

Honors in Advanced Communication Engineering

Department of Electronics and Communication Engineering

Tabel V Honors in Advanced Communication Engineering

S.No.	Semester	Course Code	Course Name	Category	Type	Credit	L-T-P
1	V		Mathematical Modeling and Simulation for Communication Engineering Systems		Theory	3	3-0-0
2	V		Advanced Digital Communication Systems		Theory	3	3-0-0
3	VI		Advanced Antenna Engineering		Theory	3	3-0-0
4	VI		Advanced Mobile and Wireless Networking		Theory	3	3-0-0
5	VII*		Advanced Microwave Engineering		Theory	3	3-0-0
6	VII*		Advanced Optical Communication Systems		Theory	3	3-0-0
7	VIII*		Advanced Error Control Codes		Theory	3	3-0-0
8	VIII*		Computational Electromagnetics		Theory	3	3-0-0
9	VIII*		Mini Project on Communication Engineering		Practical	3	0-0-6

Laxu Bhargava

S.Nanda

**UG SCHEME : Department of Electronics & Communication Engineering,
Malaviya National Institute of Technology Jaipur**

Course Name: Mathematical Modeling and Simulation for Communication Engineering Systems

Course Code :

Credits : 3 (L-T-P : 3-0-0)

SYLLABUS :

Mathematical Foundational concepts for Communication Engineering: Basics of Linear Algebra, Probability and Random Variables, Stochastic Processes, Spectral Representation, Mean Square Estimation, Entropy, Markov Chains, Processes and Queuing Theory, Mathematical modelling of digital modulations, channels and detection, Channel estimation and equalization, MIMO-OFDM design concepts, Research initiatives in 4G, 5G Mobile Systems

Mathematical Foundations for Photonics/Electromagnetics: Vector Analysis, Vector Calculus, Theory of complex variables, Series Solution of Differential Equations, Sturm Liouville Theory, Bessel Functions, Legendre Functions, Fourier Series and Fourier Transforms, Solving surface integral equations by method of moments, Introduction to finite element methods, Finite element method in 2D, Finite difference time domain method – introduction, Finite difference time domain method - materials and boundary conditions, Finite difference time domain method Design concepts in Microstrip Antennas and Arrays, Beam forming Techniques, SIW

Partial Differential Equations: Laplace and Poisson's Equations, Wave Equations. Analytical and Numerical Solutions of the PDEs. Green's Function, Optimization techniques.

Simulation Tools: Various open source/commercial software for solving problems in the area of Antennas, Communication, Photonics and Microwave Engineering


Recommended Readings

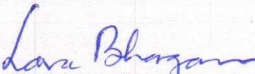
1. Text books-

- a. Probability, random variables and stochastic processes. - Papoulis, Athanasios, and H. Saunders.
- b. The theory of information and coding - Robert J. McEliece, Cambridge University Press.
- c. Advanced engineering electromagnetics - Constantine A. Balanis, John Wiley & Sons.
- d. Computational Methods for Electromagnetics - Peterson, Ray, Mitra, IEEE Press
- e. Microstrip Antennas: The Analysis and Design of Microstrip Antennas and Arrays - David M. Pozar, Daniel H. Schaubert, Wiley-IEEE Press.

2. Reference books-

- a. Microstrip Antennas - I. J. Bahl and P. Bhartiya, Artech House.
- b. Mathematical methods for physics and engineering: A Comprehensive Guide - K. F. Riley, M. P. Hobson and S. J. Bence, Cambridge University Press, 2002.


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**UG SCHEME : Department of Electronics & Communication Engineering,
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Course Name: Advanced Digital Communication Systems

Course Code :

Credits : 3 (L-T-P : 3-0-0)

SYLLABUS :

Review: Signals and Systems with focus on Random Signals, Sampling Theorem, Signal Space and Constellation Diagrams and Orthogonal Signal Sets. Baseband modulation and Demodulation: Detection of binary signals in Gaussian Noise, ISI, Equalization, Carrier and symbol synchronization, and Signal Design for bandlimited channels.

Bandpass modulation and Demodulation: Modulation Techniques, Coherent and Non Coherent Detection, Error performance for binary system, and Symbol error performance for M-ary systems.

Communication link analysis: Link budget analysis, Simple link analysis, system trade-offs, and Modulation coding trade-offs.

Spread Spectrum: signal PN sequences, DS-CDMA, FH-CDMA, and Jamming consideration. Communication through Fading Channels

References :

1. Text books-

- a. Digital Communications-Bernard Sklar, Fredric Harris, Pearson Education
- b. Digital Communications- John G.Proakis, McGraw Hill Education.
- c. Modern Digital and Analog Communication-B.P. Lathi, Oxford University Press.

