M.Tech Syllabus- Scheme 2017
(Communications & Signal Processing)
M.Tech I Semester

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Credits</th>
<th>Scheme of Instruction periods/week</th>
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<td>1.</td>
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<td>Detection &amp; Estimation Theory (DET)</td>
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M.Tech II Semester

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### List of Subjects for Electives

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<th>Subject title</th>
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<tr>
<td>Elective-I</td>
<td>Coding Techniques (CTH)</td>
<td>EC805</td>
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<tr>
<td>Elective-I</td>
<td>Applied Mathematics for Communication Engineers (AMCE)</td>
<td>EC806</td>
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<tr>
<td>Elective-I</td>
<td>Microwave Integrated Circuits (MIC)</td>
<td>EC807</td>
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<tr>
<td>Elective-I</td>
<td>Advanced 3G &amp; 4G Wireless Communications (3G&amp;4G)</td>
<td>EC808</td>
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<td>Elective II</td>
<td>Radar Signal Processing (RSP)</td>
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<td>Elective II</td>
<td>Speech Processing (SP)</td>
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<td>Neural Networks &amp; Fuzzy Logic (NNFL)</td>
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<td>Wavelet Transforms and Applications (WTA)</td>
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<td>Elective III</td>
<td>Internetworking with TCP/IP (TCP/IP)</td>
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<td>Cognitive Radio (CR)</td>
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<td>Wireless Communications and Networks (WCN)</td>
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<td>Elective III</td>
<td>High Speed Networks (HSN)</td>
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<td>Elective IV</td>
<td>System Modeling &amp; Simulation (SMS)</td>
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<td>Elective IV</td>
<td>Artificial Intelligence (AI)</td>
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<td>Advanced Operating System (AOS)</td>
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<td>Elective IV</td>
<td>Design of Digital Processing Systems (DDPS)</td>
<td>EC912</td>
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I Semester : CSP  
Course Code  
EC801  
Course Outcomes : 
CO1: Understand the basic properties of estimators  
CO2: Understand Detection Theory & detection of signals in noise.  
CO3: Understand Linear & Nonlinear Estimations.  

Introduction  
Properties of estimators, Finding good estimators, Estimation of spectrum from finite duration observations.  

Detection theory  
Binary decisions - Single observation. Maximum likelihood decision criterion; Neymann-Pearson criterion; Probability of error criterion; Bayes risk criterion; Minimax criterion; Robust detection; Receiver operating characteristics. Multiple observations.  

Detection of Signals in Noise1  
Minimum probability of Error criterion, Neyman-Pearson criterion for Radar detection of constant and variable, amplitude signals.  

Detection of Signals in Noise2  
Matched Filters, optimum formulation, detection of random signals, simple problems thereon with multisample cases.  

Estimation of signals in Noise  
Linear mean squared estimation, non-linear estimates, MAP and ML estimates, maximum likelihood estimate of parameters of linear system, simple problems.  

Text Books :  

Reference Books :  

Web References:  
2) www dspguide com pdfbook htm  
3) www.pearsonhighered.com/...Digital-Signal-Processing-4th.../PGM258227.htm  

Question Paper Pattern:  
Internal Assessment: The question paper shall consist of Six questions out of which the student shall answer any Four questions  
End Exam: The question paper shall consist of Eight questions out of which the student shall answer any Five questions.
ADAPTIVE SIGNAL PROCESSING (ASP)

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Sessional Exam Duration : 2 Hrs
End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Understand the fundamentals of Adaptive Filters
CO2: Analyze the concept of Discrete time random process
CO3: Understand linear predictors and Lattice Predictors of Wiener Filter.
CO4: Analyze Linear FIR Adaptive Filters using steepest descent and Least square approaches.
CO5: Analyze the Linear Adaptive filters using kalman Filtering Algorithm.

Introduction to Adaptive Filters
Adaptive filters, Filter structures, Approaches to the development of Adaptive Filter theory, Applications

Discrete time Stochastic Processes

Linear Optimum FIR Filtering

Method of Least Squares

Kalman Filtering

Text Books:

Reference Books:

Web References:
1. nptel.ac.in/syllabus/syllabus_pdf/117105026.pdf
2. https://books.google.co.in/books?isbn=0470575743
3. https://www.spbc.tugraz.at/courses/adaptive

Question Paper Pattern:
Internal Assessment: The question paper shall consist of Six questions out of which the student shall answer any Four questions
End Exam: The question paper shall consist of Eight questions out of which the student shall answer any Five questions
ADVANCED DIGITAL COMMUNICATIONS (ADCM)

I Semester : CSP

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Continuous Internal Assessment | End Exam | TOTAL

Sessional Exam Duration : 2 Hrs | End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Understand the concepts of Digital Communication model, MSK, GMSK and Transmultiplexers

CO2: Analyze the operation of Equalizers in designing optimum receivers

CO3: Thoroughly understand the concept and operation of MSAT networks

CO4: Implement the knowledge of Mobile data communications in the design of wireless networks.

CO5: Understand the concepts of GSM, GPRS network architecture.

Overview Of Digital Communication

Digital communication system model, Communication channels characteristics and Models, MSK and GMSK, Transmultiplexers.

Communication through Band-Limited Linear Filter Channels

Optimum receiver structures for AWGN channel. Signal design for band limited and power limited channels, power and bandwidth efficiency tradeoff. ISI and equalization—Linear equalization, Decision feedback equalization, Turbo equalization, Self recovering equalization, Adaptive linear equalization.

Global Mobile Satellite Systems

MSAT networks, Operating environment, concept, CDMA network, Iridium, Global star and Teledesic systems and their comparisons.

Mobile Data Communications

Wireless LANs – IEEE 802.11 and HIPERLAN, Mobile IP, Mobile multimedia, WATM, Bluetooth, Wi-Fi.

GSM & GPRS

Global System for Mobile Communication (GSM) system overview- GSM Architecture, Mobility management, Network signaling. General Packet Radio Services (GPRS)- GPRS Architecture, GPRS Network Nodes.

