M.Tech Communication Systems Engineering Syllabus

(2020-22)

Department of Electronics and Communication Engineering, Sambalpur University Institute of Information Technology, Burla, Odisha,

Pin: 768019

M.Tech Communication Systems Engineering Syllabus

(2020-22)

SEMESTER-I

S. No	Course Codes	Subject	Credits	Subject Category
1.	CSY611	Advance Communication Theory	4	ECE
2.	CSY612	Advance Digital Signal Processing	4	ECE
3.		Program Elective-I	4	PE
4.		Program Elective-II	4	PE
5.		Program Elective-III	4	PE
6.	CSY613	Advance Communication Lab	2	ECE
7.	CSY614	Advance Digital Signal Processing Lab	2	ECE
		TOTAL	**24**	

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SEMESTER-II				
Code	**Course Codes**	**Subject**	**Credits**	**Subject Category**
1.	CSY621	Secure communication	4	ECE
2.	CSY622	Advance Wireless Communication	4	ECE
3.		Program Elective-IV	4	PE
4.		Program Elective-V	4	PE
5.		Program Elective-VI	4	PE
6.	CSY623	Advance Wireless Communication Lab	2	ECE
7.		Program Elective Lab-I	2	PE
		TOTAL	**24**	

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SEMESTER-III				
S. No	**Course Codes**	**Subject**	**Credits**	**Subject Category**
1.	CSY631	Masters Research Project(Phase-I)	20	ECE
		TOTAL	**20**	

Semester-IV				
S. No	**Course Code**	**Subject**	**Credits**	**Subject Category**
1.	CSY641	Masters Research Project (Phase-II)	20	ECE
2.	CSY642	Comprehensive Viva	4	ECE
		TOTAL	**24**	

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I	II	III	IV	TOTAL
24	24	20	24	92

List of Electives(Credit 4)

1. Mobile satellite communication (CSY6E01)
2. Detection and Estimation (CSY6E02)
3. Random processes and queueing theory (CSY6E03)
4. Wireless networks and mobile computing (CSY6E04)
5. RF MEMS (CSY6E05)
6. Integrated Opto-Electronics(CSY6E06)
7. Wireless sensor Network (CSY6E07)
8. Advanced Techniques for Wireless Reception(CSY6E08)
9. Probability and Stochastic Processes (CSY6E09)
10. Communication Switching & Multiplexing(CSY6E10)
11. Signal Compression (CSY6E11)
12. Application Specific Integrated Circuits(CSY6E12)
13. Error Control Coding (CSY6E13)
14. Digital Image Processing (CSY6E14)
15. Digital Speech Processing (CSY6E15)

16. CAD VLSI (CSY6E16)
17. Adaptive Signal Processing(CSY6E17)
18. Internet of Things (CSY6E18)
19. RF and Microwave system (CSY6E19)
20. Optical communication Systems(CSY6E20)
21. Optical Network(CSY6E21)
22. Digital Mobile system(CSY6E22)
23. Analog VLSI Design(CSY6E23)

List of Elective Lab (Credit-2)

1. Optical communication Lab(CSY6EL01)
2. Communication Design and simulation Lab (CSY6EL02)
3. Free Space optical communication lab(CSY6EL03)
4. Simulation techniques for wireless communication lab(CSY6EL04)
5. Antenna design lab(CSY6EL05)
6. Wireless channel modelling lab((CSY6EL06)
7. Embedded system Lab(CSY6EL07)
8. VLSI Lab(CSY6EL08)
9. Statistical simulation lab(CSY6EL09)
10. HFSS lab(CSY6EL10)
11. Internet of things(IOT) Lab(CSY6EL11)
12. Adaptive Signal Processing Lab (CSY6EL12)

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N.B-

- **A student will be eligible to get M. Tech. degree only if he/she completes the course work including the MOOCs courses recommended by the department.**
- **The students can register for these courses through SWAYAM (Govt. of India) directly as per the courses offering in Odd/Even Semesters by them.**
- **SWAYAM will charges minimal fee per course and awards a certificate of completion. Students need to register for the course on payment of their own and submit the certificate to the institute.**
- **For registration to MOOCs, the students shall abide by the norms and policies proposed by SWAYAM.**
- For Masters Research Project, students shall choose a topic from the latest technological developments / research in Communication Systems Engineering or in allied fields in consultation with the faculty. They shall submit a thesis for the presentation in an approved format on the day of presentation.
- Project work and Comprehensive Viva-Voce shall be as per Academic & Examination Guidelines of SUIIT.

Programme Outcome

PO1	**Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions**
PO2	**Effective Communication: Will be able to speak, read, write and listen clearly in person and through electronic media in English and in one Indian language**
PO3	**Social Interaction (Interpersonal Relation): Elicit views of others, mediate disagreements and prepared to work in team.**
PO4	**Entrepreneurship capability: Demonstrate qualities to be prepared to become an entrepreneurship**
PO5	**Ethics: Recognize different value systems including your own, understand the moral dimension, and accept responsibility for them.**
PO6	**Environment and Sustainability: Understand the issues of environmental contexts and sustainable development**
PO7	**Life Long Learning: Acquire the ability to engage in independent and life long learning in the context of socio technological changes**

ADVANCE DIGITAL SIGNAL PROCESSING

Credit:4 L-T-P: 3-1-0 Course Code:CSY612

Prerequisite: Basics of digital signal processing and statistics.

Objective: To help the students to understand and solve complex problems in power spectrum estimations and signal processing. Also, to have an idea about adaptive filters to deal with the effects of channel on random signals.

CO-1	Remember and understand the basic concepts/ Principles of Advance Digital Signal Processing
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours) Review of sampling theory. Sampling rate conversion by integer and rational factors. Efficient realization and applications of sampling rate conversion. Wiener filtering. Optimum linear prediction. Levinson- Durbin algorithm. Prediction error filters.

Module 2 (12 hours) Adaptive filters. FIR adaptive LMS algorithm. Convergence of adaptive algorithms. Fast Algorithms. Applications; Noise canceller, echo canceller and equalizer.

Module 3 (12hours) Recursive least–squares algorithms. Matrix inversion lemma. Convergence analysis of the RLS algorithm. Adaptive beam forming. Kalman filtering.

Module 4 (12 hours) Spectrum estimation. Estimation of autocorrelation. Periodogram method. Nonparametric methods. Parametric methods.

Text Books: 1. J.G.Proakis et al, Advanced Digital Signal Processing, McGraw –Hill, 1992
2. S.Haykin, Adaptive Filter Theory (3/e), Prentice- Hall, 1996

Reference Books:

1. D.G.Manolakis et al, Statistical and Adaptive Signal Processing, McGraw-Hill, 2005

2. Marple, Spectral Analysis, 3. M.H.Hays, Statistical Digital Signal Processing and Modelling, John-Wiley.

ADVANCE COMMUNICATION THEORY

Credit: 4 L-T-P: 3-1-0 Course Code: CSY611

Prerequisite: Basics of digital communication and statistics.

Objective: To learn various digital modulations, equalization and synchronization techniques of the digital communication systems.

CO-1	Remember and understand the basic concepts/ Principles of Advance Communication Theory
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours)

Random Variables and Processes Review of Random variable: Markov's Inequality, Chebyshev's inequality, Rayleigh and Rician distributions, Correlation, Covariance matrix- Stationary processes, strict sense stationary processes, wide sense Stationary processes, ergodic process, cross correlation and autocorrelation functions- Gaussian process- 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.

Module 2 (12 hours)

Optimum Waveform and Vector 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. Implementation of Optimum waveform receiver in additive white Gaussian noise (AWGN) channels - Cross Correlation receiver, Matched filter receiver and error probabilities. Optimum waveform receiver for colored (non-white) Gaussian noise channels, whitening. Karhunen Loeve expansion approach.

