Detailed Syllabus for Individual Courses

Mathematics – I Calculus and ODE (MA 1101)

Module 1. Single variable calculus: Limit, Continuity, Integration and its Applications, Polar Coordinates, Differentiability, Applications of Differentiation, Mean value theorem and its Applications, Curve Sketching, Indeterminate Forms, Taylor's and Maclaurin's theorems, Fundamental Theorem of Calculus.

Module 2. Functions of Several Variables: Limit, Continuity, Total Differential, Extrema of functions, Lagrange multiplier method, Double and Triple integrals, Change of Order of Integration.

Module 3. Vector Calculus: Gradient, Divergence and Curl, Line, Surface and Volume Integrals, Theorems of Green, Stokes and Gauss and their applications.

Module 4. Infinite Series: Sequences, Convergence and Divergence of a series, Tests for Convergence, Conditional and Absolute Convergence, uniform convergence of sequence of functions.

Module 5. Ordinary Differential Equations: The existence and uniqueness theorem on the general first order differential equations (statement, without proof, with some simple examples). Variable separable method, reducible to variable separable. Exact differentiable equations, integrating factors. Linear differential equations, Bernoulli's equation. The general solution of the second order linear homogeneous equations with constant coefficients. Undetermined coefficients, Variation of parameters. Cauchy problem for differential equation systems. Existence theorem (without proof), differential linear systems with constant coefficients. Geometric study in phase plane of simple equations, orthogonal polynomials.

Textbooks:

1. Tom M. Apostol, One Variable Calculus, with an Introduction to Linear Algebra (Text Book for First, Second and Fifth Modules)
2. Tom M. Apostol, Multi-Variable Calculus and Linear Algebra, with Applications to Differential Equations and Probability (Text Book for Third and Fourth Modules)
3. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications (Reference Book)
4. E. Kreyszig, Advanced engineering mathematics, John Wiley (1999). * George B. Thomas, Jr., Maurice D. Weir, Joel Hass, Thomas' Calculus
5. W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005).

Chemistry – I (CH 1101)

Module 1: Atomic structure and periodic properties (6 lectures): Wave-particle duality. Schrodinger equation. Principles of quantum mechanics. Particle in a one-dimensional box solutions and its applications. Hydrogen atom wave functions. Shape and size of atomic orbitals. Multi-electron atoms –

shielding – effective nuclear charge – orbital penetration. Periodic table and periodic properties of elements: electronic configuration, ionization energy and electron affinity.

Module 2: Chemical bonding and intermolecular interactions (8 lectures): Molecular orbitals as linear combinations of atomic orbitals. Molecular orbital energy level diagrams of homonuclear and heteronuclear diatomic molecules - electronegativity. Multi-atomic molecules, molecular geometry and symmetry. Crystal field theory of transition metal ions. Band theory of solids. Molecular properties: Dipole moment and Polarizability. Intermolecular interactions: dipolar and van der Waal's interactions.

Module 3: Analytical methods (10 lectures): Theoretical background of UV-Visible Spectroscopy, Infrared and Raman spectroscopy, Microwave spectroscopy, NMR spectroscopy and magnetic resonance imaging. Introduction to surface analytical techniques: X-ray photoelectron Spectroscopy, Atomic force microscopy.

Module 4: Structure determination using spectroscopic methods (6 lectures): Introduction to chemical analysis of organic molecules. Elemental analysis and Mass spectrometry. Structural elucidation of simple organic molecules using combination of different spectroscopic data.

Textbooks:

1. Atkin's Physical Chemistry; 10th edition; Peter Atkins and Julio De Paula; ISBN 978-0-19-954337-3
2. Organic Chemistry; Jonathan Clayden, Nick Greeves and Stuart Warren; ISBN: 978-0-19-927029-3
3. Fundamentals of Molecular Spectroscopy; 4th edition; Colin N. Banwell and Elaine M. McCash; ISBN-13: 978-9352601738
4. Organic Spectroscopy; 3rd Edition; William Kemp; ISBN 978-1-4039-0684-7

Introduction to Electrical Engineering (EE 1101)

Module 0: Background, Importance of EE and its everyday applications

Module 1: Circuit elements, R, L and C, voltage and current sources. Series and parallel combination of resistances, network reduction, KVL, KCL, nodal and mesh analysis, superposition and linearity

Module 2: Y-delta transformation, network theorems such as Thevenin's, Norton's and maximum power transfer theorem with dependent and independent sources

Module 3: RL, RC and RLC circuits excited by DC: Transient (forced, natural and total responses) and steady state responses. Sinusoidal steady state circuit analysis, Series and parallel resonance

Module 4: Complex representation of sinusoidal quantities, phasors, phasor diagram, concept of impedance and admittance, low pass/high pass/band pass characteristics of RC/RL/RLC circuits, complex power, real and reactive power, power factor, PF improvement. Three-phase circuits: Y and Delta; Three-phase power and power measurement.

Module 5: Magnetic circuits and transformers. Introduction to Transducers/sensors and Electro-mechanical energy conversion.

Reference books:

1. Electrical Engineering Fundamentals, V. Del Toro
2. Basic Electrical and Electronics Engineering: Nagrath and Kothari (McGraw Hill India)
3. Engineering Circuit Analysis: Hayt, Kemmerly, and Durbin

Engineering Drawing (ME 1104)

Module 1: General principles, projection systems and multiview drawing: Sizes of drawing sheets, layouts, scales, lines, and lettering. The multiview projection method: orthographic representations including first and third angle projections. Projection symbols.

Module 2: Pictorial drawing: Isometric projection. Isometric drawing / isometric view. Oblique projections: cavalier view, and cabinet view.

Module 3: Sectioning: The cutting plane and its line type. The viewing direction. Naming the sectional view. Hatching of internal surfaces contacting the cutting plane. Convention for hidden features below the cutting plane. Half sections. Offset sections. Revolved sections, removed sections, local sections, and successive sections. Conventions on not hatching shafts, ribs, keys, fasteners, and spokes of wheels.

Module 4: Computer aided drafting: Practical training on the basics of computer aided drafting using commercial software.

Module 5: Dimensioning, tolerancing, annotations, and conventions: Distinction between functional, non-functional, and auxiliary dimensions. Elements of dimensioning: projection lines (extension lines), dimension lines, and leader lines. Types of termination of dimension lines, and origin indication. Placing of dimensions: the aligned and the unidirectional systems. Shape indication, e.g., diameters, radii, etc. Special indications: chords, arcs, and angles. Arrangement of dimensions: Chain dimensioning, and dimensioning from a common feature. Tolerance stack-up in chain dimensioning. Simplified representations of intersections. Representations of square ends. Views of symmetrical parts. Simplified views of repetitive features.

Textbooks:

1. Engineering Drawing by N. D. Bhatt, Charotar Publishing House Pvt. Ltd., Anand, 2012 Reprint.

Mechanics (ME 1101)

Course Objectives:

The objective of the course is to let the students understand practically what basic laws and their effects are. They will practice mechanical, thermodynamical, optical and electromagnetical experiments and will be able to develop their intuitive understanding of natural effects. In parallel with the theoretical lectures they will face reality and will be in position to make links with its mathematical expressions.

Module 1 (Coordinate systems and Vector calculus): Vectors, Algebra of Vectors, Multiplying Vectors, Components of a Vector, Base Vectors, The Position Vector r and Displacement, Velocity and Acceleration, Formal Solution of Kinematical Equations, More about the Time Derivative of a Vector, Motion in Plane Polar Coordinates.

Module 2 (Newton's laws, Types of Forces and Application of Newton's laws): Newton's Laws and Inertial Systems, Base Units and Physical Standards, Algebra of Dimensions, Applying Newton's Laws, Dynamics Using Polar Coordinates.

Fundamental Forces of Physics, Gravity, Some Phenomenological Forces, A Digression on Differential Equations, Viscosity, Hooke's Law and Simple Harmonic Motion.

Dynamics of a System of Particles, Center of Mass Coordinates, Conservation of Momentum, Impulse and a Restatement of the Momentum Relation, Momentum and the Flow of Mass, Rocket Motion.

Module 3 (Work-energy theorems, conservative forces and angular momentum): Integrating Equations of Motion in One Dimension, Work and Energy, Conservation of Mechanical Energy, Potential Energy, What Potential Energy Tells Us about Force, Energy Diagrams, Non-conservative Forces, Conservation Laws and World Energy Usage.

Small Oscillations in a Bound System, Stability Normal Modes Collisions and Conservation Laws.

Angular Momentum of a Particle, Fixed Axis Rotation, Torque and Angular Momentum, Dynamics of Fixed Axis Rotation, Motion Involving Translation and Rotation, Work–Energy Theorem and Rotational Motion, Vector Nature of Angular Velocity and Angular Momentum, Gyroscope.

Module 4 (Central forces, gravitation, Kepler's law dynamics of rigid bodies (2D)): Central Force Motion as a One-body Problem, Universal Features of Central Force Motion, Energy Equation and Energy Diagrams, Planetary Motion, Some Concluding Comments on Planetary motion, Integrating the Orbit Integral and Properties of the Ellipse.

Module 5 (Harmonic oscillators and waves): Simple Harmonic Motion: Review, Damped Harmonic Oscillator, Driven Harmonic Oscillator, Transient Behavior, Response in Time and Response in Frequency.

Types of waves, Energy and Power of a Wave travelling along String, Wave Equation, standing waves and Resonance, Travelling Sound waves, Doppler Effect and Supersonic speed and Shock waves.

Textbooks:

1. An Introduction to Mechanics by Daniel Kleppner & Robert Kolenkow, Cambridge Univ Press
2. Berkely Physics Mechanics Vol. 1 by Charles Kittel, Walter D. Knight, Malvin A. Ruderman
3. Physics for Scientists and Engineers, Fishbane, Gasiorowicz, Thornton, Prentice Hall

LABORATORY WORK

- Maxwell's wheel: free fall, inertia momentum
- Pendulum: Eigen frequency of an oscillator, momentum, gravity force
- Collisions of projectiles: 1D motion, elastic and inelastic collisions
- Vibrating string: standing waves, eigenmodes, influence of boundary conditions
- Acoustic Doppler effect: analogic mixing of electric signal to detect a change in the frequency
- Kundt's tube: to determine velocity of sound in air
- Lee's disk method: to measure thermal conductivity of various insulators
- Force and momentum: to validate Newton's laws of motion

Environmental Sciences (CE 1101)

Module 1 - The earth system: Earth in the solar system. Atmosphere and oceans: Origin and evolution; Atmosphere-ocean interaction; Air pollution, Greenhouse effect, Ozone layer; Ocean currents and waves. Lithosphere, Hydrosphere, Cryosphere and atmosphere and their Interactions.

Module 2: Environment and Environmental Studies: Definition and Components of Environment, Relationship between the different components of Environment, Man and Environment relationship, Impact of technology on Environment, Environmental Degradation, Multidisciplinary nature of the Environment studies, its scope and importance in the present-day education system

Module 3: Ecology and Ecosystems: Introduction: Ecology- Objectives and Classification, Concept of an ecosystem- structure and functions of ecosystem, Components of ecosystem- Producers, Consumers, Decomposers. Bio-Geo- Chemical Cycles- Hydrologic Cycle, Ocean currents and waves. Lithosphere, Hydrosphere, Cryosphere and atmosphere and their Interactions, Carbon cycle, Energy Flow in Ecosystem, Food Chains, Food webs, Ecological Pyramids Major Ecosystems: Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystem, Estuarine Ecosystem.

Module 4: Population and Economic Growth: The nature of human population growth, population parameters, industrialization, urbanization, sustainable development, sustainable consumption, health and the environmental impacts. Environmental pollution: Types of Environmental Pollution: Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution: Industrial Agricultural, Municipal; Classification of water pollutants, Effects of water pollutants, Eutrophication Marine pollution- Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards,

Classification of air pollutants, Sources of common air pollutants like PM, SO2, NOX, Natural & Anthropogenic Sources, Effects of common air pollutants Land Pollution: Land uses Land degradation: causes, effects and control, soil erosion. Noise Pollution: Introduction, Sound and Noise, Noise measurements, Causes and Effects Thermal Pollution: Causes and effects, Role of individual in the prevention of pollution

Module 5: Social Issues and the Environment: From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization. Environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, and ozone layer depletion, nuclear accidents and holocaust, case studies. Wasteland reclamation – consumerism and waste products. Environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

Textbooks:

1. The Good Earth: Introduction to Earth Science. 2nd Edition, McConnell, Steer, Knight, Owens & Park (2010), McGraw-Hill, New York, USA.
2. Geology for Geotechnical Engineers, J.C. Harvey, Cambridge University Press
3. Basics of Environmental Studies, Varandani, LAP -Lambert Academic Publishing , Germany.
4. Basics of Environmental Studies U K Khare, 2011 ,Tata McGraw Hill
5. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
6. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
7. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt, Ltd, Hyderabad, 2015.
8. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

Media Project (HS 1102)

Module 1: Introduction to image, properties, elements, technology of imaging. **LAB:** sketching images, 5 hand drawn images leading to a comic strip, uses of color for the images, INSTAGRAM usage for capturing images.