Text Books:


Reference Books:


Web References:

1. https://www.youtube.com/watch?v=1POzl9tZXuQ&list=PLXjHn7CHrmTdl365uztpUVLx4zwbfgbfbl
3. nptelvideos.in/2012/12/digital-communication.html

Question Paper Pattern:

Internal Assessment: The question paper shall consist of Six questions out of which the student shall answer any Four questions

End Exam: The question paper shall consist of Eight questions out of which the student shall answer any Five questions
# MOBILE COMMUNICATIONS (MCN)

<table>
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**Sessional Exam Duration:** 2 Hrs  
**End Exam Duration:** 3 Hrs

## Course Outcomes
- **CO1**: Understand the significance of the 3G and 4G mobile networks.
- **CO2**: Analyze about the choice of proper mobile components to meet the design requirements of advanced networks.
- **CO3**: Thoroughly learn the concepts of Mobile Radio propagation.
- **CO4**: Apply the concepts of multiple channel bandwidth systems.
- **CO5**: Analyze the concepts of directional antenna array and space diversity schemes.

## Introduction
Evolution of mobile radio communications, mobile radio systems around the world, Trends in cellular radio and personal communication, First generation (1G), Second generation (2G), Third generation (3G) and Fourth generation (4G) mobile radio networks, personal area networks.

## Mobile Radio Environment
Representation of a mobile radio signal, caused propagation path loss, causes & types of fading, Reciprocity principle, cumulative probability distribution, Correlation and power spectrum, Delay spread and coherence bandwidth, False alarm rate and word-error rate.

## Mobile Radio propagation

## Frequency plans and associated schemes
Frequency reuse, FDM, TDM, Spread spectrum and frequency hopping, cellular concept, spectral efficiency and cellular schemes.

## Design factors of mobile systems
Antenna locations, antenna spacing, Antenna spacing heights, mobile unit standing still and in motion, sampling rate, directional antennas, frequency dependency, antenna connections and locations on the mobile unit.

### Text Books

### Reference Books

### Web References:
1. https://www.youtube.com/watch?v=whYljse4Abc
2. nptel.ac.in/courses/117102062/4
3. nptelvideos.in/2012/12/wireless-communication.html

## Question Paper Pattern:
- **Internal Assessment**: The question paper shall consist of Six questions out of which the student shall answer any Four questions.
- **End Exam**: The question paper shall consist of Eight questions out of which the student shall answer any Five questions.
TECHNICAL ENGLISH (TE)

I Semester: Common for All M.Tech Programmes

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Continuous Internal Assessment: End Exam: TOTAL: - - - - - -

Sessional Exam Duration: - End Exam Duration: -

Course Outcomes: At the end of the course students will be able to

CO 1: write Technical Reports, Journal Papers and Project Reports.

CO 2: write Job Applications, Resumes and Statements of Purpose.

Course Content

1. Technical Reports –Formats and Styles
   a) Feasibility Report
   b) Factual Report
   c) Project Reports
2. Journal Papers- Formats
3. Paper Presentation Strategies
4. Statement of Purpose for Internships and Apprenticeships
5. Letter Writing- Job Applications, Resume Preparation
6. Common Errors in Research Papers

Reference Books:

I Semester : CSP  
Course Code: EC81

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End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Perform BER analysis of QPSK and DPSK communication links, Maximum likelihood sequence estimator, decision feedback and linear equalizers.

CO2: Analyze the performance of convolution encoding and Viterbei decoding.

CO3: Model and estimate frequency selective and flat fading channels.

CO4: Perform BER analysis of diversity techniques and multicarrier modulation system.

CO5: Demonstrate the fundamental concepts of optical communications on Optical Fiber communications trainer kit.

LIST OF EXPERIMENTS

1. SIMULATION OF QPSK COMMUNICATION LINK.
2. BER ANALYSIS OF DPSK TRANSMITTED OVER RAYLEIGH FADEING CHANNEL.
3. BER PERFORMANCE OF DIFFERENT EQUALIZERS.
4. CONVOLUTION ENCODING AND VITERBEI DECODING.
5. MODELING OF FREQUENCY SELECTIVE CHANNEL.
6. MODELING OF FLAT FADING CHANNEL.
7. BER ANALYSIS OF DIVERSITY TECHNIQUES.
8. CDMA TXR AND RXR.
9. BER ANALYSIS OF MULICARRIER MODULATION.
10. CHANNEL ESTIMATION.
11. OPTICAL COMMUNICATIONS-I (ESTABLISHING ANALOG AND DIGITAL COMM.LINK).
12. OPTICAL COMMUNICATIONS-II (FINDING LOSSES IN OFC).

Text Books / Reference Books:

II Semester : CSP | Scheme : 2017

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Sessional Exam Duration : 2 Hrs | End Exam Duration: 3 Hrs

Course Outcomes : At the end of the course the student will be able to

**CO1:** Understand the basic concepts of 2-D image acquisition and quantization.

**CO2:** Analyze the properties image transforms.

**CO3:** Apply image enhancement and image restoration algorithms on digital images.

**CO4:** Understand image compression and image segmentation methods.

**CO5:** Understand the design concept of pattern recognition system.

Introduction to digital image processing and fundamentals

Digital image processing definition and its applications, fundamentals of digital image processing, components of an image processing system, image sampling and quantization, some basic relationships between pixels, array versus matrix operations, linear versus nonlinear operations, arithmetic operations, set and logic operations.

Image Transforms

Study analysis with examples of Fourier transforms, Walsh transform, Hadamard transform, Discrete cosine transform, Hotelling transform and Hough transform

Image Enhancement and Restoration

**Image Enhancement** : Basic intensity transformation functions, histogram equalization, histogram specification, fundamentals of spatial filtering, smoothing and sharpening spatial filters, smoothing frequency domain filtering fundamentals, smoothing and sharpening frequency domain filters.


Image Compression and Segmentation

**Image Compression**: Fundamentals, some basic compression models- Huffman coding, arithmetic coding, LZW coding, bit plane coding, block transform coding and predictive coding.

