Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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B. Tech in Electronics and Telecommunication Engineering

Structure and Detailed Syllabus

for

Major in Electronics and Telecommunication Engineering

In line with New Education Policy 2020

(Effective from Academic year 2024-25 for main campus)

Department of Electronics and Telecommunication Engineering

Major in Electronics and Telecommunication Engineering

The Bachelor's Engineering Degree with Honours in chosen Major Engg./ Tech. Discipline i.e. in Electronics and Telecommunication Engineering with Multidisciplinary Minor (180-194 credits) enables students to take up five-six additional courses of 18 to 20 credits in the Electronics and Telecommunication Engineering discipline distributed over semesters III to VIII. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are over and above the min.160-max.176 Credits prescribed for the duration of four years will be taken by Academic Authorities of University. Basic structure of the syllabus is as follows.

Semester		**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total Credits**
Basic Science Course	BSC/ESC	06-08	08-10		--	--	--	--	--	14-18
Engineering Science Course		10-08	06-04		--	--	--	--	--	16-12
Programme Core Course (PCC)	Program Courses	--	02	08-10	08-10	10-12	08-10	04-06	04-06	44-56
Programme Elective Course (PEC)		--	--	--	--	04	08	02	06	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses		-	02	02	04	02	02	02	14
Open Elective (OE) Other than a particular program		--	--	04	02	02	--	--	--	08
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	02	--	02	--	02	--	--	08
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	02	--	--	02	--	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--		02	02	--	--	--	--	04
Indian Knowledge System (IKS)			02		--	--	--	--	--	02
Value Education Course (VEC)		--	--	02	02	--	--	--	--	04
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--		04	04
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	02	--	--	--	-	-	02
Project		--	--	--	--	--	--		04	04
Internship/ OJT		--	---			--	--	12	-	12
Co-curricular Courses (CC)	Liberal Learning Courses	02	02		--	--	--	--	-	04
Total Credits (Major)		**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**160-176**

List of Courses for

Major in Electronics and Telecommunication Engineering

Students may take up to five-six additional courses of 18 to 20 credits in the Electronics and Telecommunication Engineering discipline distributed over semesters III to VIII for obtaining the major degree in Electronics and Telecommunication Engineering.

Sr. No.	Course Name	Teaching Scheme	Duration (Weeks)	Credits	Institute Offering Course	Name of Professor/ Resource person	Link
1	Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning	4 Hrs/Week	12	3	IIT Kanpur	Prof. Aditya K. Jagannatham	https://nptel.ac.in/courses/108104174
2	High Speed Semiconductor Devices	4 Hrs/Week	8	2	IIT Kanpur	Prof. Anjan Ghosh	https://nptel.ac.in/courses/117104071
3	ANTENNAS	4 Hrs/Week	12	3	IIT Bombay	Prof. Girish Kumar	https://nptel.ac.in/courses/108101092
4	Transmission Lines and EM Waves	4 Hrs/Week	8	2	IIT Bombay	Prof. R.K. Shevgaonkar	https://nptel.ac.in/courses/117101057
5	An Introduction to Electronics Systems Packaging	4 Hrs/Week	8	2	IISc Bangalore	Prof. G.V. Mahesh	https://nptel.ac.in/courses/108108031
6	EMI /EMC and Signal Integrity: Principles, Techniques and Applications	4 Hrs/Week	12	3	IIT Kharagpur	Prof. Amitabha Bhattacharya	https://onlinecourses.nptel.ac.in/noc24_ee67/preview

7	Principles of Modern CDMA/ MIMO/ OFDM Wireless Communications(Course sponsored by Aricent)				IIT Kanpur	Prof. Aditya K. Jagannatham	https://nptel.ac.in/courses/117104115
8	Digital IC Design	4 Hrs/Week	12	3	IIT Madras	Prof. Janakiraman	https://onlinecourses.nptel.ac.in/noc24_ee43/preview
9	Multirate DSP	4 Hrs/Week	12	3	IIT Madras	Prof. R. David Koilpillai	https://onlinecourses.nptel.ac.in/noc24_ee22/preview
10	Fundamentals of Wavelets, Filter Banks and Time Frequency Analysis	4 Hrs/Week	8	2	IIT Bombay	Prof. V.M. Gadre	https://nptel.ac.in/courses/108101093

Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning

COURSE PLAN:

Week 1: Introduction to vectors, properties and applications

Week 2: Introduction to matrices and Applications Circuits, Graphs, Social Networks, Traffic flow

