UNIVERSITY OF CALICUT

SCHEME AND SYLLABUS FOR
M.Tech.
in
COMMUNICATION ENGINEERING

(ELECTRONICS & COMMUNICATION ENGINEERING)

(2011 Admission onwards)
Scheme of M.Tech Programme in Communication Engineering

**SEMESTER 1**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Subject</th>
<th>Hours per week</th>
<th>Marks</th>
<th>Total</th>
<th>Credits</th>
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<td>ECE10 101</td>
<td>Probability and Stochastic Processes</td>
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<td>Digital Communication Techniques</td>
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L-Lecture T-Tutorial P-Practical ICA-Internal Continuous Assessment ESE-End Semester Examination

**ELECTIVE-I**

ECE10 105 (A) - Optimisation Techniques

ECE 10 105 (B)- OFDM for Wireless Communication
ECE 10 105 (C) - RF MEMS

ECE 10 105 (D) - Advances in data and Computer Communication

Note: 6 hours/week is meant for departmental assistance by students. Note: Each student has to undertake the departmental work assigned by the Head of Department

**SEMESTER II**

<table>
<thead>
<tr>
<th>SL No</th>
<th>Code</th>
<th>Subject</th>
<th>Hours per week</th>
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<td>Advanced Information &amp; Coding theory</td>
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<td>Communication Design and Simulation Laboratory</td>
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L-Lecture; T-Tutorial; P-Practical; ICA-Internal Continuous Assessment; ESE-End Semester Examination
**ELECTIVE-II**

ECE10 204 (A)- Multirate Signal Processing  
ECE10 204 (B) - Smart antennas  
ECE10 204 (C) - Transform Theory  
ECE10 204 (D) - Communication Switching and Multiplexing

**ELECTIVE-III**

ECE10 205 (A) - Personal Wireless Networks and Mobile Computing  
ECE10 205 (B) - Detection and Estimation  
ECE10 205 (C) – Designing with ASICs  
ECE10 205 (D)- RF Design of Communication Systems

Note: 6 hours/week is meant for departmental assistance by students. Note: Each student has to undertake the departmental work assigned by the Head of Department

**SEMESTER III**

<table>
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<tr>
<th>SL No</th>
<th>Code</th>
<th>Subject</th>
<th>Hours per week</th>
<th>Marks</th>
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<td>Elective-IV</td>
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ELECTIVE-IV

ECE10 301 (A) - Signal Compression
ECE10 301 (B) - Advanced techniques for wireless reception
ECE10 301 (C) — Secure Communication
ECE10 301 (D)- Adaptive Signal Processing

ELECTIVE-V

ECE10 302 (A) - Markov Modeling and Queueing Theory
ECE10 302 (B) - Space Time Coding and MIMO Systems
ECE10 302 (C) — Spectrum analysis Techniques
ECE10 302 (D)- New Generation Networks

Note: 6 hours/week is meant for departmental assistance by students. Note: Each student has to undertake the departmental work assigned by the Head of Department

SEMESTER IV

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours per week</th>
<th>Internal Marks</th>
<th>Sem-end exam.</th>
<th>Total Marks</th>
<th>Credits</th>
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<td>ECE 10 401(P)</td>
<td>Masters Research Project (Phase - II)</td>
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TOTAL | 30 150 | 150 | 150 | 150 | 600 | 12 |

Note: 6 hours/week is meant for departmental assistance by students. Note: Each student has to undertake the departmental work assigned by the Head of Department
SEMESTER I

ECE10 101 Probability and Stochastic Processes

Teaching scheme: Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
This course provides further studies on Probability and Stochastic processes which has wide areas of application in communication engineering.

Module I (13 hours)

Module II (13 hours)

Module III (14 hours)
Module IV (13 hours)

Reference Books:

2. R.B.Ash & C.Doleans-Dade, Probability and Measure Theory (2/e), Elsevier, 2005
5. Stakgold, I., Green’s Functions and Boundary value Problems (e), Wiley, 1998

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE 10 102 Digital Communication Techniques

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
This course introduces the theoretical background needed to understand digital communication techniques. The main emphasis is on digital transmission via additive white
Gaussian noise channels, synchronization aspects of communication systems and communication over band limited channels.

Module I: (12 hours)
**Random Variables and Processes:** Review of Random variable: Moment generating function, Chernoff bound, Markov's inequality, Chebyshev’s inequality, Central Limit Theorem, Chi square, Rayleigh and Rician distributions, Correlation, Covariance matrix - Stationary processes, wide sense stationary processes, ergodic process, cross correlation and autocorrelation functions- Gaussian process

Module II: (16 hours)
**Communication over Additive Gaussian Noise Channels**
Characterization of Communication Signals and Systems- Signal space representation- Connecting Linear Vector Space to Physical Waveform Space- Scalar and Vector Communication over Memory less Channels. Optimum waveform receiver in additive white Gaussian noise (AWGN) channels - Cross correlation receiver, Matched filter receiver and error probabilities. Optimum Receiver for Signals with random phase in AWGN Channels-Optimum receiver for Binary Signals- Optimum receiver for M-ary orthogonal signals-Probability of error for envelope detection of M-ary Orthogonal signals. Optimum waveform receiver for coloured Gaussian noise channels- Karhunen Loeve expansion approach, whitening.