2. Online resources-

- a. <https://nptel.ac.in/courses/108/102/108102120/>

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**UG SCHEME : Department of Electronics & Communication Engineering,
Malaviya National Institute of Technology Jaipur**

Course Name: Advanced Antenna Engineering

Course Code :

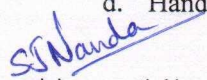
Credits : 3 (L-T-P : 3-0-0)

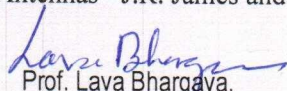
SYLLABUS :

Revision of radiation mechanism of antenna, basic performance parameters of antennalike radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, etc. Basic theorems related to antenna. Introduction to the working principles and analysis of different kinds of antenna geometries like microstrip, broadband, frequency independent, travelling wave antennas etc.

Recommended Readings

1. Text book-
 - a. Antenna Theory: Analysis and Design - C. A. Balanis, Wiley Publication, 2000.
 - b. Antenna Theory- J. D. Kraus, 4th Edition, Tata Mc-Graw Hill.
 - c. Antenna Theory and Design - W. L. Stutzman, and G. A. Thiele, John Wiley & Sons., 1998.
 - d. Antenna Theory and Design - R. S. Elliot, Revised edition, Wiley-IEEE Press, 2003.
 - e. Antennas and Radio Wave Propagation - R. E. Collin, McGrawHill., 1985.
 - f. Smart Antennas for Wireless Communications - F. B. Gross, McGraw-Hill., 2005
 - g. Micro strip Antenna Design Handbook - Ramesh Garg, Prakash Bhartia, Inder Bahl, Artech House.
 - h. Handbook of Antennas in Wireless Communication - Lal Chand Godara, CRC Press.
2. Reference book-
 - a. CAD of Microstrip Antenna for Wireless Applications - Robert A. Sainati, Artech House.
 - b. Compact and Broadband Micro strip Antenna - Kin-Lu Wong, John Wiley & Sons.
 - c. Microstrip Patch Antennas - Robert B. Waterhouse, Kluwer academic Publishers.
 - d. Handbook of Microstrip Antennas - J.R. James and P.S. Hall, Peter Peregrinus


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3. Online resources-

- a. <https://nptel.ac.in/courses/108/101/108101092/>
- b. <https://nptel.ac.in/courses/108/105/108105114/>
- c. <https://nptel.ac.in/courses/117/107/117107035/>

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**UG SCHEME : Department of Electronics & Communication Engineering,
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Course Name: Advanced Mobile and Wireless Networking

Course Code :

Credits : 3 (L-T-P : 3-0-0)

SYLLABUS :

Operation of Cellular Systems, Frequency reuse concept, Co-channel Interference, Techniques for reducing co-channel interference, Adjacent channel interference, Near end and Far end interference, Crosstalk, interference between systems.

Channel Assignment Techniques, Hand-off Techniques, Concept of smaller Cells, Trunking and Teletraffic Theory

Orthogonal Frequency Division Multiplexing, Orthogonal Frequency Division Multiple Access, MIMO-OFDM, Effect of frequency offset in OFDM, Peak to average power ratio (PAPR) in OFDM

Cognitive Radio and Software Defined Radio Concepts. Evolution of Mobile Communication Systems, Details of 3G-UMTS, 4G-LTE and 5G Mobile Communication systems.

Mobility Management in Wireless Networks, Mobile IP, Mobile Ad hoc Networks, Ad hoc Routing Protocols, Performance Analysis of DSR and CBRP, Cluster Techniques, Incremental Cluster Maintenance Scheme,


Recommended Readings


1. Text book-

- a. Mobile Cellular Telecommunications- William C.Y. Lee, TMH.
- b. Wireless Communications - T S Rappaport, IEEE Press.
- c. Wireless Communication and Networking - John W. Mark, WeihuaZhuang.
- d. Wireless Adhoc Networks - M. Ilyas, CRC Press.

2. Reference book-

- a. Wireless and Mobile Communication Systems - D. P. Agarwal & Qing Anzen, Thomson Press


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**UG SCHEME : Department of Electronics & Communication Engineering,
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Course Name: Advanced Microwave Engineering

Course Code :

Credits : 3 (L-T-P : 3-0-0)

SYLLABUS :

Review of Electromagnetic Theory, Transmission Lines and Waveguides, Impedance Matching and Tuning; Analysis of microwave networks and components based on different parameters of two port network; Microwave linear beam and crossed field tubes; Introduction to different microwave solid state devices; Introduction to striplines; Microwave filters, amplifiers and oscillators

Recommended Readings

1. Text books-

- a. Microwave Devices and Circuits- Samuel Y. Liao, Prentice Hall
- b. Microwave and Radar Engineering- Kulkarni, McGraw Hill Education
- c. Microwave Solid State Circuit Design- Inder Bahl, John Wiley & Sons.
- d. Microwave circuits & passive devices- Sisodia and Raghuvanshi, New Age International.
- e. Radio-Frequency And Microwave Communication Circuits-Devendra K. Mishra, Wiley

2. Reference books-

- a. Microwave engineering-David M. Pozar, John Wiley & Sons, Inc.
- b. Introduction to Microwaves –Wheeler G.J., Prentice-Hall
- c. Foundations of Microwave Engg.- Collin, John Wiley and Sons

