****

**MIT ART, DESIGN AND TECHNOLOGY UNIVERSITY, PUNE**

**Department of Electronics and Communication Engineering**

**MIT SCHOOL OF ENGINEERING, PUNE**

**STRUCTURE AND SYLLABUS**

**FOR**

**M. Tech. ECE- Signal Processing and Communication Engineering**

**UNDER FACULTY OF TECHNOLOGY**

 **(w.e.f. 2017-2018)**

**UNDER FACULTY OF TECHNOLOGY**

**M. Tech. Mechanical Engineering (Mechatronics)**

**2017-Course**

**kundlik mali**

**M.Tech. (ECE- Signal Processing and Communication Engineering) (SC)**

**(Minimum credits to be earned: 74)**

**SEMESTER-I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code**  | **Course Name**  | **Hours/week** | **Maximum Marks** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **CA** | **FE** | **Total** |
| 17MTSC101 | Advanced Mathematics | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 17MTSC102 | Probability & Random Processes | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 17MTSC103 | Digital Signal Processing & its Applications | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 17MTSC104 | Digital Message Transmission  | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 17MTSC1[31-32] | Elective-I | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 17MTSC111 | Laboratory-I | 0 | 0 | 4 | 2 | 40 | 60\*\* | 100 |
| 17MTSC121 | Technical Seminar-I | 0 | 0 | 4 | 2 | 100 | -- | 100 |
| **Total** | **15** | **1** | **8** | **20** | **340** | **360** | **700** |

**SEMESTER-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code**  | **Course Name**  | **Hours/week** | **Maximum Marks** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **CA** | **FE** | **Total** |
| 17MTSC201 | Communication Networks | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 17MTSC202 | Information Theory and Coding | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 17MTSC203 | Image Processing | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 17MTSC204 | Error Correcting Codes | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 17MTSC2[31-32] | Elective-II | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 17MTSC211 | Laboratory -II | 0 | 0 | 4 | 2 | 40 | 60\*\* | 100 |
| 17MTSC221 | Mini Project | 0 | 0 | 4 | 2 | 100 | -- | 100 |
| **Total** | **15** | **1** | **8** | **20** | **340** | **360** | **700** |

**CA = Continuous Assessment, FE= Final Examination,**

**\*\*Final Lab exam will be conducted with viva-voce of the respective practical (50 exam +10 viva = 60)**

**Coding for course/ subject: 17AE101,** Where; **17** = Year of BOS, **AE** = Branch Code, **1**= Semester No.,

**01 to N** = Sequence No of Subject. **For,** SE to BE & also PG follow the above scheme of regulation.

**SEMESTER-III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code**  | **Course Name**  | **Hours/week** | **Maximum Marks** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **CA** | **FE** | **Total** |
| 17MTSC301 | Adaptive Signal Processing  | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 17MTSC302 | Machine Learning  | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 17MTSC3[31-32] | Elective-III | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 17MTSC3[33-34] | Elective-IV | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 17MTSC321 | Technical Seminar-II | 0 | 0 | 4 | 2 | 40 | 60\*\* | 100 |
| 17MTSC322 | Project Phase-I | 0 | 0 | 4 | 2 | 40 | 60\*\* | 100 |
| **Total** | **12** | **4** | **8** | **20** | **240** |  | **600** |

**SEMESTER-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code**  | **Course Name**  | **Hours/week** | **Maximum Marks** |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **CA** | **FE** | **Total** |
| 17MTSC421 | Project Phase-II | 0 | 0 | 28 | 14 | 100 | 200 | 300 |
| **Total** | **0** | **0** | **28** | **14** | **100** | **200** | **300** |