**Image Segmentation**: Detection of discontinuities, edge linking and boundary detection- local processing, regional processing, global processing via Hough transform and graph theoretic technique, region based segmentation.

Pattern recognition system

Basic concepts, fundamental problems in pattern recognition system design, design concept and methodologies, character recognition, speech recognition, finger print recognition, clustering concepts, clustering seeking algorithm, minimax distance algorithm and k-means clustering algorithm.

Text Books :


Reference Books :

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<tr>
<td>1. <a href="https://stanford.edu/class/ee368/">https://stanford.edu/class/ee368/</a></td>
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<td>2. <a href="http://nptel.ac.in/courses/117105079/">http://nptel.ac.in/courses/117105079/</a></td>
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<tr>
<td>3. <a href="https://engineering.purdue.edu/~bouman/ece637">https://engineering.purdue.edu/~bouman/ece637</a></td>
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II Semester: CSP

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Continuous Internal Assessment: 40
End Exam: 60
TOTAL: 100

Sessional Exam Duration: 2 Hrs
End Exam Duration: 3 Hrs

Course Outcomes:
- **CO1**: The students will be able to understand the concepts of signal propagation through optical fiber.
- **CO2**: The students will be able to understand the working principles of optical components like couplers, isolators, circulators, interferometers and amplifiers.
- **CO3**: The students will be able to understand the concepts of modulation and demodulation in an optical communication system.
- **CO4**: The students will be able to understand the concepts of transmission engineering like system model, power penalty, dispersion limitations and compensation techniques.
- **CO5**: The students will be able to understand the elements of optical networks and their architectures.

Signal propagation in Optical Fibers:

Optical components:
- Operating Principles of Couplers, Isolators, Circulators, Mach-Zehnder Interferometer, EDFA and SOA

Modulation and Demodulation:

Transmission System Engineering:

Optical Networks:
- SONET/SDH, Multiplexing, SONET/SDH Layers, VCAT and LCAs, SONET Frame Structure, Elements of SONET/SDH infrastructure.

Text Books:

Reference Books:

Web References:
1. http://nptel.ac.in/courses/117101002/
2. http://nptel.ac.in/courses/117104127/
3. http://nptel.ac.in/courses/106105081/9

Question Paper Pattern:
- **Internal Assessment**: The question paper shall consist of Six questions out of which the student shall answer any Four questions.
- **End Exam**: The question paper shall consist of Eight questions out of which the student shall answer any Five questions.
## Course Outcomes

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

**CO1:** Understand the concept of Discrete Time random Processes.

**CO2:** Understand the signal modeling using Pronys method ,Iterative Prefiltering, Finite data records and stochastic models.

**CO3:** Analyse the properties of Levinson Recursion.

**CO4:** Analyse Spectrum Estimation Using parametric and Non Parametric methods.

### Discrete Time Random Processes
Introduction, random variables, random processes, filtering random processes, spectral factorization, special types of random processes.

### Signal Modeling

### Levinson-Durbin Recursion

### Non-Parametric Spectral Estimation

### Parametric Spectral Estimation
Time series models, relationship between auto-correlation and the model parameters, AR Parameters by Yule-walker, Burg and Sequential estimation methods, selection of AR model order, MA and ARMA models for power spectrum estimator, Maximum entropy spectral estimator, Minimum variance spectral estimator.

### Text Books


### Reference Books


Web References:
1. http://nptel.ac.in/courses/117104127/
3. http://nptel.ac.in/courses/106105081/9

Question Paper Pattern:
**Internal Assessment:** The question paper shall consist of **Six** questions out of which the student shall answer any **Four** questions

**End Exam:** The question paper shall consist of **Eight** questions out of which the student shall answer any **Five** questions
### Course Outcomes
At the end of the course the student will be able to

- **CO1**: Understand the Concepts of Microwave Propagation and the Microwave Radio System
- **CO2**: Understand the Satellite frequency ranges and the concepts of Satellite links and its Services
- **CO3**: Understand the Concepts of Earth station design and different tracking techniques
- **CO4**: Understand the concepts of Tropospheric Propagation

### Microwave Radio System
Types of propagation, line of sight transmission, Radio Horizon, Microwave links, Repeaters, Diversity, Frequency and space diversity systems, Fading, System gain and path losses, Noise and Absorption in Microwave links.

### Satellite Links
Frequency ranges, orbits, up link, transponders, downlinks, satellite system parameters, multiple access, system noise ratio G/T ratio, calculation of system noise temperatures, Noise figures, Design of satellite links for specified (C/N), Radio attenuation model.

### Satellite Services
MSAT service, BSAT service, RADARSAT service, SAR SAT service, INTEL SAT service, INMAR SAT service, VSAT service

### Earth Station
Earth station design for low system noise temperature, linear apertures, rectangular apertures, circular apertures, tracking techniques, low noise amplifiers, high power amplifiers, terrestrial links and distribution.

### Microwave Troposcatter propagation
Introduction to OTH (Over The Horizon) systems, Tropospheric forward-scatter radio link, Block diagram of Troposcatter Communication link, Transmission interference and signal damping, derivation of LOS communication range, derivation for field strength of a Tropospheric wave, Fading in troposphere and its effect on Troposcatter propagation

### Text Books

### Reference Books
2. Combes, Graffewil and Sauterean, *Microwave Components, Devices and Active Circuits*, John wiley

### Web References
1. https://www.youtube.com/watch?v=whYljse4Abc
2. nptel.ac.in/courses/117102062/4

### Question Paper Pattern
**Internal Assessment**: The question paper shall consist of **Six** questions out of which the student shall answer any **Four** questions

**End Exam**: The question paper shall consist of **Eight** questions out of which the student shall answer any **Five** questions
RESEARCH METHODOLOGY (RM)

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<th>Course Code</th>
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Sessional Exam Duration : 2 Hrs
End Exam Duration: -

Course Outcomes : At the end of the course the student will be able to

CO1: Understand overview of research process, state the research problem and conduct a literature review of the concepts comprising the research questions.

