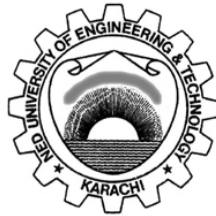


**DEPARTMENT OF  
TELECOMMUNICATIONS ENGINEERING**



**REVISED SYLLABI OF COURSES  
FOR  
BE (TELECOMMUNICATION ENGINEERING)  
DEGREE PROGRAMME  
APPLICABLE FROM BATCH 2024 & ONWARDS**

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

**B.E (TELECOMMUNICATION ENGINEERING)  
COURSES OF STUDIES  
Applicable from Batch 2024**

FIRST YEAR									
Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hours			Course Code	Course Title	Credit Hours		
		Th	Pr	Total			Th	Pr	Total
EA-111	Functional English	2	0	2	EL-106	Basic Electronics	3	1	4
MT-114	Calculus	3	0	3	CY-110	Applied Chemistry for Engineers	2	1	3
EE-120	Basic Electrical Engineering	3	1	4	EE-121	Circuit Analysis	3	1	4
TC-106	Computer Programming	3	1	4	EL-104	Electronic Engineering Drawing and Workshop	0	2	2
ES-105/ ES-127	Pakistan Studies / Pakistan Studies for Foreigners	2	0	2	MT-227	Differential Equations	3	0	3
PH-112	Applied Physics	2	1	3					
<b>Total</b>		<b>15</b>	<b>3</b>	<b>18</b>	<b>Total</b>		<b>11</b>	<b>5</b>	<b>16</b>

SECOND YEAR									
Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hours			Course Code	Course Title	Credit Hours		
		Th	Pr	Total			Th	Pr	Total
ES-205/ ES-209	Islamic Studies/ Ethical Behaviour	2	0	2	TC-212	Digital Signal Processing	2	1	3
TC-206	Signals and Systems	3	0	3	EF-305	Engineering Economics & Management	3	0	3
EL-201	Electronic Devices and Circuits	3	1	4	MT-272	Linear Algebra & Geometry	3	0	3
TC-205	Digital Logic Design	3	1	4	EE-223	Instrumentation and Measurement	2	1	3
CS-216	Data Structure and Algorithms	3	0	3	EA-214	Academic Writing	3	0	3
EE-382	Electromagnetic Fields	2	0	2	MT-331	Probability & Statistics	3	0	3
					EA-200	Community Service	NC		
<b>Total</b>		<b>16</b>	<b>2</b>	<b>18</b>	<b>Total</b>		<b>16</b>	<b>2</b>	<b>18</b>

THIRD YEAR									
Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hours			Course Code	Course Title	Credit Hours		
		Th	Pr	Total			Th	Pr	Total
EA-304	Business Communication and Ethics	3	0	3	TC-421	Telecommunication Network	3	1	4
TC-317	Artificial Intelligence and Machine Learning	2	1	3	EF-304	Occupational Safety & Health	2	0	2
EE-374	Feedback Control Systems	3	1	4	TC-314	Wireless & Mobile Communication	3	1	4
TC-313	Antenna and Microwave Engineering	3	1	4	TC-315	Optical Fiber Communication	3	1	4
TC-307	Communication System	3	1	4	TC-311	Digital Communication and Information Theory	3	1	4
					##-###	Foreign Language-1	NC		
<b>Total</b>		<b>14</b>	<b>4</b>	<b>19</b>	<b>Total</b>		<b>14</b>	<b>4</b>	<b>18</b>

FINAL YEAR									
Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hours			Course Code	Course Title	Credit Hours		
		Th	Pr	Total			Th	Pr	Total
MT-442	Numerical Methods	3	0	3	MG-481	Entrepreneurship	3	0	3
CS-430	Microprocessor programming and interfacing	3	1	4	TC-434	Telecommunications Switching Systems	2	1	3
TC-XXX	Elective 1	2	0	2	TC-XXX	Elective 2	2	0	2
MG-482	Organization Behavior	3	0	3	TC-431	Wireless Technologies and RF Planning	2	0	2
##-###	Foreign Language-II	NC			TC-432	Communication Security	2	0	2
TC-490	Telecommunications Engineering Project*	0	3	3	TC-490	Telecommunications Engineering Project*	0	3	3
<b>Total</b>		<b>11</b>	<b>4</b>	<b>15</b>	<b>Total</b>		<b>10</b>	<b>7</b>	<b>17</b>

Elective 1 courses			Elective 2 courses		
TC	Course Title	Total	TC	Course Title	Total
TC-429	Telecom Policies & Standards	2	TC-422	Satellite Communication	2
TC-430	Multimedia Communication Systems	2	TC-423	Navigational Aids and Radar Systems	2
TC-433	Internet of Things	2	TC-427	Digital Image Processing	2

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

## **FIRST YEAR (FALL SEMESTER)**

### **EA-111      Functional English**

#### **Speaking and Listening**

Listening actively through the use of skills and sub skills, and in a variety of situations, speaking: Fluency and confidence building through group discussions, role plays and public speaking.

#### **Vocabulary development**

Tips / strategies in vocabulary enhancement, Practice in vocabulary development

#### **Reading**

Reading skills, Sub skills, Reading strategies, Reading practice through variety of reading texts and comprehension exercises, Précis writing

#### **Writing**

Note taking: Techniques for taking notes from lectures, from books ( integrated with listening & reading), Process of Writing with practice in pre writing strategies, in revising, and in, editing for grammar, Writing well- structured and effective paragraphs, essays and letters (routine communication) using proper writing mechanics. Writing descriptions, narrations, cause and effect, compare and contrast etc.

### **MT-114      Calculus**

#### **Set and Functions**

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

#### **Differential Calculus**

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

#### **Integral Calculus**

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

#### **Sequence & Series**

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

**Complex Number**

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

**EE-120 Basic Electrical Engineering**

**Fundamentals of Electric Circuits:**

Charge, Current, Voltage and Power, Voltage and Current Sources, Ohm's Law;

**Voltage and Current laws:**

Nodes, Paths, Loops and branches, Kirchhoff's Current Law, Kirchhoff's voltage Law, the Single-Loop Circuits, the single Node-pair Circuit, Series and parallel Connected Independent Sources, Resistors in series and parallel, Voltage and Current Division.

