SCHEME OF STUDIES – BACHELOR OF ENGINEERING (COMPUTER SYSTEMS)

First Year

Spring Semester

Course Code	Course Title	Credit Hrs Th	Pr	Total
CS-108	Fundamentals of Computer Engineering	2	1	3
CS-109	Computer Programming	2	1	3
EE-120	Basic Electrical Engineering	3	1	4
MT-114	Calculus	3	0	3
HS-114	Functional English	3	0	3
HS-105	Pakistan Studies OR	2	0	2
HS-127	Pakistan Studies (For Foreigners)			

Fall Semester

Course Code	Course Title	Credit Hrs Th	Pr	Total
CS-111	Object Oriented Programming	2	1	3
EL-102	Basic Electronics	3	1	4
PH-122	Applied Physics	3	1	4
ME-107	Basic Mechanical Engineering	3	1	4
CS-211	Discrete Structures	3	0	3

Second Year

Spring Semester

Course Code	Course Title	Credit Hrs Th	Pr	Total
CS-216	Data Structures & Algorithms	3	0	3
CS-214	Digital Logic Design	3	1	4
EE-217	Circuit Theory	2	0	2
MT-222	Linear Algebra & Ordinary Differential Equations	3	0	3
HS-214	Academic Writing	3	0	3
HS-205	Islamic Studies OR	2	0	2
HS-209	Ethical Behaviour			

Fall Semester

Course Code	Course Title	Credit Hrs Th	Pr	Total
CS-212	Computer Organization & Design	3	1	4
CS-215	Signals and Systems	2	1	3
EL-303	Digital Integrated Circuits	3	1	4
MT-224	Complex Variables & Fourier Analysis	3	0	3
CS-306	Database Management Systems	3	1	4

Third Year

Spring Semester

Course Code	Course Title	Credit Hrs Th	Pr	Total
CS-301	Microprocessor Based System Design	3	1	4
CS-302	Software Engineering	3	1	4
CS-352	Digital Communication Systems	3	1	4
MT-335	Probability & Statistics	3	0	3
EF-303	Applied Economics for Engineers	3	0	3

Fall Semester

Course Code	Course Title	Credit Hrs Th	Pr	Total
CS-322	Computer Architecture	3	0	3
CS-318	Computer Communication Networks	3	1	4
CS-317	Operating Systems	3	1	4
HS-304	Business Communication & Ethics	3	0	3
CS-319	VLSI Design	3	1	4

Final Year

Spring Semester

Course Code	Course Title	Credit Hrs Th	Pr	Total
CS-428	Parallel & Distributed Computing	3	1	4
MT-442	Numerical Methods	3	0	3
CS-412	Artificial Intelligence	3	1	4
CS-419	Digital Signal Processing	3	1	4
CS-406	*Computer Engineering Project	-	-	-

Fall Semester

Course Code	Course Title	Credit Hrs Th	Pr	Total
HS-405	Organizational Behaviour	3	0	3
CS-4##	Elective Course	2	1	3
CS-425	Entrepreneurship for Computer Engineers	3	0	3
CS-417	Computer Systems Modelling	3	0	3
CS-406	Computer Engineering Project	0	6	6

Elective Course

CS-413	Internet Computing
CS-422	Introduction to Embedded Systems
CS-426	Computer Systems Security
CS-427	Robotics and Kinematics

* Duration one academic year: Requires literature survey and preliminary work during this Semester

First Year

Spring Semester

CS-108 Fundamentals of Computer Engineering (2+1)

Number Systems; Digital Logic Gates, Classification of Computer Systems; Structure and Organization of Computers and Computer Systems; Computer Peripherals; Classification of Software Systems; Introduction to Software Development Process; Levels of Programming Languages; Data Communication and Computer Networking Fundamentals; Introduction to Databases and Information Systems

CS-109 Computer Programming (2+1)

Basic Data types; Variables & Constants; Operators & Expressions; Input/ processing/output; Decision Making Control Structures; Loop Structure and their Implementations; Function and their Types; Arrays and Strings; Pointers and their Application; Structures and Union; Files and their Control; Hardware Interfacing Techniques;

EE-120 Basic Electrical Engineering (3+1)

Fundamentals of Electric Circuits - Charge, Current, Voltage and Power, Voltage and Current Sources, Ohm's Law; Voltage and Current Laws - Nodes, Paths, Loops and Branches, Kirchhoff's Current Law, Kirchhoff's voltage Law, the Single-Loop Circuits, the Single Node-Pair Circuit, Series and Parallel Connected Independent Sources, Resistors in Series and Parallel, Voltage and Current Division.
Basic Nodal and Mesh Analysis - Multi-Nodal Analysis, the Super node, Mesh Analysis, the Super mesh
Circuit Analysis Techniques - Linearity and Superposition, Source Transformations, Thevenin and Norton Equivalent Circuits,
Maximum Power Transfer, Delta- Wye Conversion
Capacitors and Inductors - Capacitor, Inductor, Inductance and Capacitance Combination
Basic RL and RC Circuits - The Source-Free RL Circuit, Properties of the Exponential Response, the Source-Free RC Circuit, the Unit-Step Function, Driven RL Circuits, Natural and Forced Response, Driven RL Circuits
The RLC Circuit - The Source-Free Parallel Circuit, the over damped Parallel RLC Circuit, Critical Damping, the under damped Parallel RLC Circuit, the Source- Free Series RLC Circuit, the Complete Response of the RLC Circuit, the Lossless LC Circuit

MT-114 Calculus (3+0)

Set and Functions: Define rational, irrational and real numbers; rounding off a numerical value to specified value to specified number of decimal places or significant figures; solving quadratic, and rational inequalities in involving modulus with graphical representation; Definition of set, set operations, Venn diagrams, DeMorgan’s laws, Cartesian product, Relation, Function and their types (Absolute value, greatest integer and combining

functions). Graph of some well-known functions. Limit of functions and continuous and discontinuous functions with graphical representation.