CO2: Study the data collection methods and process the data statistically.

CO3: Understand the basic properties of estimators, analyse the estimated data and interpret the data in a research paper.

Meaning, Objective and Motivation in Research
Types of Research, Research Approaches, Research Process, Validity and Reliability in Research.

Measurement and Scaling Techniques

Methods of Data Collection
Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules.

Statistical Processing
Correlation and Regression Analysis, Method of Least Squares, Regression Vs. Correlation, Correlation Vs. Determination, Types of Correlation and Their Specific Applications.

Hypothesis Testing
Tests of Hypothesis, Parametric Vs. Non-Parametric Tests, Procedure for Testing Hypothesis, Use of Statistical Techniques for Testing Hypothesis, Sampling Distribution, Sampling Theory Chi-Square Test, Analysis of Variance and Covariance, Multivariable Analysis

Interpretation of Data
Data interpretation, Layout of a Research Paper, Techniques of Interpretation.

Text Books / Reference Books :
ADVANCED DSP LAB (ADSP)

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End Exam Duration: 3 Hrs

**Course Outcomes**: At the end of the course the student will be able to

**CO1**: Design digital IIR and FIR filters for DSP applications.

**CO2**: Analyze the effect of sampling rate conversion and design multirate FIR filters.

**CO3**: Apply parametric and non-parametric methods for power spectrum estimation.

**CO4**: Demonstrate their abilities towards TMS320C6748 DSP processor based implementation of digital signal processing concepts.

**CO5**: Demonstrate real time application on TMS320C6748 DSP processor.

**LIST OF EXPERIMENTS**

**CYCLE – I (MATLAB)**
1. A) DESIGN OF BUTTERWORTH IIR FILTERS
2. UPSAMPLING AND DOWN SAMPLING.
3. SAMPLING RATE CONVERSION BY FACTOR L/M.
4. MULTIRATE IMPLEMENTATION OF FIR FILTERS.
5. POWER SPECTRUM ESTIMATION USING NON-PARAMETRIC METHODS
6. POWER SPECTRUM ESTIMATION USING PARAMETRIC METHODS CYCLE – II (TMS320C6748)
7. LINEAR CONVOLUTION
8. CIRCULAR CONVOLUTION
9. IMPULSE RESPONSE
10. DIFFERENCE EQUATION
11. N-POINT DFT
12. AUDIO LOOPBACK (INTERRUPT AND POLLING METHODS)
13. AVERAGE FILTER
14. IMPLEMENTATION OF FIR FILTER
15. FACE DETECTION

**Text Books / Reference Books**:

CODING TECHNIQUES (CTH)

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Sessional Exam Duration: 2 Hrs  
End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Main objective the course is to provide insight about introduction to source coding and channel coding.

CO2: To provide the design of the linear block codes and cyclic codes for encoding and decoding.

CO3: To familiarize the design of BCH, Reed Solomon codes.

CO4: To familiarize the design of Convolution codes for both encoding and decoding.

Source Coding:

Channel Coding:
Linear Block Codes: Systematic linear codes and optimum decoding for the Binary Symmetric channel, generator and parity check matrices, Syndrome decoding on Symmetric Channels, Hamming Codes. Cyclic codes: Algebraic structure of cyclic codes, Binary Cyclic code properties, Encoding in systematic and non-systematic form, Encoder using (n-k) bit shift register, Syndrome Computation and Error detection, Decoding of Cyclic Codes.

BCH Codes:
Idempotent and Mattson – Solomon Polynomials, Reed-Solomon Codes, Justin Codes, MDS Codes, Alternate, Goppa and Generalized BCH Codes, Spectral properties.

Decoding of BDH Codes:

Convolutional Codes
Encoding of Convolutional codes, Structural properties of Convolutional codes, state diagram, Tree diagram, Trellis Diagram, Maximum Likelihood decoding of Convolutional codes. Wozencraft’s sequential decoding algorithms, Fann’s algorithm and other sequential decoding algorithm.

Text Books:

Reference Books:

Web References:
1. https://www.youtube.com/watch?v=whYljse4Abc
2. nptel.ac.in/courses/117102062/4
3. nptelvideos.in/2012/12/codingtechniques.html

Question Paper Pattern:
Internal Assessment: The question paper shall consist of Six questions out of which the student shall answer any Four questions
End Exam: The question paper shall consist of Eight questions out of which the student shall answer any Five questions
I Semester : CSP

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Sessional Exam Duration : 2 Hrs
End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Students will able to know about all the Bessel function matrix theory, random variables for one and two dimensional and models and Applications.

SPECIAL FUNCTIONS
Bessel's equation – Bessel function – Recurrence relations - Generating function and orthogonal property for Bessel functions of first kind – Fourier-Bessel expansion

MATRIX THEORY

ONE DIMENSIONAL RANDOM VARIABLES

TWO DIMENSIONAL RANDOM VARIABLES
Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation

QUEUEING MODELS

Text Books:

Reference Books:

Web References:
1. https://www.youtube.com/watch?v=whYljse4Abc
2. nptel.ac.in/courses/117102062/4

Question Paper Pattern:
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MICROWAVE INTEGRATED CIRCUITS (MIC)

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<th>I Semester : CSP</th>
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<td>Course Code</td>
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Sessional Exam Duration : 2 Hrs
End Exam Duration: 3 Hrs

Course Outcomes:
CO1: Able to acquire the knowledge about all basic microwave devices
CO2: Able to know about all microwave tubes and integrated circuits

Introduction to Microwave Integrated Circuits
MMIC- technology, advantages and applications, Active device technologies, design approaches, multichip module technology, substrates.

Passive Components
Inductors, capacitors, resistors, microstrip components, coplanar circuits, multilayer techniques, micromachined passive components, switches & attenuators, filter design

Amplifiers
Stability & gain analysis, matching techniques, reactively matched amplifier design, LNA

Oscillators Design principles, active device CAD techniques for large signal oscillators design, phase noise, MMIC_VCO, mixers

Integrated antennas and measurement techniques
Integrates antenna selection, photonic band gap antennas, micro machined antenna, micro electro mechanical system antennas, test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques.