Module 2: Visual Design, Visual and Aural Story telling. **LAB:** Introduction to Camera, Microphones, Report writing, Editing software.

Module 3: Introduction to moving images, building up a narrative. **LAB:** Advance training in camera handling, sound recording, dealing with real life situations, editing to form a narrative with actual footage and writing scripts.

Module 4: Production of a 30 to 45 second narrative, using various images set to a pre-recorded audio track in real life situations, dealing with challenges, start of postproduction of documentaries.

Module 5: Post production editing of the raw footage to form a structured narrative, dealing with sound and music to enhance the narrative and finalizing the project. Discussing the learning outcomes from the project.

English (HS 1101)

Module 1:

- The Bet - Anton Chekhov
- Seven Ages of Man/ To be or not to be/ Mark Antony's Speech in Julius Caesar- William Shakespeare
- London- William Wordsworth; Ode on a Grecian Urn- John Keats

Skills: Paragraph Writing: types, structure, features; Topic, supporting and concluding sentences; Definition, Description, Illustration; Concord.

Module 2:

- Ulysses- Tennyson
- The Second Coming- W. B. Yeats
- Destructors- Graham Greene

Skills: Expository and Argumentative writing, Fact versus Opinion, Connectors, Noun and Adverbial clauses

Module 3:

- A Homemade Education: Malcom X
- I have a Dream: Martin Luther King OR "The Meaning of July Fourth for the Negro" by Frederick Douglas
- The Danger of a Single Story- Chimamanda Adichie

Skills: Essay – Structure, organisation, unity, coherence, cohesion; Developing the thesis; Narrative essay; Active/Passive voice

Module 4:

- Wife's Letter- Rabindranath Tagore
- Toba Tek Singh- Sadat Hassan Manto
- Imaginary Homelands- Salman Rushdie

Skills: Close reading and Comprehension; Compare/Contrast and Cause and Effect Essays; Conditionals

Module 5:

- Where I live- Arundhathi Subramaniam
- Dance Like a Man- Mahesh Dattani

Skills: Process Analysis Essay; Summarizing; Translation (from Indian language to English)

Lab Component: Phonetics & Communication Skills practice cycles (14 weeks):

I. Introduction to Phonetics: Phonetics- a branch of Linguistics, International Phonetic Alphabet (IPA), Phonetic Symbols, English as an international language.

Introduction: Introduction to effective communication, verbal/non-verbal aspects of communication, components of communication, introducing oneself and others

II. Sounds of English: Classification of English phonic sounds into Vowels and Consonants, Description and Characteristic features

Situational Dialogues: Role plays, greeting, making requests, seeking permissions, asking for and giving instructions/directions, turn taking, telephone etiquette.

III. Vowels: Classification, Description, Articulation, Acoustics, Prosody and Transcription·

Debates: Stating points of view, agreeing/disagreeing, asking for and giving information, negotiation and persuasion, making suggestions.

IV. Consonants: Classification, Description, Articulation, Acoustics, Prosody and Transcription

Presentation Skills: Individual/group presentations, poster presentations, PowerPoint presentations, describing and interpreting non-verbal data, project reports/proposals.

V. Stress Patterns: Syllable, Word Stress, Stress Patterns

Group Discussion: Team dynamics, techniques for group discussions, intervention, turn taking, summarizing, body language, tone, relevance, fluency and coherence.

VI. Intonation: Rising intonation, Falling intonation and Rise- Fall intonation

Panel Discussion: Initiating and coordinating discussion, asking for and expressing opinions, providing clarification, coordinating, conducting and participating in meetings.

VII. Rhythm: Stressed-time language, connected speech, Pitch

Public Speaking: Structure, organizing thoughts/ideas, effective transitions, summarizing and concluding, body language, tone, JAM sessions.

Introduction to Entrepreneurship (HS 1104)

Objectives: The course provides students with a structured understanding of how companies operate and can be managed. After the class, students should be familiar with concepts such as governance, strategy, partnering, organizing, etc.

Course Content:

- Introduction: objectives, stakeholders, operations and product life cycles
- Marketing of products and services
- Corporate strategy
- Growth process and strategic plan
- Structure and processes, informal organization
- Performance driving and operations management
- Management of innovation and technology

Textbooks:

1. Course reader in English + copy of the slides presented in class
2. The structuring of organizations, H. Mintzberg
3. Principles of ecomomy, N. Gregory Mankiw
4. Economics, Organization and Management, Paul Milgrom and John Roberts

French - I (HS 1103)

Objectives: To develop basic LSRW skills in French Language, from learning how to pronounce and write French alphabet to picking up phrases and words in written, spoken communication through listening and reading exercises.

Course Content:

i) Topics

- Alphabet
- Numbers
- Nationality
- Profession
- Country and Cities
- Self-introduction and introducing others

ii) Grammar

- Present tense only with 1st group regular and irregular verbs
- Negations

- Prepositions in front of countries and cities
- Likes and dislikes with simple notions

iii) Types of writing

- Very short essay on introduce oneself

Mathematics - II – Linear Algebra, Complex Analysis (MA 1102)

Module 1 - Linear Algebra: Real and complex vector spaces, Linear dependence, Matrix of a vector system, change of coordinates, Linear transformation, addition and composition; kernel and image, rank; one to one and onto maps, matrix of a linear map, Inner product, Cauchy-Schwarz, Norm, triangle inequality. Euclidean spaces, Orthogonal and orthonormal family and basis, Gram-Schmidt orthonormalization and Fourier Series.

Module 2 - Matrices: Matrix addition and multiplication, singular matrix, determinant, rank, inverse, adjoint, Linear system: abstract study, Gaussian Elimination, Transpose and conjugate matrix; similar matrix, Eigenvalues and eigenvectors of a linear map. Characteristic polynomial of a matrix, diagonalizability, Symmetric and orthogonal matrices, diagonalization of a symmetric matrix.

Module 3 - Complex Analysis: Complex numbers, Polar form, De Moivre's formula, complex differentiation. Cauchy- Riemann equations. Analytic functions, Elementary functions, Contour and contour integral. Cauchy's theorem and integral formula. Taylor's theorem, zeros of analytic functions. Maximum modulus principle, Laurent series, Cauchy residue theorem, poles and residue.

Module 4 - Integral Transform: Laplace Transform: Functions of exponential order and examples. Transforms of elementary, transcendental and special functions. Transforms of derivatives and integrals and periodic function, unit step function and impulse function. The inverse transform, Convolution theorem, solution of ordinary differential equations (IVP and BVP). Z-Transform, Fourier Transform.

Text and Reference Books:

1. H. Anton, Elementary linear algebra with applications (8th Edition), John Wiley (1995).
2. S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India (2000).
3. E. Kreyszig, Advanced engineering mathematics, John Wiley (1999).
4. J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill, 2008.
5. D.G. Zill, P.D. Shanahan, A first course in complex analysis with applications.
6. J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill, 2008.
7. JL Schiff, The Laplace transform, Springer
8. G. Strang, Linear Algebra and its Applications, Fourth Edition, Books/Cole.

Physics - I (PH 1201)

Module 1 (Coordinate systems and Vector Calculus): Vectors, Algebra of Vectors, Multiplying Vectors, Components of a Vector, Base Vectors, The Position Vector r and Displacement, Velocity and Acceleration, Formal Solution of Kinematical Equations, More about the Time Derivative of a Vector, Motion in Plane Polar Coordinates.

Module 2 (Newton's laws, Types of Forces and Application of Newton's laws): Newton's Laws and Inertial Systems, Base Units and Physical Standards, Algebra of Dimensions, Applying Newton's Laws, Dynamics Using Polar Coordinates.

Fundamental Forces of Physics, Gravity, Some Phenomenological Forces, A Digression on Differential Equations, Viscosity, Hooke's Law and Simple Harmonic Motion.
Dynamics of a System of Particles, Center of Mass Coordinates, Conservation of Momentum, Impulse and a Restatement of the Momentum Relation, Momentum and the Flow of Mass, Rocket Motion.

Module 3 (Work-energy theorems, conservative forces and angular momentum): Integrating Equations of Motion in One Dimension, Work and Energy, Conservation of Mechanical Energy, Potential Energy, What Potential Energy Tells Us about Force, Energy Diagrams, Non-conservative Forces, Conservation Laws and World Energy Usage.

Small Oscillations in a Bound System, Stability Normal Modes Collisions and Conservation Laws.

Angular Momentum of a Particle, Fixed Axis Rotation, Torque and Angular Momentum, Dynamics of Fixed Axis Rotation, Motion Involving Translation and Rotation, Work–Energy Theorem and Rotational Motion, Vector Nature of Angular Velocity and Angular Momentum, Gyroscope.

Module 4 (Central forces, gravitation, Kepler's law dynamics of rigid bodies (2D)): Central Force Motion as a One-body Problem, Universal Features of Central Force Motion, Energy Equation and Energy Diagrams, Planetary Motion, Some Concluding Comments on Planetary motion, Integrating the Orbit Integral and Properties of the Ellipse.

Module 5 (Harmonic oscillators and waves): Simple Harmonic Motion: Review, Damped Harmonic Oscillator, Driven Harmonic Oscillator, Transient Behavior, Response in Time and Response in Frequency.

Types of waves, Energy and Power of a Wave travelling along String, Wave Equation, Standing waves and Resonance, Travelling Sound waves, Doppler Effect and Supersonic speed and Shock waves.

Textbooks:

1. An Introduction to Mechanics by Daniel Kleppner and Robert Kolenkow, Cambridge University Press
2. Berkely Physics Mechanics Vol. 1 by Charles Kittel, Walter D. Knight, Malvin A. Ruderman
3. Physics for Scientists and Engineers, Fishbane, Gasiorowicz, Thornton, Prentice Hall

LABORATORY WORK

Objectives: The objective of the course is to let students understand practically what basic laws and their effects are. They will practice mechanical, thermodynamics, optical and electromagnetism experiments and will be able to develop an intuitive understanding of natural effects. In parallel with the theoretical lectures they will face reality and will be in position to make links with its mathematical expressions.

Mechanics (Semester 1)

- Maxwell's wheel: free fall, inertia momentum
- Pendulum: Eigen frequency of an oscillator, momentum, gravity force
- Collisions of projectiles: 1D motion, elastic and inelastic collisions
- Vibrating string: standing waves, eigenmodes, influence of boundary conditions
- Acoustic Doppler effect: analogic mixing of electric signal to detect a change in the frequency
- Kundt's tube: to determine velocity of sound in air
- Lee's disk method: to measure thermal conductivity of various insulators
- Force and momentum: to validate Newton's laws of motion

Chemistry-II (CH 1202)

Module1 - Chemical Kinetics: Rate Law and order of reactions; extent of reaction, Determination of reaction rates; Effect of temperature; Theories of chemical kinetics; Introduction to Catalysis (air pollution, catalytic converter).

Module2 - Organic chemistry: Structural isomers and stereoisomers, optical activity, absolute configurations and conformational analysis. Introduction to organic reactions involving substitution, addition, elimination, oxidation and reduction. Reaction mechanisms and reactive intermediates. Chromatographic techniques. Synthesis of some commonly used drug molecules.

Module3 - Polymers: Synthetic and natural polymers. Methods of polymerization, Molecular weight and determination, Glass transition temperature. Structure-property correlations. Examples of some specific polymers.

Module4 - Electrochemistry: Electrochemical Cell, Half-cell reactions and electrodes, Standard electrode potential, Electrochemical Series, Nernst equation. Electrochemistry of corrosion and preventive methods. Batteries: different types of batteries and applications.

Module5 - Nanoscience: Basics of nanomaterials, Synthesis- Bottom-up and Top-down approach, Characterization- Electron microscopy techniques, Applications- electronics, medicinal.

Textbooks:

1. Atkin's Physical Chemistry; 10th edition; Peter Atkins and Julio De Paula; ISBN 978-0-19-954337-3
2. Organic Chemistry; Jonathan Clayden, Nick Greeves and Stuart Warren; ISBN: 978-0-19-927029-3

List of laboratory experiments:

1. Determination of total hardness of water by complexometric titration.
2. Determination of surface tension of a liquid by drop count method and the effect of additives.
3. Study of kinetics of hydrolysis of ester.
4. Determination of equilibrium constant of KI + I2 = KI3 by solubility method.
5. Simultaneous determination of concentrations of strong and weak acid in a mixture using conductometric titrations.
6. Preparation of phosphate/citrate buffers and evaluating their pH resistance.
7. Estimation of amount of Cu2+ or Ni2+ present in a solution using UV-Visible spectrophotometer and Beer-Lambert's law.
8. Synthesis of silver nanoparticles by reduction of AgNO3 and the evaluation of the optical properties by UV-Vis spectrophotometry.
9. Synthesis of benzillic acid from benzil using solid phase synthesis (Green chemistry).
10. Synthesis and FT-IR spectroscopic characterization of dibenzalacetone.
11. Determination of critical micellar concentration (CMC) of a surfactant.
12. Synthesis of an organometallic complex and spectroscopic characterization.
13. Synthesis of a polymer such as Bakelite.
14. Paper chromatography and separation of natural pigments.
15. Synthesis of Aspirin.

