, token ring algorithm Fault tolerance: Introduction, Basic concept, Failure models.

Course Number: CPE 401 or CPE 402

Course Name: Nano computing

Credit Hours: (2-2-0-0)

Prerequisites: None

Course Contents: Introduction to Nanocomputing, Historical Context for Computing, What are Nanotechnologies?. Reconfigurable Computing and Crossbar-Based Computing, Comparison of different crossbar based architectures, Logic implementation using nanowire crossbar, Logic gate implementation using asymmetric nano-crossbar. General Properties of Nanoarrays, Introduction to nanowires, Undifferentiated nanowires (NW) Decoders, Decoders nanowires, Encoded nanowires (NW) Decoders, Nanowire-Based PLA, NanoFabrics – an early model for Nanoarrays, NanoPLAs - A programmable architecture, NanoPALs - A programmable architecture, field-programmable nanowire interconnect (FPNI). DNA (Deoxyribonucleic Acid) computing, RNA (Ribonucleic Acid) computing, Reliable Computation with Unreliable Elements, Codes and Finite Fields. Coded Computation, Spielman's Computational Model. Three Parallel Models of Computation (Parallel Random Access Model (PRAM), Hypercube, Mesh).

Course Number: CPE 401 or CPE 402

Course Name: Bioinformatics

Credit Hours: (2-2-0-0)

Prerequisites: Data Structures and Algorithms **(**CPE 207), Digital Image Processing (CPE 314)

Course Content: Introduction to Bioinformatics and Data Generation, What is Bioinformatics, Bioinformatics Relation with Molecular Biology (tools, databases, software), Data generation, Applications of Bioinformatics, Biological Database and its Type, Introduction to Data Types and Source, Population and sample, Classification and Presentation of Data, General Introduction of Biological Databases (Nucleic acid, Protein, Specialized Genome, and Structure databases), Data storage and retrieval and Interoperability, Flat files (relational, object oriented databases and controlled vocabularies) , File Format, Introduction to Metadata and search, The challenges of data exchange and integration, Sequence Alignments and Visualization, Introduction to Sequences, Alignments and Dynamic Programming (Local, Global, Pairwise, and sequence alignments, Methods for presenting large quantities of biological data (sequence viewers, 3D structure viewers, Anatomical visualization), Gene Expression and Representation of patterns and relationship, General introduction to Gene expression, Introduction to Regular Expression, Hierarchies, and Graphical models, Genetic variability and connections to clinical data.

Course Number: CPE 401 or CPE 402

Course Name: Distributed Databases

Credit Hours: (2-2-0-0)

Prerequisites: Database Systems (CPE 208)

Course Contents: general introduction in distributed DBMS, DDBMS Architecture: definition of DDBMS architecture, ANSI/SPARC standard, global, local, external, and internal schemas, DDBMS architectures, components of DDBMS, Distributed Database Design: conceptual design (what can be distributed, design patterns), top-down, bottom-up patterns, technical design (fragmentation, allocation and replication of fragments, optimality, heuristics) Semantic Integrity Control, view management, security control, integrity control, Distributed Query Processing: overview of query processing and query optimization, query decomposition and data localization, Query decomposition and data localization: normalization, analysis, elimination of redundancy, rewriting, reduction for HF, reduction for VF, Optimization of Distributed Queries:, basic concepts, distributed cost model, database statistics, ordering of joins and semijoins, query optimization algorithms, INGRES, System R, hill climbing, Transactions:, introduction to transactions, definition and examples, properties, classification, processing issues, execution, Concurrency Control: definition, execution schedules, examples, locking based algorithms, timestamp ordering algorithms, deadlock management Reliability: definitions, basic concepts, local recovery management, distributed reliability protocols, 2PC protocol.