**CA = Continuous Assessment, FE= Final Examination,**

**\*\*Final Lab exam will be conducted with viva-voce of the respective practical (50 exam +10 viva = 60)**

**Coding for course/ subject: 17AE101,** Where; **17** = Year of BOS, **AE** = Branch Code, **1**= Semester No.,

**01 to N** = Sequence No of Subject. **For,** SE to BE & also PG follow the above scheme of regulation.

**LIST OF ELECTIVES**

|  |  |
| --- | --- |
| **Elective**  | **Course Name** |
|
| Elective-I | 17MTSC131  | Statistical signal analysis |
| 17MTSC132 | Time frequency analysis & Wavelets |
| Elective-II | 17MTSC231 | Fiber Optic Communications |
| 17MTSC232 | Computer Vision |
| Elective-III | 17MTSC331 | Wireless Networks |
| 17MTSC332 | RF and Optical Engineering |
| Elective-IV | 17MTSC333 | Multimedia Information systems |
| 17MTSC334 | Fiber optics Network |

|  |  |  |  |
| --- | --- | --- | --- |
|  **17MTSC101 Advanced Mathematics 3 1 0 4**CA: 40 Marks FE: 60 Marks No. of Total Lectures = 45 Hours **Unit I (9)**Linear Differential Equation - Linear differential equations, homogeneous higher order linear differential equations, non-homogeneous higher order linear differential Equations with constant coefficients, Initial value problems, Linear dependence and independence, Legendre Differential Equations **Unit II (9)**Probability and Statistics - Random variables and their properties, some standard discrete and continuous variables, Expectation, variance, moments, moment generating functions, function of random variables, their distribution and moments, joint, marginal and conditional distributions, independence of random variables, Hypothesis testing, Probability, discrete probability distributions. **Unit III (9)**Linear Programming - Formation of LPP, Graphical Method, Simplex method, Theory of Simplex method, Duality and sensitivity analysis, Other algorithms for linear programming –Dual Simplex method, parametric linear programming, upper bound technique.**Unit IV (9)**Linear Equations with regular singular points **-** Euler equation, second order equation with regular singular points, Exceptional cases, Bessel equation. Separation of variables, exact equations, Method of successive approximations Lipchitz condition, Approximation to and uniqueness of solutions, Complex n-dimensional space, Systems as vector equations, Existence and uniqueness of solutions to systems, Existence, Uniqueness for linear systems and equations of order n.**Unit V (9)**Partial Differential Equations-Solution of First order Partial Differential Equations,Partial differential equations with separation of variables, boundary value problems, Wave equation in cylindrical and spherical polar coordinates, Dirichlet’s problem for a rectangle, half plane and circle, Solution of Laplace equation in cylindrical and spherical polar coordinates **Reference Books:**1. Erwin Kreyszig, “Advanced Engineering Mathematics (10th edition)”, Wiley eastern Ltd.
2. George Simmons, “Differential Equations with Applications and Historical notes”, Tata Mc-Graw Hill publishing company Ltd, New Delhi.
3. H.A.Taha, “Operations Research”, Pearson Education.
4. P. Gupta, D.S. Hira, “Operations Research”, S. Chand Publications.
5. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publication.
6. F. John, Partial differential equations, Springer, 1971.
7. S. Ross, “Introduction to probability models, Wiley India.
8. A.M. Gun, M. K. Gupta and B. S. Gupta, “Fundamentals of Statistics”,
9. C.R. Wylie, “Advanced Engineering Mathematics”, McGraw Hill Publications, New Delhi.
10. Peter V. O’ Neil, “Advanced Engineering Mathematics (7th edition)”, Thomson.Brooks/Cole, Singapore.

 **17MTSC102:** **Probability And Random Processes 3 0 0 3** |  |  |  |
|  CA : 40 Marks FE : 60 Marks |  No. of Total Lectures = 45 Hours |  |  |