Electronics (EE 1202)

Module 0 - Introduction: Background, Importance of Electronics and its everyday applications

Module 1 - Voltage/Current relationships for R,L and C parameters, Basics of RC low pass filter, CR high pass filter and LC low pass filter; Resonance phenomena

Module 2 - Semiconductors: Intrinsic and Doped Semiconductors, PN junction, Carrier mobility, PN junction in forward, reverse and no bias, Shockley's equation for a PN junction diode, Diodes: Semiconductor diode (No bias, Forward, Reverse bias, Zener region, Ge Si and GaAs, Temperature effects) , Ideal v/s practical, Resistance levels (DC or static resistance, AC or

dynamic resistance, Average ac resistance), Diode Equivalent circuits(Piecewise linear, Simplified, Ideal Equivalent circuits), Reverse recovery time, Zener diodes, Light emitting diodes. Diode applications: Load line analysis, Series diode configuration, AND/OR gates, Sinusoidal inputs, Half wave rectification, Full wave rectification, Clippers, Clampers, Voltage doubler, special purpose diodes and their applications

Module 3 - Bipolar Junction Transistor (BJT): Basics of Transistor operation, Common Base Configuration, Common Emitter Configuration, Common Collector Configuration, BJT DC biasing: Fixed Bias, Emitter Bias, Voltage divider bias, Collector feedback bias, Emitter follower Bias, Common base configurations, Miscellaneous bias configurations, BJT ac analysis, Ebers Moll model of BJT

Module 4 - Transistor as a switch, Darlington pair, Linear Regulator circuits using Zener diode and BJT (output current regulation and voltage regulation), Basics of Field Effect Transistors (FETs): basic types and working principle. Pulse generators, multi-vibrators, and waveform generators.

Module 5 - Basics of Operational amplifiers: Single ended, double ended operation, equivalent circuit of ideal OPAMP, virtual ground, inverting amplifier, non-inverting amplifier, voltage summer, voltage buffer, Voltage controlled voltage source, Voltage controlled current source, Current controlled voltage source, Current controlled current source. Amplifiers: Signals, Frequency spectrum of signals, Amplifier Circuit symbol, Voltage gain, Power gain and Current gain, Expressing gain in decibels, The Amplifier Power supplies, Circuit models for Amplifiers (Sub sections: Voltage amplifiers, Cascaded Amplifiers, Other Amplifier types, Relationships between the four amplifier models),

Reference Books:

1. Electronic devices and Circuit Theory by Boylestad & Nashelsky, Pearson Publications, 10th or 11th Edition
2. Microelectronic circuits, Theory and Applications by Sedra & Smith, Oxford international student edition, 6th Edition

Introduction to Computer Science (CS 1201)

Module 1 - Representation of data: Number systems; Conversion from one base to the other; Binary number system; Representation of Binary numbers using Physical devices; Basic logic gates and binary logic; Short, Int, Long types; Integer arithmetic using logic gates; Float point representation; Float, Double, long Double data types; Characters - ascii codes; Boolean variables; IEEE standards and history.

Module 2: Von Neumann architecture of modern computing system; Low level languages vs High level Languages; Compilation and byte code; Introduction to C programming language; Variables, type declaration and operations. Control structures and manipulation of data: Conditional Constructs if, ifelse, while, for, do-while, switch, break, continue. Functions: Implementation of functions in C, recursion, Iteration vs recursion.

Module 3 - Pointers and Arrays: The pointer datatype; Declaring pointer variables; Passing a reference using pointers; Null pointers. Arrays; Declaring and using arrays; Arrays as parameters; Strings in C; Relation between arrays and pointers; N-dimensional arrays; What is an algorithm?

Algorithms: Sorting examples - Insertion sort, Bubble sort, mergesort. Searching examples - linear search, Binary search. Structures; Dynamic Memory Allocation; Malloc - Free functions; Dynamically Sized arrays; Implementation of Linked lists. File handling: Reading and writing files; Writing header files; Make and Installation Packages.

Module 4: Introduction to interpreted languages; Introduction to Python; Dynamic typing; inbuilt data types - Strings, Lists, Tuples, Sets, Dictionaries, and methods. Subcriptables and Iterables; the while and for loops; Functions – Polymorphism in Python functions; Introduction to Python classes; Brief introduction to Object Oriented Programming.

Module 5: Standard modules in Python for scientific computing and plotting; Handling files; Implementation of various algorithms (search, sort etc) in Python; Speed comparison with C; Integration of C programs into Python scripts.

Textbooks:

1. Introduction to Computing Systems: From Bits & Gates to C & Beyond; Yale Patt & Sanjay Patel
2. C: How to Program; Paul Deitel, Harvey Deitel
3. Dive into Python; Mark Pilgrim
4. Beginning Python: Novice to Professional; Magnus Lie Heitland
5. Python Algorithms; Magnus Lie Heitland

Discrete Mathematical Structures (CS 1202)

Module 1 - Foundations of Logic:

- Proof and Programming: Intuitive notion of mathematical proof and its connections with computer programming.
- What is a mathematical theory?: Propositional logic, Predicate logic, Models, Axioms, Rules of Logic, Theorems, Proof techniques.

Module 2 - Set theory:

- Naive set theory, operations on sets
- Paradoxes and crises that shook the world of mathematics - and how it led to development of computer science?
- Cardinality; Countable and Uncountable sets; examples.
    - Set theory and computability theory
    - Decision problems
    - Questions vs Problems
    - Programs vs Problems
- A brief discussion on Automata theory.
- Turing machine vs Algorithm

Module 3 – Algorithms:

- Good algorithms vs bad algorithms : need for a scientific definition.
- Asymptotic notation, complexity of an algorithm
- Complexity classes.

Module 4 - Counting techniques:

- Basic counting - The multiplication principle, Permutations and combinations, Addition and subtraction, Probability (recap), Applications of combinations : Paths on grid, Choices with repetition, Correcting for overcounting
- More counting - Inclusion – exclusion, Multinomial coefficients, Generating functions, Counting orbits, Combinatorial arguments

Module 5 - Graphs and properties:

5.1 Basics

- Motivation, Graphs and Graph models
- Notation & Special types of graphs
- Matrices
- Invariants
- Directed graphs and Markov chains

5.2 Properties

- Connectivity
- Euler circuits
- Planar numbers
- Chromatic number

Textbooks:

1. Discrete mathematics and its applications - Kenneth H. Rosen et al
2. Mathematics for Computer Science - Albert R. Meyer et al
3. Discrete mathematics - Kevin Ferland
4. Invitation to Discrete Mathematics - Jiri Matousek (for slightly advanced readers)
5. Concrete Mathematics - Donald Knuth (for slightly advanced readers)

Workshop Practice (ME 1202)

List of Typical Experiments:

- Introduction to Workshop: Overview and Safety Practices (1 week)
- Hand Tools & Machining Demonstration (1 week)
- Benchwork and Fitting (2 weeks)
- Woodwork and Carpentry (2 weeks)
- Welding Demonstration (1 week)
- Introduction to Machine Tools (1 week)
- Lathe and Milling: Basic Operations (2 weeks)

Textbooks:

1. Workshop Practice by B. L. Juneja, 2016, Cengage Learning.

French - II (HS 1203)

Objectives: To develop basic LSRW skills in French Language, from learning how to pronounce and write French alphabet to picking up phrases and words in written, spoken communication through listening and reading exercises.

Course Contents:

Topics

- Family
- Hobbies and pastimes
- Leisure activities
- Describing habit and routines
- Weather description

Grammar

- Possessive adjective
- Near future
- Past tense

- Negation
- Spatial location : - venir de / aller à + ville ou pays
- Adverb of time: now, this week, tomorrow, last month etc…
- Fixed preposition with some verbs(aller, venir, faire, jouer)

Types of writing

- Post card writing
- Family tree
- Likes and dislikes with advanced notions

Ethics (HS 1202)

Module 1: Why be moral? Introduction to ethical theories. Is and Ought. What is and what ought to be? Fact-value distinction

Module 2: End and Means. Classical dilemma, Debates and theories. Gandhian Ethics. The concept of shreyas and preyas.

Module 3: Justice. Classical theories of justice. Crime and punishment. Malpractices.

Module 3: Rights, Duties and Responsibilities. Natural rights, Fundamental rights and Human dignity. Freedom and autonomy. Duties and responsibilities. Legal rights. Patents and intellectual rights

Module 4: Good Life. Happiness. Harmony. Care and Compassion

Module 5: Case studies of professionals, institutions and organizations

Textbooks / References:

1. Handouts of classical texts by various philosophers will be provided to students. (Socrates, Kant, Hume, Locke, Mills, Bentham, Rawls, Gandhi, etc.)
2. Practical Ethics by Peter Singer
3. Applied Ethics by Peter Singer
4. What We Owe Each Other by T. M Scanlon
5. Fundamental Ethics – for Scientists and Engineers by Edmund Seebauer and Robert Barry

Mathematics - III – Probability and Statistics (MA 2103)

Module 1: Probability and Random Variables Axiomatic definition of probability, Sample Space, Events, Conditional Probability, Independence of Events, Theorem of Total Probability, Baye's Theorem, Discrete and Continuous Random Variables, Probability Mass Function, Probability Density Function, Cumulative Distribution Function, Moments, Mathematical Expectation, Variance, Standard Deviation, Moment Generating Function.

Module 2: Discrete and Continuous Distributions Binomial Distribution, Poisson Distribution, Uniform Distribution, Exponential Distribution, Normal (Gaussian) Distribution, Markov's Inequality, Chebyshev's Inequality.

Module 3: Random Vectors: Joint Probability Distribution of Functions of Random Variables, Independence of Random Variables, Covariance, Variance, Expectation, Correlation, Multinomial

Distribution, Transformations of Random Variables, The Law of Large Numbers,The Central Limit Theorem.

Module 4: Random Processes: Continuous and Discrete Random Processes, Autocorrelation Function, Auto covariance Function, Correlation Coefficient, The Bernoulli Process, The Poisson Process, The Wiener Process, The Markov Chain, Stationarity: Strict-Sense Stationary (SSS) and Wide-Sense Stationary (WSS) Processes.

Module 5: Statistics: Descriptive Statistics: Sample Mean, Sample Variance, Sample Standard Deviation and Sample Correlation Coefficient; Confidence Intervals, Parameter Estimation: Unbiasedness, Consistency, Point Estimator, Maximum Likelihood Estimators.

Textbooks:

1. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier, Fifth Edition 2016.
2. Sheldon M. Ross, Introduction to Probability Models: 11th Edition, Academic
3. Press Elsevier, 2015. Jean Jacod and Philip Protter, Probability Essentials, Springer, 2004.
4. Hogg, Tanis and Rao, Probability and Statistical Inference: 7th Edition, Pearson, 2006.
5. Alberto Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, Pearson, 2008.

Physics - II (PH 2102)

Module 1 – Electrostatics: Physical definitions of Gradient, divergence and curl operators, curvilinear coordinates, Dirac Delta function, Theory of vector fields, Coulomb's law and principle of superposition, Gauss's law and its applications, Electric potential and electrostatic

energy, Poisson's and Laplace's equations with simple examples, uniqueness theorem, boundary value problems, Properties of conductors, Multipole expansion, Electric fields in matter, Dielectrics and polarization

Module 2 – Magnetostatics: Biot & Savart's law, Amperes law, Divergence and curl of magnetic field, Vector potential, Vector potential, Magnetic field in matter, Bound currents, Field H, Classification of magnetic materials, Faraday's law in integral and differential forms, Motional EMF, Displacement current

Module 3 – Electromagnetism: Maxwell's equations, Electromagnetic waves, wave equation, e.m. waves in vacuum and media, refractive index, Energy and momentum of e.m.w., Poynting vector, Polarization of e.m. waves, Reflection and refraction, skin depth, standing electromagnetic waves, Electric dipole radiation, Waveguides with rectangular metallic boundaries, TE, TM and TEM mode.

