UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VII SEMESTER

ELECTRONICS and COMMUNICATION ENGINEERING

SCHEME -2013

VII SEMESTER

ELECTRONICS and COMMUNICATION ENGINEERING (T)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.701	Nanoelectronics (AT)	3	2	1	-	50	3	100	150
13.702	Optical Communication (T)	4	3	1	-	50	3	100	150
13.703	Microwave & Radar Engineering (T)	4	3	1	-	50	3	100	150
13.704	Information Theory & Coding (T)	4	3	1	-	50	3	100	150
13.705	Elective III	3	2	1	-	50	3	100	150
13.706	Elective IV	3	2	1	-	50	3	100	150
13.707	Microwave & Optical Communications Lab (T)	3	-	-	3	50	3	100	150
13.708	Modeling & Simulation of Communication Systems Lab (T)	3	-	-	3	50	3	100	150
13.709	Seminar (AT)	1	-	-	1	50	-	-	50
13.710	Project Design (AT)	1	-	-	1	50	-	-	50
	Total	**29**	**15**	**6**	**8**	**500**		**800**	**1300**

13.705 Elective III

13.705.1	Pattern Recognition (AT)
13.705.2	MOS Device Modeling (T)
13.705.3	Real Time Operating Systems (T)
13.705.4	Optoelectronic Devices (T)
13.705.5	Computer Vision (T)
13.705.6	CDMA Systems (T)

13. 706 Elective IV

13.706.1	Intellectual Property Rights (AT)
13.706.2	MEMS (AT)
13.706.3	Embedded Systems (AT)
13.706.4	Low Power VLSI Design (T)
13.706.5	Antenna Design (T)
13.706.6	Cryptography (T)

13.701 NANOELECTRONICS (AT)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

- *Explain the fundamental science and quantum mechanical effects associated with low dimensional semiconductors.*
- *Identify the significance of nanolevel fabrication of particles and layers and their characterization.*
- *Correlate the concept of quantum level transport and tunnelling in similar structured nano devices.*
- *Analyze nanoscale devices like SET, QW laser, CNT Transistors, RTD etc.*

Module – I

Introduction to nanotechnology and nanoelectronics, Impacts, Limitations of conventional microelectronics.

Mesoscopic Physics and Nanotechnologies - trends in Microelectronics and Optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence, Quantum wells ,wires and dots, Density of states and dimensionality The physics of low dimensional structures - basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells, quantum wires and quantum dots.

Module – II

Introduction to methods of fabrication of nanonaterials-different approaches. fabrication of nano-layers -Physical Vapor Deposition, Chemical Vapor Deposition, Epitaxy- Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide.

Fabrication of nanoparticle- grinding with iron balls, laser ablation, reduction methods, sol gel, self assembly, precipitation of quantum dots.

Introduction to characterization tools of nano materials-principle of operation of STM, AFM, SEM, TEM, XRD, PL & UV instruments.

Module – III

Semiconductor quantum nanostructures and super lattices, MOSFET structures, Heterojunctions, modulation doped quantum wells, multiple quantum wells. The concept of super lattices Kronig - Penney model of super lattice.

Transport of charge in Nanostructures under Electric field - parallel transport, perpendicular transport, quantum transport in nanostructures Transport of charge in magnetic field and quantum Hall effect - Effect of magnetic field on a crystal, the Aharonov-Bohm effect, the Shubnikov-de Hass effect, the quantum Hall effect.

Module – IV

Nanoelectonic devices and systems , MODFETS, heterojunction bipolar transistors, resonant tunnel effect, RTD, RTT, hot electron transistors, Coulomb blockade effect and single electron transistor, CNT transistors, heterostructure semiconductor laser, quantum well laser, quantum dot LED, quantum dot laser, quantum well optical modulator, quantum well sub band photo detectors, Infrared detector, nanoswitches, principle of NEMS.

References:

1. Martinez-Duart J. M., R. J. Martin Palma and F. Agulle Rueda, *Nanotechnology for Microelectronics and Optoelectronics*, Elsevier, 2006.
2. Fahrner W. R., *Nanotechnology and Nanoelctronics*, Springer, 2005
3. Chattopadhyay and Banerjee, *Introduction to Nanoscience & Technology*, PHI, 2012.
4. Poole, *Introduction to Nanotechnology*, John Wiley 2006.
5. George W. Hanson, *Fundamentals of Nanoelectronics*, Pearson Education, 2009.
6. Goser K., P. Glosekotter, J. Dienstuhl, *Nanoelectronics and Nanosystems*, Springer 2004.
7. Supriyo Dutta, *Quantum Transport- Atom to Transistor*, Cambridge, 2013.
8. Murty,Shankar ,*Text book of Nanoscience and Nanotechnology*, Universities Press, 2012.
9. Pradeep, *Nano the Essentials*, McGraw Hill, 2007.
10. Ramsden, *Nanotechnology*, Elsevier, 2011.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours　　　*Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two question from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain 20 % Analysis/Numerical Problems.*

Course Outcome:

After the successful completion of the course the student will be able to

- *Explain the fundamental science of low dimensional semiconductors.*
- *Know the fabrication of nanoparticles and their characterization.*
- *Correlate the concept of quantum level transport and tunneling in nano devices.*
- *Analyze nanoscale devices like SET, QW laser, CNT Transistors, RTD etc.*

13.702 OPTICAL COMMUNICATION (T)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *Explain mode theory and parameters of different types of optical fibers.*
- *Discuss principle, characteristics and applications of optical sources and detectors.*
- *Illustrate different types of optical amplifiers.*
- *Design optical link and analyze performance.*
- *Describe different types of optical measuring instruments.*
- *Discuss different optical components of WDM.*

Module – I

Classification of Light wave systems. Fibers- types and refractive index profiles, Mode theory of fibers- modes in SI and GI fibers. Impairments in fibers, Dispersion- Group Velocity Dispersion, modal, wave guide and Polarization Mode Dispersion. Attenuation- absorption, bending and scattering losses, fiber materials, fabrication of fibers, photonic crystal fiber, index guiding fiber , photonic bandgap fiber, hollow core fiber, fiber cables.

Module – II

Optical sources, LEDs and LDs, Structures, Characteristics, Modulators using LEDs and LDs. Coupling with fibers. Noise in Laser diodes, Amplified Spontaneous Emission (ASE) noise, effects of Laser diode nonlinearity ,optical detectors, types and characteristics, structure and working of PIN and APD, noise in detectors and comparison of performance.

Module – III

Optical receivers- Ideal photo receiver and quantum limit of detection. Digital transmission systems, Design of IMDD links- power and rise time budgets, Coherent Systems, sensitivity of a coherent receiver, comparison with IMDD systems.