Module III: (14 hours)
**Synchronization in Communication Systems**

Module IV: (11 hours)
**Communication over Band limited Channels**

Reference Books:
Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE 10 103 Wireless Mobile Networks

Teaching scheme:  
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective: The course is to introduce various mobile networks and their basic architecture starting from 2G through to 3G.

Module 1 (13 hours)
Introduction to Personal Communication Services (PCS): PCS architecture, Mobility management, Networks signalling.
Global system for Mobile Communication (GSM) system overview: GSM Architecture, Mobility Management, Network signalling.
Module 2 (13 hours)
Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.

Module 3 (13 hours)
Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G.

Module 4 (14 hours)
Wireless local Loop (WLL): Introduction to WLL architecture, WLL technologies.
Global Mobile Satellite Systems: Case studies of IRIDIUM and GLOBALSTAR systems.
Bluetooth technology and Wi-Max

References:

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per
subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE 10104 Advanced Digital Signal Processing

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
This course provides ideas of DSP techniques and some algorithms and estimation techniques which will help the students to deal with various audio and image processing

Module I (13 hours)

Review of sampling theory. Sampling rate conversion by integer and rational factors.


Module II (14 hours)


Module III1 (13 hours)

**Module IV (13 hours)**


**Reference Books:**

2. S.Haykin, Adaptive Filter Theory (3/e), Prentice- Hall,1996
4. Marple, Spectral Analysis,

**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**

Question 1: 20 marks
Question 2: 20 marks

**Module II**

Question 3: 20 marks
Question 4: 20 marks

**Module III**

Question 5: 20 marks
Question 6: 20 marks

**Module IV**

Question 7: 20 marks
Question 8: 20 marks
ECE10 105(A): Optimisation Techniques

Teaching scheme: 4 Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
The aim of this course is to expose students to various deterministic optimization tools and techniques. The course generally covers topics such as: an overview of mathematical modelling, linear and non linear programming and various constrained & unconstrained optimization techniques which will be useful for engineering applications.

Module I: (13 Hours)


Module II: (14 hours)

Module III: (14 hours)

Module IV: (12 Hours)
Constrained optimization: Lagrangian method - Sufficiency conditions - Kuhn-Tucker optimality conditions- Rate of convergence - Engineering applications Quadratic programming problems- Convex programming problems.

References:
1. David G Luenberger, Linear and Non Linear Programming, 2nd Ed, Addison-Wesley.

**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
Question 1: 20 marks
Question 2: 20 marks

**Module II**
Question 3: 20 marks
Question 4: 20 marks

**Module III**
Question 5: 20 marks
Question 6: 20 marks

**Module IV**
Question 7: 20 marks
Question 8: 20 marks

**ECE10105(B) OFDM for Wireless Communication**

**Teaching scheme:**
3 hours lecture & 1 hour tutorial per week

**Credits:** 4

**Objective:**
The aim of the paper is to introduce to the students the basics of OFDM scheme used in wireless communication. The students will be introduced with the applications also.
Module 1 (13 hours)

**OFDM Basics:** Introduction to Wireless OFDM – OFDM principles, system model – Generation of sub carrier using IFFT, Guard time and cyclic extension, windowing, choice of OFDM parameters, OFDM signal processing.

Module 2 (13 hours)

**Coding and Modulation:** Introduction – Forward error correcting coding – Interleaving – Quadrature Amplitude modulation – Coded modulation – Synchronization – sensitivity to phase noise and frequency offset and timing errors – Synchronization using cyclic extension and special training symbols.

Module 3 (14 hours)

**Channel estimation for OFDM system:** Coherent and Differential Detection – Coherent detection – one and two dimensional channel estimators, special training symbols, Decision directed channel estimation – Differential detection – Differential detection in the time and frequency domain – Differential amplitude and phase shift keying.

**Orthogonal Frequency Division Multiple Access:** Frequency hopping in OFDMA, Difference between OFDMA and MC-CDMA. OFDMA system description – channel coding, modulation, Time and Frequency synchronization, Initial modulation timing and frequency offset synchronization accuracy, power control, random frequency hopping operation – Dynamic channel allocation (simple and fast) – capacity of OFDMA.

Module 4 (13 hours)

**Application of OFDMA:** Digital Audio Broadcasting – Front end Impairments in the OFDM modem – system simulation tools – Analysis and simulation of the main front end effects – Terrestrial digital video broadcasting – Magic wand (Wireless ATM project).

IEEE 802.11, Hyper LAN/ 2 and MMAC, Wireless LAN standards – OFDM parameters, channelization, OFDM signal processing, Training, Difference between IEEE 802.11, Hyper LAN/ 2 and MMAC.

References:


**Internal continuous assessment:** 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
Question 1: 20 marks
Question 2: 20 marks

**Module II**
Question 3: 20 marks
Question 4: 20 marks

**Module III**
Question 5: 20 marks
Question 6: 20 marks

**Module IV**
Question 7: 20 marks
Question 8: 20 marks

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**ECE 105(C) RF MEMS**

**Teaching scheme:**
3 hours lecture & 1 hour tutorial per week

**Credits:** 4

**Objective:**
The course focuses on RF mem components like relays, switches, inductors, capacitors, filters, antennas etc. At the end of the course student will get an idea about RF mems their advantages, applications.

**Module 1 (13 hours)**

**Module 2 (13 hours)**

**Module 3 (14 hours)**


Micromechanical filters using comb drives. Electrostatic coupled beam structures.


