

Curriculum of M.Tech Program in Telecommunication Engineering

Semester wise distribution of the courses

Semester I (M1)

Slot	Course Type	Course	Marks		Hours L - T - P	Credits
			CIA	ESE		
A	DCC	Random Process and Applications	40	60	3 - 0 - 0	3
B	PCC	Advanced Digital Communication	40	60	3 - 0 - 0	3
C	PCC	Advanced Digital Signal Processing	40	60	3 - 0 - 0	3
D	PEC	Programme Elective1	40	60	3 - 0 - 0	3
E	PEC	Programme Elective2	40	60	3 - 0 - 0	3
S	RM	Research Methodology & IPR	40	60	2 - 0 - 0	2
T	LBC	Communication Lab 1	100	-	0 - 0 - 2	1
Total			340	360	19	18

Teaching Assistance: 6 hours

Semester II (M2)

Slot	Course Type	Course	Marks		Hours L - T - P	Credits
			CIA	ESE		
A	DCC	Estimation and Detection Theory	40	60	3 - 0 - 0	3
B	PCC	Multicarrier Communication and Applications	40	60	3 - 0 - 0	3
C	PEC	Programme Elective3	40	60	3 - 0 - 0	3
D	PEC	Programme Elective4	40	60	3 - 0 - 0	3
E	IEC	Industry/Interdisciplinary Elective	40	60	3 - 0 - 0	3
S	PR	Miniproject	100	-	0 - 0 - 4	2
T	LBC	Communication Lab 2	100	-	0 - 0 - 2	1
Total			400	300	21	18

Teaching Assistance: 6 hours

Semester III (M3)

Slot	Course Type	Course	Marks		Hours L - T - P	Credits
			CIA	ESE		
TRACK 1						
A*	MOOC	MOOC	To be successfully completed		-	2

B	AC	Audit Course	40	60	3 – 0 - 0	-
C	PR	Internship	50	50	-	3
D	PR	DissertationPhase I	100	-	0 – 0 - 17	11
TRACK 2						
A*	MOOC	MOOC	To be successfully completed		-	2
B	AC	Audit Course	40	60	3 – 0 - 0	-
C	PR	internship	50	50	-	3
D	PR	Research project Phase I	100	-	0 – 0 - 17	11
Total			190	110	20	16

Teaching Assistance: 6 hours

*MOOC must be successfully completed before the commencement of fourth semester. This course can be carried out at any time from M1 to M3.

Semester IV (M4)

Slot	Course Type	Course	Marks		Hours L - T - P	Credits
			CIA	ESE		
TRACK 1						
D	PR	Dissertation Phase II	100	100	0 – 0 - 24	16
TRACK 2						
D	PR	Research project Phase II	100	100	0 – 0 - 24	16
Total			100	100	24	16

Teaching Assistance: 5 hours

Syllabus for the theory courses

1) Core courses in M1

#	Course category	Course code	Course Name	Credits
1	DCC	22EC060A	Random Processes and Applications	3

Brief syllabus

Probability theory, Random variables, Probability Density function, Conditional and Joint Distributions and densities, Functions of Random Variables, Expectation, Conditional Expectation

Moments, Random Vector, Random Processes, WSS Processes, Power spectral density, Inequalities, Central limit theorem

Random Sequences, Ergodicity, Karhunen-Leove Expansion, Representation of Bandlimited and periodic Processes

#	Course category	Course code	Course Name	Creidts
1	PCC	22EC161A	Advanced Digital Communication	3

Brief syllabus

Digital Communication over Additive Gaussian Noise Channels- Optimum waveform receiver in Additive white Gaussian noise.

Digital Communication over Band limited Channels- Optimum receiver for channels with ISI and AWGN- Equalization Techniques.

Spread spectrum Communication- modelling, application and synchronization of spread spectrum signals. Digital Communication over Fading Multipath Channels. Multiuser Communication - techniques and capacity.

#	Course category	Course code	Course Name	Creidts
2	PCC	22EC161B	Advanced Digital Signal Processing	3

Brief syllabus

Multirate Signal Processing, Up-sampling and Down-sampling, Fractional Sampling, Frequency domain analysis.

Polyphase decomposition, Uniform filter banks, Two channel Quadrature Mirror Filter Banks. Time Frequency Analysis, Short time Fourier transform, Continuous wavelet transforms.

Multi Resolution Analysis, Power spectrum estimation of signals, Power spectral density, Non parametric methods, parametric method. Linear Prediction, Adaptive filters.

2) Core courses in M2

#	Course category	Course code	Course Name	Creidts
2	DCC	22EC060B	Estimation and Detection Theory	3

Brief syllabus

Detection theory, Decision theory and Hypothesis testing, Matched filter, Composite hypothesis testing, Detection with unknown signal parameters.