Differential Calculus: Differentiation and Successive differentiation and its application: Leibnitz theorem. Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, power series. Taylor and Maclaurin series, L Hopitals rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, exact differential and its application in computing errors, extreme values of a function of two variables with and without constraints, solution of non-linear equation using Newton Raphson's method.

Integral Calculus: Indefinite integrals and their computational techniques, reduction formulae, definite integrals and their convergence. Beta and Gamma functions and their identities, applications of integration. Centre of pressure and depth of centre of pressure.

Sequence & Series: Sequence, Infinite Series, Application of convergence tests such as comparison, Root, Ratio, Raabe's and Gauss tests on the behaviour of series.

Complex Number: Argand diagram, De Moivre formula, root of polynomial equations, curve and regions in the complex plane, standard functions and their inverses (exponential, circular and Hyperbolic functions).

HS-114 Functional English (3+0)

Listening: Types of Listening (content, critical, selective, active, reflective, empathic etc.), Problems in listening and coping strategies, Listening skills and sub skills, Practice in Listening

Vocabulary Development: Words easily confused, compound words, prefixes and suffixes, Forming adjectives, descriptive adjectives (personalities), Using synonyms and Antonyms, homophones, Use of idioms in current language, Exposure and practice to develop everyday vocabulary for formal and informal situations

Reading: Skimming, scanning, predicting, and anticipating, Guessing meanings of unfamiliar words from the context, Reading strategies, Reading practice through variety of reading texts and comprehension exercises, Beyond reading (speaking and writing outputs)

Writing: Making notes, Social formal letters (elements, style, formatting, organization and structure, types e.g. requests, invitation, thank you, condolence etc), Short reports (structure, format, and types i.e. informational, event and analytical)

Grammar: Tenses, Frequency, time and quantity expressions, Punctuation, Conditional Sentences, Active and passive, Semantic markers, Phrasal Verbs

Speaking: Giving a presentation, Discussion, Beginning a discussion, Entering a discussion (at a subsequent stage), Interrupting a discussion without giving offence, Changing your stance / point of view in the course of a discussion, Summing up a discussion, Role play/dialogue (e.g. interviewing: with respect to social interaction)

HS-105 Pakistan Studies (2+0)

An Outline of Emergence of Pakistan - A Brief Historical Survey of Muslim Community in the Sub-Continent; War of Independence (1857 and Aftermath); Sir Syed Ahmed Khan; Development of Two Nation Theory; Formation of Muslim League; Luckhnow Pact; Khilafat and Non-Cooperation Movement; Political Events from 1924 to 1937; Pakistan Resolution Struggle for Pakistan from 1940 to 1947; Emergence of Pakistan. Land of Pakistan - Geophysical Conditions; Territorial Situation and its Importance; Natural Resources - Mineral and Water. Constitutional Process - Early Efforts to Make Constitution - Problems and Issues; Constitution of 1956

and its Abrogation; The Constitution of 1962 and its Annulment; Constitutional and Political Crisis of 1971; The Constitution of 1973; Recent Constitutional Developments. Post-Independence Developments - Education in Pakistan; Planning and Development in the Field of Education; Development of Science and Technology with Special Reference to Engineering and Architecture; Brief Survey of Pakistan Economy; Industrial and Agricultural Development; Development of Science and Technology Sectors in Culture; Development of Arts; Philosophy and Literature; Internal and External Trade; Economic Planning and Prospects. Cultural Development in Pakistan - Definition; Contents and Contributing Factors in Culture. Foreign Policy - Relations with Neighbours; Super Powers and Muslim World.

HS-127 Pakistan Studies (for Foreigners) (2+0)

Land of Pakistan - Land and People - Strategic Importance; Important Beautiful Sights; National Resources. A Brief Historical Background - A Brief Historical Survey of Muslim Community in the Sub Continent British Rule and its Impacts; Indian Reaction Two Nation Theory; Origin and Development Factors Leading Towards the Demand of a Separate Muslim State Creation of Pakistan. Government and Politics in Pakistan - Constitution of Pakistan; A Brief Outline. Government Structure Federal and Provisional - Local Government Institutions Political History; A Brief Account. Language and Culture - Origins of Urdu Language Influence of Arabic and Persian on Urdu Language and Literature; A Short History of Urdu Literature.

Fall Semester

CS-111 Object Oriented Programming (2+1)

Difference between Conventional and Object Oriented Programming; Data Abstraction; Objects, Classes and Methods; Inline and Friend Function; Inheritance; Polymorphism; Handling Message; Aggregation; Exception Handling

CS-211 Discrete Structures (3+0)

History and Overview - Contributors to the subject, purpose and role of discrete structures in computer engineering, contrasts between discrete-time models and continuous-time models. Functions, Relations and Sets - one-to-one, onto, inverses, composition functions; Reflexivity, symmetry, transitivity, equivalence relations; Discrete versus continuous functions and relations; Venn diagrams, complements, Cartesian products, power sets; Cardinality and countability; Application of functions in coding theory. Applications of set theory in grammar and languages. Basic Logic - Propositional logic, logical connectives, truth tables, conjunctive and disjunctive normal forms, predicate logic, universal and existential quantification, Boolean algebra, application of logic to computer engineering. Proof Techniques - Notions of implication, converse, inverse, negation and contradiction; structures of formal proofs; Direct Proofs; Proof by counterexample, contraposition and contradiction; Mathematical induction and strong induction. Introduction to Group Theory - groups and semi-groups. Basics of counting - Permutations and combinations; Discrete probability; Counting arguments rule of products; rules of sums; The pigeonhole principle; Generating functions; recurrence relation; Applications to algorithm analysis. Graphs and Tree - Basics of trees and graphs; Directed and Undirected graphs; Spanning Trees

EL-102 Basic Electronics (3+1)