**Basic Nodal and Mesh Analysis:**

Multi-Nodal Analysis, the super node, Mesh Analysis, The Super mesh.

**Circuit Analysis Techniques:**

Linearity and superposition, source transformations, Thevenin and Norton equivalent circuits, maximum power transfer, delta-wye conversion 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

**Capacitors and Inductors:**

Capacitor, Inductor, capacitance and Inductance Combination

**Basic RL and RC circuit:**

The source free RL circuit, Properties of Exponential response, Source free RC circuits, Unit-Step function, Driven RL circuits, natural and forced response, Driven RL circuits

**The RLC Circuit:**

The Source-Free Parallel Circuit, the over damped parallel RLC Circuit, Critical Damping, the under Damped Parallel RLC Circuit, the Source-Free Series RLC Circuit, complete Response of the RLC Circuit, the Lossless LC Circuit

**Lab work:**

The practical work will be based on the above course

**TC-106 Computer Programming**

**Computer Fundamental:** Number Systems; Conversion between bases, computer arithmetic; Structure and Organization of Computers Systems; Classification of Software

Systems; Introduction to Software Development Process; Levels of Programming Languages.

**Introduction to Programming Languages:** Overview of programming, writing, compiling and debugging,

**Building Blocks:** data types, variables, Input/output functions.

**Operators:** Arithmetic, Relational, logical and Assignment Operators.

**Decisions:** if-else statements, conditional Statements, Switch, break, continue

**Loops:** for Loop, while loop, do while loop.

**Modular programming:** declaring, definition, calling functions.

**Arrays and strings:** single and multidimensional arrays, sorting, strings and string functions.

**Pointers:** Pointer overview, Returning data from functions, Pointers and arrays, Pointers and strings, Pointers to pointers.

**Structures:** defining, structures with arrays, Dynamic memory allocation.

**Object Oriented Programming:** Object-Oriented Programming Language features, Classes and objects, Constructors and memory allocations, Inheritance, Function overloading, Operator overloading.

## **ES-105**

### **Pakistan Studies**

#### **Historical and ideological perspective of Pakistan Movement**

**Two nation theory:** Definition, Significance.

**Creation of Pakistan:** Factors leading to the creation of Pakistan, Quaid-e-Azam and the demand for Pakistan

#### **Land of Pakistan:**

Geo-physical conditions, Geo-political and strategic importance of Pakistan, Natural resources, water and power

#### **Constitutional Process:**

Early efforts to make a constitution-problems and issues, Constitution of 1956 and its abrogation, Constitution of 1962 and its abrogation, Constitutional and Political crisis of 1971, Constitution of 1973, Subsequent constitutional developments

#### **Contemporary Issues in Pakistan**

**A brief survey of Pakistan's Economy:**

Agricultural and industrial development in Pakistan, Internal and external trade, Economic planning and prospects

**Social issues:**

Literacy & education in Pakistan, State of science & technology with special reference to IT education, Pakistan society and culture.

**Environmental issues:**

Hazards of atmospheric pollution, other forms of environmental degradation, their causes & solutions, Pakistan's role in preservation of nature through international conventions/efforts

**Foreign Policy**

Relations of Pakistan with neighbours, Relations with Super powers, Relations with Muslim world.

**Human Rights:**

Conceptual foundations of Human Rights- What are Human rights? Definition, significance and importance, Comparative analysis of Islamic and western Perspectives of Human rights. UN System for Protection of Human rights - an over-view: UN Charter, International Bill of Human Rights, Implementation mechanism. Other important international treaties and conventions - The convention on the elimination of all forms of discrimination against woman, International Convention on the rights of child (CRC), Convention against torture (CAT), Refugee Convention. Pakistan's response to Human rights at national and international level -Constitutional Provisions, Pakistan's obligations to international treaties and documents, Minority rights in Pakistan, Pakistan's stand on violation of Human rights in the international perspective

**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

**PH-112 Applied Physics**

**Electrostatics and Magnetism:**

Coulombs Law. Electrostatic potential energy of discrete charges. Continuous charge distribution. Gauss's Law. Electric field around conductors. Magnetic fields. Magnetic force on current. Hall effect. Biot-Savart Law. Ampere's Law. Fields of rings and coils. Magnetic dipole. Diamagnetism, Paramagnetism and Ferromagnetism.

**Semiconductor Physics:**

Energy levels in a semiconductor. Hole concept. Intrinsic and Extrinsic regions. Law of Mass Action. P-N junction. Transistor

**Waves and Oscillations:**

Simple Harmonic Oscillator, Damped Harmonic Oscillation, Forced Oscillation and Resonance, Type of Waves. Superposition Principle, Wave Speed on a stretched string.

**Optics and Lasers:**

Two-slit interference. Huygens Principle. Single-slit diffraction. Resolving power of optical instruments. Principles for laser action, Types of laser, Application of laser.

**Modern Physics:**

Planck's explanations of black body radiation Photoelectric effect, Compton effect. Bohr's theory of Hydrogen atom Atomic spectra, Reduce mass, De-Broglie hypothesis, Electron microscope, Atomic Nucleus and Properties of Nucleus, Radioactive Decay, Radioactive Dating, Radiation Detection Instruments, Nuclear Reactions and Nuclear Reactor, Nuclear Fusion.

**Lab work:**

The practical work will be based on the above course

**FIRST YEAR (SPRING SEMESTER)**

**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.

**Lab work:**

The practical work will be based on the above course

**CY-110 Applied Chemistry for Engineers**

**Gases**

Kinetic Gas Equation, Vander Waal's Equation, Critical phenomenon, Liquefaction of gases, specified heat (molar heat capacity).

