Communication engineering and Signal processing applications have been rapidly growing and evolving over the past few years. Ubiquitous communication is becoming a necessity for the society. The proposed M.Tech. Program is designed to offer not only in-depth theoretical knowledge in the area of Communications, Signal Processing, and Wireless Networks, but also system modeling and integration aspects emphasizing overall system behavioral studies in a laboratory. Such courses are unique and fall in-line with the requirements from the industries. At the end of the programme the student achieves the ability to identify pressing research issues and research directions in Communications, Signal Processing, and Wireless Networks.
# CURRICULUM

## First Semester

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*Non-credit course

Credits 19

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Credits 16

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Credits 12

Total Credits 66
## List of Courses

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### Subject Core

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### Electives

#### COMMUNICATION / SIGNAL PROCESSING

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**Project Work**

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TEXT BOOKS / REFERENCES:

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TEXT BOOKS / REFERENCES:

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**TEXT BOOKS / REFERENCES:**

**ES612 EMBEDDED SYSTEMS PROGRAMMING 3-0-1-4**

C-Data types, Operators and Expressions, Control Flow, Arrays and pointers, Storage Class, Structure and union, Functions, Stacks and Queues, linked list, doubly linked list- Implementation of stacks and queues using arrays and linked lists. Embedded C- Introduction to Embedded systems. Embedded C- Programming and examples, Compiling, Linking, Downloading and Debugging, Interrupts and exceptions, RTOS. Software process models-Software Specification, UML use cases, class diagrams, Finite State Machines-Architecture Styles-Software Design-Design qualities- Structure chart, UML diagrams for design-Testing and verification – Software Estimation-Software Configuration Management.

**TEXT BOOKS / REFERENCES:**

**CE611 DIGITAL COMMUNICATION 3-0-0-3**

CE612  RF CIRCUITS AND SYSTEMS  3-1-0-4


TEXT BOOKS / REFERENCES:

CE613  SEMINAR  0-0-1-1

CE614  SIGNAL PROCESSING – II  3-0-0-3


TEXT BOOKS / REFERENCES:

TEXT BOOKS / REFERENCES:

CE616  MODELING AND SIMULATION OF COMMUNICATION SYSTEMS3-0-1-4


TEXT BOOKS / REFERENCES:
ELECTIVE SUBJECTS

CE701  BROADBAND COMMUNICATION NETWORKS  3-0-0-3


TEXT BOOKS/REFERENCES:
1. Fred Halsall, Data Communications, Computer Networks and Open Systems, Addison-Wesley, 1996.

CE702  INFORMATION THEORY AND CODING  3-0-0-3

Information theory of wireless channels- Entropy and mutual information, capacity of Gaussian channels and parallel Gaussian channels, capacity of fading channels, ergodic capacity and outage capacity, high versus low SNR regime, water filling capacity. Computations using Galois Field Arithmetic- Linear Block Codes: Interleaved Codes, Cyclic Product Codes, Reed Solomon Codes - Trellises for Linear Block Codes – Soft Decision Decoding of Linear Block Codes: Reliability measures, General Reliability based decoding schemes, Sufficient Conditions on Optimality, Maximum Likelihood Decoding based on Iterative Processing of the Least Reliable Positions, Most Reliable Independent Position Reprocessing - Optimum decoding of Convolution Codes: Soft Output Viterbi algorithm(SOVA), BCJR algorithm - Single Level and Multilevel Concatenated codes - Turbo Coding: Design and Properties of Turbo codes, Iterative decoding of Turbo codes - Low Density Parity Check codes: Geometric Construction of LDPC Codes, Decoding of LDPC Codes, Concatenation with LDPC Codes and Turbo Codes, Applications in Long Term Evolution and Deep Space communication – Block Coded modulation.

TEXT BOOKS/REFERENCES:

**CE703 MILLIMETER WAVE COMMUNICATION SYSTEMS**


**TEXT BOOKS / REFERENCES:**

**CE704 MULTIUSER DETECTION**

Introduction - multiple access communications – Code division multiple access (CDMA) channel- Basic synchronous CDMA - asynchronous CDMA- Discrete Time synchronous model, Discrete Time asynchronous model- Single User Matched filter – matched filter in the CDMA channel, probability of error for synchronous users, probability of error for asynchronous users- asymptotic multi user efficiency and related measures - Optimum multiuser detection- synchronous two user, K user multiuser detection, asynchronous two user, K user multiuser detection - Multiuser Performance Measures, Multi-user Efficiency (MUE), Asymptotic Multiuser Efficiency (AME), near-far resistance (NFR) - Principles of optimal multiuser detection definitions of optimality, probability of error determination, ML detection - Principles of linear multiuser detection: conventional, decorrelator, MMSE detection - Adaptive multiuser detection, Blind Multiuser detection - Principles of nonlinear multiuser detection: successive cancellation, multistage detection, decision feedback.
TEXT BOOKS/REFERENCES

CE705  MULTICARRIER COMMUNICATIONS  3-0-0-3


TEXTBOOKS /REFERENCES:

CE706  OPTICAL COMMUNICATIONS AND NETWORKS  3-0-0-3

Introduction to optical communication, merits of optical fiber communication systems, transmission characteristics of optical fibers, optical sources, detectors, couplers, isolators, circulators, filters, gratings, interferometers, amplifiers, optical transmitter and receiver circuits, multiplexing strategies and OTDR. Introduction to Optical Networks, SONET / SDH standards, WDM optical network, issues in wavelength routed networks, wavelength routing algorithms, wavelength convertible networks, wavelength rerouting algorithms, control and management, network survivability and traffic grooming in WDM networks.