Optical Amplifiers- comparison of different types- doped fiber amplifiers, EDFA, structure and working, structure and working of semiconductor laser amplifier, amplifier configurations.

Optical Time Domain Reflectometer (OTDR), fault detection, length and refractive index measurements.

Module – IV

The WDM concept, WDM standards, Couplers, circulator, Add/ Drop Multiplexers, gratings, tunable filters, MZ interferometer, system performance parameters.

Introduction to soliton transmission, soilton links using optical amplifiers, GH effect, soliton-soliton interaction, amplifier gain fluctuations, design guide lines of soliton based links.

Introduction to optical networks. Introduction to free space optics, LiFi technology and VLC.

References:

1. Gerd Keiser: *Optical Fiber Communications*, 5/e, McGraw Hill, 2013.
2. Mishra and Ugale, *Fiberoptic Communication*, Wiley, 2013.
3. Joseph C. Palais – *Fiber Optic Communications*, 5/e, Pearson, 2013.
4. John M Senior- *Optical communications*, 3/e, Pearson, 2009.
5. Hebbar, *Optical Fiber Communication*, Elsavier,2014
6. Chakrabarthi, *Optical Fiber Communication*, McGraw Hill, 2015.
7. Mynbaev and Scheiner, *Fiberoptic Communication Technology*, Pearson, 2001.
8. Bandyopadhay, *Optical Communication and Networks*.PHI, 2014.
9. Khare, *Fiber Optics and Optoelectronics*, Oxford University Press, 2013.
10. Subir Kumar Sarkar, *Optical Fibers and Fiber-optic Communication System*, S Chand, 2012.
11. Arumugam, *Optical Communication and Sensors*, Anuradha Publications, 2009.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain 20 % Analysis/Numerical Problems.*

Course Outcome:

After the successful completion of the course the student will be able to

- *explain mode theory and parameters of different types of optical fibers*
- *know principle, characteristics and applications of optical sources and detectors.*
- *Illustrate different types of optical amplifiers.*
- *design optical link and analyze the performance.*
- *explain different optical components of WDM and soliton based system.*

13.703 MCROWAVE AND RADAR ENGINEERING (T)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *Differentiate between conventional tubes & microwaves tubes.*
- *Explain the principle of microwave amplifiers and oscillators and analyze their parameters.*
- *Describe the principle and characteristics of microwave solid state devices.*
- *Recognize various microwave components*
- *Discuss the methods to measure various parameters.*
- *Explain different types of radars*
- *Discuss various navigation systems*

Module – I

Microwaves: introduction, advantages, Cavity Resonators - Rectangular and Circular wave guide resonators- Derivation of resonance frequency of Rectangular cavity.

Microwave vacuum type amplifiers and sources**:** Klystron Amplifiers - Re-entrant cavities, Velocity modulation, Bunching (including analysis), Output power and beam loading.

Reflex Klystron Oscillators, Derivation of Power output, efficiency and admittance.

Module – II

Travelling Wave Tube - Slow wave structures, Helix TWT, Amplification process, Derivation of convection current, axial electric field, wave modes and gain. Magnetron oscillators - Cylindrical magnetron, Cyclotron angular frequency, Power output and efficiency.

Microwave hybrid circuits – Waveguide tees- Magic tees, Hybrid rings, Corners, Bends, Twists. Formulation of S-matrix. Directional couplers – Two hole directional couplers, S-matrix of a directional coupler. Circulators and isolators.

Module – III

Solid state microwave devices – Microwave bipolar transistors – Physical structures, Power frequency limitations equivalent circuit. Principle of Tunnel diodes and tunnel diode oscillators. Gunn diodes – Different modes, Principle of operation Gunn Diode Oscillators. IMPATT and TRAPATT diodes, Microwave measurements.

Module – IV

Radar, simple Radar equation, Pulse Radar, CW Radar , CW Radar with non zero IF, Equation for doppler frequency, FM-CW Radar using sideband super heterodyne receiver, MTI Radar-

Delay line canceller, MTI Radar with power amplifier & power oscillator, Pulse Doppler Radar, Radar Transmitters, Radar Modulator, block diagram, Radar receivers- noise figure, low noise front ends, Mixers, Radar Displays, principle of Duplexers.

Navigation- Loop Antenna, Radio compass, Hyperbolic Systems of Navigation, LORAN – A, Distance Measuring Equipment, Instrument Landing System – Localizer, Glide Slope, Marker beacons.

References:

1. Samuel Y. Liao, *Microwave Devices and Circuits*, 3/e, Pearson Education, 2003.
2. Robert E. Collin, *Foundation of Microwave Engineering*, 2/e, Wiley India, 2012.
3. Rao, *Microwave Engineering*, 2/e, PHI, 2012.
4. David M. Pozar , *Microwave Engineering*,4/e, Wiley India, 2012.
5. Merrill I. Skolnik, *Introduction to Radar Systems*,3/e, Tata McGraw Hill , 2008.
6. Nagaraja N. S., *Elements of Electronic Navigation*, 2/e, Tata McGraw Hill, 2001.
7. Roy and Mitra, *Microwave Semiconductor Devices*, PHI, 2013.
8. Raju G. S. N., *Microwave Engineering*, I.K. International, 2008,
9. Kulkarni M, *Microwave and Radar Engineering*, 4/e, Umesh Publications, 2012.
10. Somanathan Nair, *Microwave Engineering*, PHI, 2008.
11. Kumar Shukla, *Microwave Engineering*, PHI, 2014.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain 15% Analysis/Numerical Problems.*

Course Outcome:

After the studying the course the students will be able to

- *differentiate between conventional tubes & microwaves tubes.*
- *explain and analyze the microwave amplifiers and oscillators*
- *describe the principle and characteristics of microwave solid state devices.*
- *recognize various microwave components and the methods to measure various parameters.*
- *explain different types of radars*
- *explain of various navigation systems*

13.704 INFORMATION THEORY AND CODING (T)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To understand the concept of information*
- *To introduce to various aspects of error controlling and coding techniques for communication.*
- *To have idea on the different coding techniques.*

Module – I

Introduction to Information Theory. Concept of amount of information, units – entropy, marginal, conditional and joint entropies – relation among entropies – mutual information, information rate. Source coding: Instantaneous codes – construction of instantaneous codes – Kraft‘s inequality, coding efficiency and redundancy, Noiseless coding theorem – construction of basic source codes – Shannon – Fano Algorithm, Huffman coding.