Week 3: Eigenvalue decomposition, properties and Applications Principal component analysis (PCA), Eigen faces for facial recognition

Week 4: Singular value decomposition (SVD) and Applications Beam forming in MIMO, Dimensionality

reduction, Rate maximization in wireless, MUSIC algorithm

Week 5: Linear regression and Least Squares. Applications: System identification, linear regression, Support vector machines (SVM), kernel SVMs

Week 6: Optimal linear MMSE estimation. Applications MMSE Receiver, Market prediction and forecasting, ARMA models

Week 7: Data analytics: Recommender systems, user rating prediction, NETFLIX problem

Week 8: Structure of FFT/ IFFT matrices, properties, System model for OFDM/ SC-FDMA, Signal processing in OFDM systems

Week 9: Modeling of Dynamical systems Examples: Robots, Chemical plants. Solution of autonomous linear dynamical systems (LDS), solution of with inputs and outputs

Week 10: Unsupervised learning: Centroid based clustering, probabilistic model based clustering and EM algorithm

Week 11: Linear perceptron. Training a perceptron stochastic gradient. Compressive sensing, orthogonal matching pursuit for sparse signal estimation

Week 12: Discrete time Markov chains Applications: supply chain management, forecasting, Operations research - resource and inventory management.

High Speed Semiconductor Devices

COURSE PLAN:

1. High Speed Semiconductor Devices
2. Quantum Physics
3. Solution of Schrodinger Equation
4. Finite Potential Well
5. Linear Harmonic Oscillator
6. Energy Band Theory
7. Kronig - Penney Analysis
8. Eigen value equation
9. Energy in Brillioun Zone representation
10. Motion of electrons in Energy Bands
11. Effect of External forces
12. Mobility
13. Oscillation Frequency and Dispersion
14. Lattice Scattering for mobility
15. Scattering in Semiconductors
16. Carrier Density
17. Maxwell-Bottzman approximation
18. Extensive doping
19. Generation-Recombination process in semiconductors
20. Diffusion and Conrinuity Equation
21. Diodes
22. P-N junction diodes
23. Diffusion Capacitance
24. Varactor diode structure
25. PIN Diode
26. Schottky Diode
27. MESFET(Metal Semiconductor Field Effect Transistor)
28. Drain Current
29. Semiconductor Helerojunction
30. Bipolar junction Transistor
31. 1st order model of BJJ
32. Heterojunction Bipolar Transistor
33. Heterojunction FET\

Antennas

Course Plan:

Week 1: Antenna Introduction I - III, Antenna Fundamentals I - II

Week 2: Antenna Radiation Hazards I - II, Dipole Antennas I - III

Week 3: Monopole Antennas I - II, Loop Antennas, Slot Antennas

Week 4: Linear Arrays I - III, Planar Arrays

Week 5: Microstrip Antennas (MSA), Rectangular MSA, MSA Parametric Analysis I - II, Circular MSA

Week 6: Broadband MSA I - V

Week 7: Compact MSA I - III , Tunable MSA I - II

Week 8: Circularly Polarized MSA I - III, MSA Arrays I - III

Week 9: Helical Antennas I - V

Week 10: Horn Antennas I - V

Week 11: Yagi-Uda and Log-Periodic Antennas I - III, IE3D Session TA- I - III

Week 12: Reflector Antennas I - IV, Lab Session

Transmission Lines and EM Waves

Course Plan:

Module-1 Introduction

Module-2 Transmission Lines

Module-3 Maxwells Equation

Module-4 Uniform Plane Wave

Module-5 Plane Waves at Media Interface

Module-6 Wave Guides

Module-7 Antenna

An Introduction to Electronics Systems Packaging

Course Plan:

1. Overview of electronic systems packaging
2. Semiconductor Packaging Overview
3. Semiconductor Packages
4. Electrical Design considerations in systems packaging
5. CAD for Printed Wiring Boards
6. Printed Wiring Board Technologies: Board-level packaging aspects
7. Surface Mount Technology
8. Thermal Design considerations in systems packaging
9. Embedded Passives Technology
10. Conclusion and Summary
11. Chapter-wise summary

EMI /EMC and Signal Integrity: Principles, Techniques and Applications

Course Plan:

Week 1: Introduction to Electromagnetic Compatibility

Week 2: EMC Requirements for Electronic Systems

Week 3: Signal spectral analysis

Week 4: Two and three conductor transmission lines

Week 5: Elemental Radiators

Week 6: Radiated Emission

Week 7: Radiated Susceptibility

Week 8: Conducted Emission

Week 9: Conducted Susceptibility

Week 10: Cross talk

Week 11: Shielding and ESD

Week 12: System Design for EMC

Principles of Modern CDMA/ MIMO/ OFDM Wireless Communications (Course sponsored by Aricent)

Course Plan:

Week 1- Basics of Estimation, Maximum Likelihood (ML)

Week 2- Application: Wireless Sensor Network, Reliability of Estimation

Week 3- Application: Wireless Fading Channel Estimation, Cramer-Rao Bound for Estimation

Week 4- Vector Parameter Estimation, Properties of Estimate; Applications: Multi-antenna Wireless Channel Estimation

Week 5- Application: MIMO Wireless Channel Estimation, Error Covariance of Estimation, Equalization for Frequency Selective Channels

Week 6- Application: OFDM Estimation, Sequential Estimation

Week 7- Minimum Mean-Squared Error (MMSE) Estimate, Gaussian Parameter

Week 8- Application: Wireless Sensor Network, Wireless Fading Channel Estimation

Week 9- Application: MMSE Estimation for Multi-Antenna Channel

Week 10- Application: MMSE for MIMO Channel Estimation, Properties of Estimate

Week 11- Application: MMSE for Equalization of Wireless Channel

Week 12- Application: MMSE for OFDM Channel Estimation

Digital IC Design

Course Plan:

Week 1: The CMOS Inverter construction and Voltage Transfer Characteristics

Week 2: Resistance and Capacitance and transient response.

Week 3: Dynamic, Short Circuit and Leakage power – Stacking Effect

Week 4: Combinational Circuit Design and capacitance

Week 5: Parasitic Delay, Logical Effort and Electrical Effort

Week 6: Gate sizing and Buffering

Week 7: Asymmetric gate, Skewed gates, Ratio'ed logic

Week 8: Dynamic Gates and Domino logic and Static Timing Analysis

Week 9: Sequential circuits and feedback. Various D flip flop circuits – Static and Dynamic

Week 10:Setup and Hold Time measurement. Timing analysis of latch/ flop based systems

Week 11:Adders – Mirror adder, Carry Skip adder, Carry Select adder, Square Root adder

Week 12:Multipliers – Signed and Unsigned arithmetic, Carry Save Multiplier implementation

Multirate DSP

Course Plan:

Week 1: Introduction

Overview of Sampling and Reconstruction

Review Discrete-Time Systems, digital filters

Week 2 : Oversampling techniques, DT processing of continuous time signals

Week 3 : Fundamentals of Multi-rate Systems

Basic building blocks – Up sampling, down sampling, aliasing

Mathematical framework for sampling rate change

Week 4 : Sampling rate change and filtering, fractional sampling rate change

Week 5 : Interconnection of multirate DSP blocks, Multiplexer and Demultiplexer functionality, Polyphase decomposition, Noble Identities, efficient implementation of sampling rate conversion

Week 6 : Applications of Multirate DSP - DFT-based Filterbanks, Interpolated FIR filter design, Cascaded-Integrator-Comb (CIC) filters, Transmultiplexer, Filterbank interpretation of Spectral analysis using DFT

Week 7 : Two channel maximally decimated filter bank, Signal impairments - Aliasing, Magnitude distortion, Phase distortion, Aliasing cancellation

Week 8 : Allpass filters, properties, application in two channel filterbanks, Half-band filters, Power complementary filter pairs, M^{th} band filters, two channel perfection reconstruction filterbanks.

Week 9: Capacity of wireless channels, Waterfilling method, motivation for Multicarrier modulation

Week 10: Block transceivers with redundancy, Zero-padding, cyclic prefix, OFDM, extensions of OFDM incuding Filterbank Multicarrier (FBMC)

Week 11: Application of Multirate DSP – Delta Sigma A/D conversion

Week 12: Introduction to wavelets and M-channel perfect reconstruction filterbanks.

