LIST OF COURSES FOR M.ENGG. PROGRAMME IN TELECOMMUNICATION ENGINEERING

Degree Title: Master of Engineering (Telecommunications)
Specializations:
   (i)   RF Engineering
   (ii)   Telecommunication Networks
Nature of the Programme: Evening Programme
Offered at: Department of Electronic Engineering, NED University of Engineering and Technology, Karachi.
Applicable: 2020 and onwards

Compulsory Courses (common for both specializations)

S#	Code	Course Title	Credit Hours
1	TC-501	Probability and Random Processes	3
2	TC-502	Information Theory	3
3	TC-503	Digital Communication Theory	3
4	TC-504	Advanced Communication Systems	3
5	TC-511	Communication Networks	3

Elective Courses for RF Engineering specialization

S#	Code	Course Title	Credit Hours
1	TC-510	Telecommunication Management	3
2	TC-512	Microwave Systems	3
3	TC-513	Principles of Radar	3
4	TC-514	Mobile Telephone System	3
5	TC-515	Advanced Digital Signal Processing	3
6	TC-516	Satellite Communication	3
7	TC-518	Advanced Optical Communication Systems	3
8	TC-519	Antenna Theory	3
9	TC-531	RF Electronics	3
10	TC-532	Wireless Transceiver Design	3
11	TC-533	Ultra Wideband Communication	3
12	TC-534	Advanced Wireless Systems	3
13	TC-535	Digital Design for Wireless	3
14	TC-536	Software Defined Radios	3
15	TC-537	Advanced Engineering Electromagnetics	3
16	TC-5005	AI in Telecommunications	3
17	TC-5002	Thesis	6

Elective Courses for Telecommunication Networks specialization

S#	Code	Course Title	Credit Hours
1	TC-505	Telecommunications Network Operations	3
2	TC-510	Telecommunication Management	3
3	TC-517	Communication Security	3
4	TC-541	Wireless Networks	3
5	TC-542	Carrier Grade VoIP	3
6	TC-543	Network Programming	3
7	TC-544	Next Generation Networks	3
8	TC-545	Software Defined Network	3
9	TC-546	Traffic Engineering	3
10	TC-547	Optical Networks	3
11	TC-548	Advanced Multimedia Communication	3
12	TC-549	Mobile and Pervasive Computing	3
13	TC-5005	AI in Telecommunications	3
14	TC-5002	Thesis	6

CONTENTS OF COURSES FOR THE M. ENGG. PROGRAMME IN TELECOMMUNICATION ENGINEERING

TC-501   Probability and Random Process

Axioms of probability, Random variable; expected values, Gaussian and Poisson random variable distribution. Function of Random variables, sequences of random variables. Second order statistics. Properties of correlation function, time averages, stationary, Ergodicity. Frequency domain analysis. Time linear operations. Wiener filtering, Gaussian processes.

TC-502   Information Theory

Information measures, Coding Theorem, Data Compression, Entropy, source entropy and Noiseless coding Theorem. Sources coding, Huffman coding. Hamming Distance and code special codes for noise channels.

TC-503   Digital Communication Theory

Detection theory. Statistical decision theory. Bayesian decision, application of detection theory to communication systems. Signal formats binary and M-array Modulations, Coherence and non-coherent detection, probability of error performance. Signal Design and spectral analysis. Channel capacity. Optical communication.

TC-504   Advanced Communication Systems

Review of Fourier transform theory, RF sub-system design, RF channel characteristics, Modulation and demodulation, multiplexing, carrier and sub-carrier signal processing, analog and digital system design, Satellite related RF issues.

TC-505   Telecommunications Network Operations

Overview of Telecommunications Networks and Network Management Systems Introduction to Telecommunications Networks, Introduction to Telecommunications Network Management Systems, Telecommunications Management Network: TMN Functional, Physical and Logical Layered Architectures: What is TMN? Motivation for TMN, TMN Functional Architecture, TMN Physical Architecture, TMN Logical Layered Architecture, TMN Information Architecture and Generic Information Model: TMN Information Architecture, Generic TMN Information Models, Configuration Management: Network Planning and Engineering, Installation and Software Management, Provisioning, NE Resource Status and Control, Performance Management: Performance Monitoring, Performance Analysis, Performance Management Control, Fault Management: Alarm Surveillance, Fault Localisation, Test Management, Fault

Correction and Service Restoration, Trouble Administration, Accounting Management: Accounting Management Process, Usage Metering and Data Collection, AMA Data Processing, Charging and Billing, Security Management: Fraud Prevention, Fraud Detection, Fraud Containment and Recovery, Security Services, Security Mechanisms, Service Management and Service Activation: Service Configuration Management, Service Ordering, Service Provisioning, Service Performance Management.

