## Birla Institute of Technology & Science, Pilani
### Hyderabad Campus

**BITS-Pilani, Hyderabad Campus**
**First Semester 2022-2023**
**Course Handout**

Date: **10/08/2022**

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

Course Number            : **EEE G612**
Course Title               : **Coding Theory & Practice**
Course Coordinator      : **Prof. RUNA KUMARI.**

1. **Course Description**

   Codes for data-compression: instantaneous codes; Kraft inequality; Mcmillan theorem; Huffman codes; codes for error-detection and correction; binary symmetric channel; channel capacity, Shannon's fundamental theorem; linear codes; Macwilliam's identity; Reed-muller codes; cyclic codes; BCH codes; codes for secrecy and security; private-key cryptosystems; affine codes; twisted codes; one-time-pads; public-key cryptosystems based on large primes and discrete logarithms.

2. **Scope and Objective of the Course:**

   The course covers source coding, channel coding & encryption. The former deals with error correction in noisy channel, and the latter deals with secrecy of communication. Channel coding, which constitutes the major portion of the course, will introduce a number of important classes of error-detecting and error-correcting codes and their decoding. Finally the course will give an introduction to encryption & decryption of data for secret communications.

3. **Text Books:**

   Information theory, Coding and Cryptography, Ranjan Bose, Tata McGraw Hill, 3rd ed, 2017.

4. **Reference Books:**

   1. Element of Information Theory, Thomas M Cover, John Wiley & Sons, 2004
   2. Information Theory and Coding, Normal Abrahamson, Mcgraw Hill, Electronic Sciences Series.
   3. Principles of Digital Communication by Robert Gallager, Cambridge University Press.
   4. Introduction to Data Compression by Khalid Sayood, Morgan Kaufmann, Elsevier.
   5. Error Control Coding-Fundamentals and Applications, Shu Lin and Daniel Costello, Prentice Hall

5. **Course Plan / Schedule:**

| Sl. # | Learning objectives | Topics to be covered | Chapter No. | No. of lectures |
|---|---|---|---|---|
| 1. | Introduction | Introduction to the course & Coding | | 1 |
| 2. | To introduce the concept of Uncertainty, Entropy | Data compression, Entropy | TB:Ch. 1 Ref:Ch.2 | 3 |

| 3. | To introduce the concepts of coding and decoding | Unique and instantaneous codes, Kraft's inequality | TB:Ch. 1 Ref:Ch.5 | 2 |
|---|---|---|---|---|
| 4. | To introduce Universal Source coding | Huffman, Shannon-Fano-Elias, Arithmetic, L-z, Run Length Coding | TB:Ch.1 | 5 |
| 5. | To introduce optimal codes | Rate distortion theorem, Optimal code length | TB:Ch. 1 Ref:Ch. 13 | 2 |
| 6. | To introduce the concept of channel capacity and coding | Channel models, channel capacity, Shannon limit | TB:Ch. 2 | 2 |
| 7. | To introduce the concept of error correcting codes | Linear block codes, generator & parity check matrix | TB:Ch. 3 | 4 |
| 8. | To introduce the concept of syndrome and decoding through syndrome | Syndrome decoding of linear codes | TB:Ch. 3 | 2 |
| 9. | To study cyclic codes, their encoding & decoding | Cyclic codes | TB:Ch. 4 | 4 |
| 10 | To study certain well known linear codes | Well-known block codes ; Golay code, CRC codes | TB:Ch. 4 | 3 |
| 11 | To introduce the important class of BCH codes | BCH codes, Reed-Solomon codes | TB:Ch.5 | 3 |
| 12 | To introduce the important class of Convolutional coder & decoder | Convolutional codes, Viterbi decoding, turbo codes | TB:Ch. 7 | 6 |
| 13 | To introduce the concept of data encryption and decryption | Models, goals and early cipher systems | TB:Ch.9 | 2 |
| 14 | To introduce Public Key Cryptosystems | Public Key Crypto systems and some examples | TB:Ch. 9 | 2 |
| | | **Total no. of classes planned** | | **41** |

## 6. Evaluation Scheme:

| Component | Duration | Weightage | Marks | Date & Time | Remarks |
|---|---|---|---|---|---|
| Mid Sem | 90 mts. | 20% | 60 | 02/11 1.30 - 3.00PM | Closed Book |
| Quizzes | | 10% | 30 | - | Closed Book |
| Laboratory Component | | 20% | 60 | 2 Hr Lab Session per week +design expt + 2Hr End semester Practical Exam | Open Book |
| Term Project | | 20% | 60 | Weekly interaction+ literature survey + simulation + mid sem and End semester Project presentation | Open Book |
| Comprehensive | 3 Hrs | 30% | 90 | 23/12 FN | Closed Book |
| **Totals** | | **100%** | **300** | | |

## 7. Chamber Consultation Hour: To be announced in Class

## 8. Make-up Policy: Make-up will be given on extremely genuine grounds only. Prior application should be made for seeking the make-up examination.

## 9. Notices: Notices, if any, concerning the course will be put up on CMS only

## 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

**Runa Kumari**

**Instructor-in-Charge**
**EEE G612**