Module 4 – Optics: Some discussions on geometrical optics, Wave optics: Interference between two coherent waves, Fresnel and Fraunhoffer diffraction, Diffraction grating, polarization, Fiber Optics

Labs

1. Geometrical optics with lenses
2. Newton's rings
3. Single-and double-slit diffraction
4. Spectrometry of a glass prism
5. Polarization study with half and quarter wave plates
6. Helmholtz coils
7. Faraday's law
8. B-H loop
9. Hall effect

Signals and Systems (EE 2101)

Module 0: Introduction to Signals & Systems, *Continuous-Time Signals:* Signal Classification, Signal operations, *Discrete-Time Signals:* Signal Classification, Signal operations, Singularity Functions: unit Impulse signal, unit Step signal, unit ramp signal, exponential signal, Continuous/ Discrete-Time Systems Classification.

Module 1: Linear Time-Invariant (LTI) Continuous-Time Systems, Properties of LTI Systems, Impulse Response, Linear Convolution, Causality, Stability, Introduction to Fourier Analysis, Fourier Series for Periodic Signals, Properties of Fourier Series

Module 2: Aperiodic Signal Representation, Continuous-Time Fourier Transforms & its properties, Frequency Response of Continuous-Time Systems, Laplace transform & its

properties, Inverse Laplace Transform, Solution of LTI continuous-time systems using Laplace transforms; Transfer Function, pole-zero concepts, Feedback and its effect on pole-zero locations.

Module 3: Sampling & reconstruction, Discrete-time LTI systems, Discrete-time convolution, Discrete-Time Fourier Transform & its properties.

Module 4: Z-transforms & its properties, Z-transforms converting difference equations into algebraic equations, Discrete Fourier Transform (DFT), Properties of DFT.

Module 5: Fast Fourier Transform (FFT), decimation-in-time (DIT) FFT & decimation-in-frequency (DIF) FFT algorithms, Discrete-time convolution using FFT.

Text Book and References:

1. A V Oppenheim, A S Willsky, Nawab S N, *"Signals & Systems"*, PHI, Second Edition, 2006.
2. Lathi B P, Principles of *Signal Processing & Linear Systems* Oxford University Press, 2009.
3. Nagrath I J, Sharan S N, Ranjan Rakesh & Kumar S, Signals & Systems, Second Edition TMH, 2001.
4. Papoulis A, Signal Analysis, McGraw Hill Education, Indian Edition

Data Structures (CS 2104)

Module 1: Introduction to Data Structures: Single and Multi-dimensional Arrays, Sparse Matrices (Array and Linked Representation) . Introduction to Algorithms: Algorithm Development, Complexity analysis, Recursion. Growth of Functions & Asymptotic Notations. Rates of Growth: O(n), Ω(n), Θ(n), o(n), ω(n), Run-Time Complexity, Space Complexity, NP-Completeness (Time Permitting). Complexity Class - P, NP, NP Complete, NP Hard, Is P=NP? and Reductions.

Module 2: Linear Data Structures - Stacks: Operations and Applications, Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Applications of stack; Limitations of Array representation of stack. Links Lists: Operation – Creations, insertion, Deletion, Circular Lists, Doubly Linked List. (Approaches, Implementation Issues, Complexity & Efficiency), Amortized Analysis.

Module 3: Array and Linked representation of Queue, De-queue, Priority Queues, Circular Queues: Operations and Applications
Sorting Algorithms & Searching: Bubble sort, Quick Sort, Insertion Sort, Merge Sort, Selection sort, Heap Sort, Radix sort and Bucket sort. Lower bound for comparison-based sorting algorithms. Linear Search, Binary Search.

Module 4: Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collusion by Open Addressing, Coalesced Hashing, Separate Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function Introduction to Tree as a data structure; Binary Trees (Insertion, Deletion , Recursive and Iterative Traversals on Binary Search Trees); Threaded Binary Trees (Insertion, Deletion, Traversals); Height-Balanced Trees (Various operations on AVL Trees).

Module 5: Graphs I: Representation and Traversal (Preorder, Inorder, Postorder) - • Representation: Matrix, Adjacency list; Traversal: Depth First Search, Breadth First Search; Graphs II: Basic Algorithms - Minimum Spanning Tree, Shortest Path, All pairs Shortest Path, Transitive Closure

Textbooks:

1. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using C and C++:, Second edition, PHI, 2009.
2. Micheal T. Goodrich and Roberto Tamassia: Algorithm Design: Foundations, Analysis and Internet examples (John Wiley &Sons, Inc., 2002)
3. Cormen T.H., Leiserson, C.E., Rivest, R.L., and C. Stein. Introduction to Algorithms, MIT Press, Second Edition (Indian reprint: Prentice-Hall).
4. Sanjoy Das Gupta, Christos Papadimitriou, Umesh Vazirani, Algorithms; Tata McGraw-Hill Publishers
5. Alfred V. Aho, John E. Hopcroft, Jeffery D.Ulman. Data Structures and Algorithms
6. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran. Computer Algorithms
7. Robert L. Kruse, "Data Structures and Program Design in C++", Pearson,1999.

Analog and Digital Circuits (EC 2101)

Course Objectives:

- To understand the working and large signal and small models of microelectronic devices
- Transistor based amplifier circuits, Feedback effect, Op-amps will be discussed
- Filters, Sinusoidal oscillators, Waveform generators, ADC and DAC will be discussed
- To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To understand the concepts of combinational logic circuits and sequential circuits

Course Content:

Module 1:

- Review of Microelectronic Devices

a. Diode, BJT, JFET, and MOSFET
b. Large-signal models
c. Small-signal models

- Single-Transistor Amplifiers

a. Common-emitter/source, Common-base/gate, and Common-collector/drain
b. Biasing, small-signal gain, input resistance, and output resistance (CE-BJT, CS-MOSFET)

- Multi-Transistor Amplifiers

a. Current mirrors
b. Cascode, differential, and cascade
c. Biasing, small-signal gain, input resistance, and output resistance (Differential BJT, MOSFET)

Module 2:

a. Feedback: Series-shunt, series-series, shunt-series, and shunt-shunt
b. Effects on gain, input resistance, output resistance, noise, distortion, and bandwidth
c. Basic OPAMP construction (3 stages), 741 IC
e. Active Filters
   i. Low-pass, high-pass, band-pass, notch filter, band-reject, all pass filters
   ii. First, second
f. Power Amplifiers

Module 3:

Number systems and Codes, Boolean Algebra, Logic Gates, minimization and Realization of a function using K-Map, and AND-OR-invert (AOI)/Universal Gates, Flip Flops and Latches, ADC and DAC

Module 4:

MOSFET as a switch, CMOS Inverter and its characterization, Combinational Logic Gates using static CMOS – functional analysis, Mono, Astable (555 Timer), and Bi-stable multivibrators, Sinusoidal oscillators, Waveform generators

.

Text Books:

1. Gray, Hurst, Lewis and Meyer; Analysis and Design of Analog Integrated Circuits; 5th edition, Wiley 2010.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw-Hill, August 2000.

3. John F Wakerly; Digital Design: Principles and Practices (5th ed.); Pearson, 2017.

French - III (HS 2103)

Objectives: The aim of this course is to understand very short, simple information in the spoken and written language and to express oneself simply and briefly in speech and in writing for practical purposes in everyday situations requiring a direct exchange of information. It is expected that productive skills will be limited and fragmented and that language will be mostly or completely formulaic at this level; receptive skills will be more developed than productive skills.

Course Content:

General themes

- People: Family, Physical description
- Places: Cafe, Restaurant, Shops, Bank, Post office, Hotel, Road
- Hobbies: Sports, Going out, Shows, Holiday trips
- Daily Life: Work, Shopping,
- Daily activities

Grammar topics

- Pronominal verbs: verbes reflechis and pronominal verbs
  Past Simple - events in the past
- Past participles
  Imperfect tense - descriptions in the past (it was, there was)
  Imperative - Affirmative and Negative - for instructions and commands
- Near Future Tense
  Future simple tense
- Conditional tense

Lean Startup (HS 2101)

Objectives: The primary objective of the course is to enable students to learn how to rapidly develop and test ideas by gathering massive amounts of customer and marketplace feedback.

More specifically, the course aims to:

1. Teach the basic principles of lean start-up
2. Build products that meet customer needs
3. The easiest and fastest ways to build minimum viable products which could be launched quickly.
4. Tactics for experimentation with landing pages, A/B tests, MVPs on real customers

Course Description: The course aims at giving you practical experience in starting a technology-based start-up or leading a new product development initiative in an established corporation. The course is based on the principles of lean-startup developed by Eric Ries and Steve Blank. Lean Startup is a new, field-tested philosophy that provides you with a toolset to minimize failure and increase your chances of success. Through practical experience, student-driven seminars, understanding of business model components in the start-up process, as well as ability to analyze and validate an idea or invention is mainly achieved through customer-based development and experimentation with minimum viable products.

Principles of Economics (HS 2102)

Objectives: The course provides students with a structured understanding of how companies operate and can be managed. After the class, students should be familiar with concepts such as governance, strategy, partnering, organizing, etc.

Course Content:

- Introduction: objectives, stakeholders, operations and product life cycles
- Marketing of products and services
- Corporate strategy
- Growth process and strategic plan
- Structure and processes, informal organization
- Performance driving and operations management
- Management of innovation and technology

Textbooks:

1. Course reader in English + copy of the slides presented in class
2. The structuring of organizations, H. Mintzberg
3. Principles of economy, N. Gregory Mankiw

Network Analysis and Synthesis (EC XXXX)

Module 1 – Analysis using graph theory: Network Topology, graphs, Edges, Trees, Circuits, Tree branches, Links, Incidence matrix, circuit matrix, Cut-set matrix, their inter relationships ABT = 0 Nodal analysis, Admittance matrix, Mesh analysis Mesh Impedance matrix, Solution of networks containing controlled sources.

Module 2 – Realizability conditions of linear passive networks: Telegen's Theorem, Energy Functions, Network properties based on energy functions, PR functions; Test for PR function, Hurwitz polynomials and Hurwitz test. Real part sufficiency, Definition of linearity. Passivity, Tellegen's reciprocity, causality.

Module 3 – Two port parameters: Z and Y parameters, interconnection of two ports S parameters and their relation to Z and Y parameters. Reciprocity, passivity and matching conditions on S parameters Measurement of s parameters.

Module 4 – Synthesis of one port networks: Driving point impedance, pole zero locations Passivity Properties of LC, RC. RL networks Synthesis of two element kind networks - Foster and Cauer forms. RLC synthesis Bott and Doffin method, Darlington method and Miyata method.

Synthesis of two port networks: Properties of impedance and admittance matrices - residue and real part condition. Obtaining transfer function from magnitude Darlington synthesis, Miyata ladder synthesis.

Synthesis of singly terminated and doubly resistive terminated networks: Darlington and Miyata synthesis, Reflection coefficient formulation for doubly terminated networks. Miyata synthesis for arbitrary source and load resistances.

Module 5 – Approximation problem: Butterworth, Tchebycheff approximation. Roots of the polynomials. Linear phase approximation- Bessel polynomials and their roots.

Synthesis of filters: LP to HP and BP transformation. Impedance level and cut off frequency scaling. Prototype LP filter based on Butterworth, Tchebycheff and Bessel approximation – Synthesis of Miyata ladder form of singly and doubly terminated prototype filters.

Image parameter theory and Zobel filters: Image parameters. Attenuation and phase pf image terminated filters. LP prototype filters- constant K, m derived filters. M and mm' derived terminations.

Module 6 – Time domain analysis: State space representation of linear networks. Solution of state equation Properties of state transition matrix. calculation of state transition matrix. Eigen values and eigen functions. Stability Choice of state variables for a linear passive network. Derivation of state and output equation for Linear Passive Time invariant network. Relation to immitance formulation of networks.

Module 7 – Active RC networks and synthesis of active filters: Structure of active RC filters-finite gain structures, Sallen Key Filters, OPAMP based RC filters Huelsman Biquad.

Textbooks:

1. Dante C Youla: Theory and Synthesis of Linear Passive Time Invariant Networks 2016 Cambridge Univ Press
2. Charles A. Desoer and Ernst Kuh: Basic Circuit Theory 1969 McGraw
3. Seshu,Balabanian, Bickart: Electrical Network Theory(comprehensively covers most of the syllabus)
4. Seshu and Reed: Linear Graphs and Electrical Networks (the first book ,an excellent one, on graph theory applications to electrical networks. not easily available)
5. Shu Park Chan: Introductory Topological Analysis of Electrical Networks (a good book for graph theoretic methods of network analysis. not easily available)
6. E A Guillemin: Mathematics of circuit Analysis (a pioneering book addressing on fundamental properties of electrical networks using complex variable theory/ available for download)
7. E A Guillemin: Synthesis of Passive Networks (the book by the pioneer and peer on the subject of formal synthesis methods for passive networks)
8. Louis Weinberg: Network Analysis and Synthesis McGraw
9. H. J. Carlin and A. Giordano: Network Theory: An Introduction to Reciprocal and Nonreciprocal Networks (the first book on nonreciprocal networks introducing ideal nonreciprocal Gyrator of Tellegen. We will not cover nonreciprocal networks but that part of the book covering reciprocal networks based on scattering matrices is of interest to us)
10. BDO Anderson Sumeth Vongpanitlerd Network Analyis and Synthesis: A system theory approach Dover 2006
11. Omar Wang Classical Circuit Theory 2008 Springer
12. George Moschytz: : Analog Circuits and Filter Theory in the Digital World
13. Vasudev K. Aatre: Network Theory and Filter Design New Age International.