**Module 4 (13 hours)**


**References:**


**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**

Question 1: 20 marks

Question 2: 20 marks

**Module II**
ECE 105(D) Advances in Data & Computer Communications

Teaching scheme: Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
The objective of the paper is to facilitate the student with the advances in the area data communications and computer network aspects that are required for his understanding of protocols used in wireless communications and lay emphasis on principles and methods used in wireless systems. The prerequisites are to have basic understanding of data networks and computer networks.

Module 1: (13 hours)
Introduction to Network models ISO – OSI, SNA, and AppleTalk and TCP/IP models.
LAN Standards: Ethernet (IEEE 802.3), Over View of Token ring and Token Bus, Wireless LAN standard (IEEE 802.11 b/a/g)

Module 2: (13 hours)
WAN Standards: X.25, Frame Relay, and ATM
Class full and Classless IP Addresses, ARP and RARP, IPv4, and IPv6, RIP, OSPF and BGP

Module 3: (13 hours)
User Datagram Protocol (UDP), Transmission Control Protocol (TCP) and Stream Controlled Transmission Protocol (SCTP)
Overview of WWW, DNS, e-mail, SNMP, RMON

Module 4: (14 hours)
Cryptography, Firewalls, Secure Socket Layer (SSL), Security at different layers in application Layer Protocols, and Virtual Private Networks (VPN)

References:
2. Wayne Tomasi, “Introduction to Data communications and Networking”, Pearson Ed. 2007
7. Laurra Chappell (Ed), “Introduction to Cisco Router Configuration”, Techmedia

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE 10 106(P): Signal Processing Lab

Hours per week: 2 hours practical

Credits: 2

Simulation Experiments

1. FIR filter design
2. IIR filter design
3. Spectral analysis of speech signals
4. Speech processing based on LPC
5. Power spectral density estimation
6. Multirate signal processing: Interpolation and decimation, filter bank design
7. Adaptive signal processing: LMS and RLS algorithm implementation for a selected application
8. Wavelet transform implementation  
9. Image processing-evaluation of histogram and histogram equalization  

**Experiments with DSP kit TMS 320CXX/AD/equivalent**  
10. Basics of assembler and C-cross compiler  
11. Real time FIR/IIR filtering  
12. DTMF signal generation and detection with DSP algorithms  

**Mini Project (Compulsory)**  
Student has to do a mini project on a topic approved by a 3 member committee and submit two copies of project report and an assessment will be conducted by the committee.  

**Internal continuous assessment: 100 marks**  
Internal continuous assessment will be as follows. 
Continuous Evaluation (Assessment of individual Experiments): 30  
Mini Project (Demonstration, Report & Viva): 30  
End Semester Exam (Practical Test & Viva): 40  

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**ECE10 107(P): SEMINAR**  

**Hours per week:** 2 hours practical  

**Credits:** 2  

**Objective:**  
To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his/her ideas and thus creating self esteem and courage that are essential for an engineer.  

Individual students are required to choose a topic of their interest preferably from outside the M.Tech syllabus and give a seminar on that topic about 45 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students based on merits of topic of representation. Each student shall submit two copies of a write up of the seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.  

**Internal Continuous Assessment (Maximum Marks-100)**  

Presentation +Discussion : 60  
Relevance + Literature : 10  
Report : 20  
Participation : 10  
Total marks : 100
SEMESTER II

ECE 10 201 Advanced Information & Coding Theory

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Objective:
The objective of the paper is to facilitate the student with the understanding of how information is measured. Further the student is made to understand the advances in Information theory. Coding methods transmitting the information without errors are studied. The student will be introduced with the advances in Coding theory.

Module 1 (15 hours)

Overview of Information Theory (Random variables, Entropy, Conditional Entropy, Relative Entropy, Mutual Entropy, Channel Capacity, Channel Coding Theorem (without proof) and its implication).


Module 2 (12 hours)

Rate Distortion Theory and Network Information Theory: Quantization, Rate Distribution Function, Rate Distribution Theorem, Strongly Typical Sequences, Channel Capacity and the Rate Distortion Function. Gaussian Multiple User Channels, Jointly Typical Sequences, Multiple
Access Channel, Encoding of Correlated Sources, Duality between Slepian – Wolf encoding and Multiple Access Channels, Broadcast Channel, Relay Channel, Source Encoding with side information, Rate Distortion with Side Information.

**Module 3 (13 hours)**

Groups (Definition and properties, Subgroups, Cyclic groups and order, Cosets, Lagrange’s theorem, Isomorphism, Homomorphism), Linear Algebra (Vector Spaces, Independence, Basis, dimension, inner product, dual space, orthogonality), Rings (Definition, Polynomials, Quotient Rings, Ideals); Number Theory and Algebra (Divisibility, Euclidean Algorithm, Sugiyama Algorithm, Congruences, \( \phi \) function, Chinese Remainder Theorem, Fields over \( \mathbb{R} \) and \( \mathbb{C} \), Galois Fields, Galois Field Arithmetic, Irreducible and Primitive Polynomials, Krawtchouk Polynomials).

**Module 4 (13 hours)**

Turbo Codes – Encoding parallel concatenated codes, decoding algorithms, Error Floor and Weight Distribution. Low Density Parity Check Codes – Construction, Tanner graphs, Decoding.

Space Time Coding – Fading Channels, Rayleigh Fading, MIMO Channel, Space Time Block Codes, Space – Time Trellis Codes.

Soft Decision and Iterative Decoding-Soft decision Viterbi algorithm- Two way APP decoding-Low density parity check codes- Turbo codes-Turbo decoding

**Reference Books:**


**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**
ECE 10 202 CDMA Technology

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
Gives a detailed concepts of CDMA technology and this course will be helpful for the student to understand various communication schemes employing this technology

Module 1 (13 hours)


Module 2 (13 hours)


Module 3 (13 hours)

Module 4 (14 hours)

**CDMA Performance and Traffic engineering:** Channel supervision-Power control parameters
- Search window sizes - Field optimization – Traffic intensity – Loads – Grade of service –

**UNIT V**

**Next Generation CDMA:** Physical channel – Multirate design – Spreading technique –
Advanced error control techniques – Coherent detection – Inter operability in next generation
CDMA – Multicarrier CDMA option – Forward link – Reverse link.

**Reference Books:**
1. Samuel C Yang, “CDMA RF System Engineering”, - Artech House Mobile
2000.

**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or
a combination of all whichever suits best. There will be minimum of two tests per
subject. The assessment details are to be announced right at the beginning of the semester
by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
Question 1: 20 marks
Question 2: 20 marks

**Module II**
Question 3: 20 marks
Question 4: 20 marks

**Module III**
Question 5: 20 marks
Question 6: 20 marks

**Module IV**
Question 7: 20 marks
Question 8: 20 marks
ECE 10 203 Advanced Optical Communication

Teaching scheme: 
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
This course is aimed to provide the students the various optical networking schemes and their important issues.

Module 1 (14 hours)

Components

First Generation Optical Networks

Module 2 (13 hours)

WDM Technology

Module 3 (13 hours)

OTDM Technology

Module 4 (13 hours)

FTH and PON Technology
Proposed architecture and issues of Fiber to the home (FTH) – Passive optical networks (PON) – Near space communication – Open air optical communication – Inter satellite link hops (ISL). Introduction to all optical networks (AON). Military, civil, consumer and industrial applications.
Reference Books:

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.
Module I
Question 1: 20 marks
Question 2: 20 marks
Module II
Question 3: 20 marks
Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks
Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE 10 204(A): Multirate Signal Processing

Teaching scheme: Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
The course focuses on multirate signal processing which is the basic to modern signal processing. Topics include multirate signal processing material such as decimation, interpolation, filter banks, polyphase filtering, advanced filtering structures and nonuniform sampling and the cosine modulated filter banks.

Module 1: (14 hours) Fundamentals of Multirate Theory
The sampling theorem: sampling at sub-nyquist rate - Basic Formulations and schemes. Basic Multirate operations: Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities- Polyphase representation Maximally decimated filter banks: Polyphase representation - Errors in the QMF bank- Perfect reconstruction (PR) QMF Bank - Design of an alias free QMF Bank

Module 2: (12 hours)
M-channel perfect reconstruction filter banks
Uniform band and non uniform filter bank - tree structured filter bank- Errors created by filter bank system- Polyphase representation- perfect reconstruction systems

Module 3: (14 Hours)
Perfect reconstruction (PR) filter banks
Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity- Two channel FIR paraunitary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property- Quantization Effects: -Types of quantization effects in filter banks. -coefficient sensitivity effects, dynamic range and scaling.

Module 4: (13 Hours)
Cosine Modulated filter banks
Cosine Modulated pseudo QMF Bank- Alas cancellation- phase - Phase distortion-
Closed form expression- Polyphase structure- PR Systems

References:

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks
**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
Question 1: 20 marks
Question 2: 20 marks

**Module II**
Question 3: 20 marks
Question 4: 20 marks

**Module III**
Question 5: 20 marks
Question 6: 20 marks

**Module IV**
Question 7: 20 marks
Question 8: 20 marks

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**ECE10 204(B)  Smart Antennas**

**Teaching scheme:**
3 hours lecture & 1 hour tutorial per week

**Credits:** 4

**Objective:**
This course is aimed to introduce the students with the concepts of smart antenna technology, the modeling and estimation. At the end of the course student will be able to have a good knowledge about all the modern smart wireless systems.

**Module 1 (13 hours)**

**Module 2 (13 hours)**
Digital radio receiver techniques and software radios. Cognitive radios

**Module 3 (14 hours)**
Optimal spatial filtering – adaptive algorithms for CDMA. Multitarget decision – directed algorithm.

**Module 4 (13 hours)**

DOA estimation – conventional and subspace methods. ML estimation techniques.

Estimation of the number of sources using eigen decomposition. Direction finding and true ranging PL systems. Elliptic and hyperbolic PL systems. TDOA estimation techniques.

**References:**


**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**

Question 1: 20 marks
Question 2: 20 marks

**Module II**

Question 3: 20 marks
Question 4: 20 marks

**Module III**

Question 5: 20 marks
Question 6: 20 marks

**Module IV**

Question 7: 20 marks
Question 8: 20 marks
ECE 10 204(C): Transform Theory

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Objective:
To impart a thorough knowledge in Discrete Fourier Transform and
the Karhunen-Loeve transform

Module I (12 hours)
Review of Linear Algebra: Vector Spaces and Bases, Linear Transformations, Matrices, and
Change of Basis, Diagonalization of Linear Transformations and Matrices, Inner Products,
Orthonormal Bases, and Unitary Matrices, Spectral Theorem for Matrices.