|  |
| --- |
| **Unit I (9)**Sets and set operations; Probability space, Conditional probability and Bayes theorem, Combinatorial probability and sampling models**Unit II (9)** Discrete random variables, probability mass function, probability distribution function, example random variables and distributions, Continuous random variables, probability density function, probability distribution function**Unit III (9)**Example distributions, Joint distributions, functions of one and two random variables, moments of random variables, Conditional distribution, densities and moments**Unit IV (9)** Characteristic functions of a random variable, Markov, Chebyshev and Chernoff bounds; Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square).**Unit V (9)**Limit theorems, Strong and weak laws of large numbers, central limit theorem.Random process. Stationary processes. Mean and covariance functions.Ergodicity. Transmission of random process through LTI. Power spectral density. |
| **Reference Books:** |
| 1. H.Stark and J. Woods,``Probability and Random Processes with Applications to Signal Processing,'' Third Edition, Pearson Education. (Indian Edition is available).
2. A. Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes,'' Fourth Edition, McGraw Hill. (Indian Edition is available).
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International Student Edition.
4. P. G. Hoel,S. C.Port and C.J. Stone Introduction to Probability, UBS Publishers,l
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes,UBS Publishers
6. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

|  |  |  |  |
| --- | --- | --- | --- |
|  **17MTSC103: Digital Signal Processing And Applications 3 1 0 3** | **3 2 0 4** |  |  |
|  CA : 40 Marks FE : 60 Marks |  No. of Total Lectures = 45 Hours |  |  |

 |
| **Unit I (9)**Discrete time signals: Sequences, representation of signals on orthogonal basis, Sampling and reconstruction of signals, Discrete systems: attributes, Z-Transform, Inverse ZT and Applications of ZT**Unit II (9)**Analysis of LTI systems Frequency analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Implementation of Discrete Time Systems. **Unit III (9)**Design of FIR Digital filters: Linear phase FIR filters, Window method, Park-McClellan's method.Effect of finite register length in FIR filter design**Unit IV (9)**Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations, Lowpass, Bandpass, Bandstop and High pass filters. Parametric and non-parametric spectral estimation. **Unit V (9)**Introduction to multirate signal processing. Application of DSP to Speech, biomedical and Radar signal processing. |
| **Reference Books:**1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
3. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
4. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
5. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing,J Wiley and Sons, Singapore, 1988.
 |
|

|  |  |  |  |
| --- | --- | --- | --- |
|  **17MTSC104:** **Digital Message Transmission 3 0 0 3** |  |  |  |
|  CA : 40 Marks FE : 60 Marks |  No. of Total Lectures = 45 Hours |  |  |

 |
|  |
| **Unit I (9)**Examples of analog pulse and digital transmission systems, Performance analysis of analog and pulse modulation systems.**Unit II (9)**Role and review of probability theory and stochastic processes in digital message transmission, Principles of detection theory: Binary and m-ary hypothesis testing. **Unit III (9)**Bayes' likelihood ratio test Performance analysis of digital communication systems. Spectrum of digital signals: Spectral efficiency of digital communication systems.**Unit IV (9)**Nyquist pulse shaping, Correlative coding schemes, Equalization techniques.**Unit V (9)** Synchronization techniques. Carrier, bit and frame synchronization schemes.**Reference Books:** |
|  |
| 1. Wozencraft J.M. and Jacobs I.M., Principles of Communication Engineering, John Wiley, 1965.
2. Carlson A., Communication Systems, 3rd ed., McGraw Hill, 1986.
3. Van Trees H.L., Detection Estimation and Modulation Theory, Vol. 1., Wiley, 1968.
4. Proakis J.J., Digital Communications, 2nd Ed., McGraw Hill, 1989.
5. Blahut R.F., Digital transmission of Information, Addison Wesley 1990.
6. Benedetto S., Biglieri E. and Castellari V., Digital Transmission Theory, Prentice Hall, 1989
7. [John M. Wozencraft](http://www.amazon.in/s/ref%3Ddp_byline_sr_book_1?ie=UTF8&field-author=John+M.+Wozencraft&search-alias=stripbooks), [Irwin Mark Jacobs](http://www.amazon.in/s/ref%3Ddp_byline_sr_book_2?ie=UTF8&field-author=Irwin+Mark+Jacobs&search-alias=stripbooks), “Principles of Communication Engineering”,Waveland Pr Inc; Reprint edition Jun 1990
8. [Bruce Carlson](http://www.amazon.in/A.-Bruce-Carlson/e/B001IXQBBK/ref%3Ddp_byline_cont_book_1) , [Paul B. Crilly](http://www.amazon.in/s/ref%3Ddp_byline_sr_book_2?ie=UTF8&field-author=Paul+B.+Crilly&search-alias=stripbooks), “Communication Systems”, McGraw-Hill Education; 5 edition (1 March 2009)
9. [Harry L. Van Trees](http://as.wiley.com/WileyCDA/Section/id-302477.html?query=Harry+L.+Van+Trees), [Kristine L. Bell](http://as.wiley.com/WileyCDA/Section/id-302477.html?query=Kristine+L.+Bell) with [Zhi Tian](http://as.wiley.com/WileyCDA/Section/id-302477.html?query=Zhi+Tian), “Detection Estimation and Modulation Theory, Part I: Detection, Estimation, and Filtering Theory”, Wiley, 2nd Edition
10. John Proakis , “Digital Communications, 5th Edition”.