Module 3 (12 hours)

Synchronization in Communication Systems, Carrier Recovery and Symbol Synchronization in Signal Demodulation- Carrier Phase Estimation- Effect of additive Noise on the phase estimate- Maximum Likelihood phase estimation, Symbol Timing Estimation- Maximum Likelihood timing estimation- Receiver structure with phase and Timing recovery-Joint Estimation of Carrier phase and

Symbol Timing- Frequency offset Estimation and tracking.

Module 4 (12 hours)

Communication over Band limited Channels - Communication over band limited Channels- Optimum pulse shaping- Nyquist criterion for zero ISI, partial response Signalling- Equalization Techniques- Zero forcing linear Equalization- Decision Feedback equalization- Adaptive Equalization.

Text Book: 1. J.G. Proakis, ―Digital Communication, MGH 4TH edition, 1995.
Reference Books:
1. Edward. A. Lee and David. G. Messerschmitt, ―Digital Communication, Allied Publishers (second edition).
2. J Marvin.K.Simon, Sami. M. Hinedi and William. C. Lindsey, ―Digital Communication Techniques, PHI.
3. William Feller, ―An introduction to Probability Theory and its applications, Vol 11, Wiley 2000.
4. Sheldon.M.Ross, -Introduction to Probability Models, Academic Press, 7th EDN.

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SECURE COMMUNICATION

Credit:4 L-T-P: 3-1-0 Course Code: CSY621

Prerequisite: A fundamental study on Digital communication and data transmission are needed prior to the course.

Objective: The objective of the course is to learn the basics of digital communication system using source coding and error control.

CO-1	Remember and understand the basic concepts/ Principles of Secure Communication
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

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Module 1 (12 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 (12 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 (12 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 (12 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

Text Books:

1. Douglas A. Stinson, ―Cryptography, Theory and Practice‖, 2nd edition, Chapman & Hall, CRC Press Company, Washington

2. William Stallings, ―Cryptography and Network Security‖, 3rd edition, Pearson Education

Reference Books:

1. Lawrence C. Washington, ―Elliptic Curves‖, Chapman & Hall, CRC Press Company, Washington.

2. David S. Dummit, Richard M. Foote, ―Abstract Algebra‖, John Wiley & Sons

3. Evangelos Kranakis, ―Primality and Cryptography‖, John Wiley & Sons

4. Rainer A. Ruppel, ―Analysis and Design

Advanced wireless communications

Credit:4 L-T-P: 3-1-0 Course Code: CSY622

Prerequisite: Basics of analog and digital communication and antenna fundamentals.

Objective: To impart the new concepts in wireless communications.

CO-1	Remember and understand the basic concepts/ Principles of Advanced Wireless Communications

CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module-I: (12 Hours)

Overview & Classification of wireless Communication Systems. wireless Communication Channel. Modeling of Propagation Loss. Diversity reception. Cellular System Concepts. Ways of increasing system capacity. Introduction to 1G,2G,3G,4G and 5G cellular systems.

Module-II: (12 Hours)

GSM Cellular Telephony. GSM Architecture. Radio Transmission Parameters of GSM. GSM Logical Channels. GSM Burst Structures. Call setup Procedures & Handover in GSM System. Data Transmission in GSM. HSCSD, GPRS, EDGE. CDMA in Mobile Communication Systems. Spreading Sequences. Basic Transmitter & Receiver Schemes in CDMA Systems.

Module- III: (12 Hours)

Equalization, Diversity techniques, Multiple accesses, FDMA, TDMA, CDMA, FHMA and introduction to OFDM.

Module-IV: (12Hours)

Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain –data transmission using multiple carriers, multicarrier modulation with overlapping sub channels-mitigation of subcarrier fading, Beamforming.

Application of Smart Antennas in Cellular Telephony. Satellite Mobile Communication Systems.

TEXT BOOKS:

1. Wireless Communication, Upena Dalal, Oxford Higher Education.

2. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005

3. Mobile Communication , Jochen Schiller, Institute of Informatics, Freuie ,Universitat Berlin, 2nd edition, Pearson

ADVANCE DIGITAL SIGNAL PROCESSING LABORATORY

Credit:2 L-T-P: 0-0-3 Course Code: CSY614

Prerequisite: Basics of digital signal processing and advanced digital signal processing.

Objective: To help the students to do MATLAB programming for processing discrete signals, to do frequency domain analysis of the signal and use simulink model of adaptive filters for practical applications.

CO-1	Remember and understand the basic concepts/ Principles of Advance Digital Signal Processing Laboratory
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1. Basic Operations on Signals, Generation of Various Signals and finding its FFT.

2. Program to verify Decimation and Interpolation of a given Sequences.

3. Program to Convert CD data into DVD data

4. Generation of Dual Tone Multiple Frequency (DTMF) Signals

5. Plot the Periodogram of a Noisy Signal and estimate PSD using Periodogram and Modified Periodogram methods

6. Estimation of Power Spectrum using Bartlett and Welch methods

7. Verification of Autocorrelation Theorem

8. Parametric methods (Yule-Walker and Burg) of Power Spectrum Estimation

9. Estimation of data series using Nth order Forward Predictor and comparing to the Original Signal 10. Design of LPC filter using Levinson-Durbin Algorithm

11. Computation of Reflection Coefficients using Schur Algorithm

12. To study Finite Length Effects using Simulink

13. Design and verification of Matched filter

14. Adaptive Noise Cancellation using Simulink

15. Design and Simulation of Notch Filter to remove 60Hz Hum/any unwanted frequency Component of given Signal (Speech/ECG

16. Familiarity with Digital Signal Processing Kits (DSK) - TMS 320C3x and TMS320C67x, generation of different types of signals - sine, square and noise using the DSK, study of aliasing effects.

ADVANCE COMMUNICATION LABORATORY

Credit:2 L-T-P: 0-0-3 Course Code: CSY613

CO-1	Remember and understand the basic concepts/ Principles of Advance Communication Laboratory
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1. Generation of Random variable using Uniform Distribution.

2.Generation of Random variable using Gaussian distribution.

3. Generation of Random variable using Rayleigh Distribution.

4. Generation of Random variable using Rician Distribution.

5.Design of a PCM encoder & decoder.

6. Design of a DM encoder & decoder

7. Design of ADM encoder & decoder.

8. Study of digital matched filter properties

9. Implementation of symbol clock recovery circuit

10. Design of a FSK modulation & demodulation, compute BER

11.Design of a PSK modulation & demodulation, compute BER

12. Design of a QPSK modulation & demodulation, compute BER

13. Design of a MSK modulation & demodulation, compute BER

14. Design of a QPSK modulation & demodulation, compute BER

15. Plot the constellation diagram of a digital modulation system using MATLAB.

16.To simulate a digital communication system with Rayleigh fading channel using MATLAB and compute its BER.

17. To simulate a digital communication system with Rician fading channel using MATLAB and compute its BER.

18. To implement the following equalizer

A. Linear Equaliser

B. Decision Feedback Equaliser(DFE)

C. Maximum Likelihood Sequence Estimation (MLSE) Equaliser.

List of Electives

MOBILE SATELLITE COMMUNICATION

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E01

Prerequisite: A brief study on basic communication system is needed.

Objective: The objective of the course is to provide a complete knowledge of satellite system, orbital mechanism, and the communication over the satellite communication.

CO-1	Remember and understand the basic concepts/ Principles of Mobile Satellite Communication

CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours)

Introduction to Satellite Communication: Satellite Orbits – Satellite Constellations – Orbital Mechanics –Equation of orbit – Orbital Elements – Look angle determination – Orbital perturbation – Satellite coverage –Space environment – Eclipse – Sun Transit outage – Limits of visibility – sub satellite point – launching procedures and Launch Vehicles.

Module 2 (12 hours)

Radio link and satellite access: Spectrum issues – Propagation characteristics and frequency considerations– Radio link analysis – Modulation – coding and multiple access schemes and comparison of multiple access schemes. Spacecraft Technology: Satellite subsystems – Satellite for MSS, Intersatellite links – Emerging Technologies – Launching Satellite constellation- Gateways – Mobile Terminals – Environmental issues.