Non parametric detection, Parameter estimation, Cramer-Rao lower bound, Linear Signal Waveform Estimation, Levinson Durbin and innovation algorithms, Applications of detection and estimation.

#	Course category	Course code	Course Name	Credits
3	PCC	22EC161C	Multicarrier Communications and Applications	3

Brief syllabus

Wireless channel characteristics, Multi carrier and OFDM system fundamentals – OFDM system model and analysis, Comparison.

Synchronization in OFDM, Timing and Frequency Offset in OFDM, Timing and Frequency Offset estimation.

Channel Estimation in OFDM systems. Clipping in Multi carrier systems, Multi-Carrier CDMA, DS-CDMA and MC-CDMA Systems, Applications of OFDM.

3) Elective courses

a) Program Elective courses

List of Program Elective courses

#	Course code	Course Name
1	22EC162A	Optical Communication Systems
2	22EC162B	WDM Optical Network and Optical switching
3	22EC162C	Modeling and Simulation Of Communication Systems
4	22EC162D	Design of VLSI Systems
5	22EC162E	Antenna Theory and Design
6	22EC162F	Adaptive Filters
7	22EC162G	Digital Microwave Communication
8	22EC162H	Embedded Systems for Communication
9	22EC162I	Information Theory
10	22EC162J	Radio Frequency System Design
11	22EC162K	Adaptive Coding Theory
12	22EC162L	RF MEMs for Communication

13	22EC162M	Image and Video Processing
14	22EC162N	High Performance Communication Networks
15	22EC162O	Advanced Digital System Design Using Verilog
16	22EC162P	Neuro Fuzzy systems
17	22EC162Q	Secure Communication
18	22EC162R	Space Time Coding and MIMO Systems
19	22EC162S	Advanced VLSI DSP Architectures
20	22EC162T	Machine Learning for Communication

Syllabus of Program Elective courses

#	Course category	Course code	Course Name	Credits
1	PEC	22EC162A	Optical Communication Systems	3

Brief syllabus

Optical Fibers – Dispersion, Fiber losses, Non-linear optical effects. Optical Transmitters- LED, Semiconductor lasers, Transmitter design. Optical receivers-Detectors, Coherent receiver, Receiver design, Transmission system performance assessment.

Architecture and Design of Light wave systems- Loss limited and Dispersion limited lightwave systems. Link budget analysis. Optical amplifiers: Doped fiber amplifiers, Design of optical amplifiers.

Various Techniques for Dispersion management. Optical OFDM and Radio over Fiber. Soliton based systems- Impact of amplifier noise-Timing Jitter, Gordon – Hauss Effect, Bit Error Rate Performance. WDM systems – Components , design and performance issues of WDM.

#	Course category	Course code	Course Name	Credits
2	PEC	22EC162B	WDM Optical Network and Optical switching	3

Brief syllabus

Introduction to Optical Networks. Basics of optical Packet Switching and transmission. Propagation of Signals in Optical Fiber, Nonlinear Effects Networks.

Client Layers of the Optical Layer. Introduction to WDM Network Elements. Dimensioning Wavelength Routing Networks, Statistical Dimensioning Models.

Control Management:Optical Layer services and Interfacing.Network Survivability, Access Network: Photonic Packet Switching,Deployment considerations, Designing transmission Layer.

#	Course category	Course code	Course Name	Creidts
3	PEC	22EC162C	Modelling and Simulation of Communication Systems	3

Brief syllabus

Simulation and Modelling Methodology, Review of Random Processes, Random Number generation, Testing Random Number Generators.

Modelling of Transmitter and Receiver subsystems, Communication channels and models, Fading and multipath channels, The Almost Free space channel, Conducting and Guided wave media.Finite state channel models, Methodology for simulating Communication systems operating over Fading Channels.

Estimation of parameters in simulation, Estimation of performance measures from simulation, Analysis of simulation results.

#	Course category	Course code	Course Name	Creidts
4	PEC	22EC162D	Design of VLSI Systems	3

Brief syllabus

CMOS Inverter - Static and Dynamic Behaviour, Performance, Power, Energy, Delay, CMOS Circuit, Logic Design.

Advanced techniques in CMOS Logic Circuits -Mirror circuits, Pseudo NMOS, Tri-state circuits, Dynamic CMOS Logic circuits.

Arithmetic Circuits in CMOS VLSI-Bit Adder Circuits, Ripple Carry Adder, Carry Look Ahead Adders, High speed adders, Multipliers.

Low power design- Power consumption, Various Power reduction techniques.Designing Memory and Array Structures- Memory classification, Non-volatile Read Write Memories. Content - Addressable or Associative Memories, Memory Peripheral Circuits.