Module – II

Channel capacity – redundancy and binary symmetric channel (BSC), Binary erasure channel (BEC) – capacity of band limited Gaussian channels, Shannon – Hartley theorem – bandwidth – SNR trade off – capacity of a channel of infinite bandwidth, Shannon‘s limit.
Information Capacity of Coloured noise channel, Water-Filling Interpretation of Information Capacity Theorem, Rate Distortion Theory.

Module – III

Introduction to rings, fields, and Galois fields. Codes for error detection and correction – parity check coding – linear block codes – error detecting and correcting capabilities – generator and parity check matrices – Standard array and syndrome decoding – perfect codes, Hamming codes – encoding and decoding, cyclic codes – polynomial and matrix descriptions – generation of cyclic codes, decoding of cyclic codes, BCH codes – description and decoding, Reed – Solomon Codes, Burst error correction.

Module – IV

Convolutional Codes – encoding – time and frequency domain approaches, State Tree & Trellis diagrams – transfer function and minimum free distance – Maximum likelihood decoding of convolutional codes – The Viterbi Algorithm. Sequential decoding,. Cryptography : Secret key cryptography, block and stream ciphers. DES, Public key cryptography.

References:

1. Symon Haykins: Digital *Communication Systems*, Wiley India, 2013.

2. Sathya Narayana P.S., *Concepts of Information Theory & Coding* , Dynaram Publications, 2005
3. Ranjan Bose, *Information Theory, Coding and Cryptography*, 2/e, TMH, 2008.
4. Shu Lin and Daniel J. Costello Jr., *Error Control Coding : Fundamentals and Applications*, 2/e, Pearson, 2011
5. Kulkarni, Shivaprakasha, *Information Theory and Coding*, Wiley, 2015.
6. David J.C Mackay, *Information Theory, Inference and Learning Algorithms*, Cambridge, 2005.
7. Paul Garrett, *The mathematics of Coding Theory*, Prentice Hall, 2004.
8. Das Mullick Chatterjee, *Principles of Digital Communication*, Wiley Eastern Ltd, 2012
9. Sklar R., *Digital Communication, Fundamental and Applications,* 2/e, Pearson, 2011.
10. Saha, Manna and Mandal, *Information Theory*, Pearson, 2013.
11. Kelbert M. and Y. Suhov, *Information Theory and Coding*, Cambridge Press, 2013.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain 20% Problems, derivations and proofs*

Course Outcome:

After the course the student will be able to

- *Understand the concept of Information*
- *Understand the concept of various theorems proposed by Shannon*
- *Understand the concept of channel capacity*
- *Understand the idea of groups, rings, field, and codes.*
- *Understand the different error codes for communication systems.*

13.705.1 PATTERN RECOGNITION (AT) (Elective III)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *Introduce pattern classification and structural pattern recognition.*
- *Discuss topics like feature extraction, Bayesian decision theory, nearest-neighbour rules, clustering, support vector machines.*
- *Understand neural networks, classifier combination, and syntactic pattern recognition techniques such as stochastic context-free grammars.*

Module – I

Basics of pattern recognition. Bayesian decision theory- Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, Discrete features. Parameter estimation methods - Maximum-Likelihood estimation.

Module – II

Gaussian mixture models, Expectation-maximization method, Bayesian estimation. Hidden Markov models for sequential pattern classification - Discrete hidden Markov models, Continuous density hidden Markov models. Dimension reduction methods, Fisher discriminant analysis.

Module – III

Principal component analysis. Non-parametric techniques for density estimation - Parzen-window method, K-Nearest Neighbour method.

Linear discriminant function based classifiers – Perceptron Support vector machines.

Module – IV

Non-metric methods for pattern classification - Non-numeric data or nominal data, Decision trees, Cluster validation. Unsupervised learning and clustering - Criterion functions for clustering, Algorithms for clustering: K-means, Hierarchical and other methods.

References:

1. Duda R. O., P.E.Hart and D.G.Stork, *Pattern Classification*, John Wiley, 2001.
2. Theodoridis S. and K. Koutroumbas, *Pattern Recognition*, 4/e, Academic Press, 2009.
3. Bishop C.M., *Pattern Recognition and Machine Learning*, Springer, 2006.
4. Castleman K. R., *Digital Image Processing*, Prentice Hall of India, 1996.
5. Chou W. and B.H. Juang, *Pattern Recognition in Speech and Language Processing*, CRC Press, 2003.
6. Tou J. I. and R. C. Gonzalez, *Pattern Recognition Principles*, Addition Wesley, 1974.

7. Schalkoff R., *Pattern Recognition -Statistical, Structural and Neural Approaches*, John Wiley, 1992.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 20%* problems, derivations, proof and algorithms.

Course Outcome:

At the end of this course, students will be able to:

- *Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.*
- *Summarize, analyze, and relate research in the pattern recognition area verbally and in writing.*
- *Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.*
- *Apply pattern recognition techniques to real-world problems such as document analysis and recognition.*
- *Implement simple pattern classifiers, classifier combinations, and structural pattern recognition*

13.705.2 MOS DEVICE MODELING (T) (Elective III)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *Explain the equations, approximations and techniques available for deriving a model*
- *Offer clues to qualitative understanding of the physics of a new device and conversion*
- *Simulate characteristics of a simple device using MATLAB, SPICE and ATLAS / SYNOPSYS*
- *List mathematical functions representing various non-linear shapes*

Module – I

Basics of MOS circuits: MOS Transistor structure and device modelling, MOS Inverters ,MOS combinational circuits - Different logic families, Sources of Power dissipation:
Dynamic power dissipation, Short circuit power, Switching power, Gliching power, Static power Dissipation, Degrees of freedom.

Module – II

Supply Voltage Scaling Approaches**:** Device feature size scaling Multi-Vdd Circuits, Architectural level approaches: Parallelism, Pipelining, Voltage scaling using high-level transformations, Dynamic voltage scaling, Power Management.

Module – III

Switched Capacitance Minimization Approaches: Hardware Software Tradeoff, Bus Encoding, Two's complement Vs Sign Magnitude, Architectural optimization, Clock Gating, Logic styles.

Module – IV

Leakage Power minimization Approaches: Variable-threshold-voltage CMOS (VTCMOS) approach, Multi-threshold-voltage CMOS (MTCMOS) approach, Power gating, Transistor stacking, Dual-Vt assignment approach (DTCMOS).
Special Topics**:** Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design CAD tools for low power synthesis.

References:

1. Lundstrom M., *Fundamentals of Carrier Transport*, Cambridge University Press, 2009.
2. Snowden C., *Introduction to Semiconductor Device Modeling*, World Scientific, 1998.
3. Tsividis Y. and C. McAndrew, *MOSFET Modeling for Circuit Simulation*, Oxford University Press, 2011.
4. BSIM Manuals available on BSIM homepage on the internet.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 20%* problems, derivations and proof.

Course Outcome:

After completion of the course the student will be able to:

- *Explain the equations, approximations and techniques available for deriving a model*
- *with specified properties, for a general device characteristic with known qualitative theory*
- *Apply suitable approximations and techniques to derive the model referred to above starting from drift-diffusion transport equations (assuming these equations hold)*
- *Offer clues to qualitative understanding of the physics of a new device and conversion of this understanding into equations*
- *Simulate characteristics of a simple device using MATLAB, SPICE and ATLAS/ SYNOPSYS*
- *List mathematical functions representing various non-linear shapes*

13.705.3 REAL TIME OPERATING SYSTEMS (T) (Elective III)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

The course shall provide

- *A fundamental knowledge about general operating systems.*
- *An introduction to Real Time Operating Systems, its basic structure, building blocks and various operations on it.*
- *An insight into the different scheduling algorithms used in RTOS*
- *An overview of the different applications of real time operating systems*

Module – I

Operating system : Introduction. Kernel, Process- states, Process control block, Creation and termination Scheduling, Thread. Memory management, Interrupts: interrupt sources and handlers- saving and restoring the content, disabling interrupt, interrupt latency.

The shared data problem- atomic and critical section.

Module – II

Real Time Operating Systems: Structure of real time systems: task, task classes, typical task operations Performance measures. Re-entrancy, re-entrancy rules. RTOS semaphores: types, typical operations, applications. Memory management, Exceptions and Interrupts, Handling exceptions and interrupts.

Module – III

Inter task communication: message queues, mailboxes and pipes, events

Task scheduling: Task constraints. Aperiodic task scheduling: EDD. EDF, LDF, EDF with precedence constraints. Periodic task scheduling: rate monotonic, EDF, deadline monotonic.

Module – IV

Structure of a real-time kernel, Process states, Data Structures, Kernel primitives, Inter-task communication mechanisms, System overhead.

Real Time Operating Systems: MicroC/OS-II – Overview only. Commercial Real-time operating systems: General concepts -Unix and Windows as RTOS

Applications of RTOS: Real Time Communication – Architecture. Embedded systems - Block diagram.

References:

1. Abraham Silberschatz, *Operating System Concepts*, 7e. John Wiley,2004.
2. Giorgio C. Buttazzo, *Hard Real-Time Computing Systems Predictable Scheduling Algorithms and Applications*, Kluwer Academic Publishers, 2000
3. Jean J Labrosse, *Micro C/OS-II, The Real-Time Kernel*, CMP Books, 1998.
4. Robert Krten, *Getting started with QNX Neutrino*, Parse Software Devices, 1999.
5. Krishna C.M., Kang Singh G, *Real time systems*, Tata McGraw Hill, 2003.
6. Liu J. W. S., *Real-Time Systems*, Prentice Hall, 2000.
7. Rajib Mall, *Real-Time Systems: Theory and Practice*, Pearson, 2008.
8. Qing Li, *Real-Time Concepts for Embedded Systems*, CMP Books, 2003
9. David E. Simon, *An Embedded Software Primer*, Pearson, 2012.
10. Sriram V. Iyer and, Pankaj Gupta, *Embedded Real Time Systems Programming*, Tata McGraw Hill, 2003
11. Raj Kamal, *Embedded Systems – Architecture, Programming and Design*, Tata McGraw Hill,2003

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 20 %* problems, derivations, proof and algorithms.

Course Outcome:

At the end of the course the students will be familiar with operating systems. They will have an in depth knowledge about the real Time Operating systems and its applications.

13.705.4 OPTOELECTRONIC DEVICES (T) (Elective III)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *Explain the physics of absorption, recombination and photoemission from semiconductors.*
- *Analyse different types of photo detectors based on their performance parameters.*
- *Discuss different LED structures with material properties and reliability aspects.*
- *Explain optical modulators and optical components*
- *Illustrate different types of lasers with distinct properties.*

Module – I

Optical processes in semiconductors – electron hole recombination, absorption, Franz-Keldysh effect, Stark effect, quantum confined Stark effect, deep level transitions, Auger recombination.

Lasers – threshold condition for lasing, line broadening mechanisms, axial and transverse laser modes, heterojunction lasers, distributed feedback lasers, quantum well lasers, modulation of lasers, nitride light emitters.

Module – II

Franz-Keldysh and Stark effect modulators, quantum well electro-absorption modulators, electro-optic modulators, quadratic electro-optic effect quantum well modulators, Ram-Nath modulators, optical switching and logic devices.

Module – III

Optical detection – PIN, APD, modulated barrier photodiode, Schottky barrier photodiode, wavelength selective detection, microcavity photodiodes.

Optoelectronic ICs – hybrid and monolithic integration, integrated transmitters and receivers, guided wave devices.

Module – IV

Introduction to optical components, directional couplers, multiplexers, attenuators, isolators, circulators, tunable filters, fixed filters, add drop multiplexers, optical cross connects, wavelength convertors, optical bistable devices.

References:

1. Pallab Bhattacharya: *Semiconductor Optoelectronic Devices*, 2/e; Pearson Education, 2002.
2. Yariv, *Photonics Optical Electronics in Modern Communication*, 6/e, Oxford Univ Press, 2006.
3. Saleh B. E. and M. C. Teich, Fundamentals of Photonics, Wiley-Interscience, 1991.

4. Bandyopadhay, *Optical Communication and Networks*, PHI, 2014.
5. Mynbaev and Scheiner, *Fiberoptic Communication Technology*, Pearson, 2001.
6. Piprek, *Semiconductor Optoelectronic Devices*, Elsevier, 2008.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain 20*% problems, derivations and proof

Course Outcome:

After completion of the course the student will be able to

- *Explain the property of absorption, recombination and photoemission in semiconductors.*
- *Illustrate different types of lasers with distinct properties*
- *Explain different LED structures with material properties*
- *Analyse different types of photo detectors*
- *Explain optical modulators and optical components.*

13.705.5 COMPUTER VISION (T) (Elective III)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *To have a thorough understanding of the Computer vision and digital image processing.*
- *To study about Cameras used for sensing images, its parameters and its calibration*
- *To study the different ways of Segmenting the images and Tracking*
- *To have a thorough understanding of the Feature Selection, Classification and Recognition.*
- *To have a basic idea of motion analysis.*

Module – I

Cameras- Pinhole Cameras, Camera with lenses, CCD cameras - Camera Parameters and Perspective Projections - Camera model and Camera calibration - Radiance, BRDF – sampling and quantization in 2D Light sources and its effects – Shadows – Shading - Shape from X - Shape from shading.

