Course outline of CT214: Analog and Digital Communications

1. Title: Analog and Digital Communications (Instructors: Prof. Laxminarayana Pillutla (main instructor) and Prof. S. C. Sahasrabudhe)

2. Credit Structure (L-T-P-Cr): 3 0 1.5 4.5

3. Course Code: CT 214

4. Semester: 4th

5. Category: B. Tech core

6. Prerequisites: CT 203: Signals and Systems, CT 111: Intrdouction to Communication Systems and SC 217: Electromagnetic Theory.

7. Foundation for: Communications and Signal Processing

8. Abstract Content:

Module 1: Introduction to communication systems and Review of Signals and Systems

- History and evolution of communication systems, review of signals and spectra, Time and frequency relations, Response of LTI systems, Transfer functions, Frequency response, Band-limited signals Signal distortion in transmission, Filters, Hilbert transforms, Correlation and spectral density functions.

Module 2: Linear CW Modulation

- Band pass signals and systems, AM, DSB, signals and spectra, Product modulators, Square law modulators, Switched modulators, Envelope detection, SSB, VSB signals and spectra, generation and synchronous detection, QAM

Module 3: Angle Modulation

- Phase and frequency modulation, Narrow band PM and FM, single Tone and multi-tone modulations, Transmission bandwidth, Generation and detection of FM and PM signals, De-emphasis and pre-emphasis filtering.

Module 4: Sampling, Pulse Modulation and PCM

- Review of sampling theorem, Ideal sampling, Practical sampling Aliasing and reconstruction, Pulse code modulation (PCM): generation, reconstruction, quantization noise, and companding. Differential-PCM (D-PCM) and delta modulation, **Digital multiplexing (T1/E1, T3/E3, etc.) and introduction to ISDN (Newly proposed content)**.

Module 5: Digital Modulation Schemes and Multiplexing

- Digital modulation techniques: ASK, PSK, FSK, QAM and MSK. Frequency division multiplexing, quadrature carrier multiplexing and time division multiplexing.

9. Suggested Text/s:

- Communication Systems: An Introduction to Signals and Noise in Electrical Communication (Latest Edition) by A. Bruce Carlson, Paul B. Crilly and Janet C Rutledge. Publisher: McGraw-Hill **(Preferred)**.
- Modern Digital and Analog Communication Systems (Fourth edition) by B. P. Lathi and Z. Ding. Publisher: Oxford University Press.
- An Introduction to Analog and Digital Communications, Second edition, by S. Haykin, Wiley.
- Communication Systems by S. Haykin and M. Moher, Fifth Edition, Wiley
- Digital Telephony (third edition) by John C Bellamy, John Wiley and Sons, 2002.
- Digital Communications by Simon Haykin.
- Digital Communications by John G Proakis

10. Detailed Contents: Please see above.

11. Objectives:

- The course aims to build on the rudimentary content that was taught in CT 111: Introduction to Communication Systems. Specifically, the course exposes the students to frequency domain analysis of communication systems. Further, the course introduces students to analog-to-digital conversion aspects involved in communication systems.

12. Outcomes:

- At the end of the course the student would be able to demonstrate understanding of analog modulation systems, analog-to-digital conversion and digital modulation schemes.
- The course would be an excellent foundation course for students who intend to do pursue further studies in the area of communications.

13. *Comments:*

- As noted above, the course would have 2 instructors namely Prof. Pillutla and Prof. Sahasrabudhe. Prof. Pillutla would focus on modules 1, 2 and 3. Prof. Sahasrabudhe would focus on modules 4 and 5.
- All the students should enroll into the course web page available on the courses.daiict.ac.in website. All the course announcements such as labs, etc., will be made through the course web page.

14. Grading Policy:

- 1 – Insem examination: 15%
- 2 – Insem examination: 25%
- Final examination (comprehensive): 35%
- Two (surprise) lab examinations: 10%
- Pop (or surprise) quizzes: 15%

(Note: The syllabus for all the three exams would be based on whatever that has been covered till that point in time.)

15. Policy on academic dishonesty: Instances of academic dishonesty could entail a maximum penalty of Grade “F” in the course. These instances could include cheating during in class quizzes, lab exams and the three regular exams.

16. Attendance policy: Students should try to attend lecture and lab sessions accordingly. Regular attendance gets reflected in the form of credit that one accrues for surprise quizzes. Under any circumstances the missed quizzes or lab exams would not be re-administered.

17. Leave exemption policy: **As per the DA-IICT leave policy.**

18. Lab Guidelines:

- The purpose of lab is to complement the theoretical concepts covered in the class. For most part the lab would be based on the stuff covered in the class, although, occasionally you may be taken outside the syllabus to broaden your thinking horizon.
- To promote group work the lab sessions are done in teams of size no more than 2. Once you identify your team mate you are required to retain him/her for entire semester.
- You are requested to do your lab work on the designated day and time. Please do not shift your lab timings for any reason.
- Lab Attendance is compulsory, the TAs would take attendance for all the labs. **If your lab attendance is not 100%, then you may stand to loose the entire lab examination credit.**
- The software labs would be based on LABVIEW. It is your duty to get accustomed to this software. The first lab would help you in getting started with LABVIEW.
- Every lab would be put one week before the corresponding date of the lab. It is your duty to go through the lab and do the required pre-lab preparation (both on the theoretical and software front).
- As mentioned in the grading policy, there can be surprise lab exams based on the labs that were done until then. The lab exam grading would be based on (i) viva-voce and (ii) lab report. The guidelines for lab report are given below.
- The following are a few guidelines you need to follow in preparing your lab report (each report should have a cover page that contains following: Subject code and Name, Experiment Number and title, Experiment date and Your name, id and lab group)::
    1. The report must have a lab objective.
    2. You need to state clearly the theoretical concepts and equations used.
    3. Lab results (in the form of plots, tabular columns, etc., as and where applicable) and the associated analysis.
    4. Conclusions.
    5. Appendices showing your source code.
- Note: Always ensure you carry a pen drive with you to copy the data corresponding to a particular lab. The stored data can be of use later.