

**DEPARTMENT OF
ELECTRONIC ENGINEERING**



**SYLLABI OF COURSES
FOR
B.E. (ELECTRONIC ENGINEERING)
DEGREE PROGRAMME
APPLICABLE FROM BATCH
2025 & ONWARDS**

**NED UNIVERSITY OF ENGINEERING & TECHNOLOGY,
KARACHI-75270, PAKISTAN**

B.E. (ELECTRONIC) DEGREE PROGRAMME

AT

**NED UNIVERSITY OF ENGINEERING
AND TECHNOLOGY, KARACHI**

COURSES OF STUDIES

**Detailed Syllabi
2025 & ONWARDS**

**DEPARTMENT OF ELECTRONIC ENGINEERING
NED UNIVERSITY OF ENGINEERING & TECHNOLOGY,
KARACHI-75270, PAKISTAN**

*Issued by the
Registrar*

**NED UNIVERSITY OF ENGINEERING & TECHNOLOGY,
KARACHI-75270, PAKISTAN**

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B.E. (ELECTRONIC ENGINEERING)
COURSES OF STUDIES
Applicable for Batches: 2025 & ONWARDS

First Year									
Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hrs			Course Code	Course Title	Credit Hrs		
		Th	Pr	Total			Th	Pr	Total
EA-128	Functional English	3	0	3	EL-106	Basic Electronics	3	1	4
EE-125	Basic Electrical Engineering	3	1	4	MT-221	Linear Algebra & Ordinary Differential Equations	3	0	3
MT-116	Calculus and Analytical Geometry	3	0	3	PH-129	Applied Physics	3	0	3
EF-101	IT Fundamentals and Applications	2	1	3	EL-104	Electronic Engineering Drawing & Workshop	0	2	2
ES-105/ ES-127	Pakistan Studies/ Pakistan Studies (For Foreigners)	2	0	2	EL-108	Computer Programming	3	1	4
ES-206/ ES-209	Islamic Studies/ Ethical Behavior (For Non-Muslims)	2	0	2	ES-108	Ideology & Constitution of Pakistan	2	0	2
CY-100	Essentials of Chemistry	-	-	NC					
Total		15	2	17	Total		14	4	18
Second Year									
Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hrs			Course Code	Course Title	Credit Hrs		
		Th	Pr	Total			Th	Pr	Total
EL-201	Electronic Devices & Circuits	3	1	4	EL-202	Integrated Circuits	3	1	4
EE-127	Circuit Analysis	3	1	4	CS-216	Data Structure & Algorithms	3	0	3
TC-206	Signals & Systems	3	0	3	EL-204	Electronic Instrumentation	2	1	3
EE-382	Electromagnetic Fields	2	0	2	EE-246	Electrical Machines	2	1	3
TC-201	Digital Logic Design	2	1	3	ME-110	Basic Mechanical Engineering	2	0	2
EF-201	Civics & Community Engagement	2	0	2	EA-244	Academic Reading and Writing	3	0	3
					EF-200	Community Service	-	-	NC
Total		15	3	18	Total		15	3	18
Third Year									
Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hrs			Course Code	Course Title	Credit Hrs		
		Th	Pr	Total			Th	Pr	Total
EL-310	Artificial Intelligence and MachineLearning	2	1	3	CS-430	Microprocessor Programming & Interfacing	3	1	4
EL-307	Power Electronics	3	1	4	TC-307	Communication Systems	3	1	4
EE-375	Feedback Control Systems	3	1	4	TC-212	Digital Signal Processing	2	1	3
MT-331	Probability & Statistics	3	0	3	EL-311	Industrial Electronics	3	1	4
EL-315	Project Management	2	0	2	MG-257	Organizational Behavior	2	0	2
					##-###	Foreign Language-I	-	-	NC
Total		13	3	16	Total		13	2	15
Final Year									
Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hrs			Course Code	Course Title	Credit Hrs		
		Th	Pr	Total			Th	Pr	Total
MT-442	Numerical Methods	3	0	3	TC-421	Telecommunication Networks	3	1	4
EL-409	VLSI Systems Design	2	1	3	MG-485	Entrepreneurship	2	0	2
EF-305	Engineering Economics & Management	3	0	3	EL-421	Embedded Electronics	3	1	4
EL-422	Robotics	3	1	4	EL-###	Elective*	2	0	2
EF-309	Occupational Safety & Health	1	0	1	EL-401	Electronic Engineering Design Project	0	3	3
EL-401	Electronic Engineering Design Project	0	3	3					
##-###	Foreign Language-II	-	-	NC					
Total		12	5	17	Total		10	5	15
* Elective: EL-410 Nano electronics EL-411 Optoelectronics EL-412 Microwave and RF Circuits EL-413 System on Chip EL-414 Sustainable Electronics and Energy Systems									

EA 128 FUNCTIONAL ENGLISH

Listening skills and subskills: Effective listening techniques: listening for gist, details, and specific information in a range of situations (AV lectures, interviews, documentaries etc.)

Speaking skills: Speaking with fluency and accuracy in a variety of situations including conversations, group discussion, academic and social interaction, public speaking, presentation skills, and interviews; Pronunciation improvement exercises (through websites, apps, and in class worksheets)

Reading and subskills: Reading strategies: Skimming, scanning, and detailed reading, identifying main ideas, supporting details, and inferences (multiple genres including newspapers, books, stories, documentaries etc). Reading Practice: Reading comprehension tasks. Reading output tasks (notes, summary, discussion, counter argument etc.)

Study skills: Effective note-taking strategies for lectures, meetings, and reading texts. Taking in varied forms paragraph, lists, infographics etc.) ; Interpreting instructions oral and written. Effective examination taking technique (comprehending instructions, planning, and writing answers ensuring relevance and precise.

Writing skills: Writing process, Pre-writing strategies (mindmapping, cubing, outlining, clustering etc.); Writing to describe, argue, compare and contrast, persuade through writing prompts; Writing academic and professional genres: emails, letters, short report, resume, cover letter, building profiles on various job portal; Writing accuracy: Identifying and overcoming grammatical problems.

Vocabulary and grammar development: Vocabulary Development strategies. Exposure and practice to develop everyday and academic vocabulary for formal contexts.

EE 125 BASIC ELECTRICAL ENGINEERING

Fundamentals of Electric Circuits: Charge, Current, Voltage and Power, Voltage and Current Sources, Ohm's Law. Equivalent resistance of a circuit.

Voltage and Current Laws: Node, Loop and Branches, Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), single-loop circuits, single Node Pair Circuit, Series and Parallel Connected Independent Sources.

Circuit Analysis Techniques: Nodal Analysis, Mesh Analysis, Linearity and Superposition, Source Transformations, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer theorem.

Capacitors and Inductors: Capacitor, Inductor, Inductance and Capacitance Combination, voltage current relationship for inductor and capacitor. Energy storage.

Introduction to AC Circuits: Sinusoids and Phasors, Phasor Relationships for Circuit Elements, Impedance and Admittance, Kirchhoff's Laws in the Frequency Domain, Impedance Combinations, Instantaneous and Average Power, Maximum Average Power Transfer, Effective or RMS Value, Apparent Power and Power Factor, Complex Power, Conservation of AC Power.

Sinusoidal Steady-State Analysis: Nodal Analysis, Mesh Analysis, Superposition Theorem, Source Transformation, Thevenin and Norton Equivalent Circuits.

MT 116

CALCULUS & ANALYTICAL GEOMETRY

Set and Functions: Define rational, irrational and real numbers; rounding off a numerical value to specified value to specified number of decimal places or significant figures; solving quadratic, and rational inequalities in involving modulus with graphical representation; Definition of set, set operations, Venn diagrams, De Morgan's laws, Cartesian product, Relation, Function and their types (Absolute value, greatest integer and combining functions). Graph of some well-known functions. Limit of functions and continuous and discontinuous functions with graphical representation.

Differential Calculus: Differentiation and Successive differentiation and its application: Leibnitz theorem. Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, power series. Taylor and Maclaurin series, L' Hopitals rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, extreme values of a function of two variables with and without

constraints. Solution of non-linear equation, using Newton Raphson method.

Integral Calculus: Indefinite integrals and their computational techniques, reduction formulae, definite integrals and their convergence. Beta and Gamma functions and their identities, applications of integration relevant to the field.

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

Analytical Geometry: Review of vectors, scalars and vector products, Three-dimensional coordinate system and equation of straight line and plane and sphere, curve tracing of a function of two and three variables, surface revolutions, coordinate transformation.

