Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2022-2023
Course Handout Part II

Date: 29-08-2022

In addition to Part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No.	**:**	**ECE F311 / EEE F311**
Course Title	**:**	**Communication Systems**
Instructor-in-charge	**:**	**Dr. Subhradeep Pal**
Instructors	**:**	**Dr. Balasubramanian M, Prof. Runa Kumari, Dr. Gopal Krishna Kamath**

1. Course description:

Analysis and design of communication systems; analog and digital modulation and demodulation, frequency conversion, multiplexing, noise and distortion; spectral and signal-to-noise ratio analysis, probability of error in digital systems, spread spectrum. Introduction to the basic principles of the design and analysis of modern digital communication systems. Topics include source coding, channel coding, baseband and passband modulation techniques, receiver design, and channel equalization.

2. Scope & Objective:

This course intends to cover the basic understanding of functionalities of various block-sets involved in communication system. The topics like Analog to Digital conversion, Pulse coding, Modulation (Analog and Digital, Baseband and Bandpass), source coding, channel coding, Multiple access, Multiplexing techniques, Advanced Modulation Format will be covered with appropriate detail and mathematical description. Important topics related wireless/ mobile communications will be emphasized to appreciate the practical applications. Students will be introduced to the functioning of modern communication systems and how they perform in the presence of noise. Students will be given assignments on communication system modeling using MATLAB. The laboratory component involves system design and simulation exercises using MATLAB and Simulink and experiments based on HW boards. Advance/application areas like wireless communication will be covered towards the end. Students are expected to have sound understanding of Signals and systems, Mathematics, Electromagnetic Field theory.

3. Text Books

T1	B.P. Lathi and Zhi Ding	Modern Digital and Analog Communication Systems (3e / 4e)	Oxford University Press
T2	S. Haykin and M. Moher	Communication Systems (4e / 5e)	John Wiley & Sons.

4. Reference Books

R1	John Proakis	Digital Communications (4e)	Tata McGraw Hill
R2	K. Sam Shanmugam	Digital and Analog Communication Systems	John Wiley & Sons.
R3	B. Sklar and P. K. Ray	Digital Communications: Fundamentals and Applications	Pearson Education
R4	U. Madhow	Introduction to Communication Systems	Cambridge University Press
R5	H. Nguyen and E. Shwedyk	A First Course in Digital Communications	Cambridge University Press
R6	A.B. Carlson and P. B. Cirilly	Communication Systems (5e)	McGraw Hill

5. Course Plan

Sl. No.	Topics to be covered	Learning Objectives	Chapter in the Text Book	No. of Lectures
1	Overview of the course, introduction to communication systems.	History of electronic communications, blocks of a typical communication system, Electronic Communication Channels, twisted pair, cable, wave guide, wireless channels, need for modulation, concept of a carrier, analog and digital communication concepts.	T1: 1 T2: 1	2
2	Deterministic and random signals and	Signals, nature of signals, Review of energy and power signals, correlation functions, power and	T1: 2, 3 T2: 2	2

	their properties	energy spectral densities, Fourier series and Fourier Transforms, signal distortions. Real world signals, pure, distorted and noise corrupted signal examples, typical BW of various signals.	R4: 2	
3	Transmission and reception of analog Signals: Amplitude modulation (AM)	Overview of AM and FM, Different Amplitude Modulation Techniques: DSB-SC, SSB-SC, VSB, AM with carrier: BW requirements of above modulation schemes. Circuits for Generation and demodulation. Frequency Division multiplexing, Super heterodyne Receivers, Some Practical circuits, Concept of synchronization, Frequency and Phase Synchronization, Costas Loop	T1: 4 T2: 3, 6 R2: 7 R6: 4	5
4	Transmission and reception of analog Signals: Frequency modulation (FM) and Phase modulation (PM)	Angle modulation, FM transmitter and receivers, interference and bandwidth considerations, comparison of AM and FM, FM generation and demodulation, PLL	T1: 5 T2: 4, 6 R2: 7 R6: 7	4
5	Digital Representation of Analog Signals and Pulse Modulation	Sampling theorem, aliasing, quantization and encoding, PAM, TDM, PPM, PWM, Quantization, PCM, Delta Modulation	T1: 6 T2: 7 R2: 10	3
6	Random variables, processes and Noise	Recap of Probability, Random variables & processes, statistical averages, Power spectral density, Gaussian process, Noise, Nature of noise, Sources of Noise, white noise, KTB, Noise Figure and Noise temperature, calculations, Signal-to-Noise ratio, Noise performance of different AM systems and angle modulation systems	T1: 8, 9 T2: 5 R3: 5 R6: 8, 9, 10	4
7	Baseband Transmission of Digital Signals	Line codes: NRZ, RZ, AMI, etc., Concept of eye diagram, Distortion-less transmission, pulse shaping, equalization	T1: 7 T2: 8	4
8	Baseband Reception of Digital Signals and Noise performance	Probability of error due to noise, detection of digital signal in noise, threshold determination, Bit error rate calculation, Gram-Schmidt Orthogonalization Correlation receiver, Matched filter receiver	T1: 10 R3: 3 R5: 5	4
9	Band-Pass transmission of Digital signals	Band-Pass Transmission Model, Binary PSK, FSK and QAM, Noise performance of PSK & FSK Systems, Concept of ISI	T2: 9 T1: 10 R3: 4 R2: 8	4
10	Digital receiver design & performance analysis.	Goals of communication system designer, Error probability plane, Nyquist bandwidth, Shannon-Hartley capacity theorem, bandwidth-Efficiency plane, BW efficiency of different modulation schemes, Some advanced modulation formats: OQPSK, MSK, GMSK, CPM	R3: 9 R4:4 R5: 7	3
11	Emerging Trends in Communication Systems: Wireless/Mobile communications.	Modelling wireless systems, Rayleigh Fading Wireless Channel, Baseband model, SNR and BER in wireless systems, Channel Estimation, Diversity in wireless communications, Delay spread, Coherence bandwidth, ISI, Doppler Shift, Coherence Time	Supplementary notes and Reference Books	3
12	Information & Forward Error Correction	Measure of information, entropy, Source Coding Theorem, discrete memory less channels, Channel capacity & Channel Coding, Error Control Codes, Linear block & convolutional codes	T1: 13,14 T2: 10 R3: 6 R2: 9	3
		Total Number of Lectures		41

Laboratory component: Laboratory exercises will involve simulations using MATLAB. Also, experiments will be conducted using HW boards, Signal Sources or Function Generator, Oscilloscopes & RF Spectrum Analyzer.

6. **Evaluation Scheme**

Components	Duration	Weightage	Marks	Date & Time	Nature of Component
Class Tests (I and II)	30 mins.	10%	30	TBA	Closed Book
Mid Term Evaluation	90 mins.	20%	60	31/10 1.30 - 3.00PM	Closed Book
Continuous Lab Evaluation		15%	45		Lab attendance and performing experiments (Open Book)
Final Lab Examination		15%	45		Experiment to be performed & viva-voce
Tutorial		10%	30		Regular assessment in tutorial lectures (Open Book)
Comprehensive Examination	3 hrs.	30%	90	19/12 FN	Closed Book
Total		**100%**	300		

7. **Chamber Consultation Hour**: Will be announced in the class.

8. **Notices**: Notices concerning this course will be on Google Classroom and in CMS.

9. **Make-up Policy:**
   Make-up will be given on genuine grounds only. Prior application should be made for seeking the make- up examination. No make-up will be given for the quiz.

10. **Academic Honesty and Integrity Policy:**
    Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Subhradeep Pal
Instructor-in-Charge
ECE/EEE F311