

PRINCIPLES OF COMMUNICATION SYSTEMS		Semester	4
Course Code	BEC402	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/practical/Viva-Voce/Term-work/Others		

Course objectives:

This course will enable students to

- Understand and analyse concepts of Analog Modulation schemes viz; AM, FM
- Design and analyse the electronic circuits for AM and FM modulation and demodulation.
- Understand the concepts of random variable and random process to model communication systems.
- Understand and analyse the concepts of digitization of signals.
- Evolve the concept of SNR in the presence of channel induced noise

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE-1

Random Variables and Processes: Introduction, Probability, Conditional Probability, Random variables. Statistical Averages: Function of a random variable, Moments, Random Processes, Mean, Correlation and Covariance function: Properties of autocorrelation function, Cross-correlation functions, Gaussian Process: Gaussian Distribution Function.

[Text 2: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.9]

RBT: L1, L2

MODULE-2

Amplitude Modulation Fundamentals: AM Concepts, Modulation index and Percentage of Modulation, Sidebands and the frequency domain, AM Power, Single Sideband Modulation.

AM Circuits: Amplitude Modulators: Diode Modulator, Transistor Modulator, collector Modulator. Amplitude Demodulators: Diode Detector, Balanced Modulators: Lattice Modulators.

Frequency Division Multiplexing: Transmitter-Multiplexer, Receiver-Demultiplexer.

[Text1: 3.1, 3.2, 3.3, 3.4, 3.5, 4.2, 4.3, 4.4, 10.2]

RBT: L1, L2, L3

MODULE-3

Fundamentals of Frequency Modulation: Basic Principles of Frequency Modulation, Principles of Phase Modulation, Modulation index and sidebands, Noise Suppression Effects of FM, Frequency Modulation versus Amplitude Modulation.

FM Circuits: Frequency Modulators: Voltage Controlled Oscillators, Frequency Demodulators: Slope Detectors, Phase Locked Loops.

Communication Receiver: Super heterodyne receiver, Frequency Conversion: Mixing Principles, JFET Mixer.

[Text1: 5.1, 5.2, 5.3, 5.4, 5.5, 6.1, 6.3, 9.2, 9.3]

RBT: L1, L2, L3

MODULE-4

Digital Representation of Analog Signals: Introduction, Why Digitize Analog Sources?, The Sampling process, Pulse Amplitude Modulation, Time-Division Multiplexing, Pulse Position Modulation: Generation and Detection of PPM wave. The Quantization Process. Pulse Code Modulation: Sampling, Quantization, Encoding, line Codes, Differential encoding, Regeneration, Decoding, filtering, multiplexing.

[Text2: 7.1,7.2,7.3,7.4,7.5,7.6,7.8,7.9]

RBT: L1,L2,L3

MODULE-5

Baseband Transmission of Digital signals: Introduction, Intersymbol Interference, Eye Pattern, Nyquist criterion for distortionless Transmission, Baseband M-ary PAM Transmission.

[Text2:8.1,8.4,8.5,8.6,8.7]

Noise: Signal to Noise Ratio, External Noise, Internal Noise, Semiconductor Noise, Expressing Noise Levels, Noise in Cascade Stages.

[Text1:9.5]

RBT:L1,L2,L3

PRACTICAL COMPONENT OF IPCC (Experiments can be conducted using MATLAB/SCILAB/OCTAVE)

Sl.NO	Experiments
1	Basic Signals and Signal Graphing: a) unit Step, b) Rectangular, c) standard triangle d) sinusoidal and e) Exponential signal.
2	Illustration of signal representation in time and frequency domains for a rectangular pulse.
3	Amplitude Modulation and demodulation: Generation and display the relevant signals and its spectrums.
4	Frequency Modulation and demodulation: Generation and display the relevant signals and its spectrums.
5	Sampling and reconstruction of low pass signals. Display the signals and its spectrum.
6	Time Division Multiplexing and demultiplexing.
7	PCM Illustration: Sampling, Quantization and Encoding
8	Generate a)NRZ, RZ and Raised cosine pulse, b) Generate and plot eye diagram
9	Generate the Probability density function of Gaussian distribution function.
10	Display the signal and its spectrum of an audio signal.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1. Understand the principles of analog communication systems and noise modelling.
2. Identify the schemes for analog modulation and demodulation and compare their performance.
3. Design of PCM systems through the processes sampling, quantization and encoding.
4. Describe the ideal condition, practical considerations of the signal representation for baseband transmission of digital signals.
5. Identify and associate the random variables and random process in Communication system design.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test (**duration 02/03 hours**) after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks**.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.
- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Suggested Learning Resources:**Books**

1. Louis E Frenzel, Principles of Electronic Communication Systems, 3rd Edition, Mc Graw Hill Education (India) Private Limited, 2016. ISBN: 978-0-07-066755-6.
2. Simon Haykin & Michael Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010. ISBN: 978-81-265-2151-7.

Reference Books


1. B P Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems", Oxford University Press., 4th edition, 2010, ISBN: 97801980738002.
2. Herbert Taub, Donald L Schilling, Goutam Saha, "Principles of Communication systems", 4th Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN: 978-1-25-902985-1

Web links and Video Lectures (e-Resources):

1. Principles of Communication Systems <https://nptel.ac.in/courses/108104091>
2. Communication Engineering <https://nptel.ac.in/courses/117102059>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Assignments and test – Knowledge level, Understand Level and Apply level
2. Experiential Learning by using free and open source software's SCILAB or OCTAVE
3. Open ended questions by faculty, Open ended questions from students


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