**Properties of Solution & Liquids**

Surface Tension, Viscosity, Osmosis, Osmotic Pressure, pH-Buffer solution, Spectrophotometer, Basic concepts of Colloidal Chemistry, Classification purification (dialysis).

**Thermochemistry**

Chemical thermodynamics, Hess's Law, Heat of reaction, Relation between H and U measurement of heat reaction, Bomb Calorimeter

**Electrochemistry**

Laws of Electrolysis, E.M.F. series, corrosion (Theories, inhibition & protection).

**Water & Sewage**

Sources of water, impurities, hardness, water softening, purification of water for potable and industrial purposes, electro dialysis, introduction to environmental pollution, main sources and effects, Sewage treatment.

**Fuels**

Types of fuels, classification of fossil fuels.

**Metals & Alloys**

Properties and general composition of metals and alloys such as Iron, Copper, Aluminum, Chromium, Zinc used in engineering field

**Engineering Materials**

Inorganic engineering materials: Cement, Class Organic engineering materials: Polymers, Rubbers, Plastics and Paints, Semiconductors and Dielectric materials.

**Lab work:**

The practical work will be based on the above course

**EE-121      Circuit Analysis**

**AC Circuits:**

Sinusoids and Phasors, Phasor Relationship for Circuit Elements, Impedance and Admittance, Kirchhoff's Laws in the Frequency Domain, Impedance Combinations

**Sinusoidal Steady State Analysis:**

Nodal Analysis, Mesh Analysis    Superposition Theorem, Source Transformation, Thevenin and Norton Equivalent Circuits, Op Amp AC Circuits

**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 why- Delta Connection, Balanced Delta-Delta Connection, Balanced Delta-Why 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

**Lab work:**

The practical work will be based on the above course

**EL-104      Electronic Engineering Drawing and 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

## **MT-272      Differential Equations**

### **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 . Application in relevant Engineering: orthogonal trajectories: Numerical approximation to solutions ; Solution in series. Euler method, Euler modified method, Runge Kutta method of order 4.

### **2<sup>nd</sup> and Higher Orders Equations**

Special types of 2<sup>nd</sup> 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.

### **Laplace Integral & Transformation**

Definition, Laplace transforms of some elementary functions, first translation or shifting theorem, second translation or shifting theorem, change of scale property, Laplace transform of the nth order derivative, initial and final value theorem Laplace transform of integrals. Laplace transform of functions  $t^n F(t)$  and  $F(t)/t$ , Laplace transform of periodic function, evaluation of integrals, definition of inverse Laplace transform and inverse transforms, convolution theorem, solutions of ordinary differential using Laplace transform

## **SECOND YEAR (FALL SEMESTER)**

### **ES-205      Islamic Studies**

**Quranic Verses: Tauheed:** Al-Ambiya – 22, Al-Baqarah – 163 & 164.

**Prophet hood:** Al-Imran – 79, Al – Huda – 7, Al-Maidah – **Here-After:** Al-Baqarah – 48, and one Hadith. **Basic Islamic Practices:** Al-Mu' minun-1-11, and two Ahadith

#### **Amer-Bil – Ma ‘ Roof Wa-Nahi Anil Munkar:**

The concept of Good & Evil, Importance and necessity of Da'wat-e-Deen Al-Imran – 110, Method of Da'wat-e-Deen An-Nehl-125, Al-Imran-104, and two Ahadith

#### **Unity of the Ummah:**

Al-Imran-103, Al-Hujurat-10, Al-Imran-64, Al-An' am –108, and two Ahadith .

**Kasb-e-Halal:**

Ta ha-81, Al- A'raf-32-33, Al-Baqarah-188, and two Ahadith.

**Haquq-ul-Ibad:**

Protection of life (Al-Maidah-32), Right to Property (Al-Nisa-29), Right to Respect & Dignity (Al-Hujurat –11-12), Freedom of Expression (Al-Baqarah-256), Equality: (Al-Hujurat-13) , Economic Security: (Al-Ma' arij – 24-25), Employment Opportunity on Merit: (An-Nisa-58), Access to Justice: (An- Nisa-135)

**Women's Rights:**

An-Nehl - 97, Al-Ahzab - 35, An-Nisa - 07. Relations with Non-Muslims: Al-Mumtahanah-8-9, Al-Anfa'al –61 and The last sermon of Hajj of Holy Prophet (PBUH): Relevant extracts

**Seerat (life) of the Holy Prophet (PBUH):**

Birth, life at Makkah, declaration of prophet hood, preaching & its difficulties, migration to Madina, brotherhood (Mawakhat)& Madina Charter, The Holy Wars of the Prophet (Ghazwat-e-Nabawi), Hujjat-ul-Wida, The last sermon of Khutbatulwida, Translation and important points

**Islamic Civilization:**

a) In the sub-continent: pre- Islamic civilizations. The political, social & moral impacts of Islamic civilization (b) EEin the world: academic, intellectual, social & cultural impact of Islam on the world

**ES-209**

**Ethical Behaviour**

**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, rationalism, Kant's moral Philosophy.

**Ethics & Religion:**

The relation of Ethics to religion, Basic ethical principles of major religions: Hinduism, Judaism, Buddhism, Zoroastrianism, Christianity, and Islam.

**Ethics, Society and moral theory:**

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

**TC-206**

**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.

**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

**Lab work:**

The practical work will be based on the above course

**TC-205 Digital Logic Design**

**Combinational Logic Design:** Logic gates, Boolean Equation, Boolean Algebra, Multilevel Combinational Logic, Karnaugh Maps, Combinational Building Blocks (Multiplexers and Decoders), NAND and NOR based combinational circuits, and Multiplexer based combinational circuit.

**Sequential Logic Design:** Latches, Flip Flops, Registers, Counters, Finite state machines, Pipelining, Timing issues of sequential logic.

**Programmable Logic Devices (PLDs):** Introduction to PLDs, Structure of complex PLDs, Structure of FPGA.

**Hardware Description Language (HDL):** Introduction to HDL coding, HDL coding of Combinational logic, HDL coding of Sequential Logic, HDL coding of Finite state machine, and basic of Test benches.