PN Junction Diode: Introduction. PN junction diode, Unbiased diode, Barrier potential, Diffusion & drift current, Forward & reverse bias, Minority carrier current. Diode models: Ideal, practical & complete, Diode characteristics, Load line, Diode current equation. Capacitive effect on diode operation at high-frequency, Transient current, Temperature effect on diode operation. Diode applications; Rectifier, Switch, Communication, Wave-shaping, Voltage multiplier etc; Breakdown diode, Voltage regulator, Power Supply; BJT: Physical structure & operation modes of BJT, operation in the active mode, Large-signal model. DC analysis of BJT. BJT as an amplifier; Small signal equivalent circuit models, Biasing techniques for discrete-circuit design. BJT as switch: Operation of npn in the cut-off & saturation modes, Basic BJT inverter. FET: Field effect transistor; Device, Structure & Physical operation of the MOSFET, Current-voltage characteristics. DC analysis of MOSFET circuit, MOSFET as an amplifier and as a switch, Biasing in MOS amplifier circuits. Amplifiers and Oscillators

ME-107 Basic Mechanical Engineering (3+1)

Engineering Mechanics: Statics: Fundamental concepts, Definitions and Units, Newton's First Law, Forces, Moments and couples, Laws of Equilibrium, Free Body Diagrams, Structures, Frames and Mechanics, Dynamics: Fundamentals of Dynamics, Rigid Body Dynamics, Newton's Second Law, Analysis of Motion in Two & Three Dimensional Spaces, Rectilinear & Curvilinear Motions, Work & Energy, Conservation of Energy. Solid Mechanics / Design: Stress, Strain, Elastic & Plastic deformation, Hysteresis, Mechanical Power Transmission (Pulleys, Chains, Fly wheel, Shaft, Coupling etc.) Friction, Bearings
Thermodynamics: Work, Heat, Open, Closed and Steady flow systems, Thermodynamics Properties and Processes, Absolute & Gauge Pressure, Pressure Temperature and Flow

PH-122 Applied Physics (3+1)

Introduction: Types of Errors and Error Calculation, Graphical Techniques (Log, semi-log and other non-linear graphs).
Vectors: Coordinate Systems, Review of vectors, Vector Differentiation (Ordinary and Partial Differentiation), Vector Integrations.
Mechanics: Motion under Constant Acceleration, Newton Laws and their Applications, Frictional Forces, Work-Energy Theorem, Law of Conservation of Mechanical Energy, Angular Momentum.
Electrostatics and Magnetism: Coulombs Law, Continuous charge distribution, Electrostatic potential energy of discrete charges, Gauss’s Law, Electric field around conductors, Magnetic fields, Magnetic force on current, Hall effect, Biot-Savart Law, Ampere’s Law, Field of rings and coils, Magnetic dipole, Diamagnetism, Paramagnetism and Ferromagnetism.
Semiconductor Physics: Energy levels in a semiconductor, Hole concept, Intrinsic and Extrinsic regions, Law of Mass Action, p-n junction, Transistor.
Waves and Oscillations: Simple Harmonic Oscillator, Damped Harmonic Oscillation, Forced Oscillation and Resonance, Type of Waves and Superposition Principle, Wave Speed on a stretched string.
Optics and Lasers: Huygen’s Principle, Two-slit interference, Single-Slit Diffraction, Resolving power of Optical Instruments Principals for laser action, Types of laser, Applications of laser.

Modern Physics: Planck's explanations of Black Body Radiation Photoelectric Effect, Compton Effect, Bohr's Theory of Hydrogen Atom, Atomic Spectra, Reduced Mass, De-Broglie Hypothesis, Electron Microscope, Atomic Nucleus and Properties of Nucleus, Radioactive Decay and Radioactive Dating, Radiation Detection Instruments, Nuclear Reactions and Nuclear Reactor.

Second Year

Spring Semester

CS-214 Digital Logic Design (3+1)

Truth Functions; Logic Families; Speed and Delays in Logic Circuits; Review of Boolean Algebra; NAND and NOR Implementation; Duality; Negative Logic; Switches and Relays; Gate-Level Minimization of Boolean Functions using Karnaugh Map and Tabular Method; Storage Devices and Sequential Logic; Latches and Flip Flops; Shift Registers; Synchronous and Asynchronous Counters; Synthesis of Sequential Networks; State Minimization techniques (pair chart) for completely specified sequential circuits; Design of Combinational Logic Circuits; Analysis and Design of Adders, Decoders, Encoders, Multiplexers, Demultiplexers, Magnitude Comparators and Code Converters; Programmable Logic Devices: ROMs, PLA, PALs and FPGAs

CS-216 Data Structures & Algorithms (3+0)

Basic Concepts - Introduction and classification of Data Structures; Basic operations, Classification of Algorithms - Classification by implementation; Classification by design paradigm. Basics of Complexity Analysis - Rate of Growth of Complexity of Algorithms; Asymptotic notations; Time-Space Trade Offs. String Processing - Operations on strings; Word Processing; Pattern Matching Algorithms. Arrays - One-dimensional Arrays: Searching and Sorting Algorithms; Multi-dimensional Arrays: Matrix Multiplication, Sparse Matrices. Stacks, Queues and Recursion - Basic concepts and functions; Polish Notation; Quick-sort; Deques; Priority Queues; Factorial Calculation; Fibonacci Series; Ackermann Function, Towers of Hanoi. Linked Lists - Definition and Representation; Traversal and Searching; Insertion; Deletion; Circular Lists; Doubly Linked Lists. Trees - Terminology; Representation in memory; Binary Trees: Traversal Algorithms; Binary Search Trees, Heaps; Heap-sort algorithm. Graphs - Terminology; Representation in memory; Traversal Algorithms; Shortest Path Algorithms. Sorting and Searching - Sorting Algorithms; Hashing.

EE-217 Circuit Theory (2+0)

Elementary Transient Analysis - Differential and integral forms of circuit equations, Initial voltage on a capacitor, Initial current in an inductor, First -order circuits, Solution of single first order differential equations, particular and total solution of second order linear time invariant differential equations. Matrix Analysis - Systematic formulation of network equations, Loop variable analysis, State variable analysis, formulation of state equations, source transformations Duality. Elementary Time Functions - Introduction to singularity functions, The impulse functions and response, The unit step function and response, Ramp function, Exponential function & response. Exponential Excitation and the Transformed Network - Representation of excitations by exponentials functions, Single element response, Forced response with exponential excitation, Introduction to the transformed network, Driving point impedance and admittance. Two Port Network - Introduction, Characterization of linear time invariant two-ports by six sets of parameters, Relationship among parameter sets. Networks Functions and Frequency Response - The concept of complex frequency, transform impedance and transform circuits, Network functions. Poles and zeros of network functions, Restrictions on pole and zero transfer function, magnitude and phase.