TEXT BOOKS / REFERENCES:

**TEXT BOOKS / REFERENCES:**

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**TEXT BOOKS / REFERENCES:**

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TEXT BOOKS / REFERENCES:

CE710 SOFTWARE DEFINED RADIO 3-0-0-3


TEXTBOOKS/REFERENCES:

CE711 VEHICULAR COMMUNICATIONS AND NETWORKS 3-0-0-3

TEXTBOOKS / REFERENCES:

CE712 WIRELESS NETWORKS AND PROTOCOLS 3-0-0-3

Introduction to Wireless Networks and Protocols: Wireless networks, History, Standards and market issues, Evolution and trends on wireless networking (Wireless local area network – WLAN); Wireless Networks Concepts and Systems: WLAN, Project IEEE 802.11, Architecture, components, and protocols, Mobility concepts and management; Physical and MAC Layer Characteristics and Protocols: Physical layer characteristics and technologies, MAC Layer Protocol such as DCF, PCF; Routing in Wireless Networks (Ad Hoc Networks and WSNs), Transport layer protocols and security: Routing and Transport layer protocols in WLANs, Security and Privacy. Wireless Technology and Standards: Bluetooth, ZigBee etc.; Quality of service: Characterization and model.

TEXTBOOKS / REFERENCES:

CE713 RADAR SYSTEMS 3-0-0-3


TEXT BOOKS / REFERENCES:

TEXTBOOKS / REFERENCES:


TEXT BOOKS / REFERENCES:

TEXT BOOKS / REFERENCES:

CE717 COMPUTER VISION AND PATTERN RECOGNITION 3-0-0-3


TEXTBOOKS/REFERENCES:

CE718 COMPUTATIONAL INTELLIGENCE TECHNIQUES 3-0-0-3


TEXT BOOKS / REFERENCES:
CE719  CONVEX OPTIMIZATION  3-0-0-3


TEXT BOOKS/REFERENCES:

CE720  IMAGE AND VIDEO PROCESSING  3-0-0-3

Two dimensional signals and systems-Sampling in two dimensions-Two dimensional discrete transforms—DCT –DWT- Application to images -2D Hadamard Transform, Walsh Transform, KLT, Application to images- Z Transform and its properties, Application to images- Image Acquisition-Filtering in Spatial and Frequency domain-Image Compression-3D signals and Systems-3D sampling and reconstruction-Digital Video Processing-Digital Video Compression

TEXT BOOKS/REFERENCES:

CE721  MACHINE LEARNING  3-0-0-3

generative architectures – Convolution neural networks - Auto encoders - Restricted Boltzmann machines – Variants of RBMs and auto encoders.

**TEXT BOOKS/REFERENCES:**

**CE722**  
**MULTIMEDIA PROCESSING AND CODING**  
3-0-0-3


**TEXTBOOKS /REFERENCES:**

**CE723**  
**MULTIRATE SIGNAL PROCESSING FOR COMMUNICATION SYSTEMS**  
3-0-0-3


**TEXT BOOKS / REFERENCES:**

**CE724**

**SPEECH AND AUDIO PROCESSING**

3-0-0-3

Speech analysis-source filter modeling - speech sounds - lip radiation - linear prediction - lattice filters - Levinson-Durbin recursion, Feature extraction for speech processing-short term Fourier transform-wavelets -ceptrum, sinusoidal and harmonic representations -mel frequency cepstral coefficients (MFCC) - perceptual linear prediction (PLP) –mel filter bank energies, use of temporal patterns (TRAPS) in speech processing, Principles of speech coding -main characteristics of a speech coder - key components of a speech coder - from predictive coding to CELP - Improved CELP coders - wide band speech coding, audio-visual speech coding, Speech synthesis-Linguistic processing - acoustic processing - training models automatically - text pre-processing, grapheme to phoneme conversion – rule based and decision tree approaches - syntactic prosodic analysis, prosodic analysis - speech signal modeling, Principles of speech recognition-Hidden Markov models (HMM) for acoustic modeling - observation probability and model parameters - HMM as probabilistic automata - Viterbi algorithm - Language models - n-gram language modeling and difficulties with the evaluation of higher order n-grams and solutions, spoken language identification – approaches, acoustic, phonetic, LVCSR based – Introduction to speaker recognition, DET, EER, Cost function, weighted error rate and HTER.

**TEXT BOOKS/REFERENCES:**