LIST OF COURSES FOR M.S. PROGRAMME IN TELECOMMUNICATION SYSYTEMS (Weekend Programme)

Applicable to Batch 2016-17 and onwards

Following is the list of courses for the M.S. (Telecommunication Systems) programme.

a. Non-Credit (NC) Courses

S#	Code	Course Title	Credit Hours
1	TC- 401	Mathematical Methods for Telecommunications	NC
2	TC-402	Signals and Linear Systems	NC
NOTE: Students may be required to take Non-credit (NC) courses to fulfill the deficiency, if any, at the undergraduate level as determined by the department.			

b. Compulsory Courses

S#	Code	Course Title	Credit Hours
1	TC- 501	Probability and Random Processes	3
2	TC-506	Information Systems	3
3	TC-507	Analog and Digital Communication	3
4	TC-508	Data Communication and Networks	3
5	TC-509	Telecommunication Policies and Regulations	3

c. Elective Courses

S#	Code	Course Title	Credit Hours
1	TC-505	Telecommunications Network Operations	3
2	TC-515	Advanced Digital Signal Processing	3
3	TC-516	Satellite Communication	3
4	TC-521	RF communication Systems	3
5	TC-522	Data Security	3
6	TC-523	Wireless Systems and Networks	3
7	TC-524	Optical Communication	3
8	TC-525	Next Generation Networks	3
9	TC-526	Broadband Communication Systems	3
10	TC-527	QoS in Telecommunication Systems	3
11	TC-5005	AI in Telecommunications	3
12	TC-5002	Thesis	6

TC- 401 Mathematical Methods for Telecommunications

Complex Number: Argand diagram, De-Moivre formula, roots of polynomial equations. Linear Algebra: Linearity and linear dependence of vectors, basis, dimension of a vector space, matrix and type of matrices, Rank of a matrix, echelon and reduced echelon forms of a matrix, Determinants, Solution of system of linear equations. Differential Calculus: Differentiation and Successive differentiation and its application, L' Hopitals rule, extreme values of a function, partial differentiation. Integral Calculus: Indefinite integrals and their computational techniques, reduction formulae, definite integrals, applications. Differential Equations: Basic concept; Formation of differential equations and solution of differential equations by direct integration and by separating the variables; Solution of linear differential equations. Numerical Methods: Error analysis, Solution of equations. Transforms: Fourier transform, Laplace transform. Software tools

TC-402 Signals and Linear Systems

Basic Signal Concepts: Types of signals, commonly used signals. Unit impulse and unit step functions, frequency domain representation. Basic system concepts: continuous time and discrete time systems, system properties, causality, BIBO stability, time invariance, linearity, convolution and correlation. Linear Time Invariant (LTI) systems: properties of LTI system, causal LTI systems, Time and Frequency characterization of LTI System, transmission of signals through LTI systems, Distortionless systems, LTI systems as frequency selective filters. Fourier Analysis: Fourier series, Properties of Fourier series, Fourier Transform, Properties of Fourier Transform, Power Spectral Density, Frequency Response Characteristics of Transmission Media. Laplace Transform, inverse Laplace Transform, Properties of Laplace Transform, pole-zero plot. Sampling, Sampling theorem, aliasing. Discrete time signals and systems, difference equation, Z-Transform, inverse Z-Transform, Properties of Z-transform, region of convergence, pole-zero plot

TC- 501 Probability and Random Processes

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-506 Information Systems

Hardware, storage, Peripheral components, Processing, Software Applications, Networks, System Design through Problem Solving, System life cycle, Information System Security, Legal and Ethics issues in information Systems, Appropriate use of resources, Information System Management, Teamwork, Digital and Information Literacy, Sources, Appropriateness, Effective and efficient search, Information System Audit and Assurance, Management Information

System, Designing Management Information Systems, Modern developments in information systems.

TC-507 Analog and Digital Communication

Linear Time Invariant Systems; Time & Frequency Domain Analysis; Amplitude Modulation; Frequency Modulation; Phase Modulation; Coherent and Non-coherent Demodulation; Radio and Television Broadcasting: Effect of Noise in Analog Systems; Digital Communication; Pulse Code Modulation; Carrier Modulation; Symbol Detection; The Matched Filter; Receiver for Carrier Systems; Probability of Error; Constellation Diagrams; Information Theory; Information Content; Joint and Conditional Entropy; Source Coding; Channel Coding; Channel Capacity; Digital Transmission in Bandlimited Channels; Multiplexing.

TC-508 Data Communication and Networks

Data Communication Concepts, Networks and open system standards: the OSI reference model, Network topologies and the physical layer, Transmission Media and Transmission Technologies, Baseband and broadband transmission, Transmission bandwidth, Codes, Modems and modem standards, Transmission impairments, Data Transmission, Transmission modes, Interface standards, Data compression, Protocol basics, MAC protocols, Data Security and Integrity, Error detection and correction, Encryption and decryption, Viruses, worms, and hacking, Local Area Networks, Metropolitan Area Networks and Wide Area Networks, Network routing, Circuit-switched data network, Packet-switched data network, Internet protocol, Electronic mail, Network Architecture, Layered approach, Hierarchical approach, Network Interconnections, Repeaters, Bridges, Routers, and Gateways, Interconnection utilities. Queuing Theory.