MT-222 Linear Algebra & Ordinary Differential Equations (3+0)

Linear Algebra: Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, matrix of linear transformations, Eigen value and Eigen vectors of a matrix, Diagonalization, Applications of linear algebra (Scaling, translation, rotation and projection) with graphical representation.

Introduction to Ordinary Differential Equations (ODE): The Concepts & Terminologies: Order and Degree; Linearity & Non-linearity; A Brief Classification of ODEs; Formulation of ODEs: Concrete Examples; Solutions: General & Particular: Concrete Examples & Applications: Initial Value Problems (IYP) and Boundary Value problems (BVP): A Brief Introduction to Issues related to Existence & Uniqueness of Solutions.

The First Order ODEs: Linear and Non-Linear: Variable Separable Cases & Applications: Growth & Decay Problems, Newton's Law of Cooling, Torricelli's Law, Simple Kinematical Dynamical Applications; Exact and No-Exact ODEs: Solution Procedures and Integrating Factors; the Standard Linear Differential Equation of First Order: Solution Procedures and Applications to RL-Circuits and RC-Circuits, Bernoulli's Equations & Logistical Growth Models. Direction Fields and Euler's and Picard’s Iterative Schemes for the 1st Order ODEs,

The Linear Second Order ODEs: Homogeneous and Non-Homogeneous Cases, Linear Second Order Homogeneous ODE with Constant Coefficients: Solution Procedures and the Principle of Linear Superposition and Applications, Mechanical Systems & Electrical Systems, Undamped and Damped Harmonic Oscillators: Linear Second Order Non-Homogeneous ODEs with Constant Coefficients: Solution Procedures and the Principle of General Linear Superposition: Complementary Functions & Particular Solutions, the method of Undetermined Coefficients & Variation of Parameters, Applications: Spring-Mass Systems, Damped & Undamped Harmonic Oscillators with Forcing Terms and their ODEs and Solutions; RCL-Circuits and their ODEs and Solutions; The Physics and Mathematics of the Phenomenon of Resonance in Mechanical & Electrical Systems; Cauchy-Euler ODEs and their Solution Procedures.

Partial Differential Equation: Formation of partial differential equations, Solutions of first order linear and special types of second and higher order differential equations, Homogeneous partial differential equations of order one, Lagrange's multiplier.

Advance Calculus & Vector Calculus: Double & triple integral with application (Area, centroid, moment of inertia) vector differentiation & vector integral with applications, Green & Stokes theorem with applications.

HS-214 Academic Writing (3+0)

Writing Process: Identifying topic area, narrowing topic, planning, brainstorming, mind mapping, outlining, writing first draft, reviewing, revising, proofreading, writing final draft

Reading & Writing: Analysing different texts: identifying point of views, claims, assumptions, differentiate facts from opinions, Practicing Academic Language: differentiate using language of opinion and fact; synthesize information, developing critical write up with relevant factual information, personal views, academic evidence, examples, cause and effect etc.; presenting and describing visuals (tables & graphs)

Avoiding plagiarism and ensuring originality: summarizing, paraphrasing and quoting sources, citing, documenting sources through a referencing system (MLA/APA/Harvard style, as suggested by the discipline)
Writing products: Writing a well-structured paragraph (topic sentence, supporting details, and conclusion). Writing narrative, descriptive, expository, and argumentative essays, developing an effective essay using thesis statement, adequate development and argument, supporting details, and conclusion, writing short reports (technical reports)

HS-205 Islamic Studies (2+0)

Quranic Verses - Tauheed, (Al-Ambiyah-22, Al-Baqarah-163 and 164). Prophethood (Al-Imran- 79, Al-Huda-7, Al-Maidah-3). Here-After (Al-Baqarah-48 and one Hadith). Basic Islamic Practices (Al-Mu'minun-1 and 111, and two Ahadith). Amer-Bil-Ma'Roof Wa-Nahi Anil Munkar. The Concept of Good and Evil; Importance and Necessity of Da'wat-e-Deen (Al- Imran-110). Method of Da'wat-e-Deen (An-Nehl-125, Al-Imran-64, Al-An'an-108, and two Ahadith). Kasb-e-Halal (Taha-81, Al-A'raf-32 and 33, Al-Baqarah-188 and two Ahadith). Huquq-ul-Ibad: Protection of Life (Al-Madinah-32), Right to Property (Al-Nisa-29), Right to Respect and Dignity (Al-Hujrat-11 and 12), Freedom of Expression (Al-Baqarah-256), Equality (Al-Hujarat-13), Economic Security (Al-Ma'ar ij-24 and 25); Employment Opportunity on Merit (An-Nisa-58); Access to Justice (An-Nisa-135); Women's Rights (An-Nehl-97, Al-Ahzab-35, An-Nisa-07); Relation with Non-Muslims (Al-Muhammad-8 and 9, Al-Anfa'al-61 and The Last Sermon of Hajj of Holy Prophet (SAW); Relevant Extracts. Seerat (life) of the Holy Prophet (SAW) - Birth, Life at Makkah, Declaration of Prophet hood, Preaching and its Difficulties, Migration to Madinah, Brotherhood (Mawakhat) and Madinah Charter, the Holy Wars of the Prophet (SAW) (Ghazwat-e-Nabawi), Hujrat-ul-Wida, the Last Sermon of Khutbatulwida (Translation and Important Points). Islamic Civilization - (a) In the Sub Continent: Pre-Islamic Civilizations, the Political , Social and Moral Impact of Islamic Civilizations. (b) In the World: Academic, Intellectual, Social and Cultural Impact of Islamic Civilization.