Module – II

Human color perception – model for image color - color constancy
Linear Filters - smoothing filters and sharpening filters in spatial and frequency domain- Scaling – image pyramids - Texture – shape from texture - Stereopsis - Binocular Fusion.

Module – III

Segmentation – Line detection, Boundary detection, Curve detection – Background Subtraction – segmentation by Clustering, K – means clustering, graph-theoretic clustering- Hough transforms –fitting lines and curves - Expectation Maximization (EM) algorithm, Active Contours
Tracking – Kalman Filter, Data Association – Model based vision –pose consistency, pose clustering, geometric hashing.

Module – IV

Classification –bayes classifier, nearest neighbor classifier
Feature selection –Principal component Analysis, Gradient Decent algorithm, Support Vector machine, SIFT operator
Recognition –recognition of patterns - Hidden Markov model
Motion Analysis -Regularization theory, Optical computation, Motion estimation, Structure from motion.

References:

1. David A. Forsyth and J. Ponce, *Computer Vision: A Modern Approach*, Prentice Hall, 2002.

2. Horn B. K. P., *Robot Vision*, MIT Press, 1986.
3. Linda Shapiro and George Stockman, *Computer Vision*, Pearson, 2001.
4. Jain R, R. Kasturi and B. Schunk, *Machine Vision*, McGraw Hill, 1995.
5. Trucco and Verri, *Introductory Techniques for 3D Computer Vision*, Prentice Hall, 1998.
6. Adrian Low, *Introductory Computer Vision*, *Imaging Techniques and Solutions*, 2/e, BSP, India, 2008.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 20* % derivations, proof and algorithms.

Course Outcome:

After completion of the course the student will be able to know:

- *To have a thorough understanding of the Computer vision and digital image processing.*
- *To study about Cameras used for sensing images, its parameters and its calibration*
- *To study the different ways of Segmenting the images and Tracking*
- *To have a thorough understanding of the Feature Selection, Classification and Recognition.*
- *To have a basic idea of motion analysis.*

13.705.6 CDMA SYSTEMS (T) (Elective III)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *Understand CDMA and its evolution.*
- *Acquire the basic concepts and architecture of a CDMA network.*
- *Study the security processes and mobile identification parameters used in CDMA.*
- *Learn the concepts related to the quality of service in CDMA*

Module – I

Introduction to CDMA, Direct Sequence (DS)- Frequency Hopped(FH)- Pulse Position Hopped(PH) Spread Spectrum(SS) Communication. Modulation Schemes for SS, Generation of -DS SS and FH SS Signals. Orthogonal and Quasi-Orthogonal expansion of SS signals. Reception of SS signals in AWGN channel-. Coherent Reception of DS CDMA (uplink and downlink) and FH SS signals.

Module – II

Forward Error Control Coding in SS systems. Non coherent Reception of encoded DS CDMA Systems. convolutional coding in DS CDMA, orthogonal convolutional coding. Coding in FH CDMA Systems Pseudo Signal Generation- Pseudorandom sequences- ML Linear shift register- Randomness property.

Module – III

Generation of pseudorandom signals from pseudorandom sequences. Synchronisation of Pseudorandom signals, acquisition process. Shannon Capacity of DS CDMA , FH CDMA Systems.

CDMA Networks- hand off strategy, Power control, erlang capacity of CDMA System. Interference Cancellation -SIC and PIC Multiuser Detection: Single user matched filter-hypothesis testing.

Module – IV

Optimal receiver- matched filter in CDMA Channel, Coherent single user matched filter in Rayleigh fading channel. Optimum detector for synchronous channels- (Two-user and K-user) and asynchronous channel. Decorrelating Detector (DD)- DD in synchronous and asynchronous channels. . Non Decorrelating linear multiuser detection- optimum linear multiuser detection. MMSE Linear multiuser detection.

References:

1. Kamil Sh Zigangirov, *Theory of Code Division Multiple Access Communication*, IEEE Press, Wiley InterScience, 2004.

2. Sergio Verdu, *Multiuser Detection*, Cambridge University Press, 1998.
3. Samuel C. Yang, *CDMA RF System Engineering*, Artect House Inc.,1998.
4. Don Torrieri, *Principles of Spread Spectrum Communication Systems*, Springer 2005.
5. Andrew J. Viterbi, *CDMA: Principles of spread Spectrum Communication*, Addisson Wisley, 1996.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 20%* problems, derivations and proof.

Course Outcome:

Upon successful completion of this course, students will be able to:

- *describe CDMA and its evolution.*
- *explain the basic concepts and architecture of a CDMA network.*
- *describe the security processes and mobile identification parameters used in CDMA.*
- *describe the concepts related to the quality of service in CDMA.*

13.706.1 INTELLECTUAL PROPERTY RIGHTS (AT) (Elective IV)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *To study general features of intellectual property rights.*
- *To study IPR acts of patents, trademarks, design ,copyright, layout design of ICs*
- *To know Indian position in the global IPR structure.*
- *To know the features of TRIPS, PCT, WIPO, EPO, WTO etc.*

Module – I

Intellectual property rights-Introduction, importance, need of IPR, forms of IPR-Trade mark, Patent, Copyright, Design, Semiconductor IC layout design, geographical indication of goods, Trade secret, Protection of plant varieties and farmers rights, biodiversity and traditional knowledge, Indian position in global IPR structure.

Module – II

Trademarks-Introduction, condition and procedure for registration, rights and limitations of registration, infringement of trade mark, remedies against infringement, offences and penalties.

Patents- Meaning and purpose of patent , advantage of patent to inventor, invention not patentable, application for patent, provision for secrecy of certain inventions, grant of patent, rights of patent holder, infringement of patent, offences and penalties, international arrangements.

Module – III

Copyrights- introduction, meaning of copyrights ownership, rights of owner, subject matter of copyrights, international copyrights, infringement, offences and penalties.

Industrial design- Introduction, registration of design, copyrights in registered design Industrial and international exhibitions, infringement, offences and penalties.

Semiconductor IC layout design- Introduction, condition and procedure for registration, Effects of registration, offences and penalties.

Module – IV

IPRs in cyber space, IT related IPR, Computer software and IPR, database and protection, domain name protection, IPRs in pharmaceutical sector, IPRs in fashion industry, IPRs in biotechnology sector.

International treaties- Introduction, TRIPS, PCT, WIPO, EPO, WTO.