Module II (14 hours)
The Discrete Fourier Transform: Basic Properties of the Discrete Fourier Transform,
Translation-Invariant Linear Transformations, Circulant Matrices, Convolution Operator,
Fourier Multiplier Operator.

Module III (15 hours)
The Discrete Time Fourier Transform: $l_2(\mathbb{Z})$, Hilbert Spaces, Complete Orthonormal Sets
in Hilbert Spaces, $L_2([-\pi,\pi])$ and Fourier Series, The Fourier Transform and Convolution
on $l_2(\mathbb{Z})$.

The Fourier Transform: $L_2(\mathbb{T})$ and Approximate Identities. The Fourier Transform on $\mathbb{R}$

Module IV (12 hours)
Dimensionality Reduction. Independent Component Analysis.

Reference
2. Aapo Hyvärinen, Juha Karhunen, and Erkki Oja, Independent component analysis,
John Wiley

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a
combination of all whichever suits best. There will be minimum of two tests per subject. The
assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE10 204(D) Communication Switching & Multiplexing

Teaching scheme:  
Credits: 4

3 hours lecture & 1 hour tutorial per week

Objective:
To impart an in-depth knowledge about various switching and multiplexing schemes used in telecommunication networks

Module 1 (13 hours)


Module 2 (13 hours)

Types of blocking for a packet switch- Output conflicts- HOL blocking. Traffic analysis: Traffic measurements, arrival distributions, Poisson process, holding/service time distributions, loss systems, lost calls cleared – Erlang-B formula, lost calls returning and lost calls held models, lost calls cleared and held models with finite sources, delay systems, Little’s theorem, Erlang-C formula , M/G/1 model.


Module 3 (14 hours)

Multiplexing: Network performance and source characterization; Stream sessions in packet networks - deterministic analysis, stochastic analysis, circuit multiplexed networks; Elastic transfers in packet networks- adaptive bandwidth sharing.

Module 4 (13 hours)

Statistical multiplexing: blocking analysis in circuit multiplexed networks, with single rate or multirate traffic- Models for performance analysis of integrated packet networks; deterministic models, worst case analysis; stochastic models, large deviations analysis.

The effective Bandwidth approach for Admission control - Models for traffic flow in packet networks, long range dependence and self similar processes.

References:

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE 205(A) Personal Wireless Networks And Mobile Computing

Teaching scheme:
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
To introduce the various aspects of Bluetooth, WLAN, Infrared technologies and Home RF. The goal of IEEE and Bluetooth SIG is to find standards (802.15) Wireless PAN, which shall have interoperability between a broad range of consumer devices and allow global use of Personal Area Networks. The fundamentals of wireless networking and mobile computing. Keeping in view the three relevant technologies are studied.

Module 1 (15 hours)
Over view of all technologies, IEEE 802.15 WPAN, Home RF, Blue tooth, interface between blue tooth and WLAN, standards, major telecommunications standards organizations, the radio frequency spectrum, interoperability issues. Infrared Standards-Differences between the OSI communications model and the IEEE 802 of a radio system, infrared WLAN

Bluetooth Technology- Bluetooth protocol architecture, Link management, Logical Link control, Blue tooth profiles and Blue tooth security

Module 2 (13 hours)

**Wireless LANS:**
infrastructure Vs Ad hoc Networks, IEEE 802.11: Architecture. MAC layer- Synchronization, power management, roaming-IEEE 802.11b, 802.11a, new developments..

**Mobile IP** Overview, network elements, packet delivery agent discovery, registration - Tunneling and encapsulation optimization, IPv6, IP micro mobility support, DHCP and mobile IP, mobile transport layer - Traditional TCP and implications on mobility, indirect and snooping TCP - TCP over 2.5G/3G networks- Performance enhancing process.

Module 3 (13 hours)

**Mobile Computing** Challenges of mobile computing - File systems and WWW architectures for mobile computing - WAP-Architecture, protocols wireless applications, environment WML, push architecture, push/pull services, WAP 1.72 stacks, I-mode, WAP 2.0 - J2ME- BREW.

Module 4 (12 hours)


References:
    Dee M Bakker and others, “Blue tooth end to end” ISBN 978-0-7645-4887-1
Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE10 205(B) Detection and Estimation

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
To introduce Detection theory and impart knowledge in both single observation and multiple observations. To introduce the need of Estimation theory and different methods for estimation. To understand the different properties of estimators.

Module 1 (13hours)
Binary hypothesis testing; Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing. Signal detection in discrete time: Models and detector structures. Coherent detection in

**Module 2 (14 hours)**


**Module 3 (13 hours)**


**Module 4 (13 hours)**

Signal detection in continuous time: Detection of deterministic signals in Gaussian noise. Coherent detection in white Gaussian noise.

**Reference:**


**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**

Question 1: 20 marks
Question 2: 20 marks

**Module II**
ECE 10 205(C) Designing with ASICs

Teaching scheme          Credits: 4
3 hours lecture & 1 hour tutorial per week

Objectives:
After the completion of this course the student should be able to identify different types of
ASICs, architecture of advanced FPGAs, the need for programmable SOCs, testing methods
of SOCs and to get familiarized with High performance algorithms for ASICs and SOCs.

Module I: (13 hours)
Types of ASICs. ASIC design flow. Programmable ASICs. Antifuse, SRAM, EPROM,
EEPROM based ASICs. Programmable ASIC logic cells and I/O cells. Programmable
interconnects.

Module II: (13 hours)
An overview of advanced FPGAs and programmable SOCs: Architecture and configuration
of Spartan and Virtex FPGAs. Apex and Cyclone FPGAs. Virtex PRO kits and Nios kits.
OMAP. ASIC physical design issues. system partitioning, interconnect delay models and
measurement of delay. ASIC floor planning, placement and routing.

Module III: (13 hours)
Design issues in SOC. Design methodologies. Processes and flows. Embedded software
development for SOC. Techniques for SOC testing. Configurable SOC. Hardware/software
codesign.

Module IV: (14 hours)
High performance algorithms for ASICs/ SOCs. SOC case studies- DAA and computation of
FFT and DCT. High performance filters using delta-sigma modulators. Case Studies: Digital
camera, Bluetooth radio/modem, SDRAM and USB controllers.

References:
**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
- Question 1: 20 marks
- Question 2: 20 marks

**Module II**
- Question 3: 20 marks
- Question 4: 20 marks

**Module III**
- Question 5: 20 marks
- Question 6: 20 marks

**Module IV**
- Question 7: 20 marks
- Question 8: 20 marks

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**ECE 10 205(D) RF Design of Communication Systems**

**Teaching scheme:**  
**Credits:** 4  
3 hours lecture & 1 hour tutorial per week

**Objective:**
The objective of the paper is to facilitate the student with the understanding of RF design of various components for the use in communication devices and to impart the modeling of RF system design in the field of communication system.

**Module 1 (13 hours)**
RF Filter design-Basic resonator and filter configurations-special filter realization-filter implementation-coupled filter

**Module 2 (13 hours)**
Active RF Components-RF diodes-bipolar junction transistor –RF field effect transistor-high electron mobility transistors-diode models-transistor models-measurement of active devices-scattering parameter device characterization

**Module 3 (13 hours)**
Matching and biasing networks
Impedance matching using discrete components-micro strip line matching networks-amplifier classes of operation and biasing networks

**Module 4 (14 hours)**

RF Transistor amplifier design
Characteristics of amplifier-amplifier power relations-stability consideration-constant gain-broadband, high power, and multistage amplifiers, Oscillators and mixers: Basic oscillator model-high frequency oscillator configuration-basic characteristics of mixer.

**Reference Books:**


**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
Question 1: 20 marks
Question 2: 20 marks

**Module II**
Question 3: 20 marks
Question 4: 20 marks

**Module III**
Question 5: 20 marks
Question 6: 20 marks

**Module IV**
Question 7: 20 marks
Question 8: 20 marks

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**ECE 10 206(P): Communication Design & Simulation Lab**

**Hours per week:** 2 hours practical

**Credits:** 2

**Objectives:** Upon completion, the students will
Be able to design enlisted experiments and implement using hardware
Acquire sufficient expertise in simulating these systems using MATLAB
Be able to design and implement self standing systems of their choice with sufficient complexity.

Tools:
Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool

Expts.:
1. Implementation of digital modulation schemes – BASK, BFSK, BPSK. Plot BER vs $E_b/N_0$ in AWGN channels.
2. Performance comparison of QPSK, DPSK, MSK & GMSK.
4. Comparison of diversity combining techniques – SC, EGC & MRC.
5. Simulation of CDMA systems.
8. Carrier recovery and bit synchronization.
9. Implementation of multicarrier communication.
11. Constellation diagram of various digital modulation schemes.

Mini Project (Compulsory)
Student has to do a mini project on a topic approved by a 3 member committee and submit two copies of project report and an assessment will be conducted by the committee.

Internal continuous assessment: 100 marks
Internal continuous assessment will be as follows.
Continuous Evaluation (Assessment of individual Experiments): 30
Mini Project (Demonstration, Report & Viva): 30
End Semester Exam (Practical Test & Viva): 40
ECE10 207(P): SEMINAR

Hours per week: 2 hours practical

Credits: 2

Objective:
To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his/her ideas and thus creating self esteem and courage that are essential for an engineer.

Individual students are required to choose a topic of their interest preferably from outside the M.Tech syllabus and give a seminar on that topic about 45 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students based on merits of topic of representation. Each student shall submit two copies of a write up of the seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Internal Continuous Assessment (Maximum Marks-100)
Presentation +Discussion : 60
Relevance + Literature : 10
Report : 20
Participation : 10
Total marks : 100

SEMESTER III

The student has to credit 2 theory subjects from the two groups of electives listed. The student has to undergo an industrial training of duration one month during the semester break after the semester II and complete that within 15 calendar days from the start of semester III.

ECE10 301(A) Signal Compression

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
To familiarise with different data compression techniques and standards

Module 1 (13 hours)
Brief history of data compression applications, Overview of information theory, redundancy. Overview of Human audio, Visual systems, Taxonomy of compression techniques.

Overview of source coding, source models, scalar quantisation theory, rate distribution theory, vector quantisation, structure quantizers. Evaluation techniques - error analysis and methodologies.