Text Books:

Reference Books:

Web References:
1. https://www.youtube.com/watch?v=whYljse4Abc
2. nptel.ac.in/courses/117102062/4

Question Paper Pattern:
Internal Assessment: The question paper shall consist of Six questions out of which the student shall answer any Four questions
End Exam: The question paper shall consist of Eight questions out of which the student shall answer any Five questions
Course Code | Hours/Week | Credits | Maximum Marks
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EC808 (Elective-I) | L | T | P | C | Continuous Internal Assessment | End Exam | TOTAL
3 | - | - | 3 | 40 | 60 | 100

Sessional Exam Duration: 2 Hrs
End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Understand the wireless channel, fading and diversity
CO2: Understand the broad band wireless channel modeling
CO3: Understand the concept of frequency reuse and multiple access technologies
CO4: Analyze the concept of CDMA, OFDM, MIMO & UWB
CO5: Analyze the concept of 3G and 4G Wireless Standards

Wireless Communications and Diversity:
Introduction to 3G/4G Standards, Wireless Channel and Fading, Rayleigh Fading and BER of Wired Communication, BER for Wireless Communication, Introduction to Diversity, Multi-antenna Maximal Ratio Combiner, BER with Diversity, Spatial Diversity and Diversity Order

Broadband Wireless Channel Modelling
Wireless Channel and Delay Spread, Coherence Bandwidth of the Wireless Channel, ISI and Doppler in Wireless Communications, Doppler Spectrum and Jakes Model

Cellular Communication
Introduction to Cellular Communications, Frequency reuse, Multiple Access Technologies, Cellular Processes - Call Setup, Handover etc., Teletraffic Theory.

CDMA & OFDM

MIMO & UWB (Ultra wide Band):
Introduction to MIMO, MIMO Channel Capacity, SVD and Eigenmodes of the, MIMO Channel, MIMO Spatial Multiplexing – V-BLAST, MIMO Diversity – Alamouti, OSTBC, MRT, MIMO -OFDM, UWB Definition and Features, UWB Wireless Channels, UWB Data Modulation, Uniform Pulse Train, Bit-Error Rate Performance of UWB.

3G and 4G Wireless Standards
Architectures of WCDMA, LTE, WiMAX

Text Books:
2. Fundamentals of Wireless Communications – David Tse and PramodViswanath, Publisher - Cambridge University Press.

Reference Books:
2. MIMO Wireless Communications – EzioBiglieri – Cambridge University Press.
### Web References:
1. https://www.youtube.com/watch?v=-ymnQ5rpcYA
2. www.nptelvideos.in/2012/11/advanced-3g-and-4g-wireless-mobile.html

### Question Paper Pattern:

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Sessional Exam Duration: 2 Hrs  
End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Able to know about the all radar systems, design of radar systems and requirements of radar systems

CO2: Able to characterize the performance of radar system

CO3: Able to analyze Phase, Frequency and Linear FM Coding Techniques

Introduction

Radar functions and application, target, detection, resolution and clutter, Basic surveillance Radar – implementation.

Radar Range Performance

Radar Range equation – parameters, loss factors, Radar detection with noise Jamming, volume clutter and area clutter. Detection probability, false alarm sensitivity and introduction to CFAR technique, basics of CACFAR processor, Resolution cell and measurement accuracy, Ambiguities in Range and Doppler.

Signal Processing & Wave form Selection-I


Signal Processing & Wave form selection – II

Transmit waveforms – types, design criteria, Radar Ambiguity function – principles, properties, expels, Radar environmental diagram, optimization, desirability of range- Doppler Ambiguities.

Phase coding techniques


Linear FM and frequency coding Techniques

Principles, linear FM pulses, generation and decoding, distortion effects on LFM signals, discrete frequencies – waveform analysis, capabilities. Resolution properties of frequency coded pulses.

Text Books:


Reference Books:


Web References:

1. https://www.youtube.com/watch?v=whYljse4Abc
2. nptel.ac.in/courses/117102062/4

Question Paper Pattern:

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SPEECH PROCESSING (SP)

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Sessional Exam Duration: 2 Hrs  
End Exam Duration: 3 Hrs

### Course Outcomes
- **CO1**: Understand the mechanism of speech productions and speech models and time domain models
- **CO2**: Analyze the modulation schemes of speech waveforms and Short Time Fourier analysis
- **CO3**: Understand the properties of Homomorphic speech processing
- **CO4**: Analyze the Linear Predictive Coding of speech and their applications

#### Digital Models for the Speech Signal

- The process of speech production, Acoustic theory of speech production, Lossless tube models, and digital models for speech signals

#### Time domain models for speech processing

- Time dependent processing of speech, short time energy and average magnitude, zero crossing rate, pitch period estimation, short time auto-correlation function, median smoothing and speech processing

#### Digital representation of speech waveform

- Quantization, instantaneous and adaptive delta modulation, DPCM, comparison of systems.

#### Short time Fourier Analysis


#### Homomorphic speech processing

- complex cepstrum approach, pitch detection, Format detection, homomorphic vocoder

#### Linear Predictive coding of speech

- Principles of linear predictive analysis, solution of LPC Equation; Prediction error signal, frequency domain representation of LPC analysis; Relation between the various speech parameters, synthesis of speech from LP parameters and applications.

#### Speech Coding

- Sub–band coding, transform coding, channel Vocoder, Formant Vocoder, cepstral Vocoder, LP Vocoders. Vector quantizer coders. Man-machine communication, speaker recognition system, speech recognition systems.