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

EF 101

IT FUNDAMENTALS AND APPLICATIONS

Fundamentals of IT: Introduction to Information and Communication Technologies (ICT), Components and scope of ICT, ICT productivity tools, Emerging technologies and future trends, Ethical Considerations in Use of ICT Platforms and Tools, Applications of ICT in education, healthcare and finance. Digital citizenship.

Data Representation and Number Systems: Binary, octal, decimal, hexadecimal systems, data representation: characters, numbers, multimedia.

Databases: Fundamentals of databases, organization and storage, introduction to Information Systems (IS) and Management Information Systems (MIS), real world IS and MIS applications.

Data Communication and Computer Networking: Network topologies, types of network.

Programming Languages: Evolution and structures: syntax, semantics, special purpose vs. general-purpose languages, comparative study of data types, control structures and algorithms, basics of coding, practical problem solving.

ES 105

PAKISTAN STUDIES

Historical and Ideological Perspective of Pakistan Movement:

Two Nation Theory, Factors leading to the creation of Pakistan, Jinnah and demand for Pakistan.

Land of Pakistan: Geophysical conditions of Pakistan, Geopolitical and strategic importance of Pakistan, Natural resources of Pakistan: mineral, water and power resources.

Constitutional process: Early efforts to make a constitution (1947-1956), Salient features of the Constitution of 1956, 1962, Political and Constitutional crisis of 1971, Salient features of the Constitution of 1973, Constitutional amendments from 1973 to date.

Contemporary issues of Pakistan: A brief Survey of Pakistan's economy, The Current Economic Situation of Pakistan: Problems & Issues and future perspective, Social Issues: Pakistan's society and culture: broad features, Literacy and education in Pakistan: problems and issues, Scientific and technical development in Pakistan, Citizenship: national and international. Environmental Issues: Environmental pollution: causes, hazards and solutions, National policy, International treaties, conventions and protocols.

Pakistan's Foreign Policy: Pakistan's Foreign Policy from 1947 to present, Relations with immediate neighbors, Relations with major powers, Relations with the Muslim world.

Human Rights: Conceptual foundations, Western and Islamic perspective of Human Rights, Human Rights in the Constitution of 1973, Human rights issues in Pakistan.

ES 127 PAKISTAN STUDIES (For Foreigners)

Land of Pakistan: Land & People-Strategic importance- Important beautiful sights, Natural resources.

A Brief Historical Background: A brief Historical survey of Muslim community in the sub-continent, British rule & its impacts, Indian reaction, Two nation theory, Origin & development, Factors leading towards the demand of a separate Muslim state, Creation of Pakistan.

Government & Politics in Pakistan: Constitution of Pakistan, A brief outline, Governmental structure, Federal & Provincial, Local Government Institutions, Political History, A brief account.

Pakistan & the Muslim World: Relations with the Muslim countries.

Language and Culture: Origins of Urdu Language, Influence of Arabic & Persian on Urdu Language & Literature, A short history of Urdu literature.

ES 206 ISLAMIC STUDIES

Fundamentals of Islam: Tauheed, Arguments for the Oneness of God; Al-Ambiya-22, Al-Baqarah-163-164, **Impact of Tauheed on human life, Place of Man in the Universe:** Al Israa/Bani Israil-70; **Purpose of creation:** Al zariyat-56, **Prophethood, Need for Prophet, Characteristics of Prophet, Finality of Prophethood:** Al-Imran-79, Al-Hashr-7, Al-Maidah-3, **and Faith in Hereafter (Aakhirat), Effects on worldly life:** Al-Hajj-5, Al-Baqarah-48, Hadith.

Ibadah: Concept of Ibadah, Major Ibadah, Salat, Zakat, Hajj and Jihad. Al-Mu'minun-1-11, Al Anfaal- 60, & Two Ahadiths.

Basic Sources of Shariah: The Holy Quran, Its revelation and compilation, the authenticity of the Text, Hadith, Its need, Authenticity and Importance, Consensus (Ijmaa), Analogy (Qiyas)

Moral and Social Philosophy of Islam: The concept of Good and Evil; **A'l e Imran - 110, Al Nahl-125, Akhlaq-e-Hasna** with special reference to **Surah Al-Hujrat, verses 10, 11, 12, 13, Professional Ethics (Kasb-e-Halal) Al Taha-81, Al Baqar 188, one hadith.**

Seerat of the Holy Prophet(PBUH):

a) Moral and ethical teachings of the Holy Prophet (PBUH) with special reference to Hajjat-ul-Wida, (Fundamentals of Islam, Social aspects, Economics aspects, political aspects (**Safi ur Rahman Mubarakpuri , Al Raheeql Makhtoom (The Sealed Nector by)**

b). Personal Characteristics: perseverance & trust in Allah, honesty & integrity, simplicity & humility, mercy & compassion, clemency & forgiveness, bravery & valor, generosity, patience.

c) Engagement and communication with collaborators and foes: (Cases Study from Seerah: Charter of Madina, Ghazwa e Khandaq, Treaty of Hudaibya , Ghazwa e Khayber, Najran's Delegation, Victory of Makkah).

d) Social values and rights, (peace & harmony, tolerance, solidarity, collaborations, inclusivity & cohesion) (**Case Studies from Seerah:** Al – Fudoul Confederacy, Placement of Black stone, charter of Medina, Treaty of Hudaibya)

e) leadership skills (Vision, communication, negotiation, conflict management, decision making, relationship building, Integrity, positivity, compassion, empathy, loyalty, accountability, confidence, delegation, empowerment, problem- solving, foresightedness, openness, gratitude and justice).

Teaching of Holy Quran: Translation and tafseer of **Surah-e- Fatiha**, and The Selected Section of Sura Al-Furqan verses (63-77), **Surah-e- Luqman** (verses (12-19)).

Nazraah and Tajveed of: Suratul Fatiha, Ayatal Kursi, and last 10 surahs of the Holy Quran. (Ghunnah, Qalqalah, Al-Madd, Noon Sakinah & Tanween Rules).

ES-209

ETHICAL BEHAVIOR (for Non- Muslims)

Introduction to Ethics: Definition of Ethics, Definition between normative and positive science, Problem of freewill, Method of Ethics, Uses of Ethics.

Ethical Theories: History of Ethics: Greek Ethics, Medieval, Modern Ethics, Basic concept of right and wrong: good and evil, Utilitarianism, hedonism, self-realization: egoism, intuitionism, rationalism, Kant's moral philosophy.

Ethics & Religion: The relation of Ethics to religion, Basic ethical principles of major religions: Hinduism, Judaism, Buddhism,

Zoroastrianism, Christianity, Islam.

Ethics, Society and moral theory: Society as the background of moral life, Ethical foundation of Rights and Duties, Universalism and Altruism, Applied Ethics, Theories of punishment.

CY 100 ESSENTIALS of CHEMISTRY

Stoichiometry: Significant figures, mole and Avogadro number, empirical and molecular formulas, stoichiometry yield.

Atomic structure and Bonding: Subatomic particles, Rutherford's and Bohr's atomic models, quantum numbers, electronic configuration, chemical bond, theories of covalent bond, shapes of molecules.

States of Matter: Kinetic molecular theory, gas laws, liquid properties types of solids, types of crystals.

Acid, Base and Salt: Theories of acid and bases, buffer solution.

Solutions and Colloids: Properties and types of solutions, concentration units, colloids and its classification.

Electrical Conductance: Redox reaction with balancing concept, electrode, electrode potential and electrochemical series, corrosion.

Organic Chemistry: Organic compounds and their classification, homologous series, functional groups, nomenclature of organic Compounds.

Inorganic Chemistry: Periodic classification of elements, periodic laws, group trends of various properties of s and p block elements, general characteristics of transition elements, IUPAC nomenclature of complexes.

EL 106 BASIC ELECTRONICS

PN Junction Diode: Introduction. PN junction diode, Unbiased diode, Barrier potential, Diffusion & drift current, Forward & reverse bias, Minority carrier current. Diode characteristics, Load line, Diode current equation. Diode applications: Rectifier switch, Wave-shaping, Voltage multiplier. Breakdown diode, Voltage regulator, Power Supply.

FET: Field effect transistor; Device, Structure & Physical operation of the MOSFET, Current-voltage characteristics. DC analysis of MOSFET circuits, MOSFET as an amplifier. MOSFET amplifier configurations Common Source, common drain and common gate with passive loads. Determining voltage gain, input and output resistance for each configuration.