Module 3 (12 hours)

System architecture: System planning – Service Distribution model – Investment Routes – Regulatory issues– Traffic Forecast – Air interface –system development – network considerations and network management – Licensing issues.

Module 4 (12 hours)

Satellite system & services: Representative MSS system – Distress and Safety Systems navigation systems – Direct Satellite broadcast – Direct TV Broadcast system – Very Small Aperture Terminal systems- Terrestrial Cellular system – Future Trends – Broadband systems – ATM over Satellite – Role of Satellite in Feature Networks.

Text books:

1. M.Richharia, ―Mobile Satellite Communications-Principles & Trends‖, Pearson Education, 2003

2. T.Pratt and Bostian, ―Satellite Communications‖, John Wiley, 2001.

3. W.L.Prichand and A.Sciulli, ―Satellite Communication systems Engineering‖, Prentice Hall, 1986

4. Tri.T.Ha, ―Digital Satellite Communication Systems Engineering‖, McGraw Hill, 1998

DETECTION AND ESTIMATION

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E02

Prerequisite: A brief study on signal system, and Digital Signal Processing is needed.
Objective: The objective of the course is to Learn the different methods of estimation of random signals.

CO-1	Remember and understand the basic concepts/ Principles of Detection and Estimation
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours)

Binary hypothesis testing; Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing. Signal detection in discrete time: Models and detector structures. Coherent detection in independent noise. Detection in Gaussian noise. Detection of signals with random parameters. Detection of stochastic signals. Performance evaluation of signal detection procedures.

Module 2 (12hours)

Bayesian parameter estimation; MMSE, MMAE and MAP estimates. Nonrandom parameter estimation. Exponential families. Completeness theorem. ML estimation. Information inequality. Asymptotic properties of MLEs.

Module 3 (12 hours)

Discrete time Kalman- Bucy filter. Linear estimation. Orthogonality principle. Wiener-Kolmogorov filtering – causal and noncausal filters.

Module 4 (12hours)

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

Text Books:

1. H.V.Poor, an Introduction to Signal Detection and Estimation (2/e) Springer, 1994. 2. H.L.Vantrees, Detection, Estimation and Modulation theory, Part I, Wiley.

Reference Books:

1. M.D.Srinath & P.K.Rajasekaran, Statistical Signal Processing with Applications, Wiley. 2. J.C.Hancock & P.A. Wintz, Signal Detection Theory, Mc-Graw Hill.

RANDOM PROCESSES AND QUEUEING THEORY

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E03

Prerequisite: A brief study on Probability theory and Digital Signal Processing is needed.
Objective: The objective of the course is to teach the discrete random processes and the estimation of the signals.

CO-1	Remember and understand the basic concepts/ Principles of Random Processes and Queuing Theory
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours)

Discrete Random Variables Random Variables and their event spaces – The probability mass function- Distribution functions – Special discrete distributions (Bernoulli, Binomial and Geometric, Negative Binomial, Poisson, Hypergeometric, Discrete Uniform, Constant, Indicator) – Probability Generating function. Continuous Random Variables The Exponential distribution – The Reliability, Failure density and Hazard function – Some important distributions (Hypoexponential, Erlang, Gamma, Hyperexponential, Weibull, Gaussian, Uniform and Pareto distributions)

Module 2 (12 hours)

Stochastic Processes Definition, Classification of Stochastic Processes - Strictly Stationary Process, Wide Sense Stationary, Independent Process, Renewal Processes – Availability analysis, Bernoullli process – Poisson process – Renewal processes – Availability analysis.

Module 3 (12 hours)

Discrete Parameter Markov Chains Introduction, Computation of n-step transition probabilities – Chapman-Kolmogorov equation – State classification and limiting Probabilities – M/G/I queueing system, Pollaczek-Khinchine transform equation.

Module 4 (12 hours)

Continuous Parameter Markov Chains The Birth and Death process (M/M/1, M/M/C, M/M/1/N, M/M/C/N (N>C), M/M/C/C, M/M/∞ models only, derivation of Mean number of customer in the system, in the queue and Waiting time – Simple applications) – Special case of Birth and Death model (Pure Birth and Pure Death Processes)

Text Book:

1. Kishor S.Trivedi, Probability and Statistics with Reliablity, Queueing and Computer Science Applications, second Edition, 2002, John Wiley & Sons, Inc.

Reference Books:

1. J.Medhi, Stochastic Processes, New Age International (P) Ltd., Second Edition, 1994.

2. D.Gross and C.M.Harris, Fundamentals of Queueing Theory, Third Edition, Wiley Students Edition.

WIRELESS NETWORKS AND MOBILE COMPUTING

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E04

Prerequisite: A brief study on data communication, wireless and mobile communication is needed.

Objective: Students taking this course will understand the mobile technologies used in wireless communication and may able to design the mobile interactivity.

CO-1	Remember and understand the basic concepts/ Principles of Wireless Networks and Mobile Computing
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours)

Introduction Introduction to wireless networks and mobile computing-Challenges of mobile computing-Mobile channel characteristics-Folding and shadowing communication issuesReview of cellular schemes, model and methodology. Medium Access Control Hidden /Exposed terminals-Near / Far terminals-SDMA, FDMA, TDMA and CDMA.

Module 2 (12 hours)

Wireless LANS: Infrared radio transmission, infrastructure Vs Ad hoc Networks, IEEE 802.11: Architecture. MAC layer- Synchronization, power management, roaming-IEEE 802.11b, 802.11a, new developments. Blue tooth overview. Mobile IP Overview, network elements, packet delivery agent discovery, registration - Tunnelling 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 (12 hours)

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)

Wireless Security Public key infrastructure and certification authorities- wireless public key infrastructure- Characteristics of SIM - Security protocols- Authentication.

Text Book:

1. "Mobile Communication", John Schiller, Addison Wesley-2003.

Reference Books:

1. "Principles of Wireless Networks - A Unified Approach ",K.Pahlvanand P.Krishnamurthy‖, Pearson Education, 2004.

2. "Introduction to Wireless and Mobile Systems", D.P.Agarwal and Qing.An Zeng, Thamson- Brooks.cole, 2003.

3. "Wireless Network Evolution: 2G to 3G", V.K.Garg - Prentice Hall, 2002.

4. "Mobile and Wireless Networks",V.Blook - Prentice Hall , 1996.

5. "Mobile IP Design-Principles and practice",C.E.Perkins - Addison Wesley ,1998.

6. "Ad Hoc Wireless Networks- Architectures and Protocols", Siva Ram Murthy and B.S.Manoj Prentice Hall, 2004.

7. "Wireless Personal Communication Systems", DJ.Goodman-Addisson Wesley, 1997.

RF MEMS

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E05

CO-1	Remember and understand the basic concepts/ Principles of RF MEMS
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours)

RF MEMS relays and switches. Switch parameters. Actuation mechanisms. Bistable relays and micro actuators. Dynamics of switching operation.

Module 2 (12 hours)

MEMS inductors and capacitors. Micromachined inductor. Effect of inductor layout. Modeling and design issues of planar inductor. Gap tuning and area tuning capacitors. Dielectric tunable capacitors.

Module 3 (12 hours)

Micromachined RF filters. Modeling of mechanical filters. Electrostatic comb drive. Micromechanical filters using comb drives. Electrostatic coupled beam structures. MEMS phase shifters. Types. Limitations. Switched delay lines. Micromachined transmission lines. Coplanar lines. Micromachined directional coupler and mixer.

Module 4 (12 hours)

Micromachined antennas. Microstrip antennas – design parameters. Micromachining to improve performance. Reconfigurable antennas.

Text Books:

1. H.J.D.Santos, RF MEMS Circuit Design for Wireless Communications, Artech House, 2002. 2. G.M.Rebeiz , RF MEMS Theory , Design and Technology, wiley , 2003.