Fundamentals of Wavelets, Filter Banks and Time Frequency Analysis

COURSE PLAN:

Module 1: Lecture 1: Introduction

Module 1: Lecture 2: Origin of Wavelets

Module 1: Lecture 3: Haar Wavelet

Module 2: Lecture 1: Dyadic Wavelet

Module 2: Lecture 2: Dilates and Translates of Haar Wavelets

Module 2: Lecture 3: L2 Norm of a Function

Module 3: Lecture 1: Piecewise Constant Representation of a Function

Module 3: Lecture 2: Ladder of Subspaces

Module 3: Lecture 3: Scaling Function for Haar Wavelet Demo

Demonstration 1: Piecewise constant approximation of functions

Module 4: Lecture 1: Vector Representation of Sequences

Module 4: Lecture 2: Properties of Norm

Module 4: Lecture 3: Parseval's Theorem

Module 5: Lecture 1: Equivalence of sequences and functions

Module 5: Lecture 2: Angle between Functions & their Decomposition

Demonstration 2: Additional Information on Direct-Sum

Module 6: Lecture 1: Introduction to filter banks

Module 6: Lecture 2: Haar Analysis Filter Bank in Z-domain

Module 6: Lecture 3: Haar Synthesis Filter Bank in Z-domain

Module 7: Lecture 1: Moving from Z-domain to frequency domain

Module 7: Lecture 2: Frequency Response of Haar Analysis Low pass Filter bank

Module 7: Lecture 3: Frequency Response of Haar Analysis High pass Filter bank

Module 8: Lecture 1: Ideal two-band filter bank

Module 8: Lecture 2: Disqualification of Ideal filter bank

Module 8: Lecture 3: Realizable two-band filter bank

Demonstration 3: Demonstration: DWT of images

Module 9: Lecture 1: Relating Fourier transform of scaling function to filter bank

Module 9: Lecture 2: Fourier transform of scaling function

Module 9: Lecture 3: Construction of scaling and wavelet functions from filter bank

Demonstration 4: Demonstration: Constructing scaling and wavelet functions
Module 10: Lecture 1: Introduction to upsampling and down sampling as Multirate operations
Module 10: Lecture 2: Up sampling by a general factor M- a Z-domain analysis.
Module 10: Lecture 3: Down sampling by a general factor M- a Z-domain analysis
Module 11: Lecture 1: Z domain analysis of 2 channel filter bank.
Module 11: Lecture 2: Effect of X (-Z) in time domain and aliasing
Module 11: Lecture 3: Consequences of aliasing and simple approach to avoid it
Module 12: Lecture 1: Revisiting aliasing and the Idea of perfect reconstruction
Module 12: Lecture 2: Applying perfect reconstruction and alias cancellation on Haar MRA
Module 12: Lecture 3: Introduction to Daubechies family of MRA
Module 13: Lecture 1: Power Complementarity of low pass filter
Module 13: Lecture 2: Applying perfect reconstruction condition to obtain filter coefficient
Module 14: Lecture 1: Effect of minimum phase requirement on filter coefficients
Module 14: Lecture 2: Building compactly supported scaling functions
Module 14: Lecture 3: Second member of Daubechies family
Module 15: Lecture 1: Fourier transform analysis of Haar scaling and Wavelet functions
Module 15: Lecture 2: Revisiting Fourier Transform and Parseval's theorem
Module 15: Lecture 3: Transform Analysis of Haar Wavelet function
Module 16: Lecture 1: Nature of Haar scaling and Wavelet functions in frequency domain
Module 16: Lecture 2: The Idea of Time-Frequency Resolution
Module 16: Lecture 3: Some thoughts on Ideal time- frequency domain behavior
Module 17: Lecture 1: Defining Probability Density function
Module 17: Lecture 2: Defining Mean, Variance and "containment in a given domain"
Module 17: Lecture 3: Example: Haar Scaling function
Module 17: Lecture 4: Variance from a slightly different perspective
Module 18: Lecture 1: Signal transformations: effect on mean and variance
Module 18: Lecture 2: Time-Bandwidth product and its properties
Module 18: Lecture 3: Simplification of Time-Bandwidth formulae
Module 19: Lecture 1: Introduction
Module 19: Lecture 2: Evaluation of Time-Bandwidth product
Module 19: Lecture 3: Optimal function in the sense of Time-Bandwidth product
Module 20: Lecture 1: Discontent with the "Optimal function".

Module 20: Lecture 2: Journey from infinite to finite Time-Bandwidth product of Haar scaling function

Module 20: Lecture 3: More insights about Time-Bandwidth product

Module 20: Lecture 4: Time-frequency plane

Module 20: Lecture 5: Tiling the Time-frequency plane

Module 21: Lecture 1: STFT: Conditions for valid windows

Module 21: Lecture 2: STFT: Time domain and frequency domain formulations

Module 21: Lecture 3: STFT: Duality in the interpretations

Module 21: Lecture 4: Continuous Wavelet Transform (CWT)

Demonstration 5

Student’s Presentation