Operational Amplifiers: Terminal characteristics only, ideal op-amp characteristics, inverting and non-inverting configurations, op-amp applications like weighted summer, difference amplifier, instrumentation amplifier, differentiator, integrator, logarithmic amplifier etc.

MT 221 LINEAR ALGEBRA & ORDINARY DIFFERENTIAL EQUATION

Linear Algebra: Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non-singular, symmetric, non-symmetric, upper, lower, diagonal), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, matrix of linear transformations, eigen value and eigen vectors of a matrix, Diagonalization. Applications of linear algebra in relevant engineering problem.

1st Order Differential Equations: Basic concept: Formation of differential equations and solution of differential equations by direct integration and by separating the variables: Homogeneous equations and equations reducible to homogeneous form; Linear differential equations of the order and equations reducible to the linear form; Bernoulli's equations and orthogonal trajectories: Application in relevant Engineering.

2nd and Higher Orders Equations: Special types of 2nd order differential equations with constant coefficients and their solutions: The operator D ; Inverse operator $1/D$; Solution of differential by operator D methods; Special cases, Cauchy's differential equations; Simultaneous differential equations; simple application of differential equations in relevant Engineering.

Partial Differential Equation: Basic concepts and formation of partial differential equations: Linear homogeneous partial differential equations and relations to ordinary differential equations: Solution of first order linear and special types of second and higher order differential equations;

D' Alembert's solution of the wave equation and two dimensional wave equations: Lagrange's solution; Various standard forms.

Fourier Series: Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients: Expansion of function with arbitrary periods. Odd and even functions and their Fourier series; Half range expansions of Fourier series.

PH 129

APPLIED PHYSICS

Vectors & Mechanics: Review of vectors, Newton Laws and their Applications, Frictional Forces and determination of Co-efficient of Friction, Work-Energy Theorem, applications of law of Conservation of Energy, Angular Momentum, Centre of Mass.

Waves and Oscillations: Simple Harmonic Oscillator, Damped Harmonic Oscillation, Forced Oscillation and Resonance, Types of Waves and Superposition Principle.

Optics and Lasers: Huygens Principle, Two-slit interference, Single-Slit Diffraction, Types of Lasers, Applications of Laser.

Modern Physics: Planck's explanations of Black Body Radiation Photoelectric Effect, De-Broglie Hypothesis, Electron Microscope, Atomic structure, X-rays, Radioactive Decay and Radioactive Dating, Radiation Detection Instruments.

Electrostatics and Magnetism: Electric field due to different Charge Distribution, Electrostatic Potential Applications of Gauss's Law, Lorentz Force Ampere's Law, Magnetism, Magnetization, Magnetic Materials.

Electrical Elements and Circuits: Review of electric current, voltage, power, and energy, Ohm's law, inductance, capacitance, Basic Electrical circuits, Electromechanical systems.

Semiconductor Physics and Electronics: Energy levels in a Semiconductor, Hole concept, P-N junction, Diodes, Transistors, Basic Electronic circuits (e.g. rectifier).

Thermodynamics: Review of Laws of Thermodynamics, conduction, convection, and radiation. Thermal conductivity, specific heat, and overall heat transfer coefficients. Heating, Ventilation and Air Conditioning (HVAC).

EL 104 ELECTRONIC ENGINEERING DRAWING & WORKSHOP

PCB Design & Workshop: PCB design and layout drawings using PCB software: From Schematic & Layout to Machine File generation. PCB technologies, single layers and multi-layer boards, PCB testing, Switches, PCB standards, Routing. Fabricating PCB, Assembling & soldering components on PCB, PCB Processes; CNC Drilling, Electroplating, Photo-plotting, Laminating, Developing and Exposing.

Electronic Workshop: Introduction to Operations of Voltmeters, Ohmmeters, Power supplies, Function generators & Oscilloscopes. Measuring parametric values of discrete passive components fabricating simple electronic circuits on breadboard, Simulate an electronic circuits using PSPICE/MultiSim/Simulink.

EL 108 COMPUTER PROGRAMMING

Procedural vs Object-Oriented Approach

Overview of fundamental concepts: data types, variables, and constants.

Operators, Decisions and looping: Use of arithmetic, relational, logical, and assignment operators in expressions and computations. Implementation of conditional logic using if else, switch, break, continue, and ternary operators. Iterative control structures: for, while, and do-while loops for repeated execution.

Modular Programming, arrays and pointers: Function declaration, definition, and invocation for modular code organization. Single and multi-dimensional arrays, sorting techniques, and manipulation using string functions. Pointers, returning values via pointers, pointer-array relationships, pointer-to-pointer concepts, and handling C-style strings.

Foundations of Object-Oriented Programming (OOP) Introduction to classes and objects, encapsulation, data hiding, and the use of access specifiers (public, private, protected), along with constructors and memory management.

Inheritance and Code Reusability Types of inheritance: single, multiple, and hierarchical; understanding base and derived classes; use of virtual functions, polymorphism, abstract classes, and interfaces.

Polymorphism Compile-time and runtime polymorphism through function overloading and operator overloading.

Introduction to Generative AI Fundamentals of artificial intelligence, machine learning, and deep learning; application of generative AI in software development; tools for generating text, images, and code using generative models. The practical work will be based on the above course.

ES 108

IDEOLOGY AND CONSTITUTION OF PAKISTAN

Two-Nation Theory: Nation and Nationalism in British India. Inclusive nationalism, Exclusive nationalism, Freedom movement in British India, Two-Nation Theory.

Ideology: definition and its significance: Difference between Philosophy, Ideology, and Theory. Evolution of Islamic ideology in British India. Pakistan movement: role of ideology. Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949).

Introduction to the Constitution of Pakistan: Definition and importance of a constitution. First Constituent Assembly of Pakistan. Main issues that delayed the Constitution-making in Pakistan. Dissolution of the Constituent Assembly. Second Constituent Assembly of Pakistan. Third Constituent Assembly of Pakistan.

Constitution and State Structure: Federal form of State. Parliamentary form of government. Structure of Government (executive, legislature, and judiciary). Distribution of powers between federal and provincial governments.

Fundamental Rights, Principles of Policy, and Responsibilities: Duty of the citizens of Pakistan (Article 5). Overview of fundamental rights to citizens of Pakistan guaranteed by the Constitution 1973 (Articles 8-28). Overview of Principles of Policy (Articles 29-40).

Constitutional Amendments: Procedures for amending the Constitution. Notable constitutional amendments and their implications: 8th, 13th, 17th, and 18th

EL 201

ELECTRONIC DEVICES AND CIRCUITS

Differential Amplifier: MOS differential pair operation with differential and common mode input voltage, large signal analysis, small signal analysis, differential and common mode gain calculations, non-ideal characteristics of differential pairs. Common Mode Rejection Ratio.

Current Sources: Simple MOS current sources and mirrors, MOS based current steering circuits. Cascode current source design.

Active Loading and Multistage amplifiers: Active loaded MOS differential pair, differential and common mode gains of actively loaded MOS differential pair, Useful cascades of single stage MOS amplifiers like CS-CS, CS-CG (Cascode amplifier) etc.

Introduction to BJT: Construction, configuration and biasing.

Output Stages: Introduction to classes of power amplifier (A, B, C, AB etc.).

Frequency Response: Introduction, High frequency small-signal model of MOSFET, Miller's Theorem, Analysis of Common-Source, Common-Gate, Common-Drain.

Feedback and stability: Negative feedback circuits, Birkhausen Criterion, phase margin and gain margin, Oscillators Ring Oscillator, LC oscillator.

EE 127

CIRCUIT ANALYSIS

Introduction to Circuit Analysis: Definition of circuit, analysis, modeling significance of circuit analysis for engineers.

Basic RL and RC Circuits: The Source-Free RL Circuit, Properties of the Exponential Response, the Source-Free RC Circuit, the Unit-Step Function, Driven RL Circuits, Natural and Forced Response, Driven RL Circuits.

The RLC Circuit: The Source-Free Parallel Circuit, the overdamped Parallel RLC Circuit, Critical Damping, the under damped Parallel RLC Circuit, the Source-Free Series RLC Circuit, the Complete Response of the RLC Circuit, the Lossless LC Circuit.

AC Power Analysis: Instantaneous and Average Power, Maximum Average Power Transfer, Effective or RMS Value, Apparent Power and Power Factor, Complex Power, Conservation of AC Power, Power Factor Correction.

Three-Phase Circuits: Balanced Three-Phase Voltages, Balanced Wye-Wye Connection, Balanced Wye-Delta Connection, Balanced Delta-Delta Connection, Balanced Delta-Wye Connection, Power in Balanced System, Unbalanced Three-Phase Systems.

Magnetically Coupled Circuits: Mutual Inductance, Energy in a Coupled Circuit, Linear Transformers, Ideal Transformers, Ideal Autotransformers, Three-Phase Transformers.

Two-Port Network: Impedance Parameters, Admittance Parameters, Hybrid Parameters, Transmission Parameters, Relationship between Parameters, Interconnection of networks.

Measurement of Electrical Quantities: Basics of electromechanical instruments, Active and Reactive power measurement, Max. Demand indicator, Induction type KWH meter, p.f meter. Measurement of resistance, measurement of Inductance and capacitance. Measurement of dielectric strength of insulators, high voltage surges. Electronic and digital voltmeters, digital frequency meter, time interval measurement.

TC 206 SIGNALS AND SYSTEMS

Signals and Systems: Continuous time and discrete time signals, periodic signals, even and odd signals, exponential and sinusoidal signals, the unit impulse and unit step functions, Continuous time and discrete time systems, system properties, causality, BIBO stability, time invariance, linearity

Linear Time Invariant (LTI) systems: Continuous time LTI system, Convolution Integral, Discrete time LTI system, Convolution Sum, properties of LTI systems, causal LTI systems, difference equation, time domain analysis of LTI Systems.

Fourier Series: Continuous time Fourier series, Properties of Continuous time Fourier series, Parseval's Theorem, Discrete Time Fourier Series, Properties of Discrete time Fourier series.

Fourier Transform: Continuous time Fourier Transform, Properties of Continuous time Fourier Transform, Discrete Time Fourier Transform, Properties of Discrete Time Fourier Transform, Parseval's and Duality Theorem.

Laplace Transform: Laplace Transform, inverse Laplace Transform, Properties of Laplace Transform, region of convergence, pole-zero plot, Stability, Frequency Analysis of Continuous time LTI System.

z-Transform: z-Transform, inverse z-Transform, properties of z-Transform, region of convergence, pole-zero plot, System Stability, Frequency Analysis of Discrete-time LTI System.

EE 382 ELECTROMAGNETIC FIELDS

Vector Analysis: scalars and vectors, vector algebra, the Cartesian coordinate system, vector components and Unit vectors, the vector field, the dot product the cross product, other coordinate systems, circular cylindrical coordinates, the spherical coordinate system, transformations between coordinate systems.

Coulomb's Law and Electric Field Intensity: The experimental law of coulomb, Electric field intensity, field of a point charge, field due to a continuous volume charge distribution, field of line charge, field of sheet charge, streamlines & sketches of fields.

Electric Flux Density Gauss's Law and Divergence: Electric flux density, Gauss's law, application of Gauss's law, some symmetrical charge distributions, differential volume element, divergence, Maxwell's first equation, electrostatics, the vector operator and the divergence theorem.

Energy and Potential: Energy expended in moving a point charge in an electric field, the line integral, definition of potential difference and potential, the potential field of a point charge, the potential field of a system of charges, conservative property, potential gradient, the dipole, Energy density in the electrostatic field.

Conductor Dielectrics and Capacitances: Current and current density continuity of current metallic conductors, conductor properties and bounded conditions, semiconductors, the nature of dielectric materials, capacitance, several capacitance examples, of a two wire lines . Curvilinear square, physical modules, current analogies, fluid flow maps the iteration method.

Poisson's and Laplace's Equations: Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solution of Laplace's equation, examples of the solution of poisson, product solution of Laplace's equation.

The Steady Magnetic Field: Biot Savart's Law, Amperes circuit law,

curl, Stoke's theorem, Magnetic flux and magnetic flux density, the scalar and vector magnetic potentials, derivation of steady magnetic field laws.

Magnetic Forces Materials and Inductance: Force on a moving charge, force on a differential current element, force between differential current element, force and torque on a closed circuit, the nature of magnetic materials, Magnetization and permeability, magnetic boundary conditions, the magnetic circuit, potential energy and forces on magnetic materials, inductance and mutual inductance.

Time Varying fields and Maxwell's Equations: Faraday's Law, displacement current, Maxwell's equation in point form, Equation in integral form, the related potentials

The Uniform Plane Wave: Wave motion in free space, wave motion in perfect dielectric, plane waves in loose dielectrics. The Poynting vector and power considerations, propagation in good conductors, skin effect, reflection of uniform plane waves standing wave ratio.

TC 201 **DIGITAL LOGIC DESIGN**

Computer Operations: Evaluation of the computer, basic organization of digital computer, instruction formats, some different types of computers, special purpose and general purpose computers.

Number Systems: Conversion between bases, arithmetic with bases other than ten, negative numbers, binary coded decimal numbers, octal, and hexadecimal number systems.

Truth Function: Binary connectives, evaluation of truth functions, many statement compounds, physical realizations, sufficient sets of connectives, digital computer examples.

Boolean Algebra: Truth functional calculus as Boolean algebra, duality, fundamental theorems of Boolean algebra, examples of Boolean simplifications, remarks on Switching functions.

Switching Devices: Switches and relays logic circuits, speed and delays in logic circuits, integrated logic circuits.

Minimization of Boolean Functions: Standard forms of Boolean functions, Minterm and maxterm, Designation of Boolean functions,

Karnaugh map representation of Boolean functions, simplification of functions on Karnaugh maps, map minimization of product of sums expressions, incompletely specified functions.

Tabular Minimization: Cubical representation of Boolean functions, Determination of prime implicants, Selection of an optimum set of prime implicants, Design of NAND and NOR Networks and properties of combinational network, Introduction to design of NAND and NOR Networks, Switching expressions for NAND and NOR Networks, Transient response of combination Networks.

Introduction to sequential Networks: Latches, Sequential Networks in fundamental mode, Introduction to the Synthesis of Sequential Networks, Minimization of the number of states, Clocked Networks.

Introduction to Verilog HDL and VHDL Lab work:

EF 201

CIVICS AND COMMUNITY ENGAGEMENT

Introduction to Civics and Citizenship: Definition of civics, citizenship and civic engagement, Historical evolution of civics participation, Types of citizenship: active, participatory, digital etc. The relationships between democracy and citizenship.

Civics and Citizenship: Concepts of civics, citizenship and civic engagement, Foundation of modern society and citizenship. Types of citizenship: active, participatory, digital etc.

State, Government and Civil Society: Structure and functions of government in Pakistan, The relationships between democracy and civil society, Right to vote and importance of political participation and representation.

Rights and Responsibilities: Overview of fundamental rights and liberties of citizens under constitution of Pakistan 1973, Civic responsibilities and duties, Ethical considerations in civic engagement (accountability, non-violence, peaceful dialogue, civility, etc.).

Community Engagement: Concept, nature and characteristics of community, Community development and social cohesion, Approaches to effective community Engagement, case studies of successful community driven initiatives.

Advocacy and Activism: Public discourse and public opinion, role of advocacy in addressing social issues, Social action movements.

Digital Citizenship and Technology: The use of digital platforms for civic engagement, Cyber ethics and responsible use of social media, Digital divides and disparities (access, usage, socioeconomic, geographic etc.) and their impact on citizenship.

Diversity, Inclusion and Social Justice: Understanding diversity in society (ethnic, cultural, economic, political etc.), Youth, women and minorities' engagement in social development, addressing social inequalities and injustice in Pakistan, Promoting inclusive citizenship and equal rights for societal harmony and peaceful co-existence.

EL 202 INTEGRATED CIRCUITS

Integrated Circuits: Introduction to IC processing for MOS integrated circuits.

Op-amp: One and Two-stage CMOS Op Amps, input common mode range, voltage gain, and slew rate.

IC Packaging: Different types of packaging and their need. Wire-bond vs. flip-chip.

MOSFET as a switch: MOS Inverter Circuits: Voltage transfer Characteristics, Noise Margins.

Static MOS Gate Circuits: CMOS gate circuits, Flip-Flops & Latches, Pseudo NMOS and Pass Transistor Logic circuits.

Transmission gate and Dynamic Logic: Pass Transistor Logic, CMOS Transmission Gate Logic, Dynamic D latches, Domino Logic.

Semiconductor Memory Design: Memory Organization, Address Buffers & Decoders, Static RAM Cell Design, SRAM Column I/O Circuits. Dynamic RAM circuits.

CS 216 DATA STRUCTURE AND ALGORITHMS

Introduction and classification of Data Structures; Basic operations; Classification of Algorithms, Classification by implementation; Classification by design paradigm. Basics of Complexity of Analysis;

Rate of growth of Complexity of Algorithms; Asymptotic notations; Time-Space Tradeoffs.