Reference Books:

1. V.K.Varadan etal, RF MEMS and their Applications, Wiley, 2003

INTEGRATED OPTOELECTRONICS

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E06

Prerequisite: Conventional electronic elements and devices like modulators, detectors, couplers, switches etc. The basic idea of waveguides and different modes propagation is also required.

Objective: To teach the students about advanced materials for opto-electronics including the dielectric thin films, techniques for the fabrications, application in opto-electronic devices and some optical ICs.

CO-1	Remember and understand the basic concepts/ Principles of Integrated Optoelectronics
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in

	the course

Module-1 (12 hours)

Opto-electronic materials: Growth and characterization of III-V and II-VI semiconductor materials required for optoelectronic devices for visible and IR range. Ternary and quaternary semiconductors.

Module-2 (12 hours)

Theory of Optical Waveguides: Planar waveguides, basic three layer planar waveguide, the symmetric waveguide, asymmetric waveguide, anisotropic and gyrotropic rectangular waveguides, channel waveguides, strip loaded Waveguides and coupled mode theory.

Module-3 (12 hours)

Integrated Circuits: Waveguide modulators, detectors, wave-guiding lasers, prism, lens, polarizers, couplers, waveguide fabrication. Electronics effect and devices, magnetoopic effect and devices and Acousto-optic effect and devices, Non-linear optical components, integrated optic memories.

Module-4 (12 hours)

Optical A/D, and D/A converters, semiconductor quantum well structures. Quantum wires and dots Heterostructure super-lattice, photon switching.

Reference Books:

1. Fundamental of Photonics by Bahaa E A Saleh, Mavin Carl Teich, 1ST edition, 1991

2. Integrated Optics: Theory & Technology" By R. G. Hunsperger, Springer Section of -1

WIRELESS SENSOR NETWORK

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E07

Prerequisite: Basics knowledge of Mobile computing.
Objective: Students will be able to Design principles and technique appropriate to wireless sensor network systems.

CO-1	Remember and understand the basic concepts/ Principles of Wireless Sensor Network

CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

UNIT – I: (12 hours)

Networked wireless sensor devices, Applications, Key design challenges. Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, and Mobile deployment.

UNIT – II: (12 hours)

Localization: issues & approaches, Coarse-grained & Fine-grained node localization, Network-wide localization, Theoretical analysis of localization techniques. Synchronization: Issues & Traditional approaches, Fine-grained clock synchronization, and Coarse-grained data synchronization.

UNIT – III: (12 hours)

Wireless characteristics: Basics, Wireless link quality, Radio energy considerations, SINR capture model for interference. Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols. Sleep-based topology control: Constructing topologies for connectivity, constructing topologies for coverage

UNIT – IV: (12 hours)

Routing: Metric-based approaches, Routing with diversity, Multi-path routing, Lifetimemaximizing energy-aware routing techniques, Geographic routing, Routing to mobile sinks. Data-centric networking: Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval, The database perspective on sensor networks.

Introduction to Tiny OS, NesC, Sensor Simulator,

Refrence Books:

1. Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, Taieb Znati, Wiley Inter Science.

2. Wireless Sensor Networks: Architectures and Protocols: Edgar H. Callaway, Jr. Auerbach Publications, CRC Press.

3. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, Taieb Znati , Springer.

4. Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press

5. Distributed Sensor Networks: A Multiagent Perspective, Victor Lesser, Charles L. Ortiz, and Milind Tambe , Kluwer Publications.

6. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.

ADVANCED TECHNIQUES FOR WIRELESS RECEPTION

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E08

Prerequisite: Basics of wireless communication and digital modulation.
Objective: To help the students to understand the advanced techniques used at the receiver side to process the signal to extract the desired information.

CO-1	Remember and understand the basic concepts/ Principles of Advanced Techniques for Wireless Reception
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours)

Wireless signaling environment. Basic signal processing for wireless reception. Linear receivers for synchronous CDMA. Blind and group-blind multiuser detection methods. Performance issues.

Module 2 (12 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 (12 hours)

Turbo multiuser detection for synchronous and turbo coded CDMA. Narrowband interface suppression. Linear and nonlinear predictive techniques. Codeaided techniques. Performance comparison.

Module 4 (12 hours)

Signal Processing for wireless reception: Bayesian and sequential Montecarlo signal processing. Blind adaptive equalization of MIMO channels .Signal processing for fading channels. Coherent detection based on the EM algorithm. Decision-feedback differential detection. Signal processing for coded OFDM systems.

Text Books:

1. X.Wang & H.V.Poor, Wireless Communication Systems, Pearson, 2004. 2. R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001.

Reference Books:

1. Mohamed Ibnkahla, Signal Processing for Mobile Communications, CRC Press, 2005.

2. A.V.H. Sheikh, Wireless Communications Theory & Techniques, Kluwer Academic Publications, 2004. 1. A.Paulraj etal, Introduction

PROBABILITY AND STOCHASTIC PROCESS

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E09

CO-1	Remember and understand the basic concepts/ Principles of Probability and Stochastic Process
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

COMMUNICATION SWITCHING & MULTIPLEXING

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E10

Prerequisite: A fundamental study on digital baseband communication, switching network is needed before learning this subject.

Objective: The objective of the course is to learn about data formatting, network establishment and the data transmission over the computer communication network.

CO-1	Remember and understand the basic concepts/ Principles of Communication Switching & Multiplexing
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours)

Switching: Performance and architectural issues: Packet switches- Circuit switches. Time and Space division switching - Point to point circuit switching – multistage switching network - Paull's matrix for representing connections - Strict sense no blocking Clos network. Generalized circuit switching- Cross Point Complexity (CPC) - Fast packet switching- Self routing Banyan networks- Combinatorial limitations of Banyan networks.

Module 2 (12hours)

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. Blocking probability: Analysis of single stage and multistage networks –Blocking for Unique path routing- Alternate path routing- The Lee approximation – The Jacobaeus method.

Module 3 (12 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 (12 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.

Reference Books:

1. A. Kumar, D. Manjunath, J. Kuri, Communication Networking: An Analytical Approach, MorganKaufman Publishers, 2004

. 2.Hui, J.Y., Switching and Traffic Theory for Integrated Broadband Networks, Kluwer

SIGNAL COMPRESSION

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E11

CO-1	Remember and understand the basic concepts/ Principles of Signal Compression
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 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 quanitizers.Evaluation techniques-error analysis and methodologies

Module 2 (12 hours)

Compact techniques-Huffmann coding-arithmetic coding-Shannon-Fano coding and dictionary techniques-LZW family algorithms. Entropy measures of performance-Quality measures. 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-Vocoders Predictive techniques-PCM, DPCM, DM.

Module 3 (12 hours)

Contour based compressionadtrees,EPIC,SPIHT,Transformcoding,JPEG,JPEG- 2000, JBIG Video signal representation, Video compression techniques-MPEG, Motion estimation techniques-

Module 4 (12 hours)

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

References:S:

1. Mark Nelson,Dta compression book,BPB Publishers,New Delhi,1998

2. Sayood Khaleed,Introduction to data compression,Morgan Kauffman,London,1995

3. Watkinson,J.Compression in video and audio,Focal press,London.1995

4. Jan Vozer,Video compression for multimedia,AP profes,NewYork,1995

ERROR CONTROL CODING

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E13

Prerequisite: A fundamental study on basic data communication and error control are needed.

Objective: The objective of the course is to learn different source coding and encryption technologies for secure data communication.

CO-1	Remember and understand the basic concepts/ Principles of Error Control Coding

CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours)

Finite Field Arithmetic (9 hours) Introduction, Groups- Rings- Fields- Arithmetic of Galois Field- Integer Ring- Polynomial Rings-Polynomials and Euclidean algorithm, primitive elements, Construction and basic properties of Finite Fields-Computations using Galois Field arithmetic- sub fields- Minimal polynomial and conjugates- Vector space-Vector Subspace-Linear independence.