### Text Books:


### Reference Books:


### Web References:

1. https://www.youtube.com/watch?v=whYljse4Abc
2. nptel.ac.in/courses/117102062/4

### Question Paper Pattern:

- **Internal Assessment**: The question paper shall consist of Six questions out of which the student shall answer any Four questions
- **End Exam**: The question paper shall consist of Eight questions out of which the student shall answer any Five questions
I Semester : CSP
Course Code | Hours/Week | Credits | Maximum Marks |
---|---|---|---|
EC811 (Elective-II) | L T P C | Continuous Internal Assessment | End Exam | TOTAL |
3 | - | 3 | 40 | 60 | 100 |

Sessional Exam Duration : 2 Hrs
End Exam Duration: 3 Hrs

Course Outcomes : At the end of the course the student will be able to

**CO1**: Understand organization of biological neural networks, characteristics of artificial neural networks and their training methods.

**CO2**: Understand basics of learning and training algorithms and applications of various Neural Networks such as Perceptron, Counter Propagation Networks, Recurrent Networks, BAM and ART

**CO3**: Understand fundamentals of Fuzzy Systems, relations, measures and various Fuzzy System architectures

### Biological Neural Network
Organisation of human brain, Neuron functions-cell body, Dendrites, Axon, Cell membrane, computers and human brains

### Artificial Neural Networks
Characteristics, single layer and multi-layer Artificial Neural Networks, Training: objective, supervised and unsupervised training, overview

### Perceptrons
Perceptron representation, learning, training algorithm, advanced algorithms and applications.

### Neural Dynamics
Counters propagation Networks: Introduction, Network structure, Normal operation, training the Kohonen and Grossberg layers, full counter propagation network, applications

### Statistical Methods
Training, applications, applications to non-linear optimisation problems, Back propagation and Cauchy training

### Hopfield Networks
Recurrent network configurations, applications

#### Bi-directional Associative Memories
BAM structure, retrieving a stored association, encoding the associations, Memory capability, continuous, adaptive and competitive BAM

### Adaptive Resonance Theory
ART architecture and implementation training example, characteristics.

### Introduction to Fuzzy Systems
Crisp sets, notation, basic concepts, classical logic, Fuzzy logic, Fuzzy operations -Complement, Union and Intersection

### Fuzzy Relations
Binary relations, Equivalence and Similarity relations, compatibility relation, Orderings, morphisms

### Fuzzy Measures
Belief and plausibility measures, probability measures, possibility and necessity measures

### Fuzzy Associative Memories
Fuzzy and Neural function estimators, Neural vs Fuzzy representation of structured knowledge, FAMs as mappings, Fuzzy hebb FAMs: The Bi-directional FAM, theorem, superimposing FAM rules, FAM system Architecture
<table>
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<tr>
<th><strong>Text Books:</strong></th>
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<tr>
<td>1. Bart Kosko, <em>Neural Networks and Fuzzy Systems</em>, PHI.</td>
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WAVELET TRANSFORMS AND APPLICATIONS (WTA)

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Sessional Exam Duration: 2 Hrs  
End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Students are able to understand the wavelet transforms & wavelet filters in image processing applications

CO2: Students are able to apply STFT, CWT & DWT for analyzing signals in Spatial domain

CO3: Students are able to apply the wavelet transforms for analyzing speech & Music signals, SONAR Spectral analysis, image compression, fractal signal analysis and denoising of signals.

Introduction


Fourier Analysis

Fourier transform- Drawbacks of Fourier analysis- Short –time Fourier Transform (STFT) analysis- Spectrogram plot –phase- space plot in time-frequency plane, Time and frequency limitations, Uncertainty principle , Tiling of the Time-Frequency plane for STFT.

Continuous Wavelet Transform

Wavelet Transform-definition and properties – concept of scale and its relation with frequency – Continuous Wavelet Transform (CWT)- Scaling function and wavelet functions ( Debauchis, Haar, Coiflet, Mexican, Hat, Sinc, Gaussian , Bi-orthogonal)- Tiling of time- scale plane for CWT.

Discrete Wavelet Transform


Applications

Case study-I : Sub-band coding of speech and music. Case study-II : Multi-band wavelet transform based SONAR spectral classification and Transient detection, Case study –III : Image compression using 2- D DWT, Case study-IV : Fractal signal analysis, Case study-V: Denoising of signals

Text Books :


Reference Books :


Web References:

1. https://www.youtube.com/watch?v=whYljse4Abc
2. nptel.ac.in/courses/117102062/4

Question Paper Pattern:

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INTERNETWORKING WITH TCP/IP (TCPIP)

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<th>Scheme : 2017</th>
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<td>Course Code</td>
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Sessional Exam Duration : 2 Hrs  End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Students acquire knowledge about latest Protocols in the field of Network Domain.  
CO2: Students acquire knowledge about encryption and decryption algorithms used in communication and Networking Domain.

Introduction and overview
Review of underlying network technologies, Internetworking concept and architectural model

Internet addresses
Mapping Internet addresses to physical address (ARP), determining and Internet address at startup (RARP)

Internet Protocol
Connectionless datagram service, Routing IP datagram, error and control messages (ICMP), Internet multicasting (IGMP) Subnet and supernet address extensions

User Datagram
Protocol, Reliable stream transport service (TCP), TCP State machine, core routers, peers, GGP, SPF protocols, Routing on an autonomous systems (EGP)

TCP/IP over ATM
Networks, Client server model of interaction, the socket interface, DHCP, Domain name system (DNS)

Applications
Remote Login, FTP, TFTP, NFS, Electronic mail (SMTP, MIME), Internet management SNMP, SNMPV2, Internet Security and Firewall design, features of IPV6.

Text Books:

Reference Books:
2) High Performance TCP/IP Networking-Mahbub Hassan, Raj Jain, PHI, 2005

Web References:
1. https://www.youtube.com/watch?v=whYljse4Abc
2. nptel.ac.in/courses/117102062/4

Question Paper Pattern:
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COGNITIVE RADIO (CR)

I Semester : CSP
Course Code  | Hours/Week | Credits  | Maximum Marks
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EC906 (Elective-III) | L | T | P | C | Continuous Internal Assessment | End Exam | TOTAL
3 | - | - | 3 | 40 | 60 | 100

Sessional Exam Duration : 2 Hrs
End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to
CO1: gain knowledge on multi rate systems.
CO2: develop the ability to analyze, design, and implement any application using FPGA.
CO3: be aware of how signal processing concepts can be used for efficient FPGA based system design
CO4: understand the rapid advances in Cognitive radio technologies.
CO5: explore DDFS, CORDIC and its application.