**Computer Architecture:** RISC and CISC architecture, Addressing modes, Cache, Machine/assembly instruction, Micro architecture.

**Lab work:**

The practical work will be based on the above course

**CS-216 Data Structure and Algorithms**

**Basic Concepts:**

Introduction and classification of Data Structures; Basic operations,

**Classification of Algorithms:**

Classification by implementation; Classification by design paradigm.

**Basics of Complexity Analysis**

Rate of Growth of Complexity of Algorithms; Asymptotic notations; Time Space Trade Offs.

**String Processing:**

Operations on strings; Word Processing; Pattern Matching Algorithms.

**Arrays:**

One dimensional Arrays: Searching and Sorting Algorithms; Multidimensional Arrays: Matrix Multiplication, Sparse Matrices.  
Stacks,

**Queues and Recursion:**

Basic concepts and functions; Polish Notation; Quicksort; Deques; Priority Queues; Factorial Calculation; Fibonacci Series; Ackermann Function, Towers of Hanoi.

**Linked Lists:**

Definition and Representation; Traversal and Searching; Insertion; Deletion; Circular Lists; Doubly Linked Lists.

**Trees Terminology:**

Representation in memory; Binary Trees: Traversal Algorithms; Binary Search Trees, Heaps; Heapsort algorithm. Graphs Terminology; Representation in memory;

**Traversal Algorithms:**

Shortest Path Algorithms. Sorting and Searching, Sorting Algorithms; Hashing

**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, semi-conductors, 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

**SECOND YEAR (SPRING SEMESTER)**

**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, Quantization effects.

**Design of Digital Filters:**

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

**Multirate Signal Processing:**

Down sampling and Up sampling, Decimation and Interpolation.

**Lab work:**

The practical work will be based on the above course

**EF-305      Engineering Economics & Management**

**Introduction:**

Basic concepts and principals of economics, micro- and macro-economics theory, problem of scarcity, basic concept of engineering economics, financial effectiveness and non-monetary factors

**Economic Environment:**

Consumer and producer goods, goods and services, demand and supply concepts, market equilibrium, elasticity of demand, elasticity of supply, measures of economic 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 than once a year, present value , future value and annuities, uniform gradient and geometric sequence of cash flow

**Depreciation and Taxes:**

Depreciation concepts, economic life, methods of depreciation, gain (loss) on the disposal of an asset, depreciation as tax shield

**Basic Cost Concepts and Break-Even analysis:**



Types of costs and cost curves, determination of Cost/Revenue numerical and graphical presentation, practical application, BEL as management tool for achieving financial/operational efficiency

**Linear Programming:**

Mathematical statement of Linear Programming, problems, Graphical solutions, Simplex method, Duality problem

**Business organizations and Financial Institutions:**

Type of ownership, Single ownership, partnership, Corporation, types 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, reduce project time, Project selection and comparing alternative techniques, scheduling resources

**Introduction to Production Management and Production concepts:**

Basic production function, stages of production, returns to scale, Production lead time, Production rate capacity, operations, Planning and control, order processing, scheduling, material requisitions planning, Line of balance

**MT-272**

**Linear Algebra and Geometry**

**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 tri-diagonal matrix), 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, transitions matrix.

**Euclidean Spaces and Transformation:**

Geometric representation of vector, norm of vector, Euclidean inner product, projections and orthogonal projections, Euclidean n spaces n properties Cauchy-Schwarz inequality, Euclidean transformations, apply geometric transformations to plane figure, composition of transformations.

**Application of linear Algebra:**

Leontief Economic models, Electrical Networks, Scaling, translation, rotation, and projection etc.

**Eigen values & Eigen Spaces:**

Interpret eigenvectors and eigenvalues of a matrix in terms of transformation it represents, convert a transformation into a matrix eigen value problem, find the eigenvalues and eigenvectors of order not more than  $3 \times 3$  matrices algebraically, determine the modal matrix for a given matrix, reduce a matrix to diagonal (form and Jordan form, state the Cayley-Hamilton theorem and use it to find powers and the inverse of a matrix, understand a simple numerical method for finding the eigenvectors of a matrix, use appropriate software to compute the eigenvalues and eigenvectors of a matrix, Define quadratic form and determine its nature using eigenvalues.

**Solid Geometry:**

Coordinate Systems in three dimensions. Direction cosines and ratios, vector equation of a straight line, plane and sphere, curve tracing of a function of two and three variables, Surfaces of revolutions. Transformations (Cartesian to polar & cylindrical)

**EE-223 Instrumentation and Measurement**

**General Theory**

Classification of Instruments, block diagram of various instrumentation schemes, performance characteristics of instrumentation

**Measurement of electrical Quantities**

Basics of electromechanical instruments, moving coil and electro-dynamometer instruments as ammeter, voltmeter and ohmmeter, extension of ranges

**Instrumentation transformers:**

Their burden and accuracy, clamp meter, active and reactive power measurement, Max. demand indicator, classification of energy meter, induction type KWH meter, p.f meter

**Electronic Instruments:**

Data Acquisition, A/D conversion, electronic and digital voltmeters, digital frequency meter, time interval measurement, power and energy meter

**Transducers:**

Temperature transducers, pressure transducers, variable resistance and inductance transducers, linear variable differential transformers (LVDT), capacitive photoconductive and piezo-electric transducers, thermos electric transducers

**Measurement of Non-electrical quantities:**

Measurement of temperature, pressure, flow strains, thermal conductivity, motion, speed and vibrations

**Lab work:**

The practical work will be based on the above course

**EA-214 Academic Writing**

**Writing Process**

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

**Reading & Writing**

Analyzing different texts: identifying point of views, claims, assumptions, differentiate facts from opinions, Practicing Academic Language: differentiate using language of opinion and fact. Synthesize information: Developing critical write up with relevant factual information, personal views, academic evidence, examples, cause and effect etc. Presenting and describing visuals (tables & graphs) Avoiding plagiarism and ensuring originality: summarizing, paraphrasing and quoting sources, citing, documenting sources through a referencing system (MLA / APA / Harvard style, as suggested by the discipline)

**Writing products**

Writing a well-structured paragraph (topic sentence, supporting details, conclusion)  
Writing narrative, descriptive, expository, and argumentative essays Developing an effective essay using thesis statement, adequate development and argument, supporting details, and conclusion, Writing short reports (technical reports)

**MT-331 Probability & Statistics**

**Statistics:**

Introduction, Types of data & variables, presentation to data, object, classifications, Tabulation, Frequency distribution, Graphical representation, Simple & Multiple Bar diagrams, Sartorial & Pie-Diagram, Histogram, Frequency Polygon, Frequency Curves & their types.