Module 2 (12 hours)

Linear Block Codes (13 hours) Linear Block codes- Properties- Minimum Distance- Error detection and correction- Standard Array and Syndrome decoding- Hamming codes- Perfect and Quasi-perfect codes- Extended codes- Hadamard codes.

Module 3 (12 hours)

Cyclic Codes Basic theory of Cyclic codes- Generator and Parity check matrices - Cyclic encoders- Error detection & correction- decoding of cyclic codes- Cyclic Hamming codes-Binary Golay codes- BCH codes- Decoding of BCH codes-The Berlekamp- Massey decoding algorithm. Reed Solomon codes- Generalized Reed Solomon codes- MDS codes.

Module 4(12 hours)

Convolutional Codes) Generator matrices and encoding- state, tree and trellis diagram-Transfer function -- Maximum Likelihood decoding Hard versus Soft decision decoding- The Viterbi Algorithm- Free distance- Catastrophic encoders. Soft Decision and Iterative Decoding Soft decision Viterbi algorithm- Two way APP decoding- Low density parity check codes- Turbo codes- Turbo decoding

Reference Books:

1. R.E. Blahut, ―Theory and Practice of Error Control Coding‖, MGH 1983.

2. W.C. Huffman and Vera Pless, ―Fundamentals of Error correcting codes‖, Cambridge University Press, 2003. 3. Shu Lin and Daniel. J. Costello Jr., ―Error Control Coding: Fundamentals and applications‖, Prentice Hall Inc, 1983.

DIGITAL IMAGE PROCESSING

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E14

Prerequisite: A fundamental study on matrix convention, probability theory and statistical principles are needed to be learned.

Objective: The objective of the course is to understand a digital image and different processing techniques for the better analysis of an image.

CO-1	Remember and understand the basic concepts/ Principles of Digital Image Processing
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

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UNIT – I: DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS(12 hours)

Elements of visual perception: Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Image sampling and quantization Basic relationship between pixels: Basic geometric transformations-Introduction to Fourier Transform and DFT : Properties of 2D Fourier Transform , FFT, Separable Image Transforms ,Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.Perspective Projection, Spatial Domain Filtering, sampling and quantization.

UNIT – II: IMAGE ENHANCEMENT TECHNIQUES(12 hours) Spatial Domain methods: Basic grey level transformation, Histogram equalization, Image subtraction, Image averaging, Spatial filtering: Smoothing, sharpening filters,Laplacian filters, Frequency domain filters : Smoothing, Sharpening filters,Homomorphic filtering.

UNIT – III: IMAGE RESTORATIONAND IMAGE COMPRESSION(12 hours) Model of Image Degradation/restoration process: Noise models, Inverse filtering, Least mean square filtering, Constrained least mean square filtering, Blind image restoration, Pseudo inverse, Singular value decomposition.

Lossless compression: Variable length coding: LZW coding, Bit plane coding- predictive coding, DPCM. Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG, Basics of Vector quantization

UNIT – IV: IMAGE SEGMENTATION AND REPRESENTATION (12 hours) Edge detection: Thresholding, Region Based segmentation, Boundary representation: chair codes, Polygonal approximation, Boundary segments: boundary descriptors: Simple descriptors, Fourier descriptors, Regional descriptors, Simple descriptors, Texture

TOTAL: 41 Hours

TEXT BOOKS:

1. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education.

REFERENCE BOOKS:

1. Fundamentals of Digital Image Processing, By Anil K Jain

2. Digital Image Processing, By William K Pratt, John Willey (2001)

3. Image Processing Analysis and Machine Vision, By MillmanSonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniy (1999).

4. Digital Image Processing and Applications, By, B. Chanda, D. DuttaMagundar, Prentice Hall of India, 2000.

RF & MICROWAVE SYSTEM

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E19

Pre-requisite: Signals and system, Basic and analog electronics, Basics of communication, Electromagnetic theory.

CO-1	Remember and understand the basic concepts/ Principles of RF & Microwave System
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in

	the course

Module 1 (12 hours)

Introduction to microwave circuit concepts, Microwave network analysis : Impedance and Equivalent Voltages and Currents, Impedance and Admittance Matrices, Relation between [s], [z], [y] parameter, Signal Flow Graphs, Impedance matching, Lumped & Distributed Elements

Module 2 (12 hours)

Active RF and Microwave devices : Diodes and Diode Circuits, Microwave Transistor, Tunnel Diode, Microwave Field Effect Transistor, Transferred Electron Devices, Avalanche Transit Time Devices

Module 3 (12 hours)

Unilateral and non-unilateral design - One stage and multistage design - Lownoise Amplifiers - High-power amplifiers - Balanced amplifiers - Feedback - Design examples - Small-signal distributed amplifiers. Resonators – Dielectric resonators – YIG resonators – Varactor resonators – Resonator Measurements – Two-port oscillator design – Noise Lesson's oscillator model – Low noise Design.

Module 4 (12 hours)

Integrated microwave workstation approach - Non-linear tools - Field drivers design - Designing non-linear circuits using the harmonic balanced method programmable Microwave tuning system - Introduction to MMIC considering layout effects - Microwave integrated circuit components.

Reference Books:

1. Microwave Engineering by David. M. Pozar, Fourth Edition, JohnWiley & Sons, Inc.
2. Microwave Devices & Circuits, By S Y Liao, Third Edition, Pearson
3. Microwave circuits design using linear and non-linear techniques by George. D. Vandelin, Anthony M. Pavio and Ulrich L. Rohde, John Wiley and sons 1990.

OPTICAL COMMUNICATION SYSTEMS

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E20

CO-1	Remember and understand the basic concepts/ Principles of Optical Communication Systems
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

UNIT –I: (12 hours)

Signal propagation in Optical Fibers: Geometrical Optics approach and Wave Theory approach, Loss and Bandwidth, Chromatic Dispersion, Non Linear effects- Stimulated Brillouin and Stimulated Raman Scattering, Propagation in a Non-Linear Medium, Self Phase Modulation and Cross Phase Modulation, Four Wave Mixing, Principle of Solitons.

UNIT –II: (12 hours)

Fiber Optic Components for Communication: Couplers, Isolators, Circulators, Multiplexers, Bragg Gratings, Arrayed Waveguide Grating, Fabry-Perot Filters, Mach Zehnder Interferometers, Tunable Filters, Optical Amplifiers, SOA, EDFA, Raman Amplifiers.

UNIT –III: (12 hours)

Modulation and Demodulation: Signal formats for Modulation, Subcarrier Modulation and Multiplexing, Optical Modulations – Duo binary, Single Side Band and Multilevel Schemes, Ideal and Practical receivers for Demodulation, Bit Error Rates, Timing Recovery and Equalization, Reed-Solomon Codes for Error Detection and Correction.

UNIT -IV: (12 hours)

Transmission System Engineering: System Model, Power Penalty in Transmitter and Receiver, Crosstalk and Reduction of Crosstalk, Cascaded Filters, Dispersion Limitations and Compensation Techniques. All Optical Networks, Optical Switches and Wavelength Converters.

TEXT BOOKS:

1. Optical Networks: A Practical Perspective - Rajiv Ramaswami and Kumar N. Sivarajan, 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An Imprint of Elsevier).
2. Optical Fiber Communications – Gerd Keiser, 3rd Ed., 2000, McGraw Hill.

REFERENCE BOOKS:

1. Optical Fiber Communications: Principles and Practice – John.M.Senior, 2nd Ed., 2000, PE.
2. Fiber Optics Communication – Harold Kolimbris, 2nd Ed., 2004, PEI
3. Optical Networks: Third Generation Transport Systems – Uyless Black, 2nd Ed., 2009, PEI
4. Optical Fiber Communications – Govind Agarwal, 2nd Ed., 2004, TMH.