TC-509 Telecommunication Policies and Regulations

A snapshot of the International Standards Structure. The role of the United Nations and ITU. The Standards Setting Process. The difference among Policy, Recommendations, Standards and Regulation. The Pakistani Policy, Standards and Regulatory Environment. The Regulatory Process: The general goals of regulation Universal Services, the specific goals of Regulatory body in Pakistan. The elements of Wire line and Wireless delivery platforms. Spectrum Management, Licensing and Regulation. Interconnect, The components of Interconnect Regulatory issues. Technical Regulation and Compliance Approval of customer premises equipment (CPE) Permit process and PTA accredited test houses. Permit variations and the consequences of non-compliance.

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-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 Communication

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-521 RF communication Systems

The structure and composition of modern integrated Telecommunication systems and Networks, Structure of PSTN, PLMN, Electromagnetic spectrum, HF, VHF and UHF communications, Radio, Television, Satellite, Radar, GSM, CDMA , Avionics, inter-modulation frequencies and applications, linear and nonlinear mixing of signals, Basic principles of Ionospheric, communications, Amplifiers, Oscillators and analogue Filters, wave propagation and tropospheric scatter, Telecommunications Receivers front end analysis (Examples from Radio, TV, Radar, Transponders), superhetrodyning, choice of Intermediate frequencies, spectrum analyzer and the superhetrodyne receiver, 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. Microwave Systems

TC-522 Data Security

Major factors addressing security analysis of a particular system, operational security goals for a given computing system, analyze an application scenario and identify common threats, vulnerabilities and risks, identify possible countermeasures against threats and vulnerabilities in a given security scenario, compare and contrast the underlying security mechanisms needed to implement security countermeasures, operational security policies to achieve specific security goals using specific security mechanisms, designing security infrastructure, contemporary analysis and implementation tools, Data security technologies Disk encryption, Software versus hardware-based mechanisms for protecting data, Backups, Data masking, Data erasure, International laws and Standards, Industry and Software

TC-523 Wireless Systems and Networks

Wave propagation through unguided media, Wireless channel properties and characterizations, Challenges of wireless system, Digital modulation and coding techniques for wireless systems, spread-spectrum modulation, Medium Access, diversity combining techniques, Frequency reuse, cellular concepts, trunking efficiency, Wireless networks, Base Stations, Access Controllers, Distributed Systems, Frame Hierarchy & Burst Structures, Authentication & Ciphering. Network Architecture, Wireless PAN, Wireless LAN, Wireless MAN, Wireless WAN, Mobile Ad hoc Networks, Wireless Sensor Networks. security in wireless systems, internetworking in wireless systems, mobility applications. Queuing Theory.

TC-524 Optical Communication

Optical Waveguides; Dispersion and Distortion Effects; Single-Mode and Multi-mode Optical Fibres; Elements of Optical communication Systems, Light emitting diodes; Lasers; Photoelectric effects; PIN photodiodes; Avalanche Photodiodes; Receiver circuits; Noise and Detection. Optical amplifiers, Noise sources, channel impairments and optical transmission system, design principles, Advanced modulation formats, polarization multiplexing, Wavelength Division Multiplexing, constrained coding, coherent detection, Multilevel modulation schemes, OFDM, Compensation of chromatic dispersion, Advanced PMD compensation, Optical channel capacity. Wireless Optical Communication Systems.

TC-525 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, 4G Wireless Architecture, LTE (Long Term Evolution).

TC-526 Broadband Communication Systems

Introduction to broadband, Broadband Optical Media, Gigabit WLANs, Gigabit LANs, Common MAC strategies, Organization of Gigabit LANs, Gigabit MANs, Metro Ethernet, Broadband WAN Architecture, Medium Access, Transmission, Switching and signaling subsystems, Broadband WAN Transmission Systems, Optical Core SDH, Broadband microwave point-to-point, Future Systems: millimetric point-to-point links, Optical, Broadband Switching and Routing, Broadband Access Networks, Copper based: ADSL2+ and VDSL2, HFC based, Optical: PON, APON, Architecture & Physical Layer, Mobile Broadband Networks, IMS and UC applications

TC-527 QoS in Telecommunication Systems

Quality of Service (QoS) background, QoS definitions, Telecommunication QoS characteristics, QoS parameters, QoS management Schemes, Policy based network management, Multiple protocol Label Switching, Asynchronous transfer mode (ATM), KPI's for Frame Relay and ATM, Leaky bucket algorithm, QoS in emerging internet-based services, Reliability issues in the telecomm systems, QoS mechanism in Multimedia Telecomm Services, QoS metrics for performance assessment, committed information rate, Discard enable, likely user perception, service being analyzed, disconnection reliability, min outage, routing speed, routing reliability, call completion rate, data error rates, handling overhead, packet latency, trunk group, call attempts, data transmission protocol, echo cancellers, service interruptions, user concerns, connection quality, evaluative concepts.

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.