HS-209 Ethical Behaviour (2+0)

Nature, Scope and Methods of Ethics; Ethics and Religion; Ethical Teachings of World Religions; Basic Moral Concepts, Rights and Wrong, Good and Evil; An Outline of Ethical Systems in Philosophy; Hedonism, Utilitarianism, Rationalism and Kant; Self Realization Theories, Intuitionism; Islamic Moral Theory: Ethics of Quran and its Philosophical Basis; Ethical, Precepts from Quran and Hadith and Promotion of Moral Values in Society.

Fall Semester

CS-212 Computer Organization & Design (3+1)

Introduction & Motivation: Instruction Set Architecture (ISA) as an interface between hardware and software; ISA: Instruction Formats, Addressing Modes, Translation of High Level Language Program into Machine Language; Classes and Comparative Study of ISAs: Accumulator-based, Stack-based, Register-Memory &

Register-Register Architectures; Instruction Encoding Techniques; Measuring and Reporting Computer Performance: Common Pitfalls, Amdahl's Law; Computer Arithmetic: Integer and Floating-Point; Basic Processor Design: Single-Cycle and Multi-Cycle datapath & control; Hardwired and Microprogrammed Control; Memory System Design: Memory Hierarchy, Cache Memory, Virtual Memory; Input/Output: Bus Standards, Arbitration Schemes, Programmed I/O; Interrupt-Driven I/O. Interrupt Processing, Direct Memory Access (DMA); Emerging Architectures.

CS-215 Signals and Systems (2+1)

Fundamental concepts: Signals and Systems, Continuous-Time Signals, Discrete-Time Signals, Examples of Systems, Basic System Properties; Systems defined by Differential Equations: Linear Input / Output Differential Equations with Constant Coefficients, System Modelling, Systems defined by nonlinear equations; Convolution Representation of Linear Time-Invariant Continuous-Time Systems: Convolution of Continuous-Time Signals, Linear Time-Varying Systems; Fourier Analysis: Representation of Signals in Terms of Frequency Components, Fourier Series Representation of Periodic Signals, Fourier Transform, Properties of Fourier Transform; Frequency-Domain Analysis of Systems: Response to a Sinusoidal Input, Response to Periodic Inputs, Response to Aperiodic Inputs, Analysis of Filters; Laplace Transform: Properties, Computation, Transfer Function Representation and Block Diagrams, Stability,

CS-306 Database Management Systems (3+1)

Database System and its components; Benefits of Database Organization; Data Independence; Database System Architecture; Distributed Databases; Data Modelling and Database Design - Entity-Relationship Model, Object-Oriented Data Models, Network and Hierarchical Models, Relational Model, Relational Algebra; Relational design principles based on functional dependencies and normal forms; Relational Database Implementation - SQL, Implementing a Database, Database Development Process; Indexing and Hashing; Transaction Management - Recovery and Concurrency Control; Security and Operation - Reliability, Protection and Integrity; Decision Support Systems, Data Warehousing and Data Mining

EL-303 Digital Integrated Circuits (3+1)

MOS Inverter Circuits: Voltage transfer Characteristics, Noise Margins, NMOS as load device, Pseudo NMOS and CMOS Inverters. Static MOS Gate Circuits: CMOS gate circuits, Flip-Flops & Latches. Bipolar & BiCMOS Logic Gates: TTL, ECL & Current Mode Logic, BiCMOS Logic Gates. High Speed CMOS Logic Design: Switching time analysis, load capacitance, Gate Sizing, Optimization. Transmission gate and Dynamic Logic: Pass Transistor, CMOS Transmission gate Logic, Dynamic D- Latches, Domino Logic. Semiconductor Memory Design: Memory Organisation, Address Buffers & Decoders, Static RAM Cell Design, SRAM Column I/O Circuits. Interconnect, Power Distribution & Timing Considerations: Interconnect RC Delays, Interconnect coupling Capacitances, Power Distribution Design, Clocking and Timing Issues.

MT-224 Complex Variable & Fourier Analysis (3+0)

Infinite Series: Application of convergence tests such as comparison, Root, Ratio, Raabe's and Gauss tests on the behaviour of series.

Complex Variable: Limit, continuity, zeros and poles of a complex function. Cauchy-Reimann equations, conformal transformation, contour integration.

Laplace Integral & Transformation: Definition, Laplace transforms of some elementary functions, first translation or shifting theorem, second translation or shifting theorem, change of scale property, Laplace transform of the nth order derivative, initial and final value theorem Laplace transform of integrals, Laplace transform of functions t" F(t) and F(t)/ t, Laplace transform of periodic function, evaluation of integrals, definition of inverse Laplace transform and inverse transforms, convolution theorem, solutions of ordinary differential and partial differential equations using Laplace transform (I.V.P's & B.V.P's), Z and Inverse Z – transformations, properties of Z - transformation and applications

Fourier series: Introduction to Fourier series. Euler Fourier formulae, even and odd functions, application of Fourier series, Fourier transform and fast Fourier transform and properties with applications.

Third Year

Spring Semester

CS-301 Microprocessor Based System Design (3+1)

Programmer Visible Architecture; Internal Bus Architecture; Pin Functions; Memory Addressing Schemes; Bus Buffering; Bus Cycles; Timing and Sequencing; The Wait State; Clock Generation Circuit; RESET Circuit; Memory Interfacing; Basic I/O Interface; Hardware Single Stepping; Memory Speed Requirements; Programmable Peripheral Interface; Programmable Interval Timer; Hardware Interrupts; Programmable Interrupt Controller; DMA Operations, Microprocessor System Design. Instruction Set Architecture & Addressing Modes; Data Transfer, Arithmetic & Logic; Branch & String Instructions; Program Assembly and Testing; Assembler Directives; Macros; Procedures; Instruction Encoding; Two Pass Assemblers; Software Interrupts

CS-302 Software Engineering (3+1)