TC-510   Telecommunication Management

Historical perspective of Telecommunications as a regulated industry. Effects of regulation on industry growth in pre- and post-divestiture environments. Government regulatory agencies and processes. PTA role in Telecom Industry. Management issues related to business between regulated and non-regulated corporations. Tariff structures, rules, and rate-making in the regulated environment. Telecom network operation and management; Traffic Management, Configuration management, Fault management, Telecom Fraud and Billing, Performance Management. Management of Access and Transport networks. Network planning and expansion strategies. Network management using SNMP: Object management, Management information base, Traps.

TC-511   Communication Networks

Review of Markov chain, Queuing theory, open and closed network of queues, priority queuing. Application of stochastic modeling. Optimisation techniques to Communication Network design and Analysis. Data Link Control, Performance models of multi-access channels, Routing and flow control.

TC-512   Microwave Systems

Wave guides and transmission lines, General Microwave circuit theorem. Resonant Cavities, Microwave Junction and scattering matrices, Non-reciprocal devices. Fundamentals of Microwave Filter design.

TC-513   Principles of Radar

Signal propagation problems. Antennas and RF processing. Reflection from targets. Radar equation. Target detection, Swerling's models. Resolution and ambiguity function. Pulse compression, Processing of Pulse train.

TC-514   Mobile Telephone Systems

Need for mobile system, Basic cellular system, Performance criteria, Operation of cellular system, Analog and Digital cellular systems, Elements of cellular system design, Specifications of analog

systems, Cell coverage for signal and traffic, Cell site and mobile antennas, co-channel interference reduction.

TC-515   Advanced Digital Signal Processing

Review of discrete signals and systems in temporal and spectral domains, data acquisition, discrete transforms (DFT, DCT and z-transforms), digital filters-IIR and FIR, spectral estimation, adaptive filters, multi-rate signal processing, Wavelets and joint time-frequency analysis, and real-time signal processing.

TC-516   Satellite Communications

Fundamentals of satellite communication systems: ground stations, sub-systems: link budgets modulation schemes multiple access types and beam switching. Direct Broadcast Systems (DBS). Geostationary and low earth orbit systems and services. Space and ground segment technology. Next generation broadband satellite systems. Fast packet switching on the sitcom link including Asynchronous Transfer Mode (ATM) protocols and IP applications. Satellite optical data links. Satellite position finding systems, NAVSTAR GPS and GLONASS, VSAT.

TC-517   Communication Security

An introduction to Encryption and Security Management: Analog Scrambling, Algorithms, Fundamentals in Key Management. Security Threats and Solutions. Voice Security in Military Applications. Secure GSM Systems: Architecture, Standard Security Features, Custom Security, Key Management and Tools. Electronic Protection Measures. Link and bulk Encryption. Secure e-mail. Management, Support and Training.

TC-518   Advanced Optical Communication Systems

Theory of ray optics, wave optics and electromagnetic optics, planar optical waveguides, wave propagation in cylindrical waveguides, electromagnetic mode theory for optical propagation, single-mode fibers, Transmission Characteristics of Optical Fibers, Losses in optical fibers, intermodal and intramodal dispersion, polarization, optical sources, optical detectors, optical couplers, optical modulators, optical amplifiers, optical-fiber cables and connectors, fiber-optic sensors, Direct Detection Optical Fiber Communication Systems, Coherent Optical Fiber Communication Systems, Free space optical communication.

TC-519   Antenna Theory

Antenna Fundamentals, Properties of individual antennas and arrays of antennas. Retarded potentials, dipoles of arbitrary length, radiation pattern, gain, directivity, radiation resistance.

The loop antenna. Effects of the earth. Reciprocity, receiving antennas, effective length and area. Antenna Arrays: collinear, broadside, endfire. Array synthesis. Mutual coupling. Log-periodic and Yagi arrays. Radiation from apertures: the waveguide horn antenna, parabolic dish. Microstrip patch antennas.

