3rd Sem Syllabus B.Tech CSE

EC205: Signals and Systems (3 credits)

Signals and systems as seen in everyday life, and in various branches of engineering and science.
(1 lecture)

Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.
(10 lectures)

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations. Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases (15 lectures)

The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behaviour. (3 lectures)

The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z domain analysis. (3 lectures)

State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems. (4 lectures)

CO202: Digital Logic Design (3 credits+1)

History & overview : Reasons for studying digital logic, people who influenced/contributed to the area of digital logic, applications of Digital Logic and introduction to a digital system.

Switching theory: Number systems and codes, Binary arithmetic, Complements, Boolean and switching algebra, Representation and manipulation of switching functions, Minimization of switching functions using algebraic method, K-map(2-,3-,4-,5-variable), Quine McCluskey method.

Combinational logic circuits: Basic logic gates (AND,OR,NOT,NAND,NOR,XOR), Realization of switching functions with networks of logic gates, 2-level networks:
ANDOR,OR-AND,NAND-NAND, NOR-NOR, Multi-level networks, Physical properties of logic gates (technology, fan-in, fan-out, propagation delay), Elimination of timing hazards/glitches.

Modular design of combinational circuits: Design of medium scale combinational logic modules - Multiplexers, demultiplexers, decoders, encoders, comparators, Arithmetic functions (adders, subtracter, carry look ahead), Multipliers, dividers, Arithmetic and logic units (ALUs), Hierarchical design of combinational circuits using logic modules.

Memory elements: Unclocked and clocked memory devices (latches, flip flops), Level vs. edge-sensitive, and master-slave devices, Basic flip flops (SR, D, JK, T), Asynchronous flip flop inputs (preset, clear), Timing constraints (setup time, hold time) and propagation delays, Data registers (selection, clocking, timing), Random-access memory (RAM).

Sequential logic circuits: Finite state machines (FSMs), clocked and unclocked, Mealy vs. Moore models of FSMs, Modelling FSM behaviour: State diagrams and state tables, timing diagrams, algorithmic state machine charts, Analysis of synchronous and asynchronous circuits, Design of synchronous sequential circuits:
State minimization, state assignment, next state and output equation realization, Sequential functional units: Data registers, shift registers, counters, sequence detectors, synchronizers, debouncers, controllers.

Fault detection and Location: Fault models for combinational and sequential circuits, Fault detection in combinational circuits; Homing experiments, Distinguishing experiments, machine identification and fault detection experiments in sequential circuits. Laboratory component: Study of TTL gate characteristics, Open collector and Tri-state gates, Clock generator and timer circuit. Synthesis of combinational circuits using NAND, NOR and Multiplexers, Decoder and driver circuits for 7- segment LED displays, D/A converter and 4-bit ALU realization. Synthesis of sequential circuits – study of various types of flip-flops, realization of counters, shift registers and sequence generators. ASM chart based synthesis such as, Traffic light controller, Blackjack dealer and dice game ASM synthesis, etc.

BA201: Economics (3 credits)

Module 1: Basic Principles and Methodology in Economics. Demand and Supply analysis; Elasticity measurement.

Theory of the Firm and Market Structure-Perfect Competition, Monopoly, Monopolistic Competition, Duopoly, and Oligopoly.

Basic Macroeconomics- National income, (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, inflationary growth and Phillips Curve.

Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy

Module 2: Public Sector Economics –Welfare, Externalities, Labour Market. Public utilities, public and private expenditure, and public income. Taxation.

Module 3: Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting,

Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows).

Business Forecasting – Elementary techniques.

Module 4: Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity.

Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization.

Employment–Informal, Organized, Unorganized, Public, Private.

Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.

Module 5: Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

CO210: Data Structures (4 credits)

Time and Space analysis of Algorithms – Order Notations.

Linear Data Structures : Sequential representations – Arrays and Lists, Stacks, Queues, Strings; Link Representations – Linear linked lists, Circular linked lists, Doubly linked lists; Applications.

Recursion – Design of Recursive Algorithms, Tail Recursion.

Nonlinear Data Structures :
Trees – Binary Trees, Traversals and Threads, Binary Search Trees, Insertion and Deletion algorithms, Height Balanced Trees and Weight Balanced Trees, B-trees, B+ trees, Application of trees;
Graphs – Representations, Breadth-first and Depth-first Search.

Hashing – Hashing Functions, Collision Resolution Techniques.

Sorting and Searching Algorithms: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Heap sort, Radix sort.

File Structures: Sequential and Direct Access, Relative files, Indexed files, B+ tree aas index, Multi-index files, Hashed files.