Basic Definitions, Software Development Life Cycle, Software Attributes; Software Process Models; Software Requirements: Functional, Non-functional, Domain; Requirements Engineering Process; Analysis Modelling: Data, Object, Behavioural; Software Project Management: Spectrum & Activities; Software Risk Management: Phases of Risk Management, RMMM; Software Design: Objectives and Principles; Types of Design; Rapid Software Development; Software Testing: Types of Testing, Verification & Validation; Software Quality Assurance: Quality Factors, SQA Team Structure and Activities, Formal Technical Review, Statistical SQA; Software Process & Project Metrics : Types of Metrics Software measurement, Size-oriented metrics Function-oriented metrics, Software Cost Estimation; Software Reliability; Software Maintenance: Types of Software Maintenance, Software Maintenance Process Models;

CS-352 Digital Communication Systems (3+1)

Elements of Modern Digital Communications: Channels, Fundamentals Limitations, Electromagnetic spectrum
Signal Analysis: Classification, representation of signals, Fourier Transform Theory, Baseband systems, filtering, random signal analysis, and Probability models of random process
Analog communication systems: Sampling Theory, Pulse code modulation, time division multiplexing, Satellite communication, Digital communication: Baseband digital transmission, Digital modulation techniques, Data communications, Computer Networks, Error-control and Coding: Error correction and detection techniques, Hamming code and Huffman encoding, Linear Block Encoding, Information Theory: Entropy, channel capacity, discrete channels, Hartley Shannon's Law.

EF-303 Applied Economics for Engineers (3+0)

Introduction - Basic Concepts; Engineering Economy Defined; Measures of Financial Effectiveness; Non-Monetary Values. The Economic Environment - Consumer and Producer Goods; Measures of Economic Worth; Price; Supply; Demand Relationship, Selections between Alternatives - Present Economy; Selection Among

Materials; Techniques Designs, etc.; A Basic Investment Philosophy; Alternatives Having Identical Lives; Alternatives Having Different Lives. Value Analysis - Important Cost Concepts; Cost-Benefit Analysis Feasibility Studies; Value Analysis in Designing and Purchasing. Linear Programming - Mathematical Statement of Linear Programming Problems; Graphic Solution; Simplex Procedure; Duality Problem, Depreciation and Valuation - Types of Depreciation Economic Life; Profit and Interest Returns to Capital; Productivity of Capital; Discrete Continuous Compounding; Discounting Sinking Fund Problems. Capital Financing and Budgeting - Types of Ownership; Types of Stock; Partnership and Joint Stock Companies; Banking and Specialized Credit Institution. Theory of Production - Factors of Production; Laws of Returns; Break-Even Charts and Relationships, Industrial Relationship - Labour Problems; Labour Organizations Prevention and Settlement of Disputes.

MT-335 Probability and Statistics (3+0)

Introduction to Statistics: Introduction, Types of Data & Variables, Presentation of Data, Object, Classifications, Tabulation, Frequency Distribution and their types, Graphical Representation, Simple, Multiple and Component bar diagrams, Pie-chart, Histogram, Frequency polygon and Frequency curves.

Measures of Central Tendency and Dispersion: Statistical Averages, Median, Mode, Quartiles, Range, Moments, Skewness & Kurtosis, Quartile Deviation, Mean Deviation, Standard Deviation, Variance & its coefficient.

Probability: Basic concepts, Permutation & Combination, Definitions of Probability, Laws of Probability, Conditional Probability, Bayes' Rule.

Random Variables and Random Processes: Introduction, Discrete & Continuous Random Variables, Random Sequences and Transformations, Probability Distribution, Probability Density Function, Distribution Function, Mathematical Expectations, Moment Generating Function(M.G.F), Introduction to Random Processes and Time Series, Statistical Averages of Random Processes, Stationary, Auto-Correlation of Wide Sense Stationary Random Processes, Time Averaging, Ergodicity, Markov Chain and Queuing Theory.

Probability Distributions: Introduction, Discrete Probability Distributions, Binomial, Poisson, Hypergeometric & Negative Binomial Distributions, Continuous Probability Distribution, Uniform, Exponential & Normal Distributions.

Sampling and Sampling Distributions: Introduction, Population, Parameter & Statistic, Objects of Sampling, Sampling Distribution of Mean, Standard Errors, Sampling & Non-Sampling Errors, Random Sampling with & without Replacement, Sequential Sampling, Central Limit Theorem.

Statistical Inference and Testing of Hypothesis: Introduction, Estimation, Types of Estimation, Confidence Interval, Tests of Hypothesis, Chi-Square Distribution/Test, One and Two Tails Test.

Simple Regression & Correlation: Introduction, Scatter Diagrams, Correlation & its Coefficient, Regression Lines, Rank Correlation & its Coefficient, Probable Error (P.E).

Fall Semester

CS-317 Operating Systems (3+1)

Operating System Objectives and Functions; Process States; Process Description; Process Control; Process and Threads; SMPs; Microkernel; Concurrency - Principles; Mutual Exclusion (Hardware Support, Operating System Support); Deadlock; Memory Management; Virtual Memory; Scheduling Algorithms; I/O Management and Disk Scheduling: I/O Function Organization; Operating System Design Issues; I/O Buffering; Disk Buffering; File Management - Organization and Access; Directories; Sharing; Record; Blocking; Secondary Storage Management; Networking and Distributed Processing: Communication Architecture; Servers; Process Migration; Distributed Process Communication.

CS-318 Computer Communication Networks (3+1)

Network basics: Types and topologies; internetworking devices, transmission modes, objectives and issues with computer networks, service types, need for reference models, standardization and OSI reference model, the TCP/IP reference model. The Physical layer: characteristics and functions, common media and their characteristics, PSTN and mobile phone systems. The Data Link layer: Functions and characteristics, data link sublayers, framing, flow and error control mechanisms, channel allocation and medium access protocols, data link layer addressing, HDLC operation and frame structure, point to point protocol, frame relay, ISDN, IEEE 802.3 and IEEE 802.2 protocols, LAN switch and bridge operation, STP & RSTP, VLAN implementation. The Network layer: characteristics and functions, types of switching, network layer routed protocols (IP v4 and v6) , IP addressing and subnetting, routing algorithms and their characteristics, static and dynamic routing algorithms, routing protocols and their features, supporting protocols of network layer (ARP , RARP, ICMP and IGMP). Transport layer: Characteristics and protocols.