**Measures of central tendency and dispersion:**

Statistics Averages, Median Mode, Quartiles, Range, Moments, Skew ness & Kurtosis, Quartile Deviation, Mean Deviation, Standard Deviation, Variance & its coefficient, Practical Significance in related problems.

**Curve fitting:**

Introduction, fitting of a first and second degree curve, fitting of exponential and logarithmic curves, related problems. Principle of least squares, Second order Statistics & Time series not in bit detail.

**Simple regression & correlation**

Introduction, Scatter diagrams, Correlation & its Coefficient, Regression lines, Rank Correlation & its Coefficient, Probable Error (P.E), Related problems.

**Sampling and sampling distributions**

Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors, Random Sampling, Sampling with & 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 tails & two tails tests. Application in related problems.

**Probability**

Basic concepts, Permutation & Combination, Definitions of probability, Laws of probability. Conditional probability, Baye'snile. Related problems in practical significance.

**Random variables**

Introduction, Discrete & Continuous random variables, Random Sequences and transformations. Probability distribution, Probability density function, Distribution function, Mathematical expectations, Moment Generating Function (M.G.F.), Markov random walks chain/ Related problems.

**Probability distributions**

Introduction, Discrete probability distributions, Binomial Poisson, Hyper geometric & Negative binomial distributions. Continuous probability distribution, Uniform, Exponential & Normal distributions & their practical significance

**THIRD YEAR (FALL SEMESTER)**

**EA-304 Business Communication and Ethics**

**Communication Skills (oral):**

Definitions and Conditions, Modes: verbal, non-verbal, vocal, non-vocal, sender, Receiver, en-coding, decoding, noise, context, emotional maturity, relationships, etc. Language, perception, Non-verbal, body language, physical appearance, cultural differences etc. Personal and interpersonal skills / perceptions, Communication dilemmas and problems; Public Speaking – speaking situation, persuasion, Making presentations, Interviews

**Business Writing:**

Formal / Business letters, e-mails: a) job applications and resumes/ cv, b) enquiries, c) complaints / adjustments, d) orders, e) quotations, f) banking etc. Memos: layout, language, style Meeting management: notice, agenda, conducting / participating, writing minutes. Contracts and agreements (basic theoretical knowledge and comprehension), Research / scientific reports: types, structure, layout / presentation, writing process etc. Tenders (basic theoretical knowledge and comprehension)

**Engineering / Business Ethics:**

Need and objectives for code of ethics and its importance, Type of ethics, involvement and impact in daily life Problems / conflicts / dilemmas in application (case studies) Sexual Harassment / discrimination in the workplace why it occurs, myths regarding sexual harassment, how to deal with it, gender equality, respect etc.

**Codes of conduct:**

Pakistan Engineering Council, Code for Gender Justice, Brief study of other codes of conduct.

**TC-317 Artificial Intelligence and Machine Learning**

**Introduction to Artificial Intelligence:**

Overview of AI and its applications, AI Branches.

**Machine Learning:**

Basics of Machine Learning, Supervised and unsupervised learning, Regression, Cost function, Gradient Descent and its different types, over fitting, under fitting and Regularization, Clustering, K-means clustering.

**Neural networks:**

Introduction to perceptron, its working and limitations, multilayer neural networks, cost function, cross-entropy function and classification, Back propagation Algorithm, Deep Learning and its architecture.

**EE-374      Feedback Control Systems**

Introduction to control System, Linear systems and differential equations, Time response of linear systems, Laplace transforms, z-transform, block diagram algebra, control systems characteristics, root locus, Introduction to digital controls, linear difference equations, stability analysis in z-domain, discrete equivalents of Laplace-transfer functions and PID Controller.

**Lab work:**

The practical work will be based on the above course

**TC-313      Antenna and Microwave Engineering**

**Transmission Lines:**

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, Transmission line couplers.

**Smith Chart and Scattering Parameters:**

Smith chart Impedance, Admittance manipulation on the chart, Smith chart theory and applications, Reflection coefficient, Impedance of distributed circuits, Impedance matching, S-Parameters

**Basic Features of Radio Communication Systems:**

Radio communication systems, Radio wave propagation techniques, Antenna properties and measurement of antenna characteristics.

**Array Antennas :**

Uniform linear array of Isotropic elements, Polar diagram, Broadside array of equally spaced, equal amplitude radiators, Endfire array of equally spaced, equal amplitude radiators, Scanned line array beam width, Optimum element spacing, Array design using the theory of polynomials. Optimum spacing for broadside and end-fire arrays, Harsen Condition, The binomial array, Super gain array, Chebysev array, Pattern synthesis

**Microwave Engineering:**

Strip Lines, Microstrip Lines, Coupled Strip lines/Coupled microstrip lines, Microwave Filter Design, Microwave Amplifier design, Power dividers, Directional Couplers and Circulators

**Lab work:**

The practical work will be based on the above course

**TC-307      Communication Systems**

**Introduction:**

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

**Random Signal Analysis:**

Review of probability and random variables, statistical measures, Probability models, Introduction to random processes.

**Analog Communication:**

Baseband and carrier 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.