Electromagnetic Waves (EC XXXX)

Objectives:

- Study transmission lines and waveguides and be able to apply those concepts in practice
- Study Electromagnetic waves in free space
- Study the basic concepts of Antennas

Module 0: Review of Electromagnetic Theory. Maxwell's Equations, Vector Analysis.

Module 1: Transmission Lines: voltage and current variations along ideal lines, relation of field and circuit analysis, reflection and transmission, pulse forming line, impedance transformation,

standing wave ratio, Smith chart, lossy lines, filter-type and resonant lines, group and energy velocities, backward waves;

Module 2: Electromagnetics in Free Space: Maxwell's equations and their solutions, potential functions, Poynting theorem, guided waves; linear, circular and elliptical polarized waves. Concept of angular spectrum.

Module 3: Dielectric Materials: macroscopic electric field due to a volume of polarized dielectric, complex permittivity and dielectric losses, Maxwell's equations for dielectric materials; reflection and refraction of plane waves.

Module 4: Waveguides and Resonators: TE and TM waves, parallel-plate, rectangular waveguides, evanescent waves in waveguides. dielectric waveguides, and rectangular cavity resonators;

Module 5: Antennas: Elemental and half-wave dipoles.

Text Books

1. Hayt and Buck: Engineering Electromagnetics, TMH
2. Bhooshan, S : Fundamentals of Engineering Electromagnetics, OUP

Reference books

1. Sadiku, M: Elements of Electromagnetics, OUP

Random Processes for Electrical Engineering (EC XXXX)

PRE-REQUISITES: Signals and Systems, Mathematics - III – Probability and Statistics

Course Objectives:

- To understand the basics of probability, random variables, and random processes.
- To understand and analyze the spectral properties of random processes.
- To understand different estimation techniques for unknown parameters of random signals and for unknown waveforms in presence of noise.
- To analyze LTI systems with random signal as input.
- To familiarize with different optimum linear systems.

Course Content:

Module-1: Basic Concepts of Probability Theory, Random Variables, and random vectors
Probability Models in Electrical, Electronics, and Computer Engineering;
Brief revision of probability theory;
Random Number Generators; Random variable (RV) – notion of a random variable, Discrete and Continuous Random Variables, The Cumulative Distribution Function, The Probability Density Function, Probability Mass Function, Expected value of a random variable, function of one random variable, characteristic and moment generating function.
Vector random variables, pairs of RVs, Independence of two RVs, Conditional Probability and Conditional Expectation, Joint distribution of several RVs, Transformation of random vectors, correlation and covariance of two RVs, Jointly Gaussian RVs, Central Limit Theorem and its applications.

Module -2: Random Process
Definition, joint distribution of time samples, mean, autocorrelation, and autocovariance functions, Gaussian Random Process, Discrete-time Random Processes, Multiple Random Processes – cross-covariance and orthogonality, Stationarity - WSS and SSS, ergodicity;
Orthogonal expansion of Random Processes – Karhunen-Loeve expansion.

Module-3: Estimation techniques for statistical parameters
Mean square estimation of one RV by observation of another RV;
estimation of mean, variance, correlation, autocovariance etc.;
confidence intervals - Gaussian samples with known mean and unknown variance, unknown mean and unknown variance, Non-Gaussian samples.

Module-4: Analysis, detection, and estimation of random signals
Power Spectral Density (PSD), White Noise, band-limited White Noise;
Hypothesis testing and optimum detection: Binary hypothesis, optimum detection of binary message waveform in presence of white noise, extension to M-ary detection.
Response of linear systems to random signals, Discrete-time systems – MA, AR, ARMA process;
Linear estimation in presence of noise – Optimum linear systems, Wiener filter and its implementation, causal implementation using spectral factorization.

Module-5: Kalman filter and spectral estimation
The Kalman Filter;
Spectral estimation techniques.

Text Books:

1. A. Leon-Garcia, “Probability and Random Processes for Electrical Engineering”, Pearson.
2. A. Papoulis, “Probability, Random Variables, and Stochastic Processes”, McGraw-Hill.

Reference Books:

1. Van Trees, “Detection, Estimation and Modulation: Part I”, Wiley.
2. M. H. Hayes, “Statistical Signal Processing”, Wiley.

Digital System Design (EC 2203)

Module 1: Introduction to the binary systems suitable for representing information in digital systems. The binary number system will be covered, and different binary codes will be illustrated. Will cover examples for addition and subtraction of signed binary numbers and decimal numbers in BCD formats. Introduce basic postulates of Boolean algebra and show the correlation between a Boolean expression and its corresponding logic diagram. All possible logic operations for two variables are presented, and the most useful logic gates used in the design of digital systems will be covered.

Module 2: Will cover methods for simplifying Boolean expressions. Students will be introduced to the K-map method of reducing a logic expression and the implications of reducing logic expressions on the resulting digital design will be shown. Students will learn the Quine-McCluskey method of reducing Boolean expressions with more than 4 variables.

Students will be introduced to formal procedures for the analysis and design of combinational circuits. Basic components such as adders, and code converters will be introduced as design examples. Many frequently used digital logic circuits will be covered in detail. Students will be introduced to HDL for the first time, and some basic examples of Verilog will be covered.

Module 3: Different models used for expressing same circuit at different abstraction levels in Verilog will be introduced. This will cover the structural model, data flow model, and behavioral model. Students will be introduced to flip flops, the logic behind flip flops, how flip flops are the most basic concept of memory for digital systems. Students will be taught the different kinds of flip flops, what are the problems that necessitated development of different types of flip flops. Basic introduction to synchronous sequential circuits will be covered.

Module 4: Continuation of synchronous sequential circuits. Students will learn the concept of finite state machine (FSM) and the different types of FSM that are used in digital systems design. Real life examples for what constitutes an FSM will be covered. Students will learn what a state diagram is, and how to draw/interpret any state diagram. Reduction of state diagram to optimize the circuit will also be covered.

Various sequential circuit components such as registers, shift registers, and counters will be presented in detail. Students will learn how to use these basic building blocks to build more complex digital systems.

Text Books

1. Digital Design with an Introduction to the Verilog HDL by Mano and Ciletti – latest edition
2. Digital Design: Principles and Practices by Wakerly – latest edition

Reference books

1. Switching and Finite Automata Theory by Kohavi and Jha – latest edition

Digital Signal Processing (EC XXXX)

Course Objective:

- This course aims to teach the ideas and techniques associated with representation of signals in digital form, and the processing of these signals and the information they carry.
- Digital signal processing is one of the most powerful technologies that have made revolutionary changes in a broad range of fields like audio and speech signal processing, sonar and radar signal processing, spectral estimation, statistical signal processing, digital image processing, and signal processing for communication.
- Each of these areas has developed deep DSP technology, with its own algorithms, mathematics, and specialized techniques.
- Digital signal processors, such as the TMS320 family of processors are used in a wide range of applications, such as in communications, controls, speech processing, and so on.

Course Content:

Module 0 - Introduction to Digital Signal Processing: Overview of the course, Introduction to discrete-time sequences, operations on the independent variable, elementary signals, Introduction to digital systems and their properties, LTI systems, convolution.

Module 1: Sampling lowpass & bandpass signals, Discrete-Time Fourier Transform (DTFT), Phase and group delay, Z- transform and its use for analysis of LTI systems, Discrete Fourier Transform (DFT).

Module 2 - Analog filter design: Butterworth, Chebyshev, Elliptic & Bessel Filters, Design of high-pass, band-pass, and band-stop filters.

Module 3 - Design of FIR Digital Filters: Symmetric and antisymmetric FIR filters, Design of linear phase FIR Digital Filters using Windows, Design of linear phase FIR Digital Filters by Frequency

Sampling method.

Design of IIR Digital Filters: comparison of IIR & FIR filters, IIR filter design by impulse invariance method and bilinear transformation.

Module 4 - Realization of Digital Filters: Structures for FIR systems, Direct form structures, Cascade form structures, Structures for IIR systems: Direct form structures, transposed structures, cascade form structures, Parallel form structures.

Module 5 - Multirate Digital Signal Processing: Decimation by a factor D, interpolation by a factor I, sampling rate conversion by a rational factor I/D, Finite Word-Length Effects: IIR & FIR Filters.

Text Books:

1. John G. Proakis, Dimitris G. Manolakis (2007), "Digital Signal Processing, Principles, Algorithms, and Applications", Pearson Education / PHI, India.
2. A.V. Oppenheim, R. W. Schaffer (2009), "Discrete Time Signal Processing", Prentice Hall of India, New Delhi.

Reference Books

1. B. Venkataramani & M Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", TMH, 2002.
2. Dimitris G. Manolakis and Vinay K. Ingle "Applied Digital Signal Processing: Theory and Practice", Pearson, 2015.
3. Samir S. Soliman and Mandyam D. Srinath "Continuous and Discrete Signals and Systems", Prentice-Hall Information and Systems Science Series, 1997.

French - IV (HS 2203)

Objectives: The aim of this course is to understand very short, simple information in the spoken and written language and to express oneself simply and briefly in speech and in writing for practical purposes in everyday situations requiring a direct exchange of information. It is expected that productive skills will be limited and fragmented and that language will be mostly or completely formulaic at this level; receptive skills will be more developed than productive skills.

Course Content:

General themes

- Accommodation: Units in the house, interior decor

- Everyday objects
- Countries & Cities
- Actions in daily life
- Events: Meetings, Evening out, Family events, Visits, Excursions, Accidents, TV news
- Money and payments

Grammar topics

- Transitive and Intransitive verbs - Direct and Indirect object
- Relative pronoun 'there' - place
- Relative pronouns - who, that/which
- Prepositions of place: go to, be at,come from + a place
- Connectors: but, because

Design Thinking (HS 2201)

1st week:

Exercise 1: Drawing practice using subconscious mind with the help of music…. Al Di Meola (Race with Devil on Spanish Highway), Beethoven Symphony No.9, Hans Zimmer - Kings of the Past, Pink Floyd - Terminal Frost etc. Another exercise was to create a story from subconscious mind.

Exercise 2: 2D drawing from conscious mind and create a story.

Exercise 3: 2D Story making following story board & comic strips type.

2nd week:

Introduction 3D, where 'D' stands for dimension, which means an object has three dimensions. X-axis, Y-axis and extra dimension are the Z-axis which gives height/width/depth to an object.

Exercise 1: Composition exercise 3D, Create a new 3d compound structure using any one symmetrical and asymmetrical pattern with the help of colour paper

3rd week:

3d exploratory prototyping/ connection of variety objects….Bangles, Rubber band, Scooby sticks, Marbles, Paper cups. This is a brain storming activity. Where they will learn how to build a product with the help of very limited object and also they need to calculate the mathematical way to function this game.

4th week:

2D form exploration Tangram

5th & 6th weeks:

Screening short films.

Exercise 1: First write down the basic theme.

Exercise 2: To identify and write down the visual and audio components of this design/narrative and also to state alongside as to what could be its motivation.

7th week:

Context-Concept- We are providing some objects (Syringe, Nail Cutter, and Stapler). Brain storms the following using object which is given them. Note the idea, possibilities and connection as possible.

- In what contexts do you see a use for this product?
- How did this product evolve? What are the alternatives before the product for the same need? What the problem did this product solve?
- Think of 5 important "WHAT IF CONTEXTS" for this product?
- Describe a PERSONA of the product.
- Sketch your 10 new concepts based on this product.
- What can be made it simpler, pleasurable and more meaningful?

8th week:

Typography & Photo montage (collage) – History of typography/ Calligraphy and Photomontage. Typography plays a critical role in strengthening the brand, creating interest to the product, and highlighting a central message. The core purpose of a design is communication. Whether we're talking about an online ecommerce store or a corporate brochure, typography is a vital component. Typography is the art and technique of selecting and arranging type styles/fonts for texts.

Exercise 1: To write their name in two different styles (Serif and Calligraphy).

Exercise 2: Making a collage art using magazine and newspaper.

9th week:

Book Cover Design: History and evolution of book. History of book covers designing.

Exercise 1: Create a book cover by using typography or any kind of creative image which can describe the book visually.

10th week:

Ideating objects & Mechanical transformation-

Problem review:

- Identify the object.
- User profile of the product.
- Function of the product.
- How many parts is the product made of?
- How is each part manufactured?
- What manufacturing processes are applied?
- What are the alternatives uses the product?
- What are the irritants present in this product?
- If the product had to be redesigned, what would be your approach? Sketch the design.

11th - 15th weeks:

Final Project and Prototype.

Financial Accounting (HS 2202)

Course Content:

Module 1 – Introduction to Accounting (3 lectures): Meaning of Accounting, Objectives of Accounting, Understanding Company management, stakeholders versus shareholders, financial reporting standards, financial reporting.

Module 2 – Understanding Accounting Elements (3 lectures): Elements of financial statements – assets, current assets, liabilities, current liabilities, equity, income, expenses, accounting equation

Module 3 – Accounting Concepts (4 lectures): Business entity concept, money measurement concept, going concern, consistency, matching concept, cost concept, dual aspect concept, materiality, full disclosure; Generally Accepted Accounting Principles (GAAP)

Module 4 – Journal Transactions (3 lectures): Journal, Rules of Debit and Credit, Compound journal entry, opening entry.

Module 5 – Ledger Posting & Trial Balance (4 lectures): Ledger, Posting, Relationship between Journal and Ledger, Rules regarding posting, Trial Balances

Module 6 – Bank Reconciliation & Final Accounts (4 lectures): BRS – meaning & preparation techniques; Profit and Loss account, Balance Sheet, Adjustment entities, etc.

Recommended Text Book:

1. Maheshwari, SN., Financial & Management Accounting (S. Chand & Sons)

Reference Book:

1. Ghosh, TP., Financial Accounting for Managers (Taxmann Publications, 2009)

Programmable Devices (EC 3103)

Course Objectives:

- To understand the architecture, functionality and operation of a general-purpose microprocessor/DSP Processor/FPGAs
- To be able to program a microprocessor/DSP Processor/FPGAs
- To be able to evaluate the performance of different programmable devices

Course Content:

Module 0 - Introduction: Introduction to the types of computing systems – ASIC, FPGA, ASISP, ASIC and their comparison.

Module 1 - Microprocessor Architecture: Introduction to microprocessor architecture (x86/ARM), Timing Diagrams, Logical view of memory, Internal Registers – General Purpose and Special Registers, Instruction Set, assembly level programming, Stacks for sub-routines, programming techniques, ASM inference of High-Level languages

Module 2 - Peripherals and I/O: I/O interfacing – General Purpose I/O, Addressing/Mapping, Types of I/O - Polling and Interrupt-based; Interrupts – Types – HW/SW, Interrupt Vector Maps, writing ISR; Timers – General timers, counters, watchdog timers; Serial Communication – UART; Examples of Interfacing I/O devices. Microprocessor vs Microcontroller

Module 3 - Programmable Logic Devices: Introduction to programmable logic devices (FPGAs), FPGA architecture, Hardware description languages, applications of FPGAs.

Module 4 - Digital Signal Processors: Introduction to digital signal processors (DSPs), architecture, programming techniques and applications.

Module 5 - Performance Evaluation of programmable devices: Performance metrics, Comparison between processors, FPGAs and DSPs in terms of performance, power consumption, applications.

Text Books:

1. ARM v8 Programmer's Manual / Barry B. Brey, The Intel Microprocessors, Prentice Hall, 2008
2. Steve Kilts, Advanced FPGA Design: Architecture, Implementation, and Optimization, Wiley-IEEE Press, 2007
3. Sen M. Kuo & Woon-Seng S. Gan, Digital Signal Processors: Architectures, Implementations, and Applications, Pearson, 2004

Reference Books:

1. Steve Furber, ARM System on Chip architecture, Addison Wesley; 2 ed (17 August 2000)
2. Kenneth J Ayala, The 8086 Microprocessor: Programming & Interfacing the PC, Cengage Publisher, 2007

Communication Theory and Systems (EC XXXX)

Course Objectives:

- To study and understand different type of digital and analog modulations.
- To understand different signal and parameter estimation techniques.
- To apply the estimation techniques for optimum design of analog demodulators.
- To understand and analyze different pulse modulation schemes and waveform coding techniques.
- To analyze the problem of inter-symbol interference (ISI) and to study the signal design methods for ISI-free communication.

PRE-REQUISITES: Signals and Systems, Random Processes for Electrical engineering

Course Content:

Module-0: Background and general overview

Brief revision of Random Processes – Gaussian Random Process, White and non-white Noise, Orthogonal Representation of Random Processes;
Overview of a communication system: Basic structure and components of a communication system; Efficient utilization of available power and spectrum, Shannon's Theorem.

Module -1: Basic Digital Modulations

Definition of digital continuous-time (C-T) and digital discrete-time (D-T) signals; difference with analog (C-T and D-T) signals;
Difference between baseband and passband transmissions, transformation of baseband signals to passband signals and vice versa, reason for shifting to passband transmissions using carrier modulation;
Signal Space representations; Orthogonal, Simplex, Bi-orthogonal signal sets;
Digital modulations – ASK, OOK, PSK, FSK, M-ary ASK, M-ary PSK, M-ary QAM; energy efficiency of constant amplitude modulations compared to dynamic amplitude modulations;
Spectrum of digitally modulated signals, bandwidth requirements for transmission.

Module-2: Estimation techniques for noisy waveforms

Estimation of unknown parameters in presence of noise – single observation, multiple observations;

Estimation of unknown parameters of known signal in presence of AWGN; structure of optimum estimators.
Very brief revision of Waveform estimation or estimation of unknown random signal in presence of noise.

Module-3: Analog modulations and demodulations
Overview of analog modulations;
Amplitude Modulations: conventional AM, DSB-SC, SSB;
Analog Signal Multiplexing – FDM, QAM.
Angle Modulations – Phase Modulation (PM) and Frequency Modulation (FM), generation of FM and FSK signals using VCO;
Optimum receivers (demodulators), AM and FM demodulators, Carrier phase estimation – optimum and sub-optimum structure, carrier tracking, PLL – BW requirement, SNR, PLL as an optimum receiver for PM and FM, application of PLL; COSTAS LOOP;

Module-4: Pulse modulation schemes and waveform coding
Pulse modulation schemes - PAM, PFM, PWM, PPM.
Types of Redundancy in analog sources and signals; Temporal Coding techniques for analog sources - Linear Predictive Code (LPC), PCM;
Performance of PCM - quantization noise, SNR, DPCM.
Time-division multiplexing with PCM/DPCM; Introduction to Spectral Waveform Coding - Transform coding (DFT, DCT).

Module-5: Signal transmission in band-limited channels
Inter-symbol interference (ISI) problem in band-limited channels; Nyquist criterion for pulse shaping in band-limited channels; Signal design for ISI-prone channels – Nyquist pulse, raised-cosine filtering, partial-response signals;

Text Books:

3. J. G. Proakis, “Digital Communications”, 4th Edition, McGraw-Hill.
4. Carlson: Communication systems.
5. Van Trees, “Detection, Estimation and Modulation: Part I”, John Wiley.
6. U Madhow, “Introduction to Communication Systems”.

Reference Books:

1. Wozencraft and Jacobs: Principles of Communication Engineering, John Wiley
2. Oppenheim and George Verghese: Signals, Systems and Interference

VLSI Design (EC 3111)

Course Objectives:

- To learn basic MOS device physics.
- To learn basic CMOS Circuits.
- To learn CMOS process technology.
- To learn techniques of chip design using CMOS.
- To learn the concepts of designing VLSI subsystems.
- Design of VLSI circuits using Cadence Full Custom EDA tool.

Module 1: Introduction; Quality Metrics of a Digital Design- Cost of an Integrated Circuit, Functionality and Robustness, Performance, Power and Energy Consumption; MOS Transistors: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances; Fabrication of MOSFETs: Introduction, Fabrication Process Flow: Basic Steps, The CMOS n-Well Process, Layout Design Rules, Full-Custom Mask Layout Design.

Module 2: MOS Inverters: Static Characteristics; Types of Inverters: Resistive-Load Inverter, Inverters with n-Type MOSFET Load, Pseudo NMOS/PMOS Inverter, CMOS Inverter; V-I characteristics; Switching Threshold; Noise Margin; Buffer design; Fan-In and Fan-out of Inverter/Buffer; Effect on CMOS characteristic by W/L ratio, threshold voltage and process, voltage, temperature (PVT).

Module 3: MOS Inverters: Switching Characteristics and Interconnect Effects; Delay-Time Definitions; Calculation of Delay Times; Inverter Design with Delay Constraints; Estimation of Interconnect Parasitic; Calculation of Interconnect Delay; Delay models; Switching Power Dissipation of CMOS Inverters.

Module 4: Dynamic Logic Circuits: Basic Principles of Pass Transistor Circuits: Working Principle, V-I Characteristics, Capacitances, Timing analysis; Voltage Bootstrapping; Synchronous Dynamic Circuit Techniques; High-Performance Dynamic CMOS Circuits; Design and analysis of combinational and sequential logics using CMOS, transmission gate logic and dynamic logic; Introduction to VLSI Technology and Systems design.

Lab Module

Design of a CMOS Inverter, combinational and sequential logics; Schematic design of CMOS Inverter; Design entry; Specification; Pre-layout functional simulation; Pre-layout: Current, voltage, performance, power analysis and Noise Margin estimation; Layout design; DRC and LVS check; Post-layout RC extraction; Post-layout simulation; Post-layout functional and timing analysis; Post-layout current, voltage, power and performance estimation. GDS II generation for tape-out.

Text Books:

1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits Analysis & Design", McGraw Hill Education 2003, 3rd Edition.
2. J. M. Rabaey, A. Chandrakasan, B. Nikolic, "Digital Integrated Circuits", A Design Perspective, 2nd Edition, Prentice Hall of India.
3. Neil H. E. Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design", A Circuits and Systems Perspective, 3rd Edition, Pearson Education Pvt. Ltd.

Analog Integrated Circuits (EC XXXX)

Course Objectives: This is a course which covers analysis and design of Analog Integrated Circuits. The course covers the basic understanding of the different semiconductor devices such as BJT, MOSFET by applying small/large signal models and its applications such as Amplifiers (Single and Multi-Transistor Circuits). This course also covers fundamental concepts of feedback effect, analog IC design with CMOS fabrication and layout considerations. Op-Amp and its applications, ADC and DAC.

Course Content:

Module 1 - Review of Semiconductor devices: BJT: structure and modes of operation. Normal mode. Emitter Base and Collector currents Early effect. BJT model as a 3-T network IAM for CE, CB, CC models. Hybrid Pi model, Alpha cut-off frequency. MOSFET; Structure, Regions of operation, Id vs Vgs, Id vs Vds. Short channel effects. Model of MOSFET in saturation region. Linear applications of semiconductor active devices- General characteristics of amplifiers - VCVS, VCCS, CCVS and CCCS representation. 2-port model, Activity and passivity Mason's U factor and its Implications

Module 2 - Single Transistor Amplifiers: Biasing: Current sources (current mirrors) for biasing. Simple current mirror, base current compensation, Widlar and Wilson current mirrors. Single

Transistor amplifiers: Resistive loads and active loads - CE, CS; CB, CG; CC, CD with active loads including emitter/source degeneration (with equivalent circuits). Voltage gain, input and output impedances and frequency response. Dominant pole concept. Open circuit time constant (OCTC) approximation for calculating dominant pole

Module 3 - Multistage Amplifiers: Cascade, Differential, Cascode, Darlington, Totempole, and CMOS, Push-Pull. Differential Topology-Transfer characteristics of Differential pair. Application of differential topology as amplifier, logic gate, Gilbert cell and analog multiplier, as mixer, cross coupled diff amp as one-port negative resistance. Diff amp: Symmetry of Diff amp, Concept of common mode and differential input in relation to symmetric networks. Differential gain and common mode gain, CMRR. Double-ended to single-ended conversion Biasing for single ended output with current sources, gains and input and output impedances, Frequency response. Simplified frequency dependent model of Differential amplifier. Analysis using BJT and MOS. Cascode topology: Advantages of cascode connection. Equivalent circuit and calculation of gain, input and output impedances, Bandwidth. Folded cascode. opamps: Anatomy of opamp. Stability, Compensation, Slew, Design considerations of opamp. Innovations in circuit topologies of commercial opamps with examples of opamp applications.

Module 4 - Feedback: General properties of feedback. Mixing and sampling. Feedback topologies - Ideal Series-Series, Series-Shunt, Shunt-Series, Shunt-Shunt, effect on appropriate gains, input and output impedances. loading effect due to feedback circuit on the open loop gains. Method of including loading effects on amplifiers with feedback in all the four topologies

Module 5 - Power amplifiers: Power gain: Definition of power gain Efficiency of amplifier, calculation of power gain and efficiency of CE amplifier. Distortion - Definition, Distortion measures classes of operation, Class B push-pull amplifiers with complementary devices. crossover Class AB, Efficiency. Class D operation Stability of power amplifiers Impedance Matching

Module 6 - Analog IC Design: CMOS Fabrication Process, IC components and their models; Layout considerations; Analog and Digital Signals and their interconversion, Analog to Digital Conversion (ADC) - Flash ADC, Dual Slope, Successive Approximation. Digital to Analog Conversion (DAC) - Weighted Resistor, R-2R Ladder DAC.