|  |  |  |  |
| --- | --- | --- | --- |
|  **17MTSC131: Statistical Signal Analysis 3 0 0 3** |  |  |  |
|  CA : 40 Marks FE : 60 Marks |  No. of Total Lectures = 45 Hours |  |  |

|  |
| --- |
| **Unit I (9)**Review of probability theory and random variables: Transformation (function) of random variables, Conditional expectation; Sequences of random variables: convergence of sequences of random variables.;**Unit II (9)** Stochastic processes: wide sense stationary processes, orthogonal increment processes, Wiener process, and the Poisson process**Unit III (9)** KL expansion.; Ergodicity, Mean square continuity, mean square derivative and mean square integral of stochastic processes.**Unit IV (9)**Stochastic systems: response of linear dynamic systems (e.g. state space or ARMA systems) to stochastic inputs, Lyapunov equations, correlational function, power spectral density function, **Unit V (9)**Introduction to linear least square estimation, Wiener filtering and Kalman filtering. |
| **Reference Books:** |
| 1. A. Papoulis, Probability, Random Variables and stochastic processes, 2nd Ed., McGraw Hill, 1983.
2. A. Larson and B.O. Schubert, Stochastic Processes, Vol.I and II, Holden-Day, 1979.
3. W. Gardener, Stochastic Processes, McGraw Hill, 1986.
4. A. Papoulis, [S. Unnikrishna Pillai](http://eeweb1.poly.edu/~pillai/), Probability, Random Variables and stochastic processes, 4th Ed., McGraw Hill, 2002.

|  |  |  |  |
| --- | --- | --- | --- |
|  **17MTSC132: Joint Time-Frequency Analysis 3 0 0 3** |  |  |  |
|  CA : 40 Marks FE : 60 Marks |  No. of Total Lectures = 45 Hours |  |  |

 |

**UNIT-I (9)**Review of Fourier Transform, Parseval Theorem and need for joint time-frequency Analysis. Concept of non-stationary signals, Short-time Fourier transforms (STFT), Uncertainty Principle, and Localization/Isolation in time and frequency, Hilbert Spaces, Banach Spaces, and Fundamentals of Hilbert Transform**UNIT-II (9)**Bases for Time-Frequency AnalysisWavelet Bases and filter Banks, Tilings of Wavelet Packet and Local Cosine Bases, Wavelet Transform, Real Wavelets, Analytic Wavelets, Discrete Wavelets, Instantaneous frequency, Quadratic time-frequency energy, Wavelet Frames, Dyadic wavelet Transform, Construction of Haar and Roof scaling function using dilation equation and graphical method.**UNIT-III (9)**Multiresolution AnalysisHaar Multiresolution Analysis, MRA Axioms, Spanning Linear Subspaces, nested subspaces, Orthogonal Wavelets Bases, Scaling Functions, Conjugate Mirror Filters, Haar 2-band filter Banks, Study of up samplers and down samplers, Conditions for alias cancellation and perfect reconstruction **UNIT-IV (9)** Discrete wavelet transform and relationship with filter Banks, Frequency analysis of Haar 2-band filter banks, scaling and wavelet dilation equations in time and frequency domains, case study of decomposition and reconstruction of given signal using orthogonal framework of Haar 2-band filter bank**UNIT-V (9)** JTFA ApplicationsRiesz Bases, Scalograms, Time-Frequency distributions: fundamental ideas, Applications: Speech,audio, image and video compression; signal denoising, feature extraction, inverse problem.**Reference Books:**1. L. Cohen, “Time-frequency analysis”, Prentice Hall, 1995
2. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1993.

|  |  |  |  |
| --- | --- | --- | --- |
|  **17MTSC201: Communication Networks 3 2 0 4** |  |  |  |
|  CA : 40 Marks FE : 60 Marks |  No. of Total Lectures = 45 Hours |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|

|  |  |  |  |
| --- | --- | --- | --- |
|

|  |
| --- |
| **Unit I (9)**Introduction to computer communication networks and layered architecture overview. Packet switching and FastFast packet switching. Point to Point Protocols and links:**Unit II (9)** ARQ retransmission strategies. Selective repeat ARQ. Framing and standard Data Link Control protocol-HDLC, SDLC, LAPD. Queuing models in communication networks**Unit III (9)**Multiaccess Communication and multiple access protocols: ALOHA, slotted ALOHA, CSMA, CSMD/CD. Performance modelling and analysis.**Unit IV (9)**Local Area Networks: Ethernet, Token Ring and FDDI. Design and analysis. Internetworking issues: Bridges, Routers and Switched networks, Routing and Flow Control algorithms in data networks.**Unit V (9)** Broadband Networks: ATM, Frame relay and Gigabit Ethernet. Traffic Management in ATM networks. |
| **Reference Books:** |
| 1. R G Gallager and D Bertsekas, Data Networks, Prentice Hall of India, 1992.
2. J F Hayes, Modelling and Analysis of Computer Communication Networks, Plenum Publishing Corporation, New York, 1984.
3. W Stallings, Data and Computer Communications, Prentice Hall of India, 1997.
4. R Rom and M Sidi, Multiple Access Protocols, Springer Verlag, 1990.
5. M DePrycker, ATM-solutions for Broadband ISDN, Prentice Hall of USA, 1995.
6. William Stallings, “DATA AND COMPUTER COMMUNICATIONS”, 8th Edition, 2007
7. [Raphael Rom](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Raphael+Rom%22), [Moshe Sidi](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Moshe+Sidi%22), “Multiple Access Protocols: Performance and Analysis”Springer New York, 03-Oct-2011
 |

 |
|  |
|  |

 |  |
|  |
|

|  |  |
| --- | --- |
|  **17MTSC202: Information Theory and Coding 3 0 0 3** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

 |
| * **Unit I (9)**
* Mutual information, entropy for discrete ensembles, Shannon's noiseless coding theorem, Encoding of discrete sources.
* **Unit II (9)**
* Markov sources; Shannon's noisy coding theorem and converse for discrete channels
* **Unit III (9)**
* Calculation of channel capacity and bounds for discrete channels, Application to continuous channels. Unit IV
* Techniques of coding and decoding
* Huffman codes and uniquely detectable codes,
* **Unit V (9)**
* Cyclic codes, Convolutional arithmetic codes.
 |
| **Reference Books:** |
| 1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.
5. Shu Lin and D.J. Costello Jr., Error Control Coding, Pearson-Prentice Hall, 2004
 |
|

|  |  |
| --- | --- |
|  **17MTSC203: Image Processing 3 1 0 3** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