**Module 2 (14 hours)**


Audio compression techniques - frequency domain and filtering - basic sub band coding - application to speech coding - G.722 - application to audio coding - MPEG audio, progressive encoding for audio — silence compression, speech compression techniques - Vocoder - Predictive techniques - PCM, DPCM, DM.

**Module 3 (13 hours)**

Contour based compression - adtrees, EPIC, SPIHT, Transform coding, JPEG, JPEG-2000, JBIG Video signal representation, Video compression techniques - MPEG, Motion estimation techniques -

**Module 4 (13 hours)**

H.261. Overview of Wavelet based compression and DVI technology, Motion video compression, PLV performance, DVI real time compression

**References:**


**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**

Question 1: 20 marks
Question 2: 20 marks

**Module II**
ECE10 301(B) Advanced Techniques for Wireless Reception

Teaching scheme: 
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective: To impart the knowledge about wireless reception techniques and signal processing techniques. Students will be introduced to the reception techniques used in the new generation wireless systems.

Module 1 (13 hours)

Module 2 (13 hours)
Robust multiuser detection for non Gaussian channels; asymptotic performance, implementation aspects. Adaptive array processing in TDMA systems. Optimum space-time multiuser detection.

Module 3 (14 hours)
Turbo multiuser detection for synchronous and turbo coded CDMA.


**Module 4 (13 hours)**


**References:**


**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**
- Question 1: 20 marks
- Question 2: 20 marks

**Module II**
- Question 3: 20 marks
- Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE10 301(C) Secure Communication

Teaching scheme:
Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
To introduce the basic concept encryption techniques, To familiarise with the concept of private key and public key cryptosystems, To introduce the concept of Elliptic curves

Module 1 (13 hours)
Rings and fields - Homomorphism- Euclidean domains - Principal Ideal Domains - Unique Factorization Domains -- Field extensions- Splitting fields - Divisibility- Euler theorem - Chinese Remainder Theorem -Primality

Module 2 (13 hours)
Basic encryption techniques - Concept of cryptanalysis - Shannon's theory - Perfect secrecy - Block ciphers -Cryptographic algorithms - Features of DES - Stream ciphers - Pseudo random sequence generators – linear complexity - Non-linear combination of LFSRs - Boolean functions

Module 3 (14 hours)
Private key and Public key cryptosystems - One way functions - Discrete log problem – Factorization problem - RSA encryption - Diffie Hellmann key exchange - Message authentication and hash functions -Digital signatures - Secret sharing - features of visual cryptography - other applications of cryptography -

Module 4 (13 hours)
Elliptic curves - Basic theory - Weirstrass equation - Group law - Point at Infinity -Elliptic curves over finite fields - Discrete logarithm problem on EC - Elliptic curve cryptography - Diffie Hellmann key exchange over EC - Elgamal encryption over EC – ECDSA

References:


5. Evangelos Kranakis, “Primality and Cryptography”, John Wiley & Sons


**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
Question 1: 20 marks
Question 2: 20 marks

**Module II**
Question 3: 20 marks
Question 4: 20 marks

**Module III**
Question 5: 20 marks
Question 6: 20 marks

**Module IV**
Question 7: 20 marks
Question 8: 20 marks

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**ECE 10 301(D) Adaptive Signal Processing**

**Teaching scheme:**  
Credits: 4

*3 hours lecture & 1 hour tutorial per week*
Objective:
This course is intended to impart to the students the principles of Adaptive signal processing, different algorithms used for design of Adaptive Filters, Performance evaluation of systems Modelling systems like multipath communication channel and Synthesis of filters.

Module I (14 Hours):
Adaptive systems - definitions and characteristics - applications - properties-examples - adaptive linear combiner-input signal and weight vectors - performance function-gradient and minimum mean square error - introduction to filteringsmoothing and prediction - linear optimum filtering-orthogonality - Wiener - Hopf equation-performance surface

Module II (13 Hours):

Module III (13 Hours):
LMS algorithm convergence of weight vector-LMS/Newton algorithm - properties - sequential regression algorithm - adaptive recursive filters - random-search algorithms - lattice structure - adaptive filters with orthogonal signals

Module IV (13 Hours):
Applications-adaptive modelling and system identification-adaptive modelling for multipath communication channel, geophysical exploration, FIR digital filter synthesis, inverse adaptive modelling, equalization, and deconvolution-adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis

References:
2. Simon Haykin, Adaptive Filter Theory, Pearson Education.

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
ECE10 302(A) Markov Modeling And Queueing Theory

Teaching scheme:  Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
This course is a thorough treatment of Markov chains and Markov models of systems. It also deals with the essential queuing theory and application of Markov models in the analysis of queuing networks.

Module I (14 Hours)
Stochastic Processes: Renewal Processes - Reward and Cost Models, Poisson Process; Point Processes; Regenerative Processes; Renewal Theorems.

Module II (13 Hours)

Module III (13 Hours)
Single Class & Multi-class Queuing Networks: Simple Markovian queues; M/G/1 queue; G/G/1 queue; Open queuing networks; Closed queuing networks; Mean value analysis; Multi-class traffic model; Service time distributions; BCMP networks; Priority systems.

Module IV (13 Hours)
Time Delays and Blocking in Queuing Networks: Time delays in single server queue; Time delays in networks of queues; Types of Blocking; Two finite queues in a closed network; Aggregating Markovian states.