#	Course category	Course code	Course Name	Creidts
5	PEC	22EC162E	Antenna Theory and Design	3

Brief syllabus

Review of Antenna Parameters, Antenna matching. Review of dipole antennas, Monopole antennas, Folded dipole. Analysis of Circular Loop and Biconical Antenna. Helical Antennas. Current induced in a dipole antenna. Near fields of linear antennas, arrays of parallel dipoles, Yagi-Uda antennas. Aperture antenna.

Radiation from open-ended wave-guides, horn antennas, optimum horn design, rectangular micro-strip antennas – Field analysis and design, parabolic reflector antennas, aperture-field and current-distribution methods, Antenna arrays.

Grating lobes. One dimensional array. Concept of beam steering. Design of array. Adaptive Beam forming, 2D arrays

#	Course category	Course code	Course Name	Creidts
6	PEC	22EC162F	Adaptive Filters	3

Brief syllabus

Adaptive systems- definitions and characteristics. adaptive linear combiner, input signal and weight vectors, Smoothing and Prediction filtering, MSE predictors.

Linear optimum filtering, Searching performance surface -stability and rate of convergence, Newton's method, method of steepest descent, Convergence of weight vector.

Adaptive recursive algorithms - LMS and RLS algorithms and their tracking performance, Applications of adaptive filters.

#	Course category	Course code	Course Name	Creidts
7	PEC	22EC162G	Digital Microwave Communication	3

Brief syllabus

Digital Microwave Communication systems, Structure of 30 channel Primary MUX, Signalling in Telecommunication, R2 Signalling, Equalization techniques in DMR-770 Digital Microwave radio.

Bit Stream integration in Digital Transmission systems, Multiplexing of synchronous data signals, Multiplexing asynchronous signals Waveguide components, Waveguide Accessories.

#	Course category	Course code	Course Name	Credits
8	PEC	22EC162H	Embedded Systems for Communication	3

Brief syllabus

Introduction to Embedded Systems- Evolution of microprocessors and embedded systems, ARM Architecture- registers and flags, operation modes, memory map, Nested Vector Interrupt Controller, power management.

Overview of Communication Buses and protocols- Serial and Parallel Bus Protocols, Internet Embedded Systems -Overview of Hardware for Embedded Communication.

Hardware Software Co-design and Program Modelling.Fundamental Issues, Computational Models, Inter-process Communication and Synchronization of Processes, Data sharing by multiple tasks and routines.

Introduction to Real Time Operating Systems, Study of Real Time Operating Systems - Vx works, MicroC/OS-II RTOS. Case study /design using ARM processor for applications in Telecommunications.

#	Course category	Course code	Course Name	Credits
9	PEC	22EC162I	Information Theory	3

Brief syllabus

Entropy- Memory less sources- Markov sources- Entropy of a discrete Random variable and its properties, source coding theorem and its significance. Importance of typical set in source coding techniques, computation of channel capacity, Channel coding theorem.

Differential entropy - Capacity of Continuous Channels.Gaussian multiple user channels - Multiple access channels - Broadcast channels

#	Course category	Course code	Course Name	Credits
10	PEC	22EC162J	Radio Frequency System Design	3

Brief syllabus

RF behaviour of passive Components,ScatteringParameters,Smith Chart and applications. ABCD parameters of simple Two Port Networks, RF Filter Design- Firstorderlowpass,highpassandbandpassfiltercircuits.

Analysis of Tunnel Diode, Gunn Diode, Varactor Diode.Design of simple matching andbiasingnetworks.Power relations for RF transistor and MESFET Amplifiers,Stabilizationmethods.

High frequency Oscillator configuration.Design of simple RF Mixer CircuitbasedonBJTandMESFET.

#	Course category	Course code	Course Name	Credits
11	PEC	22EC162K	Adaptive Coding Theory	3

Brief syllabus

Arithmetic operations in GF(2) and GF(2^M), Primitive polynomials and Minimal polynomials, linear block codes, generation and detection of Cyclic codes – error trapping decoding, BCH Codes - Generation of Primitive and Non-primitive BCH code with binary arithmetic, RS Code generation and Decoding.

Convolutional Codes - Generator matrix - State, tree and trellis diagram- Maximum Likelihood decoding - Hard versus Soft decision decoding- The Viterbi Algorithm- Soft output Viterbi algorithm – Sequential decoding.

Convolutional interleaving – Concatenated codes – Turbo codes – Trellis coded Modulation, Low-density parity check (LDPC) codes

#	Course category	Course code	Course Name	Credits
12	PEC	22EC162L	RF MEMS for Communication	3

Brief syllabus

Introduction to RF MEMS- application. Introduction to Microfabrication Technique. Materials properties, Bulk and surface micromachining, Wet and dry etching, Thin-film depositions, design and testing.