 |  |
| **Unit I (9)**Image representation - Gray scale and colour Images, image sampling and quantization.;Two dimensional orthogonal transforms - DFT, FFT, WHT, Haar transform, KLT, DCT.**Unit II (9)**Image enhancement - filters in spatial and frequency domains, histogram-based processing, homomorphic filtering.;Edge detection - non parametric and model based approaches, LOG filters, localisation problem.**Unit III (9)**Image Restoration - PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.**Unit IV (9)**Mathematical morphology - binary morphology, dilation, erosion, opening and closing, duality relations, gray scale morphology, applications such as hit-and-miss transform, thinning and shape decomposition.;Computer tomography - parallel beam projection, Radon transform, and its inverse, Back-projection operator, Fourier-slice theorem, CBP and FBP methods, ART, Fan beam projection.**Unit V (9)**Image communication - JPEG, MPEGs and H.26x standards, packet video, error concealment.;Image texture analysis - co-occurence matrix, measures of textures, statistical models for textures.Misc. topics such as - Hough Transform, boundary detection, chain coding, and segmentation, thresholding methods.**Reference Books:** |
|  |
| 1. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of , 1989.
2. R.M. Haralick, and L.G. Shapiro, Computer and Robot Vision, Vol-1, Addison Wesley, , 1992.
3. R. Jain, R. Kasturi and B.G. Schunck, Machine Vision, McGraw-Hill International Edition, 1995.
4. W. K. Pratt, Digital image processing, Prentice Hall, 1989.
5. A. Rosenfold and A. C. Kak, Digital image processing, Vols. 1 and 2, Prentice Hall, 1986.
6. H. C. Andrew and B. R. Hunt, Digital image restoration, Prentice Hall, 1977
 |
|

|  |  |
| --- | --- |
|  **17MTSC204: Error Correcting Codes 3 0 0 3** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

 |  |
| **Unit I (9)**Linear block codes : Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding   on symmetric channels**Unit II (9)**  Hamming codes; Weight enumerators and the MacWilliams identities; Perfect codes. **Unit III (9)**Introduction to finite fields and finite rings;factorization of (X^n-1) over a finite field; Cyclic Codes.; BCH codes; Idempotents and Mattson-Solomon polynomials; Reed-Solomon codes, Justeen codes, MDS codes, Alterant, Goppa  and generalized  BCH codes.**Unit IV (9)** Spectral properties of cyclic codes. ;Decoding  of  BCH  codes:  Berlekamp's  decoding   algorithm, Massey's  minimum shift register synthesis technique and  its relation  to Berlekamp's algorithm. A fast Berlekamp - Massey algorithm.**Unit V (9)**Convolution codes; Wozencraft's sequential decoding algorithm, Fann's algorithm and   other sequential decoding algorithms; Viterbi decoding algorithm. |
| **Reference Books:** |
| 1. F.J. MacWilliams  and  N.J.A. Slone,  The  theory of error correcting codes, 1977.
2. R.E.  Balahut, Theory and practice of error control codes, Addison Wesley, 1983.
 |
|

|  |  |
| --- | --- |
|  **17MTSC231: Fiber Optic Communication 3 0 0 3** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

 |  |
| **Unit I (9)**Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model. **Unit II (9)**Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR. Optical sources - LEDs and Lasers**Unit III (9)** Photo-detectors - pin-detectors, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power panelities.**Unit IV (9)** Optical switches - coupled mode analysis of directional couplers, electro-optic switches. Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and solition based communication. **Unit V (9)**Optical amplifiers - EDFA, Raman amplifier, and WDM systems.**Reference Books:** |
|  |
| 1. J.Keiser, Fibre Optic Communication McGraw-Hill, 2nd Ed. 1992.
2. J.E. Midwinter, Optical fibers for transmission, John Wiley, 1979.
3. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
4. J.Gowar, Optical communication systems, , 1987.
5. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
6. G.Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
7. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, 1992.
8. J.Keiser, Fibre Optic Communication McGraw-Hill, 4th Edition, 2008
9. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1979
10. J.Gowar, Optical communication systems, Prentice-Hall of India, 1993
11. G.Agrawal, Nonlinear fibre optics, Academic Press, illustrated Edition, Academic Press, 2013