References:

1 Sople*, Managing Intellectual Property*, PHI, 4th edition, 2014.

2 Acharya N. K., *Text book on Intellectual Property Rights*, Asia Law House, Hyderabad, 2002.

3 Ganguli, *Intellectual Property Rights*, TMH, Delhi, 2001.

4 Bare acts of (i)The Trademarks Act 1999 (ii) The patents acts 1970 (iii) The copyright act 1957 (iv) Design act 2000 (v)The semiconductor IC layout design act 2000.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

At the end of the course, students will be able to

- *Explain the importance of IPR.*
- *Practice in filing trademarks, patents, copyrights, industrial designs and semiconductor IC layout design applications.*
- *Explain the situations of infringement of rights and penalties and other legal aspects.*
- *Write the importance of IT related IPR like domain name and data base protection etc*
- *Review the role of IPR related organizations like PCT,WIPO, EPO, WTO,TRIPS etc*
- *Apply proficiency in communication and documentation.*

13.706.2 MEMS (AT) (Elective IV)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

- *To introduce MEMS and micro fabrication.*
- *To study the essential electrical and mechanical concepts of MEMS.*
- *To study various sensing and actuating technique.*
- *To know about the polymer and optical MEMS*

Module – I

History of MEMS Development, Characteristics of MEMS-Miniaturization ,Micro electronics integration - Mass fabrication with precision. Sensors and Actuators - Energy domain. Sensors, actuators Micro fabrication - microelectronics fabrication process- Silicon based MEMS processes- New material and fabrication processing.

Points of consideration for processing. Anisotropic wet etching, Isotropic wet etching, Dry etching of silicon, Deep reactive ion etching (DRIE), and Surface micromachining process- structural and sacrificial material.

Module – II

Conductivity of semiconductors, crystal plane and orientation, stress and strain - definition - Relationship between tensile stress and strain- mechanical properties of Silicon and thin films, Flexural beam bending analysis under single loading condition- Types of beam- longitudinal strain under pure bending -deflection of beam- Spring constant, torsional deflection, intrinsic stress, resonance and quality factor.

Module – III

Electrostatic sensing and actuation-Parallel plate capacitor – Application. Inertial, pressure and tactile sensor parallel plate actuator- comb drive. Thermal sensing and Actuations- Thermal sensors-Actuators- Applications. Inertial, flow and infrared sensors Piezoresistive sensors- piezoresistive sensor material.

Module – IV

Piezoresistive sensors- sensor material stress in flexural cantilever and membrane- Application-Inertial, pressure, flow and tactile sensor. Piezoelectric sensing and actuation, Application-Inertial, Acoustic, tactile, flow-surface elastic waves Magnetic actuation- Micro magnetic actuation principle, Deposition of magnetic materials-Design and fabrication of magnetic coil. Polymers in MEMS- polymide, Liquid crystal polymer(LCP)- PDMS – PMMA – Parylene - Flurocorbon, Application-Acceleration, pressure, flow and tactile sensors.

References:-

1. Chang Liu, *Foundations of MEMS,* Pearson Indian Print, 1st Edition, 2012.
2. Gaberiel M. Rebiz, *RF MEMS Theory, Design and Technology,* John Wiley & Sons, 2003.
3. Charles P. Poole and Frank J. Owens, *Introduction to Nanotechnology*, John Wiley & Sons, 2003.
4. Julian W.Gardner and Vijay K. Varadhan, *Microsensors, MEMS and Smart Devices,* John Wiley & Sons, 2001.
5. Tai-Ran Hsu, *MEMS and Micro Systems: Design and Manufacture*, TMH, 2008.
6. Jones T. B. and N. G. Nenadic, *Electromechanics and MEMS*, Cambridge University Press, 2013.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 10* % problems, derivations and proof

Course Outcome:

At the end of the course, students will be able

- *To explain the principle of MEMS and micro fabrication.*
- *To know the essential electrical and mechanical concepts of MEMS.*
- *To study various sensing and actuating technique.*
- *To know about the polymer and optical MEMS*

13.706.3 EMBEDDED SYSTEMS (AT) (Elective IV)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *To have a thorough understanding of the basic structure and design of an Embedded System.*
- *To study the different ways of communicating with I/O devices and standard I/O interfaces.*
- *To study the basics of RTOS for Embedded systems.*
- *To study the programming concepts of Embedded Systems.*

Module – I

Introduction to Embedded Systems– Components of an embedded system hardware– Software embedded into the system

Embedded Processors - CPU architecture of PIC and ARM processors

Design and Development life cycle model - Embedded system design process – Challenges in Embedded system design.

Module – II

Memory - memory technologies – DRAM, SRAM, EPROM, EEPROM – Memory Organizations

I/O Devices – Timer / Counter, Real time clock, ADC and DAC, Keyboards and Displays

DMA – DMA Controllers

Interrupts and Exceptions– Interrupt Controller

Serial Communication Standards and Devices - UART and HDLC, SCI, SPI - Parallel Port Devices - I^2C Bus, CAN Bus, USB Bus, ISA Bus, PCI and PCI-X Bus.

Module – III

Real Time Operating Systems –Structure of OS - Kernel - Process, tasks and threads – Process Management – Memory Management - Interrupt Handling

LINUX OS – Basic Features – File system, Disk partitioning, Software structure.

Inter Process Communication and Synchronization –Signals – Semaphore – Message Queues – Mailboxes – Pipes –Sockets – Remote Procedure Calls (RPCs).

Module – IV

Concepts of Embedded programming –Components for Embedded programs – Assembling, Linking and Loading – Compilation Techniques –Program Optimization

Software Implementation, Testing, Validation, Debugging and Emulation

Design Examples: Burglar Alarm, Software Modem, Telephone Answering Machine.

References:

1. Wayne Wolf, *Computers as Components: Principles of Embedded Computing System Design*, Morgan Kaufman Publishers - Elsevier 3ed
2. Steve Heath, *Embedded Systems Design*, Newnes – Elsevier, 2ed.
3. Tammy Noergaard, *Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers*, Newnes – Elsevier 2ed
4. David E.Simon, *An Embedded Software Primer*, Pearson Education Asia, First Indian Reprint 2000.
5. Frank Vahid and Tony Givargis, *Embedded Systems Design – A Unified Hardware / Software Introduction,* John Wiley, 2002.
6. Rajkamal, *Embedded Systems Architecture, Programming and Design*, TMH, 2003.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, problems based on MATLAB / any other software packages covering the syllabus etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 20* % problems, derivations and proof.

Course Outcome:

At the end of the course, students will have

- *Thorough understanding of the basic structure and design of an Embedded System.*
- *Knowledge on the different ways of communicating with I/O devices and standard I/O interfaces.*
- *Knowledge on the basics of RTOS for Embedded systems and on programming concepts of Embedded Systems.*

13.706.4 LOW POWER VLSI DESIGN (T) (Elective IV)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *To study the concepts on different levels of power estimation and optimization techniques.*
- *To introduce the concept of Low power microelectronics.*
- *To introduce Low voltage technologies and circuits.*
- *To understand circuit and logic styles.*

Module – I

Introduction- Need for low power VLSI chips, Sources of power dissipation, Dynamic power dissipation, Charging and discharging of capacitance, Short circuit current in CMOS circuits, CMOS leakage current, Static current. Power analysis **-** Gate-Level, Architecture level and Data correlation analysis. Monte Carlo Simulation. Probabilistic power analysis.

Module – II

Low voltage CMOS VLSI technology - BiCMOS and SOI CMOS technology.

Power reduction at the circuit level -Transistor and gate sizing, Equivalent pin ordering, Network restructuring and reorganization, Special latches and Flip Flops, Low power digital cell library, Adjustable device threshold voltage-Low voltage circuits-voltage scaling-sub threshold operation of MOSFETs.

Module – III

Power reduction at the logic level - Gate reorganization, Signal gating, Logic encoding, State machine encoding, Precomputation logic Power reduction at the architecture and system level - Power and performance management.

Module – IV

Power reduction at the architecture and system level - Power and performance management, Switching activity reduction, Parallel architecture with voltage reduction, Flow graph transformation. Low power SRAM architectures. Software design for low power architecture. Recent trends in low-power design for mobile and embedded application.

References:

1. Gary K Yeap, *Practical Low Power Digital VLSI Design*, Kluwer academic publishers, 1998.
2. Kaushik Roy, Sharat Prasad*, Low-Power CMOS VLSI design,* John Wiley & Sons, 2000.
3. Anantha P Chandrakasan, Robert W Brodersen,*Low Power Digital CMOS Design*, Kluwer Academic Publications,1995.

4. Kuo J B and Lou J H, —*Low Voltage CMOS VLSI Circuits*‖, John Wiley & Sons,1999.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 25* % problems, derivations and proof.

Course Outcome:

After successful completion of the course, students will be able to

- *Understand the concepts of Low power microelectronics, low voltage technologies logic styles and circuits.*
- *Design chips used for battery-powered systems and high-performance circuits.*

13.706.5 ANTENNA DESIGN (T) (Elective IV)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *Recall the fundamentals of antenna.*
- *Learn different types of antenna and antenna arrays*
- *Understand antenna matching techniques.*
- *Study measurements of different antenna parameters*

Module – I

Introduction to various methods of antenna synthesis such as Schelkunoff Polynomial, Fourier transform, Woodward Lawson. Introduction to antenna analysis methods: Integral equation method, Moment method, Finite Difference Time Domain methods; Applications of these methods to the practical antennas such as dipole, loop, helical, microstrip patch, and PIFA.

Module – II

Various optimization techniques (OT) such as Genetic algorithm, Artificial Intelligence, Fuzzy logic. Comparative analysis of the OT's for particular application and antenna type.

Various impedance matching techniques such as Quarter wavelength transformer, T match, Gamma Match, Omega match, Baluns and Transformers. Analytical comparative study of wire type and aperture type, narrow band and wide band, element and antenna array antennas.

Module – III

Designing an antenna with a set of given specifications using standard software. Material selection for antenna to be designed, understanding the specifications – errors responses – corrections methods. Concepts of antenna coupling, coupling methods, interferences and effects on performance of the antenna system.

Module – IV

Techniques to miniaturize an antenna for wireless LAN and Blue tooth applications, Wide-band and multi-band antennas, Mobile antennas and antenna diversity, Reconfigurable antennas.

Practical consideration in designing antennas for wireless communications (such as the interaction between mobile antenna and human body). Measurement of various antenna parameters necessarily needed for practical antennas. Understanding the working and design of anechoic chamber.

References:

1. Balanis C. A., *Antenna Theory: Design and Applications*, Wiley, 2007.
2. Hohnson R. C. and H. Jasik, *Antenna Engineering Handbooks*, McGraw Hill, 1993.
3. Sadiku N. O. Mathew, *Elements of Electromagnetics*, Oxford Univ. Press, 2001.
4. Harrington R. F., *Time harmonic Electromagnetic Fields*, McGraw Hill, 2005.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 25* % problems, derivations and proof

Course Outcome:

At the end of the course, students will be able to

- *design different types of antenna. and antenna arrays*
- *explain antenna matching techniques.*
- *explain different antenna parameters measurements.*

13.706.6 CRYPTOGRAPHY (T) (Elective IV)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *To understand the mathematical concepts of various Encryption,*
- *To discuss authentication and digital signature algorithms.*
- *To study the design of different general purpose and application specific security Protocols and standards.*

Module – I

Introduction to cryptology- stream and block ciphers- secret and public key cryptography. Mathematical Proof Methods: direct, indirect, by cases, contrapositive, contradiction, induction, existence. Introduction to Complexity of Algorithm- P, NP, NP-Complete classes. Number theory- primes, divisibility, liner diaphantine equations, congruences, system of linear congruences.

Module – II

Wilson theorem, Fermat‘s little theorem, Euler's theorem. Multiplicative functions, Primitive roots, Quadratic congruences- quadratic residues, Legrende symbol.

Review of algebraic structures -groups, rings, finite fields, polynomial rings over finite field.

Module – III

Affine cipher, Hill cipher, Enciphering matrices. Public key cryptography- One way functions- RSA - Discrete Log- Deffie-Helman Key Exchange system, Digital signature standards. Knapsack Crypto system - Zero-knowledge protocols.

Module – IV

Primality testing- pseudo primes- the rho method. Elliptic curves and elliptic curve cryptosystems. Data Encryption standard (DES), Advanced Encryption standard (AES). Cryptanalysis methods- linear, differential, higher order differential, quadratic. Factoring Algorithms- Trial Division, Dixon's Algorithm.

References:

1. Neal Koblitz: *A Course in Number Theory and Cryptography*, 2/e, Springer, 1994.
2. Thomas Koshy: *Elementary Number Theory with Applications*, 2e, Elsevier , 2007.
3. Menezes A, et.al.: *Handbook of Applied Cryptography*, CRC Press, 1996.
4. MR Schroeder: *Number Theory in Science and Communication*, 4/e, Springer, 2005.
5. Niven, Zuckerman: *An Introduction to Theory of Numbers*, 5/e, Wiley InterScience, 1991.
6. Mark Stamp, Richard M Low: *Applied Cryptanalysis,* Wiley Inter Science, 2007.