TC-531   RF Electronics

Transceiver architectures and principles, transmission line, smith chat and S-parameters, resonant circuit design, Filter designing, matching circuits, low noise amplifier (LNA), mixer, oscillator, frequency synthesizer, power amplifier, Transistor based RF circuit design, RF circuit design in perspective of integrated Circuit, Practical RF circuit design considerations, RF front-end design, RF design tools

TC-532   Wireless Transceiver Design

Design considerations in different radio environments, Wireless transceiver architecture, Receiver system analysis and design, Homodyne-, Heterodyne- and Superheterodyne-receivers, Direct conversion receiver, Very low IF receiver, Transmitter system analysis and design, Two-step conversion transmitter, Direct launch transmitter, baseband issues in transceiver design, Full-duplex CDMA/FDMA architecture, Performance evaluation of Transceivers, Case studies of Transceiver Design.

TC-533   Ultra Wideband Communication

Ultra wideband (UWB) System, UWB transmission regulations, Historical development of UWB, Impulse Radio UWB, Orthogonal Frequency Division Multiplexing UWB. UWB signaling, UWB data mapping, UWB modulation and demodulation Schemes, Time hop UWB Pulse position modulation UWB. Multipath propagation in UWB, UWB propagation channel model, UWB Transmitter and Receiver techniques, UWB Applications.

TC-534   Advanced Wireless Systems

Wireless Channel Models, Statistical Fading Models, Narrowband and Wideband Fading Models. Impact of Fading and ISI on Wireless Performance. Capacity of Wireless Channels. Flat-Fading Countermeasures. Adaptive Modulation Multicarrier Systems and OFDM. Multiple Antennas and Space-Time Communications, Parallel decomposition of the MIMO model, MIMO diversity gain and Multiplexing gain, Space-time modulation and coding, Space-Time Coding Design Criteria, Space-Time Block Codes, Space-Time Trellis Codes.

TC-535　　Digital Design for Wireless

wireless communications and digital broadcasting, protocols of digital wireless communications, Digital front-end and wireless system, Digital front-end for multiple standards and multimode compatibility, Front-end technologies in digital broadcasting, Circuits and system integration in digital front-end, Digital predistortion, Power amplifier nonlinear modeling for digital predistortion, crest factor reduction, Digital down-conversion and up-conversion, Space-time and space-frequency transmission over MIMO networks, Digital calibration, imbalance compensation, and error corrections.

TC-536　　Software Defined Radios

Software Radio, Digital Radio Concepts, "Onion" Model, Idealized System Layer, Modeling Corruption, Modulation and Demodulation, Sampling with Automatic Gain Control, Digital Filtering, Bits to Symbols to Signals, Simulating an Idealized System, Adaptive Component Layer, Carrier Recovery, Integration Layer, Digital Quadrature Amplitude Modulation Radio, GNU Radio and USRP, GNU Radio Installation, GNU Radio Companion, Python Programming for GNU Radio.

TC-537　　Advanced Engineering Electromagnetics

Electromagnetic fields and waves, Maxwell's equations, Constitutive Parameters and Relations, Circuit-Field Relations, Time-Varying Electromagnetic Fields, Time-Harmonic Electromagnetic Fields, Linear, Homogeneous, Isotropic, and Nondispersive Media, Solution to the Wave Equation, Uniform Plane Waves in an Unbounded Lossless Medium, Propagation of plane wave, propagation of spherical waves, Transverse Electromagnetic Modes in Lossy Media, Inhomogeneous Vector Potential Wave Equation, Radiation and Scattering Equations, Green's Functions, Green's Functions of the Scalar Helmholtz Equation.

TC-541　　Wireless Networks

Wireless network architectures: cellular networks, wireless local area networks, multi-hop networks. Narrowband digital modulation and Coding under wireless fading environments, CDMA and OFDM, Equalization, Power allocation for rate-adaptive parallel channels (Waterfilling); power control for fixed-rate independent channels, Randomized medium access networks, multi-hop wireless networks, routing trough a wireless network. The AODV and OLSR protocols for mobile ad-hoc networks. Link estimation and neighbor management, TCP over wireless networks.

TC-542　　Carrier Grade VoIP

Conventional Public switch telephone network, Transporting voice using IP, Adapting IP

Networks to Support IP, Session Initialization Protocol, H. 323, MGCP Protocol, MEGACO Protocol, Session Description Protocol (SDP), Quality of Service - Differentiated and Integrated Services, Real Time Transport Protocol (RTP), Resource Reservation Protocol (RSVP), Media gateway control and Soft switch architecture. VOIP and SS7 (SIGTRAN)

TC-543   Network Programming

Recap of networking protocol, Introduction to protocol sessions and state, client-server architecture, Socket programming, TCP programming, UDP programming, Implementing custom protocols, Design decision, debugging and development cycle, Introduction to web services, Development of web services using RESTfull API, Authentication and data signing, Common security problems, Case studies of various application layer protocol programming like ICMP, SNMP, SMTP, HTTP and Active Directory. Network protocol and Data analyzers.

TC-544   Next Generation Networks

Introduction to next generation networks, Voice, video and data over packet, SDN and NFV, NGN Core and access, WiMAX, LTE, IPTV, MPLS, VPNs, Control Plane and Data Plane, SDN in Business and Key Players, Cloud, Datacenter Architecture and protocols, Long Distance Ethernet, QoS, Security, Network Management, OpenFlow Fundamentals, Network Functions and Virtualization, SDH, FTTx, IP Networks and Real-Time Applications, Multimedia Broadcast/ Multicast Services (MBMS), Mobile TV Platforms, Ethernet's ongoing evolution, IPv6, MPLS and MPLS/VPNs. End to end QoS, Network management for NGN, 3GPP/3GPP2/TISPAN IMS, LTE (Long Term Evolution), 5G Wireless systems. The X2 and S1 Interfaces, LTE/SAE Signaling Procedures, Evolution of CDMA2000 1Xev-do, MIMO, SDMA and Beamforming, NGOSS, eTOM and SID, Fixed-Mobile Convergence.

TC-545   Software Defined Network

Software Defined Networking, Network Limitations, Network Control Plane, Forwarding Function, Network State Function, Configuration Function, Separation of Functionality, SDN Implementation, SDN Operation, SDN Devices, SDN Controllers, SDN Design, Edge-Oriented Networking, SDN Operation, SDN Applications, Telecommunication SDN Attributes, Telecommunication SDN Services, SDN Development, Existing Network Limitations, Legacy to SDN, Content Request Routing, Bandwidth Calendaring, Social Networking,

TC-546   Traffic Engineering

Digital Telephone Network, PDH and SDH multiplexing hierarchies, exchange hierarchy, PBX, Blocking Probabilities, Digital Cross Connect & Digital Switching, routing techniques, Channel SS7 signaling components, Poisson process, Markov processes, birth-death processes, purpose of tele traffic theory, tele traffic models, classical model for telephone traffic, classical model for data traffic, shared media - multiple access, circuit switched network modeled as a loss network,

packet switched network modeled as a queuing network, traffic measurements, traffic variations, traditional modeling of telephone traffic, traditional modeling of data traffic, simple tele traffic model, Poisson model, Erlang model, binomial models, Engset model M/M/1, M/M/n, statistical analysis, network planning, traffic forecasts, IP-networks.

TC-547   Optical Networks

Principles and procedures of optical networking with focus on high-speed optical signal transmission between network nodes, lightpath routing and distribution, multilayer network design, and advanced photonic techniques and devices for optical signal transmission and switching, Enabling Technologies for Optical Networks, Core Optical Networks, Metro Optical networks, Access Optical Networks, Wavelength Routing and Assignment, Traffic Grooming and Protection, Multilayer Network Structure, Performance-Limiting Factors, WDM optical networks.

TC-548   Advanced Multimedia Communication

Multimedia systems, multimedia networks and applications, networking terminology, digitizing principles, text, image audio, video information representation, text and image compression techniques (JPEG, MPEG), audio and video compression standards for multimedia communication, construction of 3-D images and videos, transport of high definition video signals and VoD, Digital Picture Compression, Digital Video Compression, Multimedia Conferencing, Digital Video Broadcasting.

TC-549   Mobile and Pervasive Computing
Emerging Wireless Technologies & Applications, Smart phones, Operating System for Smart phones, Wireless technologies, frequency & spread spectrum, mobile Services, Wireless PAN, LAN & MAN, WiFi, IEEE 802.11, 3G, 4G, Location Awareness GPS. Web Services, Ubiquitous User Localization, Composition of Pervasive Computing, Distributed Systems, Approaches for developing Pervasive Applications, Mobile and Pervasive Computing applications.

TC-5005   AI in Telecommunications
Overview of programming and AI Libraries, Perceptron Algorithm and its limitations, Multi-layer perceptron, Binary classification, Logistic regression, Regression and Classification differences Supervised learning, Unsupervised learning, Semi-supervised learning. Deep Learning concepts & Techniques, Neural networks, Forward and back propagation, Supervised learning with neural networks, Self-organizing network, Deep Learning Architectures, Autoencoders, Artificial intelligence use cases for Telecommunications: AI for RAN network management, Fault detection in RAN, Customer QoS Determination, AI for Telecommunication Network operations and optimization.