3. Online resources

- a. <https://nptel.ac.in/courses/108/103/108103141/>
- b. <https://nptel.ac.in/courses/108/105/108105181/>
- c. <https://nptel.ac.in/courses/108/101/108101112/>
- d. <https://nptel.ac.in/courses/117/105/117105138/>
- e. <https://nptel.ac.in/courses/117/105/117105130/>
- f. <https://nptel.ac.in/courses/117/101/117101119/>
- g. <https://nptel.ac.in/courses/117/105/117105122/>

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**UG SCHEME : Department of Electronics & Communication Engineering,
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Course Name: Advanced Optical Communication Systems

Course Code :

Credits : 3 (L-T-P : 3-0-0)

SYLLABUS :

Review of optical fiber waveguiding concepts, Advanced fiber design: Dispersion issues, Dispersion shifted, Dispersion flattened, Dispersion compensating fiber, Design optimization of single mode fibres. Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and soliton based communication.

Transmitter design, Receiver - PIN and APD based designs, noise sensitivity and degradation. Receiver amplifier design. Transceivers for fiber optic communication pre amplifier type- optical receiver performance calculation – noise effect on system performance receiver modules.

Coherent, homodyne and heterodyne keying formats, BER in synchronous- and asynchronous- receivers, sensitivity degradation, system performance, Multichannel, WDM, multiple access networks, WDM Components, TDM, Subcarrier and Code division multiplexing. Semiconductor laser amplifiers, Raman - and Brillouin - fiber amplifiers, Erbium doped fiber amplifiers, pumping phenomenon, LAN and cascaded in-line amplifiers. Limitations, Post- and Pre-compensation techniques, Equalizing filters, fiber based gratings, Broad band compression.

Next Generation Optical Communications: Multi-core MMF based SDM transmission, Optical wireless communications.

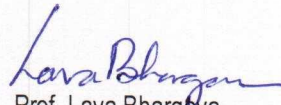
Optical networks- Basic networks-SONET/ SDH-wavelength routed networks - Nonlinear effects on network performance, performance of various systems (WDM, DWDM + SOA).

Recommended Readings

1. Text book-
 - a. Fiber-Optic Communication Systems - Govind P. Agrawal, Wiley.
 - b. Optical communication systems - Franz and Jain, Narosa Publications, New Delhi
2. Online resources-
 - a. <https://nptel.ac.in/courses/117101002/>



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**UG SCHEME : Department of Electronics & Communication Engineering,
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Course Name: Advanced Error Control Codes

Course Code :

Credits : 3 (L-T-P : 3-0-0)

SYLLABUS :

Error Control coding for wireless fading channels, Channel Estimation and Adaptive channel coding, Joint Source and Channel coding. Non binary Linear Block Codes, Hard and soft decision decoding, Coding and Decoding of BCH, Reed Solomon Codes, Convolution codes: Coding and Decoding, Distance bounds, Performance bounds Turbo codes: Coding, Decoding Algorithms, Performance comparison, Interleaver design Trellis coded Modulation, TCM Decoders, TCM for AWGN and Fading Wireless Channels, Performance comparison.

LDPC Codes, Polar Codes, Error control codes for: Audio/video transmission, mobile communications, space and satellite communication, data transmission, data storage and file transfer.

Text book-

- a. Digital Modulation & Coding - Stephen G. Wilson, Prentice Hall Inc.
- b. Information Theory Coding and Cryptography - Ranjan Bose, TMH
- c. Theory and practice of error control codes -R. E. Blahut, AWL1983.
- d. Digital Communication - J. G. Proakis, McGraw Hill Education.

Online resources-

<https://nptel.ac.in/courses/117/108/117108044/>

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**UG SCHEME : Department of Electronics & Communication Engineering,
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Course Name: Computational Electromagnetics

Course Code :

Credits : 3 (L-T-P : 3-0-0)

SYLLABUS :

Review of Electromagnetic Theory, Classification of EM Problems. Analytical Methods-Separation of Variables. Finite Difference Methods. Variation Methods. Method of Moments. Finite element Method.

Text Books :

- a. Numerical Techniques in Electromagnetics - Matthew N.O. Sadiku, CRC Press.
- b. Theory and Computation of Electromagnetic Fields – Jianming Jin, Wiley.

Online : <https://nptel.ac.in/courses/108/106/108106152/>

Course Name: Mini Project on Communication Engineering

Course Code :

Credits : 3 (L-T-P : 0-0-6)

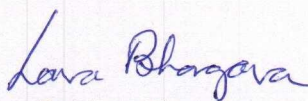
List of Experiments/ activities

Design, verification, prototyping and implementation of hardware/ software

Communication systems based on software, hardware, algorithms, protocol, concepts in emerging areas on 5G/6G communication, optical communication, wireless communication, satellite communication, modulation and demodulation techniques, microwave and antenna, signal processing and artificial intelligence algorithms application in communication and related areas.



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