Text Books:

1. Sedra & Smith, Microelectronic Circuits, Oxford Press. 2014
2. Gray, Hurst, Lewis and Meyer; Analysis and Design of Analog Integrated Circuits; 5th edition, Wiley 2010.
3. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw-Hill, August 2000.

Computer and Communication Networks (EC XXXX)

Course Objectives

- Understand the basic concepts of computer networks and internet core
- Apply the knowledge of the MAC layer protocols for computer communication networks
- Develop the different routing protocol algorithms for real time wired and wireless networks
- Design the protocols at every protocol level and evaluate their performance for various computer communication network applications

Course Content

Module 1: Application Layer: Introduction to Computer Networks History, Circuit Switching and Packet Switching, TCP/IP Protocol Stack – Basic Overview, Computer Network core and switching, Delay and losses in networking, Application layer services: DHCP, DNS: network configuration, Hierarchy tree, TLDs, SNMP: network management, NMS, FCAPS, MIB, V2 and V3, HTTP/HTTPS, FTP: browsing and file transfer, SMTP, POP3: email

Module 2: Transport Layer Primitives, Connection establishment -3-way handshake, Connection closing - 4-way handshake, Port number understanding, Difference between TCP and UDP, TCP service model, TCP congestion control and flow control, TCP Reno and Tahoe, Nagle's algorithm

Module 3: IP Addressing schemes, Network partitioning, CIDR, IPv4 classful addressing, IPv6 addressing, Routing decisions – fundamentals, Routing Protocols – link state routing and distance vector routing, Autonomous systems, inter and intra domain routing

Module 4: Data Link Layer Service Primitives – Forwarding, Flow Control, Error Control, Media Access Control - Channel Access Protocols, Framing, Logical link control, Medium access sublayer access methodologies: Token bus topology, Token ring topology, CSMA protocol, ***1***-persistent, ***p***-persistent and Non-persistent, 802.3 CSMA/CD protocol, 802.11 CSMA/CA protocol, wireless packet data network, ALOHA protocol, Slotted ALOHA protocol, sliding window protocol, End to End Principles of Computer Networks

Module 5: Data encoding techniques, PHY layer devices, Multiplexing and modulation, Guided transmission media, Wireless transmission: Baseband and passband transmission

Text Books:

1. J. F. Kurose and K. W. Ross, “Computer Networking – A top down approach” 6th edition, Pearson IN

Reference Books:

1. A. S. Tanenbaum and David J. Wetherall, “Computer Networks”, 5thedition, Prentice Hall
2. L Parziale et al., “TCP/IP Tutorial and Technical Overview” 8th edition, December 2006.

French - V (HS 3101)

Objectives:

At this level the students work in class on understanding and expressing feelings, intentions, opinions and routine tasks in order to interact with relative facility in their specific field of activities. Students are able to discuss ideas with frequently used language and can ask for information about familiar subjects concerning everyday subjects and the news. They also work on comprehension skills and writing notes. They work on improving their grasp of everyday syntax and grammar and build a lexical base corresponding to immediate needs. They also work on targeted pronunciation to improve clarity of expression.

Course Content:

Topics

1. To accept or to refuse any invitation
2. Showing possession
3. Description of an object
4. Expressing comparison
5. To express an idea
6. Description of a landscape

Grammar

1. Revision of l’imparfait (Past Continuous), le Futur simple (Simple future) et le passé composée (Simple Past)
2. Possessive Pronouns
3. Place of Adjectives
4. Recent Past
5. Forms of negation

Types of writing

1. Informal letter or email
2. A short passage

Principles of Wireless Communication (EC XXXX)

Course Objectives:

- To understand different detection techniques for digital continuous-time signals.
- To be able to evaluate and compare the error performance and spectral efficiency of digital modulation techniques
- To understand different statistical models of mobile radio propagation and the useful fading channels
- To study Multi-carrier modulation and orthogonal frequency division multiplexing (OFDM)
- To be able to compare various multiple access schemes
- To familiarize with different communication techniques capable of improving signal reception for different type of fading situations
- To be able to compare among such techniques to meet certain requirements in practical applications.

PRE-REQUISITES: Communication Theory and Systems, Digital Signal Processing

Course Content:

Module-0: Brief revision of basic modulations and transmitter-receiver block diagrams
Pictorial representation of baseband and passband transmissions; overall transmitter and receiver structure using simplified functional block diagrams; Communication Standards and Protocols; course objectives and roadmap.

Module-1: Optimum Detection techniques and spectral requirements for digitally modulated signals
Detection of Binary Signals in presence of Additive White Gaussian Noise (AWGN), Brief revision of Hypothesis Testing, Optimum Receivers for Binary communication systems, Error Probability. Optimum coherent receivers for digital modulations – BASK, BPSK, QPSK, Coherent Binary FSK;

Optimum Non-Coherent Detection: ASK, BPSK, FSK; DPSK and other Differential schemes for non-coherent communication;
Extension to M-ary Coherent and non-coherent Signal sets: Baseband M-ary PAM, Passband M-PAM or M-ASK, MPSK, M-QAM;
Shannon's limit on no. of signals (M-ary) and on data rate and spectral efficiency;
Comparison among digital modulations – spectral efficiency (bits per Hz), error probability, energy efficiency, bandwidth requirement.
Spectrum confinement techniques: Need of spectrum confinement – infinite spectrum of PSK and ASK signals, need of continuous phase signals;
Introduction to Phase and frequency modulations with memory: CPFSK, CPM signals, trellis based modulations, application in coded modulation;

Module-2: Wireless channel models

Part-A: Introduction to Mobile radio propagation: Large-scale Path Loss

Characterization of propagation effects;
Introduction to Large-scale path loss: Free-space propagation – deterministic measure of received signal power; Effect of propagation phenomena: reflection, scattering, diffraction, shadowing; random path-loss models; Link budget analysis;

Part-B: Small-scale fading in mobile radio channel:

Time-Varying Channel Impulse Response; Classification of fading channels: slow, fast, flat, frequency-selective; Multipath resolvability and time dispersion, Inter-Symbol Interference (ISI) due to time dispersion;
Understanding difference between Narrowband Fading or flat fading and Wideband Fading or frequency-selective fading; Power Delay Profile, Coherence Bandwidth, brief revision of pulse shaping for mitigation of ISI;
Frequency dispersion, Doppler Power Spectrum and Coherence Time;
Introduction to feedback equalization for mitigation of fading.
Narrowband statistical models of received signal envelope and power – Rayleigh and Rician flat fading; Level Crossing Rate and Average Fade Duration; Outage of signal and Burst error;

Module-3: Performance improvement techniques – Interleaving, error correction coding, diversity etc.

Introduction to linear block codes;
Interleaving in block codes to reduce burst error;
Introduction to spatial diversity and MIMO.

Module-4: Transmission techniques for efficient utilization of resource blocks

Orthogonal transmission techniques and their importance for mitigation of time-dispersive channels;

Introduction to Multi-carrier communication (OFDM, SC-FDE):

Basics of Multi-carrier communication – Multipath mitigation; Discrete implementation – OFDM, OFDM transmitter and receiver; Importance of Guard Interval (GI), Cyclic Prefix (CP),

and Pilot symbols; Challenges in OFDM – ICI, PAPR; System design issues with OFDM; Intro to SC-FDE;

Code Division Multiplexing (CDM) as alternate orthogonal transmission technique, Brief Introduction to Timing diversity: – Code Division Multiplexing (CDM) and RAKE receiver; comparison of energy efficiency between OFDM and CDM;
Brief Introduction to Multiple access schemes:
Introduction to FDMA, TDMA, SDMA, CDMA, and FHMA; Advantage of CDMA over FDMA or TDMA; Application of CDMA in cellular and other multi-user systems –advantages and disadvantages; Introduction to multi-user OFDM – OFDMA, SC-FDMA.
Cellular Structure:
Cell and Cluster structure, Frequency Reuse, Handoff, Co-channel and Adjacent Channel Interference, Resource allocation, User Capacity, network architecture, cellular standards; Introduction to 4G and 5G cellular networks.

Module-5: Introduction to system design for wireless protocols:
System planning and decision making for new wireless protocols and systems.

Text Books:
1. J. G. Proakis, "Digital Communications", 4th Edition, McGraw-Hill.
2. Van Trees, "Detection, Estimation and Modulation: Part I", John Wiley.
3. A. Goldsmith, "Wireless Communications", Cambridge University Press, 2005.

Reference Books:
4. W. C. Y. Lee, "Mobile Communications Engineering", 2nd ed., McGraw-Hill, 1998.
5. U Madhow, "Introduction to Communication Systems".
6. R. Steele and L. Hanzo, Eds., "Mobile Radio Communications", 2nd ed., John Wiley and Sons, 2000.
7. T. S. Rappaport, "Wireless Communication", Pearson Education.
8. W. H. Tranter, K. S. Shanmugan, T. S. Rappaport, K. L. Kosbar, "Principles of Communication System Simulation with Wireless Applications", Pearson Education. [***Required for Computer Simulation***]

Computing Systems Architecture (EC 3202)

Course Objectives:

- To analyze and synthesize instruction set architectures for general purpose processors
- To understand the memory hierarchy of a computing system
- To design and evaluate various processor architectures

Course Content:

Module 1 - Instruction Set Architecture (ISA): Introduction to ISA, Basic organization: fetch, decode, and execute; Instruction set types, instruction format, addressing modes, subroutine call and return mechanisms; Structure of machine-level programs; Low-level architectural support for high level languages. Performance assessment.
Module 2 - Computer Arithmetic: Representation of numeric data, signed and unsigned arithmetic – Addition, Subtraction, Multiplication and Division; Range, precision and errors in floating-point arithmetic; Shifters; Design of arithmetic and logic unit (ALU).
Module 3 - Processor Architecture: CISC vs RISC Designs; simple implementation schemes, Datapath design, Control unit: hardwired vs micro-programmed, multi-cycle implementation. Instruction level parallelism, instruction pipelining, pipeline hazards. Introduction to Out-of-Order processing. Superscalar Processors.
Module 4 - Memory Architecture: Storage systems, introduction to memory hierarchy: importance of temporal and spatial locality; main memory organization, cache memory: address mapping, block size, replacement, and store policies
Module 5 - Interfacing and I/O Organization: External storage; IO fundamentals: handshaking, buffering, programmed IO, interrupt driven IO; Interrupt handling mechanism, Buses: protocols, arbitration, direct memory access (DMA).

Module 6 - OS Support: Introduction to Operating Systems, Processors, Task Management and scheduling, Memory Management, Virtual memory system: page table and TLB. Drivers and Devices

Text Books:

1. Computer Architecture: A Quantitative Approach, by John L. Hennessy and David A. Patterson, Morgan Kaufmann, 5th edition, 2011, ISBN: 9780123838728.

Reference Books:

1. J.P. Hayes, Computer Architecture and Organization, Mc Graw Hill
2. A.S. Tanenbaum, Structured Computer Organization, PHI Publication
3. W. Stalling, Computer Organization and Architecture, PHI Publication

Control Systems (EC XXXX)

Module 1 - Introduction and Mathematical Modelling of Control Systems: Closed Loop versus Open loop Control, Transfer functions, Block Diagram, Signal Flow Graph, Laplace Transform Relationships, Modelling of Electrical Systems, Feedback and Control Objectives

Module 2 - Transient and Steady State Response Analyses: Time domain response of First order, Second order and Higher order systems, Steady state error constants

Module 3 - Concepts of Stability: Bounded-input and Bounded-output stability, Routh Stability Criterion, Effect of Integral and Derivative Control Actions

Module 4 - Control System Design by the Root-Locus method: Root-Locus Plots, Guidelines for sketching Root-Loci, Lead compensation, Lag compensation, Lead-Lag compensation

Module 5: Control System Design by the Frequency Response Method: Bode diagrams, Polar plots, Nyquist stability criterion, Stability analyses, Relative stability, Stability margins using Bode plots

Module 6 - PID Control: Proportional (P) and Integral (I) controllers, Proportional Integral (PI) controller, Proportional Integral Derivative (PID) controller, Analog implementation of P, PI, PID controllers using op-amp and RC elements

Module 7 - Control System Analysis and Design using State Variable Methods: State space representation of transfer functions, Solution of time-invariant state space equation, Controllability and Observability criteria, Pole placement methods

Module 8 - Application of Control System Principles to Selected Problems in Electronics & Communication Engineering: Closed-loop control of Robotic arm actuator, Design of PLL for tracking sinusoidal signals of variable frequency and phase

SUGGESTED BOOKS:

1. Katsuhiko Ogata, *Modern Control Engineering*, PHI Learning Pvt. Ltd., 5th Ed.
2. M.Gopal, *Control Systems Principles and Design*, McGraw Hill Education (India) Pvt. Ltd, 4th Ed.
3. F. Golnaraghi and Benjamin C.Kuo, *Automatic Control Systems*, Wiley Student Ed., 9th Ed. (For Reference)

Communication Electronics (EC XXXX)

Module 1: High frequency Characterisation of components, Physical realisation of passive components at high frequencies as sections of transmission lines and microstrip

High speed broadband amplifiers – peaking, distributed amplification, gain band width product limit, Negative resistance oscillators

Wideband RF amplifiers - RF amplifier topology, single and double tuned amplifiers, widebanding , Butterworth and Tchebycheff pole design,

Module 2: NOISE -Sources Characterisation and Measurement, Noise in amplifiers Dahlke Rothe model of noise in amplifiers, Friis Formula, Haus's Noise measure Matching for minimum noise figure, Minimum noise circle, LOW noise amplifiers design. Nonlinear distortion in amplifiers – modelling and analysis.