**Lab work:**

The practical work will be based on the above course

**THIRD YEAR (SPRING SEMESTER)**

**TC-421      Telecommunications 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).

**Lab work:**

The practical work will be based on the above course

**EF-304 Occupational Safety & Health**

Introduction to Occupational Safety and Health, Historic development in the subject, Safety Legislations, Safety and Ethics;

Hazards – Mechanical and Machine, Falling, lifting and Vision related hazards, Temperature and Pressure, Electrical, Fire, Radiation, Chemical and Material, Noise and Vibration, Computers and Automation related Hazards, Industrial Hygiene and Confined Spaces; Case Studies

Hazard Analysis, Concept of Risks, Incident and Accidents, Accident Prevention and Control, Personal Protective Equipment, Management Responsibilities, Accident Causation, Reporting and Investigation, case Studies

Developing and maintaining Safety Culture, OSH and Environment codes, standards and regulations, ISO standards 14001 and 45001/BS OHSAS 18001.

**TC-314 WIRELESS & MOBILE COMMUNICATION**

**Introduction to Wireless Communication Systems:**

Evolution of Mobile Radio Communications, Examples of Wireless Communication Systems, Paging Systems, Cordless Telephone Systems, Cellular Telephone Systems.

**The Cellular Concept-System Design Fundamentals:**

Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference & System Capacity, Improving Coverage & Capacity in Cellular Systems Trunking & GoS

**Mobile Radio Propagation:**

Large Scale Path Loss, Basic Propagation Mechanisms, Free Space propagation Model, Outdoor Propagation Models, Indoor Propagation Models, Practical Link Budget Design.

**Small Scale Fading & Multipath:**

Multipath Propagations, Parameters of Mobile Multipath Channels, Types of Small Scale Fading.

**Modulation Techniques for Mobile Radio:**

FM vs AM, Overview of Digital Modulation, Spread Spectrum Modulation Techniques, Modulation Performance in Fading & Multipath Channels.

**Multiple Access Techniques for Wireless Communication:**

Frequency Division Multiple Access, Time Division Multiple Access, Spread Spectrum Multiple Access, Space Division Multiple Access, Packet Radio.

**Wireless Networks**

**Lab work:**

The practical work will be based on the above course

## **TC-315      Optical Fiber Communication**

### **Introduction:**

Comparison between optical and electrical mediums, basic optical communication system, Snell's law, refractive index, line width, optical and electrical bandwidth.

### **Basics of optical fiber:**

Step index fiber, graded index fiber, refractive index profiles, meridional and skew rays, acceptance angle and acceptance con, numerical aperture for meridional and skew rays.

### **Wave theory of light for optical fibers:**

EM waves, modes, modes in planar wave guides, wave guide condition, evanescent waves, phase velocity, group velocity, group index, modes in cylindrical fibers, Parameters for single mode fiber (cutoff wavelength, mode field diameter, effective refractive index, group delay)

### **Transmission characteristics of optical fiber:**

Attenuation due to: (i) absorption, (ii) scattering (iii) bending losses Dispersion, Reflectance and optical return losses, special types of fibers.

### **Elements of Optical communication system:**

Optical sources, modulators and modulating schemes, line coding, optical detectors, demodulator and demodulation methods, couplers, connectors, switches, splicing, optical amplifiers and repeaters, Optical time division multiplexing, wavelength division multiplexing (techniques and devices) link budgeting w.r.t time and power.

### **Optical Networks:**

LAN system, FDDI, SONETS and SDH, Wavelength routing based optical networks, Optical burst switching.

### **Lab work:**

The practical work will be based on the above course

## **TC-311      Digital Communication and Information Theory**

### **Introduction to Digital Communication**

Why Digital? Elements Digital Communication System, Basic transmission, Bits, Baud, Timing, Distortion and Channel Capacity, Digital input-output Devices, Digital Transmission on Analog Channel

### **Formatting & Base Band Modulation**

Analog to Digital Conversion, Sampling Theory, Quantization & its Types, Pulse Code Modulation (Linear Companded), Delta Modulation, Waveform Representation of Binary Digits, PCM Waveform Types, M-ary Modulation Waveforms

### **Base Band Demodulation/ Detection Theory**

Basic Detection Theory & Optimum Receiver Design, Detection of Binary Signal in Gaussian Noise, The Matched Filter, Inter Symbol Interference, Equalization



**Digital Modulation Techniques**

Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Phase Shift Keying (PSK,DPSK,QPSK), Detection of Modulated Signal, M-Ary Digital Modulation Schemes, Sampled Matched Filter

**Multiplexing, Framing & Synchronization**

Information Theory, Information measure, Entropy, Information rate, Shannon's Theorem, Coding for discrete memory less source. Information Transmission on Discrete Channel, Discrete Channel Capacity, Linear Block Codes, Cyclic codes

**Lab work:**

The practical work will be based on the above course

**FINAL YEAR (FALL SEMESTER)**

**MT-442 Numerical Methods**

**Error Analysis**

Types of errors (relative, Absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart. Use any Computational tools to Analysis the Numerical Solutions.

**Linear Operators**

Functions of operators, difference operators and the derivative operators, identities.

**Difference Equations**

Linear homogeneous and nonhomogeneous difference 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 the solutions of system of linear equations (Gauss-Elimination, Gauss-Jordan Elimination, triangularization, Cholesky, Jacobi and Gauss Seidel)

**Interpolation &- Curve Fitting**

Lagrange's, Newton, Hermit, Spline, least squares approximation. (Linear and non-linear curves)

**Numerical Integration & Differentiation**

Computation of integrals using simple Trapezoidal rule, 1/3th Simpson's rule, 3/8th 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.

**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 Functions, Addressing Modes, Instruction Set Architecture: (Data Transfer Instructions, Arithmetic & Logic Instructions, Branch Instructions), Assembly Programming and Testing, Assembler Directives, Macros, Procedures, Instruction Encoding, Bus Cycles, Rest Circuit, Clock Generation Circuit, Wait States, Memory Interfacing, Memory Speed Requirements, I/O Interfacing, Programmable Peripheral Interface, Programmable Interval Timer, Programmable Interrupt Controller, Microprocessor System, Design; Recent Microcontroller Architectures.