7. Mao*: Modern Cryptography*, Pearson Education, 2011.
8. Victor Shoup: *A Computational Introduction to Number Theory and Algebra*, 2/e Cambridge University Press, 2009.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 20* % problems, derivations and proof.

Course Outcome:

At the end of the course, students will be able to explain

- *mathematical concepts of various Encryption.*
- *authentication and digital signature algorithms.*
- *design of different general purpose and application specific security Protocols and standards.*

13.707 MICROWAVE & OPTICAL COMMUNICATION LAB (T)

Teaching Scheme: 0(L) - 0(T) - 3(P) **Credits**: 3

Course Objective

- *To understand all basic Microwave and Optical devices and components.*
- *To learn few microwave measurements and analyze parameters.*
- *To understand the principles of fiber-optic communications and the different kind of losses, signal distortion and other signal degradation factors.*
- *To assess the performance of optical communication components.*

List of Experiments:

A. Microwave Experiments:

1. GUNN diode characteristics.
2. Reflex Klystron Mode Characteristics
3. VSWR and Frequency measurement.
4. Verify the relation between Guide wave length, free space wave length and cut off wave length for rectangular wave guide.
5. Measurement of E-plane and H-plane characteristics.
6. Directional Coupler Characteristics.
7. Unknown load impedance measurement using smith chart and verification using transmission line equation.
8. Measurement of dielectric constant for given solid dielectric cell.
9. Antenna Pattern Measurement.

B. Optical Experiments:

1. Measurement of Numerical Aperture of a fiber, after preparing the fiber ends.
2. Preparation of a Splice joint and measurement of the splice loss.
3. Power Vs Current (P-I) characteristics and measure slope efficiency of Laser Diode.
4. Voltage Vs Current (V-I) characteristics of Laser Diode.
5. Power Vs Current (P-I) characteristics and measure slope efficiency of LED.
6. Voltage Vs Current (V-I) characteristics of LED.
7. Characteristics of Photodiode and measure the responsivity.
8. Characteristics of Avalanche Photo Diode (APD) and measure the responsivity.
9. Measurement of fiber characteristics, fiber damage and splice loss/connector loss by OTDR.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on experiments prescribed in the list.

The following guidelines should be followed regarding award of marks

25% - Design and Implementation

50% - Result

25% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

After completion of the course student will be able to

- *understand all basic Microwave and Optical devices and components.*
- *learn few microwave measurements and analyze parameters.*
- *understand the principles of fiber-optic communications and the signal degradation factors.*
- *assess the performance of optical communication components*

13.708 MODELLING AND SIMULATION OF COMMUNICATION SYSTEMS LAB (T)

Teaching Scheme: 0(L) - 0(T) - 3(P) **Credits**: 3

Course Objective :

- *To generate digital modulated signals, detect and evaluate their performance.*
- *To study the performance of error checking and correcting code.*
- *To Simulate a AM, FM, PM and other digital modulation schemes and estimate their performance*

List of Experiments:

Part A: Hardware Experiments:

1. Delta Modulation & Demodulation.
2. PCM (using Op-amp and DAC).
3. BASK (using analog switch) and demodulator.
4. BPSK (using analog switch).
5. BFSK (using analog switch).
6. Error checking and correcting codes.
7. 4 Channel digital multiplexing (using PRBS signal and digital multiplexer).

Part B: Matlab Experiments:

1. Simulate Analog modulation schemes like AM, FM and PM
2. Sampling and reconstruction of signals in time domain and frequency domain
3. Implementation of LMS algorithm.
4. Time delay estimation using correlation function.
5. Simulate Delta modulation and demonstrate the effect of step size for avoiding slope overload error and granular noise
6. Study of eye diagram of PAM transmission system.
7. Generation of QAM signal and constellation graph.
8. Mean Square Error estimation of a signal.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on experiments prescribed in the list.

The following guidelines should be followed regarding award of marks

Circuit and design – 25 % (Logical design and flow diagram in case of software experiments.)

Implementation - 10% (Coding in case of Software experiments.)

Result - 40% (Including debugging of Program in case of Software experiments.)

Viva voce - 25%

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome

After completion of the course student will be able to

- *detect and evaluate the performance of digital modulated signals generated.*
- *study the performance of error checking code.*
- *estimate the performance of simulated AM, FM and other digital modulation schemes.*

13.709 SEMINAR (AT)

Teaching Scheme: 0(L) - 0(T) - 1(P) **Credits**: 1

Course Objective :

- *To do a detailed study of a selected topic based on current journals or published papers and present a seminar based on the study done.*
- *The seminar provides students adequate exposure to public presentations to improve their communication skills.*

The student is expected to present a seminar in one of the current topics in Electronics, Communication, Electronic Instrumentation and related areas based on current publications. The student will undertake a detailed study on the chosen subject and submit a seminar report in a soft bound form at the end of the semester. While preparing the report, at least three cross references must be used. This report shall be submitted for evaluation for the viva-voce in 8th semester. The report shall be endorsed by the Guide, Seminar coordinator and the HOD. Evaluation of presentation and report shall be conducted by a committee of the **Seminar coordinator, Guide and a senior faculty.**

Internal Continuous Assessment *(Maximum Marks-50)*

40% - 20 Marks is to be awarded for the presentation
40% - 20 marks is to be awarded for the report.
20% - 10 marks for the attendance.

Course Outcome:

At the end of the course, the students would have acquired the basic skills to for performing literature survey and paper presentation. This course shall provide students better communication skills.

13.710 PROJECT DESIGN (AT)

Teaching Scheme: 0(L) - 1(T) - 0(P) **Credits**: 1

Course Objective :

- *To identify a problem for the final-year project, outline a solution, and prepare a preliminary design for the solution.*
- *To improve the ability to perform as an individual as well as a team member in completing a project work.*

The student is expected to select a project in one of the current topics in Electronics, Communication, Electronic Instrumentation and related areas based on current publications. He/She shall complete the design of the project work and submit the design phase report. This shall be in soft bound form. This report shall be submitted for evaluation in 7th semester as well as for the viva-voce in 8th semester. The report shall be endorsed by the Guide, Project coordinator and the HOD. Evaluation of report and viva will be conducted by a committee consisting of the **Project coordinator, Guide and a senior faculty.** The number of students in a project batch shall be limited to a **maximum of four**.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - 20 Marks is to be awarded for the Viva Voce
50% - 20 Marks is to be awarded for the report.
20% - 10 marks for the attendance

Course Outcome:

At the end of the course, the students would have acquired the basic skills to for performing literature survey and paper presentation. This course shall provide students better communication skills and improve their leadership quality as well as the ability to work in groups, and thus aid them in building a successful career as an engineer.