|  |  |
| --- | --- |
|  **17MTSC232: Computer Vision 3 0 0 3** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

|  |
| --- |
|  |

**Unit I (9)**Imaging model and geometry: scene radiance and image irradiance, reflectance model of a surface, Lambertian and specular reflectance, photometric stereo.**Unit II (9)**Ill-posedness of vision problems: regularization theory. Shape from shading, structured light and texture.**Unit III (9)**  Optical flow, structure from motion and recursive motion analysis. Stereo vision and correspondence problem.**Unit IV (9)**Depth analysis using real-aperture camera: depth from defocused images, MRF approach to early vision problems:(shape from shading, matching, stereo and motion) **Unit V (9)**Image texture analysis. Introduction to image understanding. Integrated vision, sensor fusion.

|  |  |
| --- | --- |
|  **17MTSC301:** **Adaptive Signal Processing 3 2 0 4** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

|  |  |
| --- | --- |
|  |  |

 |
|  |
| **Unit I (9)**Review of linear and non-linear estimation theory. Signal modelling. **Unit II (9)**Optimal filtering, Adaptive filtering as an extension of the optimal least mean square error case**Unit III (9)** Adaptive algorithms: adaptive equalization and echo cancellation**Unit IV (9)**Adaptive lattice filters. Application to radar, sonar, geophysics and hydrology**Unit V (9)**Economic processes, communications for spread spectrum techniques |

**Reference Books:**1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986
2. B. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984
3. S. Haykin, Adaptive filter theory, Prentice Hall,1992
4. B. Widrow and S.D. Stearns, Adaptive signal processing, Prentice-Hall, 1985

|  |  |
| --- | --- |
|  **17MTSC302: Machine Learning 3 0 0 4** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

**Unit I (9)**Introduction to machine learning. Classification: nearest neighbor, decision trees, perceptron, support vector machines, VC-dimension. Regression: linear least squares regression, support vector regression. **Unit II (9)**Additional learning problems: multiclass classification, ordinal regression, ranking. Ensemble methods: boosting. Probabilistic models: classification, regression, mixture models (unconditional and conditional), parameter estimation**Unit III (9)** EM algorithm. Beyond IID, directed graphical models: hidden Markov models, Bayesian networks. Beyond IID, undirected graphical models**Unit IV (9)** Markov random fields, conditional random fields. Learning and inference in Bayesian networks and MRFs: parameter estimation, exact inference (variable elimination, belief propagation), approximate inference (loopy belief propagation, sampling)**Unit V (9)**Semi-supervised learning, active learning, structured prediction.**Reference Books:**1. Bishop. C M, Pattern Recognition and Machine Learning. Springer, 2006.
2. Duda, R O, Hart P E and Stork D G. Pattern Classification. Wiley-Interscience, 2nd Edition, 2000.
3. Hastie T, Tibshirani R and Friedman J, The Elements of Statistical Learning: Data Mining, Inference and Prediction. Springer, 2nd Edition, 2009.
4. Mitchell T, Machine Learning. McGraw Hill, 1997.
5. Current literature. Duda, R O, Hart P E and Stork D G. , “Pattern Classification”, John & Wiley sons, INC., 2nd Edition, 2012

6. Hastie T, Tibshirani R and Friedman J, The Elements of Statistical Learning: Data Mining, Inference and Prediction. Springer, illustrated Edition, 2013

|  |  |
| --- | --- |
|  **17MTSC331: Wireless Networks 3 1 0 4** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