**Lab work:**

The practical work will be based on the above course

**MG-482      Organizational Behavior**

**Foundations of Organizational Behavior (OB):**

Management functions, roles, and skills; Effective versus successful managerial activities; replacing intuition with systematic study

**Exploring OB challenges and opportunities facing globalization:**

Improving quality and productivity; improving people skills; managing work force diversity; responding to globalization; empowering people; stimulating innovation and change; coping with temporariness; handling declining employee loyalty; improving ethical behaviour

**Foundations of Individual Behaviour:**

Individuals & Organizations: Biographical traits and ability & personality,

**Perceptions and individual decision making:**

Understanding perception and its significance, factors influencing perception; linking perception and individual decision making; optimizing decision making model; alternative decision making models; issues in decision making,

**Values, attitudes and job satisfaction:**

Importance, sources, types of values; sources and types of attitude; attitude and consistency; measuring job

**TC-490 TELECOMMUNICATIONS ENGINEERING PROJECT**

The final year students will be required to consult the Chairman Department of Telecommunications Engineering regarding the offering of various projects in the department and industry. 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 and / or external supervisor.

**FINAL YEAR (SPRING SEMESTER)**

**MG-481 Entrepreneurship**

Understanding the Entrepreneurship Mind-set ,The revolution impact of Entrepreneurship, The individual Entrepreneurship Mind-set, Corporate Entrepreneurship Mind-set ,The Social and Ethical perspectives of Entrepreneurship, Launching Entrepreneurship Ventures, Creativity and innovations, Methods to initiate ventures, Legal challenges in Entrepreneurship, The search for Entrepreneurship Capital, Formulation of Entrepreneurship Plan, The assessment of function with opportunities, The marketing aspects of new ventures, Financial statements in new ventures, Business plan preparation for new ventures, Strategic Perspectives in Entrepreneurship, Strategies growth in Entrepreneurship, Valuation challenges in Entrepreneurship, Final harvest of a new venture

**TC-434 Telecommunication Switching System**

**Telephone Instruments and Public Switched Telephone Network:**

Introduction to Telephone, Basic functions of a telephone set, Switching System Evolution from Strowger Switch to Electronic Switching Systems, Network Topology and Hierarchy of Exchanges

**Switching Systems:**

Introduction, Space Division Analog Switch, PCM Switching and Digital Switches, Approaches to PCM Switching: Time switching, Space Switching, Space and Time switching and their comparison, Electronic Switching Systems, Digital network synchronization

**Integrated Services Digital Network (ISDN):**

ISDN Services, Reference Model, B, D, H- Channels, BRI, PRI, Layer 2 protocol- LAPD, Layer3 of ISDN

**Introduction to Signaling System no. 7(SS7):**

Introduction to SS7 and its services, SS7 Architecture, Network Entities, Datalinks, Signaling Units. SS7 Layers, SS7 reference model.

**Integration of PSTN and IP Telephone Network:**

Next Generation Architecture, Media Gateways, Media Gateway Controllers, Signaling Gateway, SS7 over IP (SIGTRAN), SCTP and User Adaptation

**IP Telephony:**

Voice call control protocols over IP, H.323 Protocol Suite, Session Initiation Protocol (SIP).

**Lab work:**

The practical work will be based on the above course.

**TC-431 Wireless Technologies and RF Planning**

Introduction to wireless technologies, Broadband Wireless alternatives, , LTE (Long Term Evolution), LTE-A, Mobile TV Platforms, Multimedia Broadcast/ Multicast Services (MBMS), Cellular and WLAN/ WMAN/ WPAN technologies,

RF Planning and Optimization: Introduction to RF environment and propagation model, Wireless network planning process, Antenna and feeder system, Site survey, Link budget, Network optimization process, Access optimization, signaling trace, Handoff optimization, Power control optimization, Drop call optimization.

Introduction to 5G technologies.

**TC-432 COMMUNICATION SECURITY**

**Introduction to Communications Security:** Major factors addressing security analysis of a Telecommunication systems, End points, Databases and Infrastructure.

**IT and Operational Technology security:** Overview of security standards related to IT and operational technology OT security. Goals, Policies and Governance structure.

**Risk and vulnerability identification and management:** Understanding of Different types of attacks and viruses. Risk Management including identifying common threats, vulnerabilities and risks and their mitigating strategies.

**Communications Security Tools:** Understanding of Security tools including Firewalls, Shannon's theory of perfect secrecy, shift and product cipher, secret key and public/private key cryptography, cryptographic hashes and message digests, authentication systems, digital signatures and certificates, electronic mail security, web security.

**TC-490 TELECOMMUNICATIONS ENGINEERING PROJECT**

The final year students will be required to consult the Chairman Department of Telecommunications Engineering regarding the offering of various projects in the department and industry. 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 and / or external supervisor.

## **ELECTIVE COURSES**

### **TC-422      Satellite Communication**

Introduction, Background and Applications, Orbital Mechanics, Geostationary and Non-geostationary Orbits, Launching and Spacecraft subsystems, Satellite Link Design, Modulation Schemes, Multiple Access Schemes, Coding, Propagation Aspects, Earth Station Technology, VSATs and Network Architectures, GPS and future trends

### **TC-423      Navigational Aids and Radar Systems**

#### **An Introduction to Radar:**

Basic Radar, The simple form of the Radar Equation, Radar block diagram, Radar frequencies, Application of the Radar, Origin of the radar.

#### **Radar Equations:**

Introduction, detection of signals in noise, receiver noise and signal to noise ratio, Probability density function, Probability of detection and false alarm, Integration of the Radar pulses, Radar cross section of targets, Transmitter power pulse repetition frequency

#### **MTI and Doppler Radar:**

Introduction to Doppler and MTI radar, Delay line cancellers, Staggered pulse repetition frequencies, Limitation to MTI performance.

#### **Tracking Radar:**

Tracking with Radar, Monopulse tracking, conical scan and sequential lobing.