5. Optical Fiber Communications and Its Applications – S.C.Gupta, 2004, PHI.

DIGITAL MOBILE SYSTEM

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E22

Prerequisite: Basics of mobile communication, Digital modulation.

Objective: To help the students to understand the basic cellular concept, propagation models, GSM and CDMA systems, 3G systems and how the satellites are used for mobile communication.

CO-1	Remember and understand the basic concepts/ Principles of Digital Mobile System
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module-1 (12 hours)

Overview & Classification of Mobile Communication Systems. Mobile Communication Channel. Modelling of Propagation Loss. Diversity reception. Cellular System Concepts. Ways of increasing system capacity. First Generation Cellular Telephony.

Module-2(12 hours)

GSM Cellular Telephony. GSM Architecture. Radio Transmission Parameters of GSM. GSM Logical Channels. GSM Burst Structures. Call setup Procedures & Handover in GSM System. Data Transmission in GSM. HSCSD, GPRS, EDGE.

Module-3 (12 hours)

CDMA in Mobile Communication Systems. Spreading Sequences. Basic Transmitter & Receiver Schemes in CDMA Systems. RAKE Receiver. Multi Carrier CDMA. IS- 95 System. Digital Cordless Telephony .Wire Less Local Loops.

Module-4(12 hours)

Third Generation Mobile Communication Systems. IMT 2000. Concepts of UMTS. UTRA FDD Mode, UTRA TDD Mode. WCDMA. CDMA 2000. Application of Smart Antennas in Cellular Telephony. Satellite Mobile Communication Systems. Iridium, Global Start, ICO Systems.

Recommended Books:

1) Hazysztof Wesolowski, Mobile Communication Systems, Wiley.

2) Theodore S. Rappaport, Wireless Communications Principles & Practice, Pearson Education

3) Jochen Schiller, Mobile Communications, Pearson Education.

4) Raj Pandya, Mobile & Personal Communication Systems and Service, PHI.

OPTICAL NETWORK

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E21

CO-1	Remember and understand the basic concepts/ Principles of Optical Network
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1(12 hours)

WDM Technology and Issue in WDM optical networks: Introduction – Optical networks – WDM – WDM optical networking evolution – Enabling Technologies for WDM optical networks – WDM optical network architecture – Issues in Wavelength routed networks – Next generation optical Internet networks.

Module 2(12 hours)

Wavelength Routing Algorithms: Introduction – Classification of RWA algorithms – RWA algorithms –Fairness and Admission control – Distributed control protocols – Permutation routing and Wavelength requirements.

Wavelength Rerouting Algorithms: Introduction – Benefits of Wavelength routing – Issues in Wavelength routing – Ligthpath Migration – Rerouting schemes – Algorithm AG – Algorithm

MWPG – Rerouting in WDM networks with Sparse Wavelength conversion – Rerouting in Multifiber Networks – Rerouting in Multifiber Unidirectional Ring networks.

Module 3(12 hours)

Wavelength Convertible Networks: Introduction – Need for Wavelength converters – Wavelength convertible switch architecture – Routing in convertible networks – Performance evaluation of convertible networks – Networks with Sparse Wavelength conversion – Converter placement problem – Converter allocation problem.

Module 4 (12 hours))

Virtual Topology Design: Introduction – Virtual topology design problem – Virtual topology design sub problems – Virtual Topology Design Heuristics – Regular virtual topology design – predetermined virtual topology and lightpath routes – Design of multi fiber networks. Virtual Topology Reconfiguration: Introduction – Need for virtual topology reconfiguration – Reconfiguration due to Traffic changes – Reconfiguration for Fault restoration. Network Survivability and Provisioning: Failures and Recovery – Restoration schemes – Multiplexing techniques – Distributed control protocols. Optical Multicast routing – Next Generation optical Internet networks.

Reference Books:

1. C. Siva Ram Murthy and Mohan Gurusamy, ―WDM Optical Networks: Concepts, Design and Algorithms‖, Prentice Hall India, 2002.

2. Rajiv Ramasami and Kumar N. Sivarajan, ―Optical Networks: A Practical Perspective‖, A Harcourt publi isher's international company, 2000.

Digital Speech Processing

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E15

CO-1	Remember and understand the basic concepts/ Principles of Digital Speech Processing
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in

	the course

Module-I(12 hours)

Speech Communication: Introduction, discrete-time speech signal processing, speech communication, review of signals and linear systems.Speech Production and acoustic phonetics: Anatomy and physiology of speech organs, speech sounds andclassification, International Phonetic Alphabet (IPA), Articulatory Phonetics: Manner of articulation and place ofarticulation, vowel triangle, Acoustic Phonetics: spectrograms, wide-band and narrow-band spectrograms, acoustic characteristics of speech sounds, coarticulation and prosody.

Module-II(12 hours)

Time-domain models for speech processing: Introduction to short-time speech analysis, windowing, short-time energy and average magnitude, short-time Zero-Crossing Rate (ZCR), speech vs. silence discrimination using energy and zero crossings, short-time autocorrelation function, short-time Average Magnitude Difference Function(AMDF), Short-time Fourier analysis: Short-time Fouriertransform (STFT), spectral displays, time-frequency resolution tradeoffs, Linear filtering interpretation, short-time synthesis, filter bank summation method.

Module-III(12 hours)

Linear Predictive Analysis: Basic principles of Linear predictive analysis,autocorrelation method and covariance method, computation of gain for the model, prediction error signal, frequency domain interpretation of LP analysis, frequency domain interpretation of mean-squared prediction error, applications of LPC parameters.

Module-IV(12 hours)

Homomorphic Signal Processing: Concept of Homomorphic processing, Homomorphic systems for convolution, properties of complex cepstrum, Homomorphic filtering, complex cepstrum of voiced speech, complex cepstrum of unvoiced speech, Mel-scale cepstrum

Speech Coding: Fundamentals of coding, liner prediction and harmonic noise models in speech coding, modeling excitation for voiced and unvoiced speech, Code-Excited linear prediction coding

Reference Books:

1.Speech Communication: Human and machine, D.O'Shaughnessy, Uniiversity Press

2.Digital Processing of Speech Signals, L. Rabiner and R. Schafer, Pearson Education
3.Discrete-time Speech Signal Processing, T. Quatieri,
Pearson Education

APPLICATION SPECIFIC INTEGRATED CIRCUITS

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E12

Prerequisite: Knowledge of IC design , Basics of VLSI and digial logic.
Objective: -To learn different types of application specific ICs
- To learn about different types of ASICs, ASIC library design and programmable ASICs.
- To learn about VHDL code and Verilog Code for different logic circuits.

CO-1	Remember and understand the basic concepts/ Principles of Application Specific Integrated Circuits
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module 1 (12 hours) : Introduction to ASICSTypes of ASICS – Design flow – Case study – Economics of ASICS.CMOS LogicCMOS transistors – CMOS Process –Design rules – Combinational logic cells –Sequential logic – Data path logic cells – I/O cells – Cell compilers.

Module 2 (12 hours)

ASIC Design,ASIC library design - Programmable ASICS - Programmable ASIC logic cells - Programmable ASIC I/O cells - Programmable ASIC interconnect - Programmable ASICdesign software – Low level design entry.

Module 3 (12 hours)

VHDL A counter - A 4 bit multiplier - Syntax and semantics - Identifiers and hiterds – entities architecture - Packages and library interface declaration - Sequential statements –Operators-Arithmetic - Concurrent statements - Execution – Configurations andspecifications.

Module 4 (12 hours)

Applications Verilog HDL - Logic synthesis - Simulation - Test - ASIC construction - Floor planning and placement - Routing. Design examples in Verilog.

Reference Books:

1. Michaeel John Sebastian Smith, "Application Specific integrated Circuits",

Addison Wesley, 2000.

2. M.D.Ciletti, ―Modelling, Synthesis and Rapid prototyping with the Verilog HDL‖,

PHI, 1999.