String Processing-Operations on strings; word processing; Pattern Matching Algorithms.

Array-One-dimensional Arrays: Insertion, Deletion; Multi-dimensional Arrays: Matrix Multiplication, Sparse Matrices. Stacks, Queues and Recursion; Basic Concepts and functions; Polish Notation; Priority Queues; Factorial Calculation; Fibonacci Series; Ackermann Function.

Towers of Hanoi. Linked Lists; Definition and Representation; Traversal and searching; Insertion; Deletion; Circular Lists; Doubly linked lists.

Tree; Terminology; Representation in memory; Binary search tree, Heaps; Heap-sort algorithm. Graphs; Terminology; Representation in memory, Traversal Algorithms; Shortest path Algorithms Sorting and searching; Searching and sorting Algorithm; Hashing.

EL 204

ELECTRONIC INSTRUMENTATION

Fundamentals of instrumentation and measurement: Introduction to measurement system and its components, Static and Dynamic characteristics, Accuracy, Precision and error analysis.

Sensors and Transducers: Types of Sensors: Temperature, pressure, proximity and optical sensors, Bridge Circuits to evaluate sensors.

Electronic Instruments: Structure and function of electronic instruments like Oscilloscope, function generator, digital meters and power supply.

Signal conditioning and data acquisition system: Components of signal conditioning: Amplifiers, filters and Converters. Basics of data acquisition system.

Electronic Instrumentation for Medical applications: Overview of medical instruments/devices and types of biomedical signals (ECG, EEG, EMG etc), data acquisition and analysis.

The Practical work of the course will be based on above contents.

EE 246 ELECTRICAL MACHINES

Three Phase Circuits: Three phase voltages, Currents and power, Star and Delta connected circuits, Analysis of balanced three phase circuits, Line diagram, Power and power factor measurement in 3-phase circuits.

Transformer: Basic principles, Single and 3-phase transformers, Construction, General transformer equation, Voltage and current relations in transformer, Ratio of transformation, Loading a transformer, Equivalent circuits of a transformer, OC and SC tests, Regulations and methods of calculation of regulation, Efficiency and calculation of efficiency, Auto transformer, 3-phase transformer.

Direct Current Machines: Electric circuit aspects of DC machine, Magnetic circuit aspects, Types of DC generator, Performance, Types of motors, Performance, Motor speed control, Transient and dynamic responses, Transfer functions and frequency response.

Alternating Current Machines: Rotating magnetic field, Induction motor action, Induction motor characteristics and performance, Synchronous generator characteristics and performance, Synchronous motors, Induction motor, Speed control elementary AC two phase control motors, Constructional features of fractional horse power AC motors.

Direct Current Machines Winding: Gramme Ring winding, simple lap and wave windings, Diagrams and developments and elementary calculations.

Control Systems: Motor drive systems, Introduction to feedback control systems, System aspects and classification, Elements of analysis of feedback control systems, Digital control systems.

ME 110 BASIC MECHANICAL ENGINEERING

Thermodynamic Properties: Working Substance, System, Pure Substance, PVT Surface, Phases, Properties And State, Units, Zeroth Law, Processed and Cycles, Conservation of Mass.

Energy and its Conservation: Relation of Mass and Energy, Different Forms of Energy, Internal Energy and Enthalpy Work, Generalized Work Equation Flow and Non-Flow Processes, Closed Systems, First Law of Thermodynamics, Open Systems and Steady Flow, Energy Equation for

Steady Flow, System Boundaries, Perpetual Motion of the First Kind.

Energy and Property Thermodynamic Equilibrium, Reversibility, Specific Heats and their Relationship.

Relations: Entropy, Second Law of Thermodynamics, Property relations from Energy Equation, Frictional Energy.

Ideal Gas: Gas Laws, Specific Heats of an Ideal Gas, Dalton's Law of Partial Pressure, Thermodynamic Processes. Fundamentals of Conduction and Convection, Radiation, Thermal Conductivity, Overall Heat.

Heat Transfer: Transfer Coefficients, Practical Equations.

Thermodynamic Cycles: Cycle Work, Thermal Efficiency Carnot Cycle, Reversed and Reversible Cycles, Most Efficient Engine.

Two-Phase Systems: Two-Phase System of a Pure Substance, Changes of Phase at Constant Pressure, Steam Tables, Superheated Steam, Liquid and Vapour Curves, Phase Diagrams, Rankine Cycle, Components of Steam Power Plant.

Internal Combustion Engines: Otto Cycle, Diesel Cycle, Dual Combustion Cycle, Four-stroke and Two-stroke Engines, and Types of Fuel. Reciprocating Compressors: Condition for Minimum Work, Isothermal Efficiency, Volumetric Efficiency, Multi-Stage Compression, Energy Balance for a Two-Stage Machine with Intercooler.

Introduction To Heating and Cooling Load and its calculations, Comfort Charts, Outline of A.C. Air-Conditioning and Systems, Consideration for Air – Conditioning in Buildings, Natural Ventilation.

Refrigeration: Insulating Materials.

EA 244

ACADEMIC READING AND WRITING

Introduction to Academic Literacy: Academic reading, writing, and expectations. (Academic v/s non-academic texts); Finding, evaluating, and presenting credible academic sources.; Critical Reading: Identifying main ideas, annotating texts, and analyzing arguments; Academic Texts: Structure of research proposals, Arguments & Evidence Writing Logical reasoning, integrating evidence, and avoiding fallacies,

journal articles, literature review, lab report, policy brief, case study etc.; Academic Writing- Tone, voice, formal vs. informal writing, and structured paragraphs; Academic Vocabulary Development: Discipline-Specific Academic Vocabulary.

Academic Writing Process: Outlining, organizing, and refining essay plans; Writing Introductions: Engaging openings, summarizing key points, and implications; Synthesizing Research: Connecting multiple sources and writing literature and critical reviews; Drafting & Revising: Overcoming writer's block, refining drafts, and incorporating feedback; Editing & Proofreading: Improving clarity, grammar, style, and structure. Add attention to technical formatting (e.g., equations, symbols, figures in STEM fields); Citation & Referencing: Using APA or IEEE styles and integrating sources.

Interpreting Visuals: Charts, graphs and tables Drawing logical conclusions from information contained in graphs, diagrams, pie charts and tables with specific reference to the relevant disciplines and their requirements.

EF 200

COMMUNITY SERVICE

Orientation to Community Service: [Taught component]: Introduction to the concept and practice of community service. Need, objectives and benefits of community service. Foundational theories (educational, undergraduate curriculum, humanities, social science, corporate social responsibility etc.). Tools and skills needed in community service. Contextual examples in community service; case examples. Professional and ethical conduct during community service.

Community Service Attachment: Completing 30-35 hours of formal assignment at an organization.

Community Service Experience Documentation: Writing a report documenting the experience and submitting it on the prescribed format.

NOTE: Total contact hour for theory (thought component 8 + documentation activity 6) will be 14 hours.

EL 310 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Introduction to artificial intelligence: Branches, overview of AI and its application. Programming for AI.

Problem solving by search: Searching techniques, blind, informed, uninformed, local, games and adversarial search techniques and algorithms.

Introduction to machine learning: Basics of machine learning, supervised and unsupervised learning, linear regression, cost function, gradient descent and its different types, logistic regression, over fitting, under fitting and regularization, k-mean clustering, Naïve Bayes, k-nearest neighbors (KNN). Basics of deep learning.

Deep Neural Networks: Structure of neural network, shallow and deep neural networks. Fully connected neural network, forward and backward propagation, errors and evaluation metrics. Basics of convolutional neural network, stride, padding, filters, channels, Time sequence networks including Recurrent neural networks (RNN) and long short-term memory (LSTM).

Practical work of the course will be based on above contents.

EL 307 POWER ELECTRONICS

Introduction and scope of power electronics: Solid state devices used in power electronics, such as power diode, power transistor, power MOSFET, SCRs, DIACs and TRIACs etc. SCRs turn on techniques, elementary and advanced firing schemes of power devices, VTA analysis.

Uncontrolled and controlled rectifiers: Single phase half wave uncontrolled /controlled rectifiers with R, RL and Pure inductive loads, three phase and semi convertors, full convertors, dual convertor, analysis and performance parameters as harmonic factor, utilization factor, distortion factor and etc., rectifiers with purely resistive and highly inductive and RL loads.