SOFTWARE DEFINED RADIO

SDR AS PLATFORM FOR COGNITIVE RADIO
Introduction – Hardware and Software architecture – SDR development process and Design – Application software – Component development – Waveform development – cognitive waveform development

COGNITIVE RADIO TECHNOLOGY

CR- TECHNICAL CHALLENGES
Design Challenges associated with CR – Hardware requirements – Hidden primary user problem – detecting spread spectrum primary users – sensing duration and frequency – security

SPECTRUM SENSING
Overview – Classification - Matched filter – waveform based sensing – cyclo stationary based sensing – Energy detector based sensing – Radio Identifier – Cooperative sensing- other sensing methods

OFDM BASED COGNITIVE RADIO

Text Books:

Reference Books:
5. T. Darc Chiueh, P.Yun Tsai,” OFDM baseband receiver design for wireless communications”, Wiley, 2007
6. Recent literature in Cognitive Radio
<table>
<thead>
<tr>
<th><strong>Web References:</strong></th>
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<td>2. <a href="https://www.youtube.com/watch?v=hzxgDyXbpt4">https://www.youtube.com/watch?v=hzxgDyXbpt4</a></td>
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## WIRELESS COMMUNICATIONS & NETWORKS (WCN)

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<th>II Semester : CSP</th>
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<tbody>
<tr>
<td>Scheme : 2017</td>
<td>EC907</td>
<td>L T P C</td>
<td>Continuous Internal Assessment</td>
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<td>(Elective-III)</td>
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### Course Outcomes

- **CO1**: Understand Wireless Channel Specifications, Fading & Diversity Schemes.
- **CO3**: Understand standards in cellular Mobile Communication & Wireless Adhoc Networks

### Fading & Diversity


### Cellular Communication and CDMA


### Fading Channel Capacity

Capacity of Wireless Channels- Capacity of flat and frequency selective fading channels, Multiple Input Multiple output (MIMO) systems- capacity of MIMO Channels.

### Cellular Wireless Communication Standards


### Wireless Adhoc Networks


### Report Writing


### Text Books

2. “Modern Wireless Communications” by Simon Haykin and Michael Moher, Person Education.
**Reference Books:**


**Web References:**

1. nptelvideos.in/2012/12/wireless-communication.html
3. nptelvideos.in/2012/12/digital-communication.html

**Question Paper Pattern:**

**Internal Assessment:** The question paper shall consist of Six questions out of which the student shall answer any Four questions

**End Exam:** The question paper shall consist of Eight questions out of which the student shall answer any Five questions
II Semester : CSP  
Course Code | Hours/Week | Credits | Maximum Marks |
---|---|---|---|
EC908 (Elective-III) | L | T | P | C | Continuous Internal Assessment | End Exam | TOTAL |
| 3 | - | - | 3 | 40 | End Exam | 60 | 100 |

Sessional Exam Duration : 2 Hrs  
End Exam Duration: 3 Hrs

**Course Outcomes** : At the end of the course the student will be able to

**CO1**: Understand the layered architectures, working principles & services provided by various networks like BISDN, ATM and TCP/IP.

**CO2**: Analyze the performance of High speed networks based on QOS parameters

**CO3**: Understand the concepts of Signaling, Routing and Switching the information between interconnected networks.

**Network Services & Layered Architecture**
Traffic characterization and quality of service, Network services, High performance networks, Network elements, Basic network mechanisms, layered architecture.

**ISDN & B-ISDN**
Over view of ISDN, ISDN channels, User access, ISDN protocols, Brief history of B-ISDN and ATM, ATM based services and applications, principles and building block of B-ISDN, general architecture of B-ISDN, frame relay

**ATM Networks**
Network layering, switching of virtual channels and virtual paths, applications of virtual channels and connections.

**QOS parameters**
QOS parameters, traffic descriptors, ATM service categories, ATM cell header, ATM layer, ATM adaptation layer.

**Interconnection Networks**
Introduction, Banyan Networks, Routing algorithm & blocking phenomenon, Batcher-Banyan networks, crossbar switch, three stage class networks.

**Rearrangeable Networks**
Rearrangeable class networks, folding algorithm, bens network, looping algorithm.

**ATM Signaling, Routing And Traffic Control**
ATM addressing, UNI signaling, PNNI signaling, PNNI routing, ABR Traffic management.

**TCP/IP Networks**
History of TCP/IP, TCP application and Services, Motivation, TCP, UDP, IP services and Header formats, Internetworking, TCP congestion control, Queue management: Passive & active, QOS in IP networks: differentiated and integrated services

**Text Books** :

**Reference Books** :
**Web References:**

1. nptelvideos.in/2012/12/highspeednetworks.html

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End Exam: The question paper shall consist of **Eight** questions out of which the student shall answer any **Five** questions
SYSTEM MODELLING & SIMULATION (SMS)

II Semester : CSP  
Course Code: EC909 (Elective-IV)  
Scheme: 2017

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Sessional Exam Duration : 2 Hrs  
End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Students will be able to work with different packages and simulation

CO2: Students will be able to work with Poisson process in real time

CO3: Students will be able to model and simulate models.

Basic Simulation Modeling, Systems

Models and Simulation, Discrete Event Simulation, Simulation of single server queing system, Simulation of Inventory System, Alternative approach to modeling and simulation.

Simulation Software

Comparison of simulation packages with Programming languages, Classification of Software, Desirable Software features, General purpose simulation packages – Arena, Extend and others, Object Oriented Simulation, Examples of application oriented simulation packages

Building Simulation Models

Guidelines for determining levels of model detail, Techniques for increasing model validity and credibility

Modeling Time Driven Systems

Modeling input signals, delays, System integration, Linear Systems, Motion control models, Numerical Experimentation

Exogenous Signals And Events

Disturbance signals, State Machines, Petri Nets & Analysis, System encapsulation.