3. M.G.Arnold, ―Verilog Digital Computer Design‖, PHI, 1999.

CAD VLSI

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E16

Prerequisite: Knowledge of IC design , Basics of VLSI .
Objective: -To learn different types of VLSI Design methodologies ,VLSI design Automation tools, Design rules.
- To learn about different design steps to design a VLSI chip.

CO-1	Remember and understand the basic concepts/ Principles of CAD VLSI
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Unit I VLSI Design Methodologies (12 hours)

Introduction to VLSI Design methodologies, Review of Data structures and algorithms, Review of VLSI Design automation tools, Algorithmic Graph Theory and Computational Complexity, Tractable and Intractable problems, general purpose methods for combinatorial optimization.

UNIT II Design Rules(12 hours)

Layout Compaction, Design rules, problem formulation, algorithms for constraint graph compaction, placement and partitioning, Circuit representation, Placement algorithms, partitioning

UNIT III Floor Planning and Simulation(12 lectures)

Floor planning concepts, shape functions and floorplan sizing, Types of local routing problems, Area routing, channel routing, global routing.Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, Binary Decision Diagrams, Two Level Logic Synthesis.

UNIT IV Modeling And Synthesis(12 hours)

High level Synthesis, Hardware models, Internal representation, Allocation assignment and scheduling, Simple scheduling algorithm, Assignment problem, High level transformations.

Text Books

1. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

2. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic **Publishers, 2002**

Internet of Things

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E18

CO-1	Remember and understand the basic concepts/ Principles of Internet of Things
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module-I(12 hours)

IoT & Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision,IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Module-II(12 hours)

M2M to IoT –A Basic Perspective–Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.M2M to IoT-An Architectural Overview–Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module-III(12 hours)

IoT Architecture-State of the Art –Introduction, State of the art,Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Module-IV(12 hours)

Internet of Things Privacy, Security and Governance,Introduction, Overview of Governance, Privacy and Security Issues, Contribution from

FP7 Projects,Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform,Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

Reference Books:

1.Vijay Madisetti and Arshdeep Bahga,"Internet of Things (A Hands-on-Approach)",1stEdition, VPT, 2014

2.Francis daCosta,"Rethinking the Internet of Things: A ScalableApproach to Connecting Everything",1st Edition, Apress Publications, 2013

3.Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1.

ADAPTIVE SIGNAL PROCESSING

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E17

Prerequisite: Basics of digital signal processing and statistics.

Objective: To help the students to understand and solve complex problems in power spectrum estimations and signal processing. Also how the adaptive filters are used to deal with random signal propagating through wireless medium.

CO-1	Remember and understand the basic concepts/ Principles of Adaptive Signal Processing
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module-I(12 Hours)

Multirate Digital Signal Processing:Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by rational factorI/D, Filter Design and Implementation for sampling-rate, Multistage implementation of sampling rate conversion, Sampling rate conversion of Band pass signal, Application of multi rate signal processing: design of phase shifters, Implementation of narrowband lowpass filters. Implementation of Digital filter banks. Filter Bank and Sub-band Filters and its applications.

Module-II(12 Hours)

Linear prediction and Optimum Linear Filters:Innovations Representation of a stationary random process, Forward and Backward Linear Prediction, Solution of the normal equations, Properties of the linear prediction-error filters, AR lattice and ARMA lattice- ladderfilters, Wiener filter for filtering and Prediction: FIR Wiener Filter, Orthogonality Principle in linear mean-square estimation.

Module-III(12 Hours)

Power Spectrum Estimation:Estimation of spectra from finite-duration observation of signals, Non parametric method for power spectrum estimation: Bartlett method, Blackman and Turkey method, parametric method for power estimation: Yuke-Walker method, Burg method, MA model and ARMA model.

Module-IV(12 Hours)

Adaptive Signal Processing:Basics of Wiener filtering, Widrow-Hopf Equation, Least mean square algorithm, Recursive least square algorithm, variants of LMS algorithm: FX-LMS, Fast LMS, N-LMS, PN-LMS. Design of Adaptive FIR & IIR filters, Application of adaptive signal processing: Adaptive linear combiner, System identification, Channel equalization, adaptive noise cancellation, adaptive line enhancer.

Text Books:

1. Digital Signal Processing, Third Edition, J.G. Proakis and D.G. Manolakis, Prentice Hall.
2. Adaptive Signal Processing, B. Widrow and Stern,

Reference Books:

1. Digital Signal Processing, by Sanjit K Mitra, new edition, TMH.
2. Digital Signal Processing, by Salivahanan, new edition, TMH.

Analog VLSI Design

Credit:4 L-T-P: 3-1-0 Course Code:CSY6E23

CO-1	Remember and understand the basic concepts/ Principles of Analog VLSI Design
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Module-I

Small Signal & large signal Models of MOS & BJT transistor. Analog MOS Process (Double Poly Process)**MOS & BJT Transistor Amplifiers:** Single transistor Amplifiers stages: Common Emitter, Common base, Common Collector, Common Drain, Common Gate & Common Source Amplifiers Multiple Transistor Amplifier stages: CC-CE, CC-CC, & Darlington configuration, Cascode configuration, Active Cascode. Differential Amplifiers: Differential pair & DC transfer characteristics.

Module-II

Current Mirrors, Active Loads & References

Current Mirrors: Simple current mirror, Cascode current mirrors Widlar current mirror, Wilson Current mirror, etc. Active loads, Voltage & current references. Analysis of Differential Amplifier with active load, supply and temperature independent biasing techniques, Frequency Response

Module-III

Operational Amplifier:

Applications of operational Amplifier, theory and Design; Definition of Performance Characteristics; Design of two stage MOS Operational Amplifier, two stage MOS operational Amplifier with cascodes, MOS telescopic-cascode operational amplifiers, MOS Folded-cascode operational amplifiers, Bipolar operational amplifiers. Frequency response & compensation.

Module-IV

Nonlinear Analog Circuits:

Analysis of four quadrant and variable Tran conductance multiplier, Voltage controlled oscillator, Comparators, Analog Buffers, Source Follower and Other Structures. Phase Locked Techniques; Phase Locked Loops (PLL), closed loop analysis of PLL. Digital-to-Analog (D/A) and Analog-to-Digital (A/D) Converters.

Text:

1. Paul B Gray and Robert G Meyer, "Analysis and Design of Analog Integrated Circuits".
2. Behzad Razavi, "Principles of data conversion system design", S.Chand and company Ltd, 2000. John Wiley

References:

1. D. A. Johns and Martin, Analog Integrated Circuit Design, John Wiley, 1997.
2. R Gregorian and G C Temes, Analog MOS Integrated Circuits for Signal Processing, John Wiley, 1986.
3. R L Geiger, P E Allen and N R Strader, VLSI Design Techniques for Analog & Digital Circuits, McGraw Hill, 1990.
4. Gray and Meyer," Analysis and Design of Analog IC ", Wiley international,1996.
5. Gray, Wooley, Brodersen, "Analog MOS Integrated circuits", IEEE press, 1989.
6. Kenneth R. Laker, Willy M.C. Sensen, " Design of Analog Integrated circuits and systems", McGraw Hill, 1994.

Elective Labs

Optical Communication Lab

Credit:2 L-T-P: 0-0-3 Course Code:ECL176

CO-1	Remember and understand the basic concepts/ Principles of Optical Communication Lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1. Study of PAM
2. Study of analog and digital TDM
3. Study of PWM and PPM and their demodulation
4. Study of Manchester coding and decoding
5. Study of direction coupler & determination of its various parameters
6. Far-field and near-field measurements, and determination of spot size
7. Measurement of bend and micro-bend loss
8. Measurement of Numerical Aperture of a given Optical Fiber.
9. Spot size calculation of a supplied Lazer Light.
10. Optical Signal Transmission using LED and Photo Detector.
11. Study on spectrum analyzer, OTDR and splice machines.

Communication Designed Simulation Lab

Credit:2 L-T-P: 0-0-3 Course Code:CSY6EL01

CO-1	Remember and understand the basic concepts/ Principles of Communication Design Simulation Lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems

CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Electronic design using DSP, FPGA, CPLD and Microcontrollers through simulation and direct access of the hardware.

Free space optical communication link lab

Credit:2 L-T-P: 0-0-3 Course Code:CSY6EL03

CO-1	Remember and understand the basic concepts/ Principles of Free space optical communication link lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1. Experiment with IR LED

2. Experiment with photo transistor

3.Experiment with free space communication

4.Experiment using an Infrared optical source and a photo transistor detector.

5.Experiment with amplitude modulation(AM) IR link

6.Experiment with frequency modulation(FM) IR link

7.Explore using arbitrary waveform generator(ARB)

Simulation techniques for wireless communication lab

Credit:2 L-T-P: 0-0-3 Course Code:CSY6EL04

CO-1	Remember and understand the basic concepts/ Principles of Simulation Techniques for wireless communication lab

CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1. Wireless Path loss Computations - Study of Propagation Path loss Models : Indoor & Outdoor

2.Free Space Propagation – Path Loss Model

3.Link Budget Equation for Satellite Communication

4.Carrier to Noise Ratio in Satellite Communication

5.Outdoor Propagation – Okumura Model

6. Outdoor Propagation – Hata Model

Antenna Design Lab

Credit:2 L-T-P: 0-0-3 Course Code:CSY6EL05

CO-1	Remember and understand the basic concepts/ Principles of Antenna Design Lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1. To get familiar with Different types of ANTENNAS and Kits.

2. Field pattern, beam width and directivity measurement of Dipole antenna.

3. Field pattern, beam width and directivity measurement of Yagi-Uda antenna.

4. Field pattern, beam width and directivity measurement of Horn antenna.

5. Field pattern, beam width and directivity measurement of Loop antennas (Circular, square and rectangular loops).

6. Field pattern, beam width and directivity measurement of Microstrip Antennas (Dipole, Yagi-Uda).

7. Field pattern, beam width and directivity measurement of Microstrip Antennas (Circular, square and rectangular Microstrips).

8. Field pattern, beam width and directivity measurement of Helical and Sprial antennas.

9. Introduction to Network Analyzer.

10. Antenna Testing using network Analyzer.

11. Antenna Design (Horn, Dipole, Yagi-Uda, Loop antennas)

. 12. Antenna Design (Microstrip Antenna like Square, Circular, Arrays)

Wireless channel modelling lab

Credit:2 L-T-P: 0-0-3 Course Code: CSY6EL06

CO-1	Remember and understand the basic concepts/ Principles of Wireless channel modelling lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Experiment 1: Free space Propagation – Path Loss model to determine the free space loss and the power received using Matlab program.

Experiment 2: Introduction to the IEEE80211.a WLAN PHY Communication Toolbox in MATLAB a. What is IEEE 802.11a WLAN PHY? Briefly explain the functions of each blue block in the model diagram. b. What type of shadowing is IEEE802.11 WLAN based on.

Experiment 3: Investigation on WLAN Multipath Channel c. Plot BER-SNR and Bit Rate-SNR graphs for different types of fading channel i. No Fading ii. Flat Fading iii. Dispersive Fading

Experiment 4: Introduction to Simulink a. Familiarize with the block components of Simulink in MATLAB b. Setup a basic integrator for a square wave input and note the parameters like amplitude, frequency etc

Experiment 5: Implement a Direct Sequence Spread Spectrum with Matlab Simulink

Adaptive signal processing lab

Credit:2 L-T-P: 0-0-3 Course Code:CSY6EL12

CO-1	Remember and understand the basic concepts/ Principles of Adaptive Signal Processing Lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1. Adaptive noise cancelling

2. Adaptive system modeling

3. PCM codec, mu-law compression, and ADPCM codec, transform coding with applications to speech signal

4. Sampling rate conversion and polyphase implementations

Embedded system Lab

Credit:2 L-T-P: 0-0-3 Course Code:CSY6EL07

CO-1	Remember and understand the basic concepts/ Principles of Embedded System lab

CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

Interfacing of 8051 microcontroller:

1. ADC

2.DAC

3.LED

4.Seven segment display

5. stepper motor

6. DC motor

7. Matrix keypad

8. LCD

VLSI Lab

Credit:2 L-T-P: 0-0-3 Course Code: CSY6EL08

CO-1	Remember and understand the basic concepts/ Principles of VLSI Lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

COURSE OBJECTIVE:

1. Students will be familiar with digital VLSI circuits using software.

2. They can also analyze various types of VLSI modelling techniques.

(The Following Experiments Need to be Carried out Using HDL Simulation Tools)

1. Design a full adder using dataflow modelling.

2. Design a full adder using half-adder.

3. Design a half adder.

4. Design a 4-bit adder -cum-sub tractor using: 4:1 MUX using the following: (a) Dataflow (b) Using when else (c) Structural modelling using 2:1 MUX (d) Behavioural modelling using (i) Case statement (ii) If else statement (e) Mixed style of modelling (use structural, behavioural, dataflow)

5. Design a decoder (3: 8) and Encoder (Gray to Binary).

6. Design a BCD to 7-Segment Decoder.

7. Interface the 2-bit adder with 7-segment display.

8. Design 4-bit Even/Odd parity checker & generator.

9. Design of Flip-Flops: (a) S-R Flip Flop (b) J-K Flip Flop (c) D Flip Flop (d) T Flip Flop

10. (a) Design of counters: (i) 4-bit up counter (use asynchronous reset) (ii) 4-bit down counter (use synchronous reset) (iii) 4-bit up/down counters (iv) Decade Counter (b) Design of Shift Registers: (i) Serial-in serial-out (ii) Serial-in parallel-out (c) Design the following using Generics (i) Generic Decoder (ii) Generic Parity (iii)Detector Generic parity generator

11. Design of a simple Microprocessor Data Path and Control Path using VHDL modelling

IOT Lab

Credit:2 L-T-P: 0-0-3 Course Code:CSY6EL11

CO-1	Remember and understand the basic concepts/ Principles of Internet of Things Lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1.Define and Explain Eclipse IoT Project

2.List and summarize few Eclipse IoT Projects.

3.Sketch the architecture of IoT Toolkit and explain each entity in brief.

4.Demonstrate a smart object API gateway service reference implementation in IoT toolkit.

5.Write and explain working of an HTTP-to-CoAP semantic mapping proxy in IoT toolkit.

6.Describe gateway-as-a-service deployment in IoT toolkit.

7.Explain application framework and embedded software agents for IoT toolkit.

8.Explain working of Raspberry Pi.

9.Connect Raspberry Pi with your existing system components.

10.Give overview of Zetta. Design based Problems (DP)/Open Ended Problem:

Major Equipment:

Raspberry pi, Arduino

Statistical simulation lab

Credit:2 L-T-P: 0-0-3 Course Code:CSY6EL09

CO-1	Remember and understand the basic concepts/ Principles of Statistical Simulation Lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1. Poisson/negative binomial regression models for handling extra variability often encountered in observational studies

2. Statistical methods for rates Methods for handling missing exposure data
3. Development of Bayesian hierarchical models based on output from Markov chain
4. Monte Carlo (MCMC) simulation Analysis of categorical and clustered categorical data typically found in transportation-related databases
5. Statistical modelling of survey data arising from complex sample surveys that include clustering, stratification, and weights.

HFSS Lab

Credit:2 L-T-P: 0-0-3 Course Code:CSY6EL10

CO-1	Remember and understand the basic concepts/ Principles of HFSS Lab
CO-2	Analyse the various concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute / Create the project or field assignment as per the knowledge gained in the course

1. Microwave local noise amplifier
2. Microwave micro strip antenna
3. Microwave amplifier
4. Microwave coupler
5. Microwave power divider
6. Microwave voltage controlled oscillator