References:

**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
- Question 1: 20 marks
- Question 2: 20 marks

**Module II**
- Question 3: 20 marks
- Question 4: 20 marks

**Module III**
- Question 5: 20 marks
- Question 6: 20 marks

**Module IV**
- Question 7: 20 marks
- Question 8: 20 marks

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**ECE10 302(B) Space Time Coding & MIMO Systems**

**Teaching scheme:** 4 credits
3 hours lecture & 1 hour tutorial per week

**Objective:**
To impart an in-depth knowledge about MIMO systems and the various space time coding techniques used in telecommunication networks

**Module 1 (13 hours)**

**Information theoretic aspects of MIMO**
Review of SISO communication - MIMO channel models - Classical i.i.d. and extended channels - Frequency selective and correlated channel models - Capacity of MIMO channels - Ergodic and Outage Capacity - Capacity bounds - Influence of channel properties on capacity.
Module 2 (14 hours)

**MIMO Diversity and Spatial Multiplexing**

Space Time Diversity Aspects - Sources and types of diversity - analysis under Rayleigh fading – Diversity and Channel knowledge - MIMO Spatial multiplexing - Space Time receivers - ML - MMSE - ZF – Sphere decoding - BLAST receivers - DMG tradeoff in MIMO systems.

Module 3 (13 hours)

**Space Time Block Codes**


Module 4 (13 hours)

**Space Time Trellis Codes**

Diagram - Code construction. Delay diversity as a special case of STTC- Performance Analysis.

**References:**

**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**
ECE 10 302(C)  Spectrum Analysis Techniques

Teaching scheme:  
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
To introduce Power spectral density, To impart knowledge in different methods of PSD estimation both in Nonparametric & parametric methods, To introduce the filter bank methods

Module I: (10 hours)
*Power Spectral Density:* Energy spectral density of deterministic signals, Power spectral density of random signals, Properties of PSD

Module II: (13 hours)

Module III: (17 hours)


Module IV: (12 hours)
*Filterbank methods:* Filterbank interpretation of periodogram, Slepi base-band filters, refined filterbank method for higher resolution spectral analysis, Capon method, introduction to higher order spectra.

References:
1. Introduction to Spectral Analysis, Stoica, R.L. Moses, Prentice Hall
Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE10 302(D) New Generation Networks

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
The objective of this course is to provide exposure to the new technologies and services that telecommunication operators have as they create new 3G networks and beyond where multimedia coverage is based on packet switched rather than circuit switched Telephony.

Module 1 (14 hours)
Introduction to new generation networks.
Communicating in the new Era, New Era of Networking, Technologies influencing change, IP Everywhere, Optical fiber anywhere, wireless access, building blocks for NGN, IP Networks, VOIP, Multi service Flexible Networks architecture. VPNs, Optical Networks, Wire line & Wireless Networks, NGN Services, Network Infrastructure convergence, services convergence, from technology push to service pull.

Module 2 (13 hours)
IP Networks
IP past, present and future, IP influence and confluence, IP version 4, I. P. Version 6, IP Network convergence, LAN Technologies, IP Routing, LAN Switching, WAN’s, WAN Technologies and Topologies. Wireless IP LANS, Mobility Networks, Global IP Networks, Global capacity,

Module 3 (13 hours)
Multi service Networks
Origin of multi service ATM, Next Generation Multi service Networks, Next Generation Multi service ATM switching, Multi protocol Label switching, Networks, Frame Based MPLS, Cell based MPLS, MPLS services and their benefits, multi service provisioning platforms (MSPP) & Multi service switching platform (MSSP)

Module 4 (13 hours)
NGN Applications
Internet connectivity, e-commerce, call center, third party application service provision, UMTS, WAP, WiMAX, integrated billing, security and directory enable networks.

References:
2. Next Generation Network Services, Robert Wood, Pearson

Internal continuous assessment: 100 marks
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be a minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks
Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

ECE 10 303(P): INDUSTRIAL TRAINING
Teaching scheme: 1 hour per week  
Credits: 1

The students have to undergo an industrial training of minimum two weeks in an industry during the semester break after second semester and complete within 15 calendar days from the start of third semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.

Internal continuous assessment: Marks 50

ECE 10 304(P): MASTERS RESEARCH PROJECT (PHASE – I)

Teaching scheme: 22 hours per week  
Credits: 6

Objective:
To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

The project work can be a design project / experimental project and or computer simulation project on communication engineering or any of the topics related with communication engineering stream. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute subject to the conditions in clause 10 of M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

The student is required to undertake the masters research project phase-I during the third semester and the same is continued in the 4th semester.(Phase-II). Phase-I consists of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.

Internal Continuous assessment:

First Review:
Guide 50 marks
Evaluation Committee 50 marks

Second review:
Guide 100 marks
Evaluation Committee 100 marks

Total 300 marks
SEMSITER IV

ECE10 401(P): MASTERS RESEARCH PROJECT (PHASE - 2)

Teaching scheme: 30 hours per week  
Credits: 12

Objectives:
To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Masters Research project phase-II is a continuation of project phase-I started in the third semester. Before the end of the fourth semester, there will be two reviews, one at middle of the fourth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the Thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. 
This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper is to be prepared for possible publication in National/International journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

Internal Continuous assessment:

First review:
Guide 50 marks
Evaluation committee 50 marks

Second review:
Guide 100 marks
Evaluation committee 100 marks