CS-319 VLSI Design (3+1)

Presentation of Concepts and Techniques Used in VLSI Circuit Design; CMOS Circuit Design and Performance Estimation; Integrated Circuit Fabrication; Digital Circuit Simulation and Synthesis with CAD tools; Datapath, (Adders and Multipliers), Memory and Processor Design; Testing of VLSI Systems. Analog Circuit Design

CS-322 Computer Architecture (3+0)

Instruction Level Parallelism (ILP): Concepts and Challenges - Pipeline Hazards, Basic Complier Techniques to expose ILP, Branch Prediction, Overcoming Data Hazards - Algorithms & Examples, Hardware Based Speculation, Multiple Issue Architectures - VLIW and Superscalars, Limitations of ILP, Multithreading; Data Level Parallelism in SIMD and Graphic Processing Units (GPUs) Architecture, Detecting and Enhancing Loop-Level Parallelism; Warehouse Scale Computers: Programming Model, Workload, Architecture, Infrastructure, Advanced Topics in Memory System Design - Advanced Optimizations of Cache Performance, Protection - Virtual Memory & Virtual Machines, RAID, Storage Area Networks (SANs)

HS-304 Business Communication & Ethics (3+0)

Communication Skills - Definition and Conditions; Modes: Verbal, Non-Verbal, Vocal, Non- Vocal, Sender, Receiver, Encoding, Decoding, Noise, Context, Emotional Maturity, Relationships, etc; Language, Perception; Non-Verbal, Body Language, Physical Appearance, Cultural Differences, etc; Personal and Interpersonal Skills/Perceptions; Communication Dilemmas and Problems; Public Speaking: Speaking Situation, Persuasion; Making Presentations; Interviews. Business Writing - Formal/Business Letters, Emails: Job Application and Resume/CV, Enquiries, Complaints/Adjustments, Orders, Quotations, Banking, etc; Memos: Layout, Language, Style; Meeting Management: Notice, Agenda, Conducting/Participating, Writing Minutes; Contracts and Agreements (Basic Theoretical Knowledge and Comprehension); Research/Scientific Reports: Types, Structure, Layout/Presentation, Writing Process, etc; Tenders (Basic Theoretical Knowledge and Comprehension). Engineering/Business Ethics - Need and Objective of Code of Ethics and its Importance; Types of Ethics, Involvement and Impact in Daily Life, Problems/ Conflicts/ Dilemmas in Application (Case Studies); Sexual Harassment/ Discrimination in the Workplace: Why it Occurs, Myths Regarding Sexual Harassment, How to Deal With it, Gender Equality, Respect, etc. Codes of Conduct - Pakistan Engineering Council; Code for Gender Justice; Brief Study of Other Codes of Conduct

Final Year

Spring Semester

CS-412 Artificial Intelligence (3+1)

Introduction to AI: History of AI, AI problems, AI techniques, Levels of models; Problem spaces and searching methodologies: Problem space, state space search, Blind search techniques, Heuristic search techniques. Propositional and predicate logic: revision of propositional logic, predicate calculus and first order logic; Knowledge Representation (KR): KR issues, KR techniques, Semantic networks, scripts, lists and trees, frames, Uncertainty: sources, representation and measurement; Expert Systems (ES): Need and structure of ES, ES development, Deductive, Abductive and inductive reasoning, forward and backward chaining, inference tree, case based reasoning. Introduction to Artificial Neural Networks; Fuzzy logic and Fuzzy expert Systems; Game theory and its applications: Prisoner's dilemma, Nash theorem, Auction theory, minimax algorithm &alpha-beta pruning, game programming, Applications of game theory. Advanced topics: Natural language processing, Genetic algorithms, Image processing.

CS-419 Digital Signal Processing (3+1)

Introduction to Discrete-Time Signals and Systems and an Overview of Practical Applications of Digital Signal Processing; Sampling Theorem; A Review of Discrete-Time Signals and Linear Systems; Transforms (Z, DFT, FFT) and their Applications; Digital Filter Design; Design of FIR and IIR Filters; Implementation Issues; Spectral Analysis.

CS-428 Parallel and Distributed Computing (3+1)

Some Representative Parallel Algorithms and Performance Perspective. Vector Processors – Vector and Matrix Algorithms; Instruction Set of a Vector Processor and Sample Programs. Interconnection Networks – Static and Dynamic Interconnection Networks; Parameters Characterizing Interconnection Networks. Parallel Programming – Shared Memory and Message Passing Programming; The Message Passing Interface (MPI).
Characterization of Distributed Systems, Interprocess Communication, Distributed Objects and RMI, Cloud/Grid Computing, Peer to Peer Computing, Social networking, Collaborative computing, Web services, Pervasive/Mobile computing

MT-442 Numerical Methods (3+0)

Error Analysis: Types of errors (relative, Absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart. Use any Computational tools to Analysis the Numerical Solutions. Solution of Non-linear Equations: Numerical methods for finding the roots of transcendental and polynomial equations (Secant, Newton - Raphson Chebyshev and Graeffe's root squaring methods), rate of convergence and stability of an iterative method. Solution of Linear Equations: Numerical methods for finding the solutions of system of linear equations (Gauss- Elimination, Gauss-Jordan Elimination, triangularization, Cholesky, Jacobi and Gauss - Seidel). Numerical Integration & Differentiation: Computation of integrals using simple Trapezoidal rule,

Simpson's rule, Simpson's rule, Composite Simpson's and Trapezoidal rules, computation of solutions of differential equations using(Euler method, Euler modified method, Runge Kutta method of order 4), Numerical Solutions of Partial differential Equations, Optimization problem (Simplex Method), Steepest Ascent and Steepest Descent Methods. Interpolation & Curve Fitting: Lagrange's, Newton, Hermit, Spline, least squares approximation, (Linear and non-linear curves). Linear Operators: Functions of operators, difference operators and the derivative operators, identities. Difference Equations: Linear homogeneous and non- homogeneous difference equations.