Markov Process

Probabilistic systems, Discrete Time Markov processes, Random walks, Poisson processes, the exponential distribution, simulating a poison process, Continuous-Time Markov processes.

Event Driven Models

Simulation diagrams, Queing theory, simulating queing systems, Types of Queues, Multiple servers.

System Optimization

System Identification, Searches, Alpha/beta trackers, Multidimensional Optimization, Modeling and Simulation methodology.

Text Books:
2. Averill M. Law, W. David Kelton, Simulation Modelling and Analysis, 3rd Ed, TMH.

Reference Books:

Web References:
1. nptelvideos.in/2012/12/systemmodelingandsimulation.html

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**ARTIFICIAL INTELLIGENCE (AI)**

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Sessional Exam Duration : 2 Hrs

End Exam Duration: 3 Hrs

**Course Outcomes:** At the end of the course the student will be able to

**CO1:** The student will be able to understand various artificial network and models and the applications of these models to solve engineering problems.

**PROLOG**

An overview of prolog- an example program: defining family relations, extending the example program by rules, a recursive rule definition, declarative and procedural meaning of programs. Syntax and Meaning of prolog programs - Data objects, matching. Lists, operators, Arithmetic - Representation of lists, some operations on lists, operator notation, and arithmetic. Using Structures: Example Programs - Retrieving information from a database. Doing data abstraction.

**Artificial Intelligence**

The AI problems, the underlying Assumption, What is an AI Technique? The level of the model, Criteria for success, Problems, problem spaces, and search - defining the problem as a state space search, production systems, problem characteristics, production system characteristics, issues in the design of search programs.

**Heuristic Search Techniques**

Generate and test- travelling sales man problem, Hill climbing, Best first search, problem reduction, constraint satisfaction, Mean ends analysis

**Knowledge Representation**

Representations and mappings, approaches to knowledge representation, The Frame Problem. Using Predicate logic - Representing simple facts in logic, Representing Instance and Isa relationships, Resolution.

**Representing Knowledge Using Rules**

Procedural versus declarative knowledge, logic programming, forward versus backward reasoning, matching. WEAK SLOT AND FILLER STRUCTURES - Semantic nets, Frames. STRONG SLOT AND FILLER STRUCTURES - Conceptual dependency, scripts, CYC GAME PLAYING - MIN MAX search procedure, Adding Alpha Beta cutoffs.

**Learning**

What is learning, rote learning , learning from taking advice, learning in problem solving, learning from examples: induction, explanation based learning, Hopfield networks, learning in neural networks,

**Case Studies**

**Text Books / Reference Books :**

1. Elaine Richie And Kevin Knight, *Artificial Intelligence, 2005*
2. Ivan Bratko, *Prolog*

**Web References:**

1. nptelvideos.in/2012/12/artificalintelligence.html

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Sessional Exam Duration : 2 Hrs
End Exam Duration: 3 Hrs

Course Outcomes: At the end of the course the student will be able to

CO1: Students will acquire the knowledge of OS principles-design, memory management and distributed systems

CO2: Students are able to apply the knowledge of UNIX and LINUX operating systems in system design applications and Inter-process Communications

CO3: Students are able to apply TCP/IP protocol stack to design network management protocols and socket programming.

Introduction
Introduction to Operating Systems, Type of operating systems. Overview of UNIX system, Structure, file systems, type of file, ordinary & Special files, file permissions, Introduction to shell.

UNIX
Basic commands & command arguments, Standard input/output Input/output redirection, filters and editors.

Unix Systems Calls
System calls related file structures, input / output process creation & termination.

Interprocess Communication in Unix
Introduction, file and record locking, Client – Server example, pipes, FIFOs, Streams & Messages, Name Speces, Systems V IPC, Message queue, Semaphores, Shared Memory, Sockets & TLI

Introduction to Networks and Network Programming in Unix

Linux
Introduction to LINUX System, editors and utilities, type of shells.

Linux Operations
Shell operations, file structure, file management, Operations.

Text Books:

Reference Books:

Web References:
1. nptelvideos.in/2012/12/advancedoperatingsystems.html

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DESIGN OF DIGITAL SIGNAL PROCESSING SYSTEMS (DDPS)

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Maximum Marks

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**Course Outcomes** : At the end of the course the student will be able to

**CO1**: Acquire knowledge of DSP computational building blocks and knows how to achieve Speed in DSP architecture or processor

**CO2**: Acquire knowledge about various addressing modes and Instruction set of DSP TMS320C67XX and are able to program DSP processor

**CO3**: Understanding AIC23 CODEC and programs using matlab and C

**CO4**: Design of Filters and dsp algorithms programs by using c code and ASM

**CO5**: understanding the applications of DSP in CODEC

### Introduction to a Popular DSP from Texas Instruments

CPU Architecture, CPU Data Paths and Control, Timers, Interrupts, Internal Data/Program Memory, External Memory Interface, Pipelining

### Architecture and Instruction Set of the C6x Processor


### DSP Development System


### Digital Signal Processing Applications

FIR & IIR digital filter design programs using Matlab, Fourier transform: DFT.FFT Radix 2 programs using matlab, Implementation of real time digital filters using DSP, Implementation of FFT applications using DSP, DTMF Tone generation and Detection

### DSP Application Examples in CODEC

Voice Scrambler Using DMA and User Switches, Phase-Locked Loop, Image Processing, Voice Detection and Reverse Playback

### Text Books :


### Reference Books :

1. Digital signal processing and application with C6713 and C6416 DSK, Rulph Chassaing, Worcester Polytechnic Institute, A wiley- Interscience Publication
2. Digital signal processing Implementation using the TMS320C6000 DSP platform, 1st edition ; Naim Dahnoun.

Sessional Exam Duration : 2 Hrs  
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