Introductions to AC Voltage controllers: Single phase unidirectional and bidirectional AC Voltage regulators.

Thyristors Commutation: Self- commutation, impulse commutation.

Ideal DC-DC Converter: Principle of step up and step-down choppers, with their respective operations, design and analysis, buck regulator, boost regulator, buck and boost regulator, Cuk regulators, SEPIC converter.

Isolated DC-DC Converters: Switch mode power supplies, design and analysis of isolated converters such as Flyback and Forward Converter.

Inverters: Principle of half and full bridge inverters, constant pulse width modulation (PWM), variable PW modulation, SPWM and MSPWM techniques.

Simulation and control of Power electronics Converter. MATLAB implementation of Power converters, design, open-loop and close-loop control. Controllers for Power converters.

Practical will be based on above contents.

EE 375

FEEDBACK CONTROL SYSTEMS

Introduction: Introduction to control systems, examples and classifications, Feedback and its characteristics. Nature and representation of control system problem, block diagram fundamentals, terminology of block diagram for a feedback control system, block diagram representation of various control systems.

Linear Systems and Differential Equations: Methods of writing differential equations of various physical systems such as static electric circuits, mechanical translational and rotational systems, thermal systems, hydraulic linear and rotational transmission systems, electromechanical dynamic systems DC and AC speed control systems.

Time-Response of Linear Systems: Types of standardized inputs to linear systems, steady state response and transient response of systems to standard inputs, response of second order systems time response specifications.

Laplace Transforms: Definition, derivation of Laplace transforms of simple functions, Laplace transform theorems, transformations of differential equations of physical systems, inverse transformation techniques, stability, Routh's stability criterion.

Block Diagram Algebra: Transfer functions of physical systems, canonical and unity feedback forms of control system block diagram, block diagram reduction techniques, signal flow graph algebra, block diagram reduction using signal flow graphs.

Control System Characteristics: Classification of feedback systems by type, analysis of system types, error coefficients, error constants, sensitivity.

Root Locus: Introduction, rules for construction of root locus, qualitative analysis of root locus, the spirule, analysis of performance characteristic of systems in time domain, dominant pole zero approximations, gain margin and phase margin, root locus compensation. Phase & gain compensation, root locus compensation, PID controller.

Frequency Response: Introduction, transfer function of systems in frequency domain, magnitude and phase angle frequency response of plots of closed loop control systems.

Introduction to Digital Control: Computer as control device, Single-loop digital control system, Digital control: pros and cons, Data Converters.

Linear Difference Equations (LDE) and z-transform: Scalar difference equation, z-transform of simple sequences and inversion, solving LDE using partial fraction and z-transform, z-domain transfer function and impulse response, relation between S and z-domain.

Digital control system design techniques: Digital control strategies and implementation, closed-loop characteristic equation, z-domain design considerations, General PID digital control algorithm, Tuning procedure for PID controller.

MT 331

PROBABILITY AND STATISTICS

Statistics: Introduction, Types of data and variables, Presentation of data, Objects, Classification, Tabulation, Frequency distribution, Graphical representation, Simple and Multiple Bar diagrams, Sartorial and Pie diagrams, Histograms, Frequency polygons, Frequency curves and their types.

Measures of Central Tendency: Statistical averages, Median, Mode, Quartiles, Range moments, Skewness, Quartile deviation, Mean deviation, Standard

deviation, Variance and its coefficients, Practical significance in related problems.

Curve Fitting: Introduction, Fitting of a first and second degree curve, Fitting of an exponential and logarithm curves, related problems, Principle of least squares, Second order statistics & Time series not in bits details.

Simple Regression and Correlation: Introduction, Scatter diagram, Correlation and its coefficient, Regression lines, Rank correlation and its coefficient, Probable error, related problems.

Sampling and Sampling Distribution: Introduction, Population, Parameter and statistics, Objects of sampling, Sampling distribution of mean, Standard errors, Sampling and Non-sampling errors, Random sampling, Sampling with and without replacement, Sequential sampling, Central limit theorem with practical significance in related problems.

Statistical Inference and Testing of Hypothesis: Introduction, Estimation, Types of estimates, Confidence interval, Tests of hypothesis, Chi-Square Distribution/test, one tail and two tails tests, Application in related problems.

Probability: Basic concepts, Permutation and combination. Definitions and Laws of probability, Conditional probability, Baye's rule, Related problems and practical significance.

Random Variable: Introduction, Discrete and continuous random variables, Sequences and transformations, Probability distribution, Probability density function, Mathematical expectation, Moment generating functions, Markove random walks chain and related problems.

Probability Distribution: Binomial, Poisson, Hyper geometric & Negative binomial distribution, Continuous probability distribution, Uniform, Exponential and Normal distributions and their practical significance.

EL 315

PROJECT MANAGEMENT

Introduction to Project Management: Fundamentals of Product and Process development.

Project life cycle: initiation, planning, execution, monitoring, closure, Roles and responsibilities of a project manager in business community, Producing novel products and services to hit business, Creating and identification of new business markets Prototype, fabrication and assembly routes, Strategies to promote developing technologies, Innovative technological Marketing Intellectual property rights protection from creation to commercialization, Supply chain management, Outreach

activities and Commercialization of latest technological inventions, Distribution and Financing.

Project selection criteria: vision, mission, objectives, strategic alignment, ROI, risk, Feasibility analysis (technical and economic perspectives), Development of a project charter for an electronics engineering-focused project.

Scope and Time Management: Utilization of multidisciplinary knowledge, skills and experience to achieve development goals, Scope definition and Work Breakdown Structure (WBS) for EE projects, Project scheduling techniques, network diagram and critical path identification, Gantt charts and milestone planning using real engineering project examples.

Cost and Resource Management: Budgeting techniques for electronics hardware/software projects, Resource allocation (human, tools, lab equipment, etc.), Cost estimation models and basic Earned Value Management (EVM).

Risk and Quality Management: Risk identification and categorization in electronic systems (e.g., embedded systems, PCB prototyping), Risk mitigation strategies, Quality control and assurance standards (e.g., ISO, IEEE, IPC standards).

Communication and Team Management: Problem solving, Team formation, roles, and responsibilities, Effective communication within technical teams, Leadership, collaboration, and conflict resolution strategies.

Procurement and Contracts: Material procurement (e.g., sensors, microcontrollers, software tools), Contract types (fixed-price, time & materials, etc.), Vendor selection and contract management.

Monitoring, Control, and Closure: Techniques for tracking progress and performance metrics, Status reporting and variance analysis, Final project review, documentation, and closure.

Case Study: Project Lifecycle (or Industrial Electronics System) End-to-end analysis of a real or hypothetical EE project (e.g., Smart Energy Meter, Industrial Automation System, IoT Device), Students evaluate project decisions on scope, budget, timeline, and risk, Reflection on successes, bottlenecks, and improvement areas.

CS 430 MICROPROCESSOR PROGRAMMING AND INTERFACING

Computer Architecture, Instruction Cycle, Memory Organization, Address decoding, Memory Hierarchy, Interrupts, Bus Arbitration Schemes, Programmed I/O, Interrupt-Driven I/O, Direct Memory Access. General purpose and special purpose processors, Internal Registers, Internal Bus Architecture, Pin Function, Addressing Modes, Instruction Set Architecture: (Data Transfer Instructions, Arithmetic & logic instructions, Branch instruction), Assembler Directives, Macros, Procedures, Instruction Encoding, Bus Cycles, Reset Circuit, Clock generation circuits, Wait states, Memory interfacing, Memory Speed Requirement, I/O Interfacing, Programmable Peripheral Interface, Programmable interval Timer, Programmable interrupt Controller, Microprocessor System Design, Recent Microcontroller Architectures.

TC 307 COMMUNICATION SYSTEMS

Introduction to Communication: Introduction to Communication, elements of Communication system, Fundamental Limitations, Hartley Shannon law, Needs and benefits of Modulation, electromagnetic spectrum, multiplexing and multiple access, Phasors and Line Spectra.

Probability & Random Variable: Review of probability and random variables, statistical measures, Probability models, Introduction to random processes.

Analog Communication: Linear CW (AM, SSB, DSB, VSB) Modulation and demodulation techniques, modulator and demodulator Circuits, AM and SSB Transmitters and Receivers, SSB Filters, Transmission Bandwidth for AM, Angle/ Exponential CW (FM, PM) Modulation and demodulation techniques, Modulator and demodulator Circuits, FM/ PM Transmitter, FM Generation Methods, Transmission Bandwidth for FM/PM , Carson's rule, PLL Systems, Pre-emphasis and De-emphasis circuits, Narrowband and wideband FM, Demodulation of FM/PM and Receivers.