Fall Semester

CS-417 Computer System Modelling (3+0)

Performance Modeling and Evaluation - Bench Marking; Performance Evaluation of High Parallel Systems Architecture; Application of Performance Evaluation; Measurement Techniques; Hardware Monitoring; Software Monitoring; Hybrid Monitoring, Fundamentals of Queuing Models - Structure and Performance Parameters; Operational Analysis of Queuing Models; General Features of Queuing Models; Birth and Death Processes; M/M/I and M/G/1 Systems. Dependability Modelling - Analysis of Reliable, Available and High Assurance Systems; Fault Tolerant Techniques; Software Reliability Modelling; Reliability and Availability Modelling; Combinational Modelling; Fault Tolerant Design Techniques; Markov Reliability Models. Petri Net Based Performance Modelling - Classical Petri Nets; Discrete and Timed Petri Nets; Generalized Stochastic Petri Nets, Modelling of Multiprocessor Systems - Schedule A, B and C. LPT scheduling.

CS-425 Entrepreneurship for Computer Engineers (3+0)

The nature and importance of entrepreneurship; The Entrepreneurship and Intrapreneurial mind; The Individual Entrepreneur; Entrepreneurship for IT and E-Business: Role of websites and E- commerce in the development of Global Startups, E-entrepreneurship; Creativity and Business Ideas; Legal Issues for Entrepreneurship; The Business, marketing, organizational and financial plan; Sources of Capital; Entrepreneurial Strategy

Elective Courses: CS-4##

CS-413 Internet Computing (2+1)

Introduction to internet systems: History of internet, important organizations and their contributions, standards and protocols, architecture of modern Internet. Review of Internet protocol (v4 and v6); Routing on the Internet: Basics of exterior routing, NAT, MPLS, mobility support in IPv6 and IPv4, multicast transmission through IGMP. Transport layer on the Internet: TCP and UDP functioning and header formats; Programming for the Internet: Internet applications architecture, socket programming and application development using TCP and UDP. Protocols and Services: ICMP, DNS, FTP , HTTP, SMTP, POP3, MIME, Voice over IP;Network management: Importance of auditing, SNMP. Network security: Motives and types of attacks, threats and vulnerabilities, device security

CS-422 Introduction to Embedded Systems (2+1)

Introduction to Embedded Systems, Custom Single-Purpose Processors, General-Purpose Processors, The Embedded Environment, Programming of Embedded Systems, Simulators, Emulators, and Debuggers, Code Optimization for Size and Speed, Timers and Interrupts, Interfacing, Introduction to Low-Power Computing, Operating Systems for Embedded Systems.

CS-426 Computer Systems Security (2+1)

Cryptographic foundations; Access Control Lists (ACLs); Operating System Security - Principles; Computer systems' structure and its impact on security; Principles and practices for secure system design; Security models: Properties, information flow, non-interference, separation of duties; Software vulnerabilities: Memory corruption (stack-smashing, heap overflows, integer overflows), Input validation errors, Race conditions; Web server and Browser vulnerabilities; Malware and Untrusted software: Viruses and worms, Rootkits, Botnets, Obfuscation and evasion; Defenses for software threats: Static analysis for vulnerability detection, Code transformation for runtime policy checking, Runtime policy enforcement and sandboxing, Isolation and information-flow control; Virtual machines; Network-layer threats: network probing, scanning, Defenses -intrusion detection, Side-channel attacks - covert channels, timing attacks, power analysis, emanations, remanence and reuse; Human and social engineering
- Digital rights management

CS-427 Robotics and Kinematics (2+1)

Introduction; Basics of Robotics and Linear algebra; Representing positions and rotations; Rotational transformations; Parameterizations of rotations; Homogeneous transformations; Kinematic chains and Denavit-Hartenberg (DH) convention; Forward kinematics; Inverse kinematics; Angular velocity and Jacobian Operator; Trajectory design; Configuration space; Motion planning -- potential field, roadmap; Control - PID control, Joint space control, Operational space control and Force control; Sensors and actuators; Mobile robot; Robot applications

HS-405 Introduction to Organizational Behaviour (3+0)

Foundations of Organizational Behaviour (OB): Management functions, roles, and skills; Effective versus successful managerial activities; replacing intuition with systematic study, Exploring OB challenges and opportunities facing globalization: Improving quality and productivity; improving people skills; managing work force diversity; responding to globalization; empowering people; stimulating innovation and change; coping with temporariness; handling declining employee loyalty; improving ethical behaviour.
Foundations of Individual Behaviour: Individuals & Organizations: Biographical traits and ability; and personality, Perceptions and individual decision making: Understanding perception and its significance, factors influencing perception; linking perception and individual decision making; optimizing decision making model; alternative decision making models; issues in decision making, Values, attitudes and job satisfaction: Importance, sources, types of values; sources and types of attitude; attitude and consistency; measuring job

satisfaction; determinants of job satisfaction; effect of job satisfaction on employee performance; ways employees can express dissatisfaction, Motivation- basic concepts and applications

Foundations of Group Behaviour: Group in OB: Defining and classifying groups; stages of group development, work group behaviour; dynamics of groups, Understanding work teams: Team versus group; types of teams, creating high performance teams; turning individuals into team players, Communication: communicating at interpersonal and organizational level, Leadership: basic approaches and contemporary issues, Conflict & negotiation: defining conflict; transition in conflict thought; conflict process; negotiation - strategies, process and issues.

Foundations of Organizational Structure: Organizational structure and design; work design; work stress, Organizational culture: definition; culture's functions, employees and organizational culture, Organization change and development: forces for change; managing planned change, resistance to change; approaches to managing organizational change.

CS-406 Computer Engineering Project (0-6)

The final year students will be required to consult the Chairman of Computer Systems Engineering Department regarding the offering of various projects in the department. The student or group of students will be assigned the project by teacher concerned and will carry out the assignment as required and directed by the teacher. At the end of the academic session, they will submit the written report on work of their project to the chairman, preferably in the typed form. The students will be required to appear before a panel of examiners for oral examination.

By doing project the student will demonstrate the application of the knowledge gained during his/her stay in the university. He/she may also work on a project which may help him/her to learn more in some specific area related to Computer Engineering.