Module 3: POWER AMPLIFIERS – Active 2-ports, Mason U factor, Neutralisation and unilateralisation , Power gain definitions, Stability of power amplifiers Rollet stability factor Gain circles Resistive padding, Impedance matching, matching and biasing networks, Wideband matching Wai kai Chen , Satyanarayana and Youla , Pillai synthesis Classes of power amplifiers Efficiency, Efficient Switching PAs, Power Combining. Class D efficient switching power amplifiers, power combining.

Module 4: Analog Multipliers: Using diode in feedback – log and antilog, Square law of MOS and exponential law of BJT Diff amp topology Gilbert cell Application as modulator, demodulator, phase detector

Module 5: Sinusoidal oscillators, LC oscillator, negative resistance oscillators VCO phase noise, jitter, stability of oscillators crystal oscillators atomic clocks, Noise in VCO, Injection locking of oscillators

Module 6: Phase Lock Loop (PLL) Non-linear Model of PLL, lock in range and acquisition range, linearised model, loop filter, optimum loop filter Applications of PLL- FM detectors, synchronisation, carrier extraction, integer and fractional frequency synthesizers, noise in PLL and synthesizers

Module 7: Mixers- Heterodyning principle and fundamentals of mixers. Conversion gain. mixers based on nonlinearities of devices, switching mixers, parametric mixers, reactive diode multipliers Manley Rowe relations resistive mixers, Pantell relations noise in mixers SSB and DSB NF. Use of Image rejection filter, balanced mixers

References:

1. T H Lee Design of CMOS RF Integrated circuits. Cambridge Press
2. Clarke and Hess: Communication Circuits Analysis and Design. Addison Wesley
3. Niknejad: Lecture Notes EE 242 University of California Berkeley
4. Perrott: Lecture Notes on High Speed Communication Circuits and Systems (6.976) Massachussets Institute of Technology
5. Pederson, Mayaram: Analog Integrated Circuits for Communication Principles Simulation and Design Springer
6. Pozar. Microwave Engineering. Wiley

French - VI (HS 3202)

Objectives:

At this level the students work in class on understanding and expressing feelings, intentions, opinions and routine tasks in order to interact with relative facility in their specific field of activities. Students are able to discuss ideas with frequently used language and can ask for information about familiar subjects concerning everyday subjects and the news. They also work on comprehension skills and writing notes. They work on improving their grasp of everyday syntax and grammar and build a lexical base corresponding to immediate needs. They also work on targeted pronunciation to improve clarity of expression.

Course content:

Topics

1. To Propose or to invite for a program, a party etc.
2. Writing a personal letter
3. Expressing obligation and interdiction
4. To ask for the touristic information
5. To present one's point of view and argue about it
6. To understand the difference between written and spoken language

Grammar

1. Adverb
2. To know how to change verbs into noun and vice-versa
3. The Subjunctive
4. Relative pronouns
5. Expression of duration
6. Direct and Indirect speech in present
7. Basic logical connective

Types of writing

1. A short essay
2. Informal letter or email
3. Film review

Optical Communication (EC XXXX)

Module 1 – Introduction: Brief background and history, advantage of optical communication, communication requirements, SNR and bandwidth, Shannon theorem revisited, EM spectrum and its utilization, optical communication bands, basic components of an optical communication system, free space Vs fiber-optic communication.

Module 2 - Light Sources: LEDs, laser diodes, direct modulation of lasers, external modulators – electro-absorption modulators, Mach-Zehnder modulators, phase noise in laser diodes.

Module 3 – Detectors: Principles of photodetection, PIN photodetector, avalanche photodiodes, signal-to-noise ratio.

Module 4 – Optical Fibers: Brief overview, fabrication, modal behaviour, single-mode and multi-mode fibers, loss, dispersion and nonlinear effects, channel model of optical communication.

Module 5 – Free Space: Propagation effects, channel impairments: turbulence, scattering and noise, channel model, channel equalization-diversity, MIMO, adaptive optics.

Module 6 – Modulation Schemes: Review of detection theory- binary communication, optimum receiver for additive ZMGWN for minimum probability of error criterion. LRT test, general binary communication – optimum receiver Decision Rule Decision Boundaries PE calculation, modulation, M-ary with M alphabets, M-ASK, Intensity modulation schemes OOK, NRZ, RZ, Coherent modulation schemes (phase modulation) Differential modulation Phase modulation DPSK QPSK, modulations with memory, Transmitter structure, Receiver structure, OSNR for given PE, spectral efficiency, capacity distance.

Module 7 – Multiplexing: Six dimensions of multiplexing - time, frequency, quadrature, polarization, mode, and space; Components of a DWDM link - Add-Drop Multiplexers/Demultiplexers, Couplers, Polarization controllers, Filters, Isolators

Module 8 – Link Design: Amplification: EDFA, SOA, Raman amplifiers; Dispersion compensation schemes, dispersion-managed systems; Design considerations of a fiber-optic link - Modulation, BER, power budgeting, rise-time budgeting, attenuation limit, dispersion limit.

Module 9 – Advanced Techniques: Phase distortion compensation, nonlinear equalization, Error correction coding, complex multiplexing schemes using other dimensions like polarization and space, faster ADC/DAC with high ENOB

Text book and Reference books

1. Fiber-Optic Communication Systems, G.P. Agrawal, Wiley, 5th Edition.
2. Optical communication systems, Gerd Keiser, Tata McGraw Hill, 4TH edition.

3. Introduction to Fiber Optics by A. Ghatak and K. Thyagarajan, Cambridge University Press, 2017.
4. Optical Networks - A Practical Perspective, Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki, Elsevier, 3rd edition.
5. Free space optical communication, H. Kaushal, V.K. Jain, S. Kar, Springer, 2017
6. Handouts on modulation schemes.

Embedded System Design and Programming (EC XXXX)

Course Objectives:

- To understand the architecture of microprocessors and microcontrollers
- To be able to program a microprocessor/microcontroller and its peripherals
- To Understand various on chip communication protocols such as SPI, I2C, USB etc.
- To design an embedded systems application using microprocessors/microcontrollers

Course Content:

Module 1 - Introduction to Embedded Systems: Definition of Embedded Systems, Embedded Systems vs General Computing Systems; Embedded System Requirements; Embedded Design Specification – FSMs, Petrinets, UML;

Module 2 - Embedded Hardware: ARM/RISC-V Architecture – ISA and Assembly Language Programming, Programmers model, memory mapping, Timers, Interrupts, DMA, Memory subsystem, Serial Interfaces – UART, SPI, I2C, USB.

Module 3 - Embedded Software: Embedded Software Development Toolchain – Compiler, Linker, Debugger, Object files; Interrupt driven standalone system – Design and booting process; Introduction to RTOS and RTOS constructs – tasks and scheduling; Working with multi-tasking system;

Module 4 - Applications and Case Studies: Domain Specific Sensors, Actuators and Controllers – Automotive, Industrial Automation. Commercial Electronics. Introduction to Internet of Things – IoT architecture and protocols – sensors, network, cloud, analytics, Applications of IoT.

Textbooks:

1. Wayne Wolf, Computers as Components –Principles of Embedded Computing System Design, Second Edition, Morgan-Kaufmann, 2005

2. Frank Vahid & Tom Givargis, Embedded System Design: A Unified Hardware / Software Introduction, Wiley Publications, 2006

Reference Books:

1. David E. Simon, An Embedded Software Primer, Addison Wesley, 1999
2. Michael Barr and Anthony Massa, Programming Embedded Systems with C and GNU Development Tools, 2nd Edition, O'Reilly Media Inc, 2006
3. Lyla B Das, Embedded Systems: An integrated approach, Pearson Education
4. Steve Furber, ARM System on Chip architecture, Addison Wesley; 2 edition (17 August 2000)

French - VII (HS 4101)

Objectives:

The aim is to place the students in various communication situations in French that correspond to social and professional contexts. They learn to express their ideas simply and coherently and are able to understand selective authentic French texts written in everyday language. These texts usually discuss subjects of cultural nature. Radio and television documentaries about the news or subjects linked to the students' specific area of interest are used to practice extracting key information. Students acquire sufficient vocabulary and control of the main grammatical structures to be able to express most of what they want to say relatively easy.

Course Content:

Topics

1. Intergeneration accommodation
2. Internet and cellphone
3. Pollution
4. Love, marriage, divorce
5. Carpool (Covoiturage)

The topics were studied through written articles, audio listening and television coverage. Students were also asked to do oral presentations on the above mentioned topics.

Grammar

1. Subjunctive

2. Reported speech
3. Connectors

Types of writing

1. Official letter
2. Argumentative essay

Final Year Project Phase I and Phase II (PR 4102 and PR 4203)

Course Content:

The object of Year-4 Project Work & Dissertation is to enable the student to extend further the investigative study taken up under, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from a School at MEC or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. Review and finalization of the Approach to the Problem relating to the assigned topic;
2. Preparing an Action Plan for conducting the investigation, including team work;
3. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
4. Final development of product/process, testing, results, conclusions and future directions;
5. Preparing a paper for Conference presentation/Publication in Journals, if possible;
6. Preparing a Dissertation in the standard format for evaluation;
7. Final Seminar presentation before a Committee.

French - VIII (HS 4201)

Objectives:

The aim is to place the students in various communication situations in French that correspond to social and professional contexts. They learn to express their ideas simply and coherently and are able to understand selective authentic French texts written in everyday language. These texts usually discuss subjects of cultural nature. Radio and television documentaries about the news or subjects linked to the students' specific area of interest are used to practice extracting key information. Students acquire sufficient vocabulary and control of the main grammatical structures to be able to express most of what they want to say relatively easy.

Course Content:

Topics

1. French education system
2. Employment/Unemployment
3. House exchange

The topics were studied through written articles, audio listening and television coverage. Students were also asked to do oral presentations on the above mentioned topics.

Grammar

1. Future perfect
2. Nominalization

Types of writing

1. Article for magazine
2. Writing/ Responding to queries on forum discussion platforms

Track Courses and Electives Offered

While students will focus mainly on the core subjects which will give them the breadth of knowledge in the area of Electronics and Communication Engineering, there will be opportunity for students to develop more in-depth knowledge in certain tracks starting with the 6^{th} semester of the program. During the 6^{th}, 7^{th}, and 8^{th} semesters students can elect one course from the available track courses which will give them the opportunity to acquire more in-depth knowledge in their chosen track.

In their 7th and 8th semesters, students will also be permitted to take one elective course respectively. The elective courses can be used to either enhance their knowledge in the track area, or increase the breadth of knowledge by electing to take courses that are different from their selected track.

A list of the possible Track and Elective courses is listed below:

Track A	**Circuits/IOT**
1	Advanced Digital Circuits or Systems
2	Testing and Verification
3	Advanced Analog Integrated Circuits
4	IoT Systems
5	Sensors and Instrumentation
6	Advanced VLSI Design
7	Solid State Devices
8	VLSI Technology
9	RF IC Design

Track B	**Communication Track**
1	MIMO Wireless Networks
2	Mobile Communications
3	Wireless Sensor Networks
4	Antenna and Wave Propagation
5	Mobile broadband technologies for 5G and beyond
6	Cellular broadcasting in 5G networks
7	Software defined networking
8	Statistical Signal Processing
9	Advanced DSP Applications
10	Adaptive Signal Processing

	Possible Electives
1	Terahertz Communication Systems
2	Radar Signal Processing
3	Machine Learning
4	Robotics
6	Cyber Physical Systems
7	Big Data Analytics/Computing

8	Advanced Optimization
9	Wireless Network Protocols
10	VLSI Signal Processing (GPU Design)
11	Supply Chain Management
12	Memory Design & Testing
13	Digital Image Processing
14	Biomedical Engineering
15	Cryptography and Network Security
16	Information Theory and Coding