Noise: Mathematical representation, Signal to Noise Ratio, Noise in AM, FM, and PM systems.

Digital Communication Systems: Digital transmitters and receivers, Pulse Modulation, Pulse Amplitude Modulation, Pulse Position and Pulse width Modulation, BER, Introduction to information theory, Digital CW

modulation, Coherent and non-Coherent systems, Digital modulation error-control coding.

TC 212 DIGITAL SIGNAL PROCESSING

Overview of Discrete-time Signals and Systems: Sampling, Aliasing, Quantization, Convolution, Correlation, Properties of Discrete time Signals and Systems.

Discrete Fourier Transform: Frequency Domain Sampling, DFT Properties, Inverse DFT, Windowing and DFT Leakage, Direct Computation of DFT.

Fast Fourier Transform: Divide and Conquer, Radix algorithms; Inverse FFT, Applications of FFT.

Discrete time systems implementation: Overview of z-transform, Structures of Discrete time systems, Fixed and Floating number types, and Quantization effects.

Design of Digital Filters: General Considerations, FIR and IIR Filters, Techniques of FIR and IIR filter Design.

Multi rate Signal Processing: Down sampling and Up sampling, Decimation and Interpolation.

EL 311 INDUSTRIAL ELECTRONICS

Industrial process components: Introduction to industrial process system and its components, process sensors, signal conditioning, level shifting, industrial transmitter and receivers, embedded controller based data acquisition system, Remote transducer (HART) equipment based process instrumentation system, electric industrial actuators, Pneumatic and hydraulic actuators, Plant safety management (PSM) and preventive measurements, Introduction to Industry 4.0.

Industrial process control using PLC: Introduction, architecture, I/O s detail, data storage memory architecture, programming memory blocks, OBs types and usage, FBs and FCs usage, programming syntax details, STL programming style, Ladder logic based control programming, interfacing with PLC, ON/OFF process control, PID process control, Use of Timer and Counters, Development of process and instrumentation (P&ID) diagrams, Relay ladder logics.

SCADA, DCS and robotic manipulators: introduction to SCADA and DCS, specifications, working principle, programming style, introduction to industrial robotic manipulators, Types of manipulators, Robot characteristics and kinematics.

MG 257 ORGANIZATIONAL BEHAVIOUR

Introduction to Organizational Behaviour; Foundations of OB: Management Functions, roles, and skills; Effective versus successful managerial activities; Replacing intuition with systematic study, Exploring OB challenges and opportunities facing globalization, OB Model.

Foundations of Individual Behaviour; Biographical traits and ability, Personality, Perceptions and individual decision making, Values, attitudes, and job satisfaction, Motivation – basic concepts and applications, Work stress.

Foundations of Group Behaviour; Group in OB, Defining and classifying groups, Stages of group development, work group behaviour, dynamics of groups, Understanding work teams, Leadership: basic approaches and contemporary issues; Conflict & negotiation.

Foundations of Organizational Structure; Organizational structure and design, Organizational culture, Organizational change and development.

MT 442 NUMERICAL METHODS

Error Analysis: Types of errors (Relative, Absolute, Inherent, Round-off, and Truncation) Significant digits and numerical instability, flow chart, Use of any computation tool to analyze the Numerical solutions.

Linear Operations: Functions of operators, Difference operators and the derivative operators, identities. Difference Equations: Linear homogenous equations and non-homogenous equations.

Solution of Non-Linear Equations: Numerical methods for finding the roots of transcendental and polynomial equations (Secant, Newton Raphson, Chebyshev and Graeffe's root squaring methods), Rate of convergence and stability of an iterative method.

Solution of Linear Equations: Numerical methods for finding solutions of linear equations (Gauss Elimination, Gauss-Jordan Elimination, Triangularization, Cholesky, Jacobi and Gauss-Seidel).

Interpolation and Curve Fitting: Lagrange, Newton, Hermit, Spline
Least squares approximation (Linear and non-linear curves).

Numerical Integration and Differentiation: Computation of integrals using trapezoidal rule, $1/3$ Simpson's rule, $3/8$ Simpson's rule, Composite Simpson's and trapezoidal rules, Computation of solutions of differential equations using (Euler method, Euler modified method, Runge Kutta method of order 4). Numerical solutions of partial differential equations, Optimization problem, Simplex method, Steepest ascent and steepest descent methods.

EL 409 VLSI SYSTEMS DESIGN

HDL: Programming in Verilog.
VLSI Architectures for digital signal processors, adders and multipliers.

Design Methodologies and tools: Cell based design, full custom design, platform based design, Design flows Behavioral synthesis design, mixed signal or custom design flow.

Testing and verification: Logic verification principle, design for test, System Verilog for verification.

Practical work of the course will be based on above contents.

EF 305 ENGINEERING ECONOMICS AND MANAGEMENT

Introduction: Basic Concepts and principles of Economics, Micro- and Macro-economic theory, the problem of scarcity. Basic concepts of Engineering Economy, Financial effectiveness and non-monetary factors.

Economic Environment: Consumers and producer goods, Goods and services, Demand & Supply concept. Market Equilibrium, Elasticity of demand, Elasticity of Supply, Measures of Economics worth, Price, supply-demand-relationship, Revenue, Cost and profit function.

Elementary Financial Analysis: Basic accounting equation. Development and interpretation of financial statements-Income Statement, Balance Sheet and Cash Flow, Working capital management, Financial Ratio Analysis.

Time Value of Money and Financial Returns: Concepts of simple, compound and effective interest rates, Less often than compounding

period and more once a year; Present Value, Future Value and Annuities concepts, Uniform gradient and geometric sequence of cash flow.

Depreciation and Taxes: Depreciation concept, Economic life, Methods of depreciation, Gain (loss) on the disposal of an asset, Depreciation as a tax shield.

Basic cost concepts and Break-Even Analysis: Types of costs and cost curves; Determination of Cost/Revenues. Numerical and graphical presentations. Practical applications, BEA as a management tools for achieving financial/operational efficiency.

Linear Programming: Mathematical statement of linear programming problems, Graphical solutions, Simplex method, Duality Problems.

Business Organizations and financial Institutions: Type of ownership, single ownership, partnerships, corporation, type of stocks and joint stock companies, Banking and specialized credit institutions.

Management: Project Management; Integration of Organization Strategy with Projects, Defining the project, developing a network plan, managing risk, reducing project time, project selection and comparing alternatives techniques scheduling resources.

Introduction to Projection Management and Production Concepts: Basic production function, stages of production, returns to scales, Production lead time, Production rate, capacity, operations, planning and control, order processing, Scheduling, planning, line of balance.

EL 422

ROBOTICS

Introduction: Fundamentals of Robotics including definitions, types, uses, history, key components, applications and future developments in the field.

Actuators and Drive Systems: Control Components, Embedded Robot Controller, I/O Interface, and PWM Amplifiers, Control Software, Controller Software and Sensor Inputs.

Sensors: Basic Sensor based Controls; Plan Strategy.

Robot Mechanisms: Overview and analysis of robot mechanisms.

Planar Kinematics: Displacements are rotations or translations. Rotation centers. Kinematic mechanisms. Four-bar linkages.

Differential Motion: The final location of the end effector, but also with the velocity at which the end- effector moves.

Statics: Energy Method, Hybrid Position-force Control, Compliance, End-effector Design, Non-holonomic Systems, Legged Robots, Multi-fingered Hands Dynamics: Computed Torque Control, sensors-2, computer vision, Navigation.

Force and Compliance Controls: complex tasks, including assembly of parts, manipulation of tools, and walking on a terrain, entail the control of physical environment, Interactions and mechanical contacts with the environment.

EF 309

OCCUPATIONAL SAFETY & HEALTH

Health and Safety Foundations: Nature and scope of health and safety, Reasons/benefits and barriers for good practices of health and safety, Legal framework and OHS Management System.

Fostering a Safety Culture: Four principles or safely- RAMP (Recognize, Assess, Minimize, Prepare), Re-thinking safety-learning from incidents, Safety ethics and rules, Roles and responsibilities towards safety, Building positive attitude towards safety, Safety cultures in academic institutions.

Recognizing and Communicating Hazards: Hazards and Risk, Types of hazards: Physical (mechanical and non-mechanical), chemical (Toxic and biological agents), electrical, fire, construction, heat and temperature, noise and vibration, falling and lifting etc., learning the language of safety: Signs. Symbols and labels, Finding Hazard Information, Material safety data sheets, Safety data sheets and the GHS (Globally Harmonized Systems).