|  |
| --- |
| **Unit I (9)**Introduction: Motivation, History, Challenges  Physical Layer: Modulation Techniques, Antenna, Channel Models, Fading Mitigation techniques; Case-study of 802.11a PHY **Unit II (9)**Link Layer: Single-hop MAC protocols (CSMA, TDMA, FDMA, OFDMA etc); Case-study of WiFi and Cellular networks; multi-hop MAC protocols **Unit III (9)**Network Layer: Mobile IP; distributed wireless routing algorithms (AODV, DSDV, DSR, OLSR), Routing metrics **Unit IV (9)**Transport Layer: TCP over wireless, Transport level mobility management, multichip transport protocols **Unit V (9)**Application Layer: Mobile computing platforms (android); energy efficiency of apps Future trends in wireless networks. |
|  |
| **Reference Books:** |
| 1. Wireless Communications and Networks, by W. Stallings, Pearson education publishing, 2nd edition, 2009.
2. Wireless Communications: Principles and Practice by Theodore S. Rappaport, 2nd edition, Pearson, 2010.
3. Wireless Communications, by Andrea Goldsmith, 2010.
4. Recent relevant RFCs, Internet drafts, selected research papers from relevant venues: Mobicom, MobiSys, SIGCOMM, Infocom, IEEE TMC, ACM MC2R.

 5. Wireless Communications and Networks, by W. Stallings, Pearson Education, 2011 |
|

|  |  |
| --- | --- |
|   **17MTSC332: RF and Optical Engineering 3 1 0 4** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

 |

**Unit I (9)**Fundamentals: Transmission lines &wave guiding structures, wave propagation, computational methods; dielectric waveguides**Unit II (9)**Optical fibers, modern antennas. Elements of RF engineering: components, RF System design, millimeter & submillimeter (THz) wave systems, propagation models, applications.**Unit III (9)**Optical Systems: fiber optic components, modulation techniques, system design, propagation effects-loss, dispersion, and non-linearities**Unit IV (9)**Long distance fiber optic links, wireless optical systems. Emerging Topics: metamaterials, photonic bandgap structures, plasmonics, microwave phonotics**Unit V (9)** RF over fiber, opto microwave signal generation; optical signal processing.**Reference Books:**1. Millimeter Wave Wireless Communications by Theodore S. Rappaport, Robert W. Heath Jr., Robert C. Daniels and James N. Murdock,Fiber-Optic Communication Systems , by Govind P. Agrawal

  |

|  |  |
| --- | --- |
|   **17MTSC333: Multimedia Information Systems 3 1 0 4** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

**Unit I (9)**

Multimedia Information, Delay-sensitive and Time-based Media data Modeling, Multimedia storage and retrieval techniques

**Unit II (9)**

 Multimedia Communications: Synchronization, delay compensation

**Unit III (9)**

QoS management and negotiation protocols, Architectures and Issues for Distributed Multimedia Systems

**Unit IV (9)**

Prototype Multimedia systems: Video-on-Demand

**Unit V (9)**

Video conferencing, Wireless Multimedia.

**Reference Books:**

1. P. Venkataram, Design Aspects of Multimedia Information Systems, Pearson Publishers, 2008.
2. W. I. Grosky, R. Jain and R. Mehrotra, The Hand Book of Multimedia Information Management, Prentice-Hall, 1997.
3. J. F. Koegel Buford, Multimedia Systems, Addison-Wesley, 1994.

|  |  |
| --- | --- |
|   **17MTSC334: Fiber-Optics Networks** **3 1 0 4** |  |
|  CA : 40 Marks FE : 60 Marks | No. of Total Lectures = 45 Hours |

**Unit I (9)**

Introduction to Fiber-optic networks; Components for optical networks

**Unit II (9)**

 Broadcast and select networks; Wavelength routing networks

**Unit III (9)**

Virtual topology design; Control and Management

**Unit IV (9)**

Access networks; Deployment considerations; Photonics switching.

**Unit V (9)**

Recent developments in Fiber optics networks

Futuristic issues and applications of Fiber optics network.

**References:**

1. R. Ramaswami and K. N. Sivarajan, Optical Networks: A practical Perspective, (2nd Ed), Morgan Kufmann Publishers 2002.
2. S. V. Kattalopoulos, Introduction to DWDM Technology, IEEE Press, 2000
3. Current literature: special issues of journals and review articles