#### **Radar Transmitters & Receivers:**

Introduction, Linear beam power tubes, Magnetron, The Radar receiver, The receiver noise figure, Super Heterodyne receiver, Radar displays.

#### **Propagation of the Radar Waves:**

Introduction, Forward Scattering from a flat earth, Scattering from the round earth surface, Atmospheric Refraction, Standard propagation, Nonstandard propagation.

#### **Navigational aids:**

Terminology used in navigational Systems, Direction finding, GPS, Laser Gyro, Decca, Loran, Beacon system.

### **TC-427      Digital Image Processing**

**Introduction:** Definitions, and applications

#### **Image Fundamentals:**

Models, sampling, quantization and basic operations, Image Enhancement, Point processing, Histogram equalization and specification, spatial domain filtering: Smoothing, Median, & Sharpening. 1-D and 2-D.

#### **Discrete Cosine Transform (DCT):**

Properties of DCT, Comparison with DFT, Different forms of DCT, Application of DCT in image processing

**Color Fundamentals:**

Models, transformation, and enhancement, Image restoration: Degradation and observation models, Inverse filtering, Geometric transformation,

**Image Compression:**

Fundamentals, information theory and entropy concept, Huffman and run-length coding, Compression Standards, Compression of frame Sequences and color images, Image segmentation: Detection of discontinuities, point, line, and edge detection,

**Image Segmentation:**

Thresholding, global and optimal. Region-oriented and Motion-based segmentation, Representation and Description, Computer Vision principles, Practical

**Applications:**

Videoconferencing and Internet applications

**TC-429 Telecom Policies & Standards**

Important Regulatory Terminologies, Pakistan Telecom Industry and regulatory bodies, Functioning of Telecom Regulatory Stakeholders in Pakistan, Familiarization with International and Regional Telecom Organizations, International telecom standardization and regulatory bodies, Standards Setting Process. Types of regulators, Deregulation and Liberalization, Regulating for Effective Competition, Pakistan Telecom Policies, Act, Rules and Regulations, Legislation process. Licensing Procedures, Interconnection regulation, Universal service, Spectrum Management, Number portability regulation, Regulation of electronic media, PEMRA ordinance 2002, PEMRA rules.

**TC-430 Multimedia Communication Systems**

Multimedia systems, multimedia networks and applications, digitizing principles, text, image audio, video information representation, text and image compression techniques (JPEG, MPEG), audio and video compression standards for multimedia communication, transport of high definition video signals and Video on demand. Modem Networking Methods for Multimedia, Multimedia Conferencing, Digital Video Broadcasting.

**TC-433 Internet of Things**

**Introduction to Internet of Things:**

Need and significance of IoT systems, technology and business drivers, Elements of an IoT ecosystem, Protocol layers of IoT networks, IoT applications

**IoT Link and Network Layer:**

Physical and MAC Layer Protocols used in IoT networks, IEEE 802.15.4 (ZigBee), IEEE 802.15.1 (Bluetooth, Bluetooth Low Energy), IEEE 802.11 (WiFi), Thread, LoRaWAN, Cellular IoT, and NB-IoT, network layer function and routing

**IoT Application Layer:**

IoT application layer protocols, overview of MQTT protocol, publisher/subscriber model, overview of Constrained Application Protocol (CoAP), overview of Advanced Message Queuing Protocol (AMQP)

**IoT network implementation:**

IoT use cases and technical considerations during implementation, embedded system selection for IoT end-devices and gateways, interfacing with input devices and output devices, power management, network scaling, cloud data management and analytics, security features for IoT networks

**COURSES OFFERED IN OTHER DEPARTMENTS / PROGRAMMES**

S#	Course Code	Course Title	Offered in (Department)	Credit Hours		
				Th.	Pr.	Total
1	TC-201	Digital Logic Design	Electronic Engg. (EL)	2	1	3
2	TC-202	Signals and Systems	Electronic Engg. (EL)	2	1	3
3	TC-212	Digital Signal Processing	Electronic Engg. (EL)	2	1	3
4	TC-306	Communication Systems	Electrical Engg. (EE)	3	0	3
5	TC-307	Communication Systems	Electronic Engg. (EL)	3	1	4
6	TC-421	Telecommunication Networks	Electronic Engg. (EL)	3	1	4

**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 realisations, 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.

**Minimisation 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 minimisation of product of sums expressions, incompletely specified functions.

**Tabular Minimisation:**

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, Minimisation of the number of states, Clocked Networks.

**Introduction to Verilog HDL and VHDL**

**Lab work:**

The practical work will be based on the above course

**TC-202      Signals and Systems**

**LTI Systems:**

Elementary Continuous-Time and Discrete-Time Signals and Systems, Linear Time-Invariant Systems, Differential and Difference LTI Systems.

**Transforms:**

Continuous time Fourier series, Continuous time Fourier Transform, Discrete Time Fourier Series, Discrete Time Fourier Transform, Discrete Fourier Transform, Laplace Transform, Z-Transform.

**Time-Frequency Analysis of LTI System:**

Introduction to Time Frequency Analysis of Continuous time LTI System, Introduction to Time Frequency Analysis of Discrete-time LTI System.

**Lab work:**

The practical work will be based on the above course

**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, Quantization effects.

**Design of Digital Filters:**

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

**Multirate Signal Processing:**

Down sampling and Up sampling, Decimation and Interpolation.

**Lab work:**

The practical work will be based on the above course

**TC-306      Communication Systems**

**Introduction:**

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

**Random Signal Analysis:**

Review of probability and random variables, statistical measures, Probability models, Introduction to random processes.

**Analog Communication:**

Baseband and carrier 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-307      Communication Systems**

**Introduction:**

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

**Random Signal Analysis:**

Review of probability and random variables, statistical measures, Probability models, Introduction to random processes.

**Analog Communication:**

Baseband and carrier 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.

**Lab work:**

The practical work will be based on the above course

**TC-421      Telecommunications 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).

**Lab work:**

The practical work will be based on the above course.