Accidents & Their Effect on Industry: Costs of accidents, Time lost, Work injuries. Parts of the body injured on the job, Chemical burn injuries, Construction injuries, Fire injuries.

Assessing and Minimizing the Risks from Hazards: Risk Concept and Terminology, Risk assessment procedure, Risk Metrics, Risk Estimation and Acceptability Criteria, Principles of risk prevention, selection and implementation of appropriate Risk controls, Hierarchy of controls.

Preparing for Emergency Response Procedures: Fire, Chemical Spill, first Aid, Safety Drills/Trainings: Firefighting, Evacuation in case of emergency.

Stress and Safety at work Environment: Workplace stress and sources, Human reaction to workplace stress, Measurement of workplace stress, Shift work, stress and safety, improving safety by reducing stress, Stress in safety managers, Stress and workers compensation.

Incident Investigation: Importance of investigation, Recording and reporting, Techniques of investigation, Monitoring, Review, Auditing Health and Safety.

EL 401 ELECTRONIC ENGINEERING DESIGN PROJECT

Final year students will be required to consult the Chairman of Electronic Engineering Department regarding the offering of various projects in the department. The student or group of students will be assigned the project by teacher concerned and will carry out the assignment as required and directed by the teacher. At the end of the academic session, they will submit a written report on work of their project to the Chairman, preferably in the typed form. Students will be required to appear before a panel of examiners for oral examination. The Project will be of the following scopes: A detailed theoretical study of some problem in an area related to Electronic Engineering. This may be of investigative research nature or it may be laboratory research oriented.

TC 421 TELECOMMUNICATION NETWORKS

Telecommunications Management Network (TMN), Network Management Tools and Systems. Computer Communication within the framework of the OSI and TCP/IP protocol architectures. Network architectures and switching techniques, characteristics of transmission media. Channel access protocols and their efficiency. Link control protocols, and their efficiency. Routing algorithms and protocols. Interconnection of network at the link level and at the network level, the Internet Protocol (IP) and associated control protocols. End-to-end protocols, with TCP and UDP as examples; congestion control and flow control. cursory view of application-level protocols, including electronic mail, HTTP and DNS. Introduction to network calculus (optional).

MG 485 ENTREPRENEURSHIP

Introduction to Entrepreneurship: The concept of entrepreneurship, entrepreneurial mindset, social entrepreneurship, and essential entrepreneurial skills.

Initiating entrepreneurial ventures: innovation and creativity, assessment of entrepreneurial opportunities, pathways to entrepreneurial ventures, sources of capital.

Developing the entrepreneurial plan: legal challenges, marketing challenges, financial planning, export orientation, developing an effective business plan.

Growth strategies: strategic entrepreneurial growth through scaling, valuation of entrepreneurial ventures, and harvesting the entrepreneurial venture.

EL 421 EMBEDDED ELECTRONICS

Integrated Electronics: An introduction to fundamental concepts, principles and techniques for designing integrated electronic systems, which include analog, radio, mixed-signal and digital blocks. Most common integration approaches are given using examples.

Sensor enabled Systems: An introduction to sensor enabled systems, with an emphasis on embedded platforms. Areas covered include broad sensor technologies, the physical properties they measure, and how they are used in embedded designs.

Embedded Systems Design Techniques: Introduction to techniques for system design and implementation. Introduction to hardware description languages. Modeling systems with VHDL.

Hardware and Software Algorithms: The logic/FSM and algorithm implementation as Embedded Hardware in a SoC Architecture realized as ASICs or FPGAs. The implementation methodology will be based on logic and high-level synthesis. Coherent knowledge and practical hints of relevant issues of physical (hardware) architecture design (at printed circuits board level & higher levels) of complex electronic systems.

ELECTIVE COURSES

EL 410 NANO ELECTRONICS

Introduction to Nano electronics: Back ground, approaches and scientific revolutions.

Semiconductor Materials and Crystal Properties: Crystal growth of nanostructures, quantum dots, Nanoelectronics Polymers, Energy bands and charge transport, optical properties, Drift, diffusion, Excess carriers.

Semiconductor junctions: PN junction, Metal semiconductor junctions, Hetero junctions, quantum well, Tunnel and photodiode.

Field Effect Transistors: Gate control and electrical characteristics the GaAs MESFET, MOS capacitor, CMOS scaling, Microelectromechanical systems (MEMS), Nanoelectromechanical systems (NEMS). Nano Sensors.

Applications of Nanoelectronics: Basic concept, principles and classification of Nano biotechnology, Function of Biological Nano molecules, DNA computers and microprocessors. Nanomaterials for Environmental engineering, Green nanotechnology, Nano-convergence and Environmental Engineering.

EL 411 OPTOELECTRONICS

Basic Principles of Optoelectronics: Optical rays: Reflection, Refraction and Snell's Law, Total internal Reflection, Diffraction, Mode propagation, Skew Waves, Acceptance angle and Numerical Aperture.

Optical Fiber, Modes of Optical Fiber and Fiber Losses: Modes of Optical Fiber, Step-Index: Multimode Fibers, Graded Index Fiber, Step-Index: Single-mode Fibers.

Transmission characteristics of optical fiber: attenuation due to absorption, scattering, bending losses, Reflectance and optical return losses, Material losses, Scattering, waveguide and Micro bend losses, Dispersion, Intermodal dispersion and Intramodal dispersion.

Optical Sources: LEDs and its types, modulation capabilities and

conversion efficiency, LED drive circuits, Stimulation Emission in Semiconductors, Population inversion and pumping threshold conditions, Laser modes, classes of lasers, single mode operation, Lasing conditions in semiconductors, semiconductors Laser Diodes (SLDs), Types of Semiconductors Laser Diodes, Spectral and output Characteristics, SLD Drive circuits.

Optical Detectors: Photo-detection in semiconductors, Semiconductor photodiodes and its response, PIN and APDs photodiodes.

Couplers, connectors, switches, splicing, optical amplifiers and repeaters.

Passive Optical Networks.

EL 412 MICROWAVE & RF CIRCUITS

Power Theorem and Impedance Matching Networks using Lumped Components: Maximum power transfer theorem, matching network using lumped components (L-matching, pi-matching, T-matching and LL-matching networks).

Transmission Line theory and impedance matching using stubs: Basics, types of transmission lines, Line characteristics impedance and physical parameters. Signal propagation, Waveform distribution and frequency dispersion, Transmission line of finite Lengths, Reflection, Transmission and Propagation constants of transmission line The Lumped-Element circuit model for a transmission line, wave propagation on a transmission line, the lossless line, Special cases of lossless terminated lines.

Smith Chart: Introduction to Smith Chart, Impedance Smith Chart, Admittance Smith Chart and Combined Impedance and Admittance Smith Chart, Impedance View point (Quarter wave transformer), Generator and Load mismatch.

Microwave Network Analysis: Impedance and Equivalent Voltages and currents, impedance and Admittance Matrices, The scattering Matrix.

Microwave power divider, coupler, and filter design.

EL 413 SYSTEM ON CHIP

System on Chip (SoC) introduction, SoC design approach and methodologies, SoC co-specification for hardware and software integration, modeling and analysis techniques for SoCs, hardware/software co-design principles, basics of integrated circuits (ICs) and SoC components, System on Programmable Chips (SoPC) and their applications, SoC platforms and frameworks, Network on Chip (NoC) architectures and NoC-based interconnections, SoC application Case studies across various industries, FPGA prototyping for validating hardware/software systems.

EL 414 SUSTAINABLE ELECTRONICS AND ENERGY SYSTEMS

Introduction to Sustainability and Green Electronics: Sustainability, Triple bottom line (economic, environmental, social), E-waste and lifecycle of electronic products, Materials used in electronics: toxic vs. green materials.

Fundamentals of Energy Systems: Conventional vs renewable energy, Overview of solar, wind, hydro, and fuel cells, Energy conversion principles, AC vs. DC systems in renewables.

Power Electronics for Renewable Energy: DC-DC Converters: (Buck, Boost, Buck-Boost, SEPIC, Zeta), DC-AC Inverters: (H-bridge, SPWM), Grid-tied vs. standalone systems (design considerations: efficiency, losses, thermal management).

Energy Harvesting and Storage Systems: Battery technologies (Li-ion, NiMH, flow batteries), Supercapacitors, Solar harvesting circuits (MPPT, power management ICs).