CO211: Data Structures using Object Oriented Programming Lab (3 credits)

Review of elementary programming

Recursion: The concept of recursion; recursive specification of mathematical functions (such as factorial and Fibonacci); simple recursive procedures (Towers of Hanoi, permutations, fractal patterns); divide- and-conquer strategies; recursive backtracking;
implementation of recursion

Introduction to computational complexity: Asymptotic analysis of upper and average complexity bounds; big-O notation; standard complexity classes; empirical measurements of performance

Fundamental computing algorithms: O(N log N) sorting algorithms (Quicksort, heapsort, mergesort); hashing, including collision-avoidance strategies; binary search trees

Fundamental data structures: Linked structures; implementation strategies for stacks, queues, hash tables, graphs, and trees; strategies for choosing data structures

Object-oriented programming: Object-oriented design; encapsulation and information-hiding; separation of behaviour and implementation; classes, subclasses, and inheritance; polymorphism; class hierarchies; collection classes and iteration protocols;
fundamental design patterns

CO209: Computing Workshop (2 credits)

Introduction to MATLAB: MATLAB interface; variables; keywords; commands; operators: arithmetic, relational, logical, bitwise.

Vectors and Matrices in MATLAB: Vectors and matrices: creation, deletion, access, manipulation; Special matrices; complex matrix; matrix commands; matrix operations: determinant, minor, inverse, rank, eigen value and vectors.

MATLAB Scripts: M-files; Function files: primary function, sub-function; ways of creating script files; input/output functions.

Conditional statements in MATLAB: Statements: IF, IF-ELSE, nested IF-ELSE, SWITCH case; IS-function.

Iteration and Loops: Loops: FOR loop, WHILE loop, Nested loops; control statements: break, continue; Vectorizing.

Cell arrays: Creation, deletion, access, manipulation and operations in cell arrays.

Numerical methods using MATLAB: Set operations; Solving of linear equations; Nonlinear equations; differentiation and integration.

Plotting in MATLAB: Visualizing results using plot; subplot; histogram; bar graph; pie chart etc.

Introduction to Python: Python overview; Interactive mode and Script mode; variables; keywords; datatypes: numeric, dictionary, Boolean, set, list, tuple, string; creation, deletion, access in different datatypes; operators: arithmetic, relational, assignment, logical, bitwise, membership, identity; input/output functions.

Conditional statements in Python: Statements: IF, IF-ELSE, nested IF-ELSE.

Iteration and Loops: Loops: FOR loop, WHILE loop, Nested loops; control statements: break, continue, pass.

Functions in Python: arguments: required, keyword, default, variable-length; creating function; return statements.

Matrix in Python: Numpy module for matrix in Python; creation, deletion, access, manipulation; types of matrices; matrix operations: determinant, minor, inverse, rank, eigen value and vectors; solving linear equations.

Plotting in Python: Matplotlib module for plotting in Python: plot, bar graph, pie chart, histogram, scatter plot, contour plot etc.

ES201: Environmental Science (0 credit)

Unit 1 : Introduction to environmental science

• Multidisciplinary nature of environmental sciences;

• Scope and importance; Concept of sustainability and sustainable development.

(1 lectures)

Unit 2 : Ecosystems

• What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(2 lectures)

Unit 3 : Natural Resources : Renewable and Non---renewable Resources

• Land resources and landuse change; Land degradation, soil erosion and desertification.

• Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

• Water : Use and over---exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter---state).

• Energy resources : Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(2 lectures)

Unit 4 : Biodiversity and Conservation

• Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots

• India as a mega---biodiversity nation; Endangered and endemic species of India

• Threats to biodiversity : Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity : In---situ and Ex---situ conservation of biodiversity.

• Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

(2 lectures)

Unit 5 : Environmental Pollution

• Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution

• Nuclear hazards and human health risks

• Solid waste management : Control measures of urban and industrial waste.

• Pollution case studies.

(2 lectures)

Unit 6 : Environmental Policies & Practices

• Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture

• Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

• Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

(2 lectures)

Unit 7 : Human Communities and the Environment

• Human population growth: Impacts on environment, human health and welfare.
• Resettlement and rehabilitation of project affected persons; case studies.
• Disaster management : floods, earthquake, cyclones and landslides.
• Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
• Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
• Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).
(2 lectures)

Unit 8 : Field work

• Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
• Visit to a local polluted site---Urban/Rural/Industrial/Agricultural.
• Study of common plants and basic principles of identification.
• Study of simple ecosystems---pond, river, Delhi Ridge, etc.

MS205: Mathematics III (3 credits)

Unit 1: Basic Probability (10 lectures)
Probability spaces, conditional probability, Discrete random variables, Independent random variables, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, infinite sequences of Bernoulli trials, Probability distributions: Binomial, Poisson - evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution.

Unit 2: Continuous Probability Distributions (5 lectures)
Continuous random variables and their properties, distribution functions and densities, normal, exponential, and gamma densities.

Unit 3: Applied Statistics (11 lectures)
Moments, Skewness, Kurtosis, Chebyshev's Inequality, Correlation and regression, method of least squares. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Unit 4: Curve fitting (4 lectures)
Curve fitting - fitting of straight lines, second degree parabolas and more general curves. Splines fitting.

Unit 5: Partial differential equations (15 lectures)
Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear and non-linear PDEs. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method. Second-order linear equations and their classification. Method of separation of variables.