Actuation Mechanisms in MEMS. RF MEMS switches and applications. Micro machined inductors, variable inductors, polymer based inductors, gap-tuning and area tuning capacitors, dielectric tunable capacitors.

Resonators – applications in oscillators and filters- Modeling of mechanical filters. Introduction to Micromachined antennas, design parameters and RF NEMS, Integration and Packaging

#	Course category	Course code	Course Name	Creidts
13	PEC	22EC162M	Image and Video Processing	3

Brief syllabus

Basics of Image processing, Image transforms, Image enhancement, Image Segmentation, Image texture analysis, Image Restoration, , Image Reconstruction from projections.

Basic Steps of Video Processing, Motion Estimation, Video processing operations, Image compression and standards, Video compression and standards, Introduction to Deep LearninG.

#	Course category	Course code	Course Name	Creidts
14	PEC	22EC162N	High Performance Communication Networks	3

Brief syllabus

Principles of High speed networking. Service Integration - architecture, characterization and mechanisms. Packet Switched Networks. Internet and TCP/IP Networks. Circuit switched networks. ATM and Wireless Networks.

Optical Networks and Switching, Optical links, WDM systems, optical cross-connects, optical LANs, optical paths and networks.

#	Course category	Course code	Course Name	Creidts
15	PEC	22EC162O	Advanced Digital System Design Using Verilog	3

Brief syllabus

Verilog HDL-based design Overview of FPGA and EDA software - RT-level combinational circuit - Test bench - Design examples.

FSM - FSMD, ASMD chart, Code development. Asynchronous Sequential Circuit Design :Analysis of Asynchronous Sequential Circuit (ASC) –Races ASC .

UART receiving subsystem, UART transmitting subsystem, UART verification, HDL implementation. I/O Modules, Graphics mode VGA controller, VGA synchronization, Timing calculation.

#	Course category	Course code	Course Name	Creidts
16	PEC	22EC162P	Neuro Fuzzy Systems	3

Brief syllabus

Learning processes, Single layer and Multi layer Perceptrons, Principal Component Analysis, Independent Component Analysis, Stochastic Machines, Neurodynamics, Neuroprogramming, Fuzzy systems, Neuro-fuzzy systems, Genetic Algorithms, Convergence rate, case studies

#	Course category	Course code	Course Name	Creidts
17	PEC	22EC162Q	Secure Communication	3

Brief syllabus

Complexity theory and Number theory, Elementary algebraic structures, Elliptic curves, Classical cryptography, Public Key cryptography, Cryptographic standards, Cryptanalysis algorithms, Primality tests, Integer factorization, Algorithms for discrete logarithms

#	Course category	Course code	Course Name	Creidts
18	PEC	22EC162R	Space Time Coding and MIMO Systems	3

Brief syllabus

Review of SISO communication, MIMO channels, Multidimensional channel modelling, Capacity of MIMO channels, Diversity, Diversity methods, Combining methods, Space-time code design criteria, Orthogonal space, Maximum-likelihood decoding and maximum ratio combining, Quasi-orthogonal space-time block codes, Space time trellis codes, Spatial multiplexing and receiver design, Using equalization techniques in receiver design, Combined spatial multiplexing and space-time coding, MIMO OFDM

#	Course category	Course code	Course Name	Creidts
19	PEC	22EC162S	Advanced VlsiDsp Architectures	3

Brief syllabus

Representations of DSP algorithms, Loop bound and iteration bound, Transformation techniques. Pipelining and parallel processing of FIR and IIR filters to achieve high speed and low power, Parallel FIR filters.

FIR algorithms-implementation of DCT based on algorithm -architecture transformations, Fast convolution , Parallel architectures for Rank Order filters.

#	Course category	Course code	Course Name	Creidts
20	PEC	22EC162T	Machine Learning for Communication	3

Brief syllabus

Introduction to learning and machine learning: supervised/unsupervised/reinforcement learning. Linear Regression with One Variable and Multiple Variables

Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Simplified Cost Function and Gradient Descent, Regularization: The Problem of Overfitting, Regularized Regression

Machine learning (ML) for physical layer design in wireless communication, intelligent systems and operations, mobile network design. Techniques for efficient hardware implementation of neural networks in communications, overview of ML, deep learning and AI techniques in recent applications of communication

b) Interdisciplinary courses

List of Interdisciplinary courses

#	Course code	Course Name	Offering Department
1	22EC165A	Soft Computing	ECED
2	22EC165B	Optimization Techniques	ECED