DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING, MIT Manipal

M.Tech. DIGITAL ELECTRONICS & COMMUNICATION ENGINEERING

Program Structure (Applicable to 2019 admission onwards)

Year	FIRST SEMESTER						SECOND SEMESTER					
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
I	MAT 5151	Probability, Random Variables and Stochastic Processes	4	0	0	4	ECE 5251	Optical Communication	4	0	0	4
	HUM 5151	Research Methodology and Technical Communication	1	0	3	2	ECE 5253	Wireless Communication	4	0	0	4
	ECE 5151	Communication Networks and Protocols	4	0	0	4	ECE ****	Elective I	4	0	0	4
	ECE 5152	Digital VLSI Design	4	0	0	4	ECE ****	Elective II	4	0	0	4
	ECE 5153	Modern Digital Communication	4	0	0	4	ECE ****	Elective III	4	0	0	4
	ECE 5154	Processor Architecture and Applications	4	0	0	4	*** ****	Open Elective	3	0	0	3
	ECE 5161	Digital Electronics and Communication Lab	0	0	6	2	ECE 5261	Research Lab	0	0	6	2
	ECE 5162	Networks Lab	0	0	3	1						
		Total	**21**	**0**	**12**	**25**		**Total**	**23**	**0**	**6**	**25**
II	**THIRD AND FOURTH SEMESTER**											
	ECE 6098	Project Work							0	0	0	25
								Total	0	0	0	**25**

PROGRAM ELECTIVES					
ECE 5001	Advanced Digital Signal Processing	ECE 5010	Digital Speech Processing	ECE 5019	Radar Systems
ECE 5002	Advances in Circuit Elements	ECE 5011	Embedded System Design	ECE 5020	RF Microelectronics Chip Design
ECE 5003	Analog VLSI for Signal Processing	ECE 5012	High Speed Digital Design	ECE 5021	Semiconductor Device Physics
ECE 5004	Cad Tools for VLSI	ECE 5013	Large Area Micro Electronics	ECE 5022	Spread Spectrum Communication
ECE 5005	Coding Theory	ECE 5014	Mems Technology	ECE 5023	System on Chip Design
ECE 5006	Cryptography and Network Security	ECE 5015	Microwave and Millimeter Wave Antenna	ECE 5024	Time-Frequency and Wavelet Transforms
ECE 5007	Data Compression	ECE 5016	Nanophotonics	ECE 5025	VLSI Physical Design and Verification
ECE 5008	Detection and Estimation Theory	ECE 5017	Nonlinear Fiber Optics	ECE 5026	VLSI Testing and Testability
ECE 5009	Digital Image Processing	ECE 5018	Quantum Information Science	ECE 5027	Printed Electronics

OPEN ELECTIVES			
ECE 5051	ARM Processor and Applications	ECE 5053	Neural Networks and Fuzzy Logic
ECE 5052	Nano Electronics		

SEMESTER I

MAT 5151 PROBABILITY, RANDOM VARIABLES AND STOCHASTIC PROCESSES [4 0 0 4]

Statistical Inference: Random Sampling, Sampling distributions, Parameter Estimation and Hypothesis Testing, Regression, Correlation and Analysis of Variance - Examples.
Static probabilities, Dynamic probability. Classification of states, chains of Markov process. Stability of Markov systems, limiting behavior, random walk.
Poisson Processes: assumptions and derivations, related distributions, birth and death processes. Queuing System, general concepts, Model M/M/1 and M/M/S, steady state behavior, transient behavior.

References:

1. Hogg & Craig (1975), "Introduction to Mathematical Statistics", 4th Edn., MacMillan,
2. J.Medhi, "Stochastic Processes".
3. A. Papoulis and S.U. Pillai, Probability, Random Variables and Stochastic Processes, McGraw Hill, 2002.
4. P. Z. Peebles Jr., Probability, Random Variables and Random Signal Principles, McGraw Hill International Edition, 2001, Singapore.

HUM 5151 RESEARCH METHODOLOGY AND TECHNICAL PRESENTATION [1 0 3 2]

Mechanics of Research Methodology: Basic concepts: Types of research, Significance of research, Research framework, Case study method, Experimental method, Sources of data, Data collection using questionnaire, Interviewing, and experimentation. Research formulation: Components, selection and formulation of a research problem, Objectives of formulation, and Criteria of a good research problem. Research hypothesis: Criterion for hypothesis construction, Nature of hypothesis, need for having a working hypothesis, Characteristics and Types of hypothesis, Procedure for hypothesis testing, Sampling methods- Introduction to various sampling methods and their applications. Data Analysis: Sources of data, Collection of data, Measurement and scaling technique, and Different techniques of Data analysis. Thesis Writing and Journal Publication: thesis writing, journal and conference papers writing, IEEE and Harvard styles of referencing, Effective Presentation, Copyrights, and avoiding plagiarism.

References:

1. Dr Ranjit Kumar, Research Methodology, A Step-by-Step Guide for Beginners, SAGE, 2005.
2. Geoffrey R. Marczyk, David DeMatteo& David Festinger, Essentials of Research Design and Methodology, John Wiley & Sons, 2004.
3. John W. Creswel , Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, SAGE, 2004
4. Suresh C. Sinha and Anil K. Dhiman, Research Methodology, (2 Vols-Set), Vedam Books, 2006.
5. C. R. Kothari, Research Methodology: Methods and Techniques, New Age International Publisher, 2008.
6. Donald R Cooper & Pamela S Schindler, Business Research Methods, McGraw Hill International, 2007.
7. R. Pannershelvam, Research Methodology, Prentice Hall, India, 2006
8. Manfred Max Bergman, Mixed Methods Research, SAGE Books, 2006.
9. Paul S. Gray, John B. Williamson, David A. Karp, John R. Dalphin, The Research Imagination, Cambridge University press, 2007.
10. Cochrain& Cox, Experimental Designs, II Edn. Wiley Publishers, 2006.

ECE 5151 COMMUNICATION NETWORKS AND PROTOCOLS[4 0 0 4]

Network Services and Layered Architecture. Packet Switched Network. Asynchronous Transfer Mode: Classical IP over ATM. Wireless Networks: Wireless Channel: Path loss, fading, Inter symbol Interference, Doppler frequency shift, Capacity limits. Optical Networks. single hop and Multi hop LAN, SONET/SDH

References:

1. JeanWalrand, Pravin Varia, High Performance Communication Networks, 2nd edition, 2009.
2. Behrouz. A, Forouzan, Data Communication and Networking, Tata McGrawHill,2008
3. Albert Leon-Garcia, IndraWidjaja, Communication Networks: Fundamental Concepts and Key Architectures, Tata McGraw –Hill 2nd Edition, 2004
4. Sumit Kasera and Pankaj Sethi, ATM Networks Concept and Protocol, Tata McGraw Hill Publication, 2006.
5. Rajiv Ramaswami, Kumar N. Optical Networks, Morgan Kaufmann Publishers 2nd Edition, 2008.

ECE 5152 DIGITAL VLSI DESIGN [4 0 0 4]

MOS Transistor theory, Inverters, Digital circuit design, VLSI Fabrication and Layouts, CMOS/Bulk technology, SOI technology. Basic circuit concepts and performance estimation: Design Margins and Reliability; Pseudo-NMOS circuits, Dynamic CMOS logic, Domino CMOS structure and design, CCMOS, BiCMOS; Subsystems and Building Blocks; Semiconductor memories. Interconnects in VLSI

References:

1. Neil Weste and K. Eshragian, Principles of CMOS VLSI Design: A System Perspective, Pearson Education, 2000.
2. Jan M, Rabaey, et al, Digital Integrated Circuits: A Design Perspective, Prentice Hall, 2003.
3. Wayne, Wolf, Modern VLSI design: System on Silicon Pearson Education, 2005.
4. Sung, Mo Kang and YosufLeblebici, CMOS Digital Integrated Circuits: Analysis and Design, TMH, 2003
5. Douglas A Pucknell and Kamran Eshraghian, Basic VLSI Design PHI, 2005.

ECE 5153 MODERN DIGITAL COMMUNICATION [4 0 0 4]

Characterization of Signals and Systems, Memory and Memoryless Modulation, Optimum Receivers for AWGN channels. Performance of Digital Modulation Techniques, Channel Estimation and Equalization. Synchronization techniques.Convolutional codes, Viterbi algorithm, sequential decoding algorithms, performance with soft and hard decoding,TCM and Turbo coding techniques. Modulation and Diversity reception techniques to counter fading, space- time coding techniques.

References:

1. Proakis. J. G.: MasoudSalehi, Digital communications, McGraw Hill publication,2007
2. Sklar B,:Digital Communication: Fundamentals & Applications, Pearson Education,2001.
3. Rodger E Zeimer , Wiiliam H Tranter, Principles of Communication: system, modulation, noise, Wiley Publication, 2007
4. Simon Haykin, Digital Communication, Wiley student edition, 2006
5. M.Sathish Kumar, Digital Communication, PHI Learning, 2019

ECE 5154 PROCESSOR ARCHITECTURE AND APPLICATIONS [4 0 0 4]

Processor Data Path and Control, Pipelining, pipeline hazards, Memory hierarchy, Memory and I/O interface, multiprocessors, parallel processors, performance, Digital Signal Processors, architecture and applications

References:

1. David A.Patterson& John L.Hennessy, Computer Organization and Design-The Hardware/Software Interface, Third Edition, Elsevier, 2005
2. John L.Hennessy and David A.Patterson, Computer Architecture-A Quantitative Approach, Fourth Edition, Elsevier, 2007
3. Phil Lapsley,DSP Processor Fundamentals, IEEE Press, 1997
4. Sen M. Kuo, Woon-Seng Gan Digital Signal Processors, Pearson, 2005
5. Andrew N.Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide Elsevier, 2004

ECE 5161 DIGITAL ELECTRONICS AND COMMUNICATION LAB [0 0 6 2]

Communication experiments using Matlab, HFSS, and OptSimand LabVIEW. Experiments using universal software radio peripheral (USRP) transceivers for prototyping wireless communication systems.

ECE 5162 NETWORKS LAB [0 0 3 1]

Experiments are conducted using Simulators like QualNet, NS2 and NS3. To simulate the Network Protocols, Mobile Ad hoc Network Protocols, Wireless Sensor Networks Protocols.

SEMESTER II

ECE 5253 WIRELESS COMMUNICATION [4 0 0 4]

Modeling of wireless channels, Wide-sense stationary uncorrelated scattering assumption; characterizing key parameters of wireless channels, wireless channel discretization and discrete-time representation. Non-coherent and coherent reception. Time and Frequency diversity. Rake receiver. Channel capacity; Data transmission using multiple carriers and challenges. OFDM, challenges in multicarrier modulation, MIMO systems and space time coding, smart antennas.

References:

1. Goldsmith, Andrea. Wireless communications. Cambridge university press, 2005.
2. D. Tse and P. Vishwanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005
3. T. S. Rappaport, Wireless Communication: Principles and Practice, Pearson, 2002
4. J. G. Proakis and M. Salehi, Digital Communications, McGraw-Hill, 2008
5. K. Fazel and S. Kaiser, Multicarrier and Spread Spectrum Systems, Wiley, 2003

ECE 5251 OPTICAL COMMUNICATION [4 0 0 4]

Planar dielectric waveguides: Step and graded index fibers. Hi-Bi fibers. Distortion of optical pulses propagating through fibers. Fiber amplifiers; EDFA, SOA. Advanced modulation and demodulation formats for optical fiber communications: coherent detection of ASK, FSK and PSK. Optical DQPSK, DOPSK and QAM. Multiplexing techniques. Multiplexing techniques. Wave propagation through anisotropic media. Non-linear fiber optics

References:

1. G. Keiser, Optical Fiber Communications, Tata McGraw Hill, New Delhi, 2010.
2. M. Sathish Kumar, Fundamentals of Optical Fiber Communication, Prentice Hall of India, New Delhi, 2nd ed., 2014
3. A. Ghatak and K. Thyagarajan, Optical Electronics, Cambridge University Press, NY, 1989
4. G. P, Agrawal, Nonlinear Fiber Optics, Elsevier, 4th ed., 2010

ECE 5261 RESEARCH LAB [0 0 6 2]

Student is assigned under a Faculty for specific research area like VLSI, Signal Processing, Wireless communication, Real time embedded systems, Biomedical engineering. Students are evaluated based on synopsis presentation, mid-term and final evaluation along with report. The evaluation is conducted by the assigned Faculty in consultation with program coordinator and lab coordinator.

ECE 5001 ADVANCED DIGITAL SIGNAL PROCESSING [4 0 0 4]

Signals, Multi-rate Systems, Interpolated FIR Filters for Decimation and Interpolation Filters, Quadrature Mirror Filter Bank (QMF), Half band and multiband filters, PR systems. Principle of Adaptive filters, Tapped Delay Line and Weiner Filters, Steepest Descent Algorithm, LMS Algorithm. Homomorphic system, Complex Cepstrum, Hilbert transform, Homomorphic systems, applications. Discrete-time random processes, Signal modeling, Spectrum estimation.

References:

1. J. G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, 4/e, Pearson Education, 2007.
2. P. P Vaidyanathan, Multirate Systems And Filter Banks, Prentice Hall, India,1993.
3. A.V Oppenheim.and R.W.Schafer, Digital Signal Processing, Prentice Hall, 1992.
4. S. J Orfanidis, Optimum Signal Processing, Mc GrawHill , NJ ,2007.
5. M H Hayes, Statistical signal processing and modeling, John Wiley &Sons, Inc, 2002,

ECE 5002 ADVANCES IN CIRCUIT ELEMENTS [4 0 0 4]

Fundamental circuit elements, Gyrator, Emulation of grounded and floating inductor, Emulation of negative circuit elements, New circuit elements: Frequency Dependent Negative Resistor, Constant Phase Element, Fractional Order Elements - Fractional Order Capacitor, Fractional Order Inductor, Memristor: modeling. Emulation and applications

References:

1. Georgia Tsirimokou, Costas Psychalinos, Ahmed Elwakil, Design of CMOS Analog Integrated Fractional-Order Circuits: Applications in Medicine and Biology, Springer, May 2017.
2. AlekseiTepljakov, Fractional-order Modeling and Control of Dynamic Systems, Springer Thesis, 2017.
3. Vourkas, Ioannis, Sirakoulis, Georgios, Memristor Based Nanoelectronic Computing Circuits and Architectures, Springer Publishers, 2016.
4. Vaidyanathan, Sundarapandian, Volos, Christos, Advances in Memristors, Memristive Devices and Systems, Springer Publishers, 2017.
5. Biswas, K., Bohannan, G., Caponetto, R., Mendes Lopes, A., Tenreiro Machado, J.A., Fractional-Order Devices, Springer Publishers, 2017.

PROGRAM ELECTIVES

ECE 5003 ANALOG VLSI FOR SIGNAL PROCESSING [4 0 0 4]

Basic CMOS Circuit Techniques, Continuous- Time Signal Processing. Low Voltage Signal Processing. Current- Mode Signal Processing: Continuous- Time Signal Processing, Sampled-Data Signal Processing, Switched-Current Data Converters. Analog Filters. Statistical Modeling and Simulation, Correlations and Principal Component Analysis, Statistical device Modeling, Statistical Circuit Simulation, Analog Layout.

References:

1. Mohammed Ismail, Analog VLSI : Signal and Information Processing, McGraw-Hill, 1994.
2. R.Schaumann, M.S.Ghausi, Kenneth R Laker, Design of Analog Filters Passive, Active RC, and Switched Capacitor, Prentice Hall, 1995.
3. T Deliyanis, Y.Sun and J.K.Fidler, Continuous-Time Active Filter Design, CRC Press,1999.
4. P.V.Anand Mohan, Current-mode VLSI Analog Filters: Design and Applications, Birkhauser, 2003.

ECE 5004 CAD TOOLS FOR VLSI [4 0 0 4]

Graph Theory, Graph optimization Problems and Algorithms. Programmable logic devices, FPGA Classification. Architectural Synthesis, Scheduling, Different types of scheduling with and without resource constraint algorithms. Two level combinational logic synthesis and optimization; Exact and heuristic method. Fault Simulation- Automatic test pattern generation (ATPG) techniques, Design for Testability.

References:

1. Giovanni De Michelli: Synthesis and Optimisation of Digital Circuits, Tata-McGraw Hill, New Delhi,2008.
2. Gary D. Hachtel, Fabio Somenzi, Logic Synthesis and Verification Algorithm, Kluwer Academic Publication, Boston,2002.
3. M.J.S.Smith, Application Specific ICs, Addison Wesley,2002.

ECE 5005 CODING THEORY [4 0 0 4]

Information – entropy, information rate, classification of codes, text, audio and speech coding. source coding: image and video. Error control coding: block codes, cyclic codes; syndrome calculation, encoder and decoder, CRC, convolutional codes; sequential search and Viterbi algorithm; turbo coding.

References:

1. R Bose, Information Theory, Coding and Cryptography, TMH 2007
2. Fred Halsall, Multimedia Communications: Applications, Networks, Protocols and Standards, Pearson Education Asia, 2002
3. S Gravano, Introduction to Error Control Codes, Oxford University Press 2007
4. Mark Nelson, Data Compression Book, BPB Publication 1992.
5. Watkinson J, Compression in Video and Audio, Focal Press, London, 1995.

ECE 5006 CRYPTOGRAPHY & NETWORK SECURITY [4 0 0 4]

Classical Encryption Techniques. Public-Key Cryptography and RSA.Key Management and Distribution: Wireless Network Security: Security Technology Firewalls and VPNs; Access control. Firewalls. Virtual Private Networks. Intrusion Detection and Prevention Systems. Honeypots, Honey-nets and Padded cell systems. Scanning and analysis tools. Biometric access controls

References:

1. William Stallings, Cryptography and Network Security, Pearson 6th edition. 2004
2. M. E. Whitman and Herbert J. Mattored, Principles of Information Security, Information Security Professional, Fourth edition. ,2011.
3 .K. Pachghare, Cryptography and Information Security. PHI Learning, 2015

ECE 5007 DATA COMPRESSION [4 0 0 4]

Compression techniques, modeling and coding. Information theory and coding; Prediction with partial match, the Burrows-Wheeler transform, CALIC, JPEG-LS, multi resolution approaches, Facsimile encoding. Distortion criteria, models, The quantization problem, Vector spaces, image compression and audio compression techniques. Filters, sub band coding algorithms, bit allocation, Application to speech coding, audio coding, and image compression, wavelets.

References:

1. Khalid Sayood, Introduction to Data Compression, Addison Wesley. 2000.
2. David Salomon,Data Compression, 2nd Edn., Springer,2000.
3. Toby Berger, Rate Distortion Theory: A Mathematical Basis for Data Compression,PrenticeHall, 1971.
4. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory, John Wiley & Sons, Inc,1991.
5. Ali N. Akansu, Richard A. Haddad, Multi resolution signal decomposition: Transforms, Subbands and Wavelets, Academic Press, 1992.

ECE 5008 DETECTION & ESTIMATION THEORY [4 0 0 4]

Classical detection and estimation theory and techniques, Qualities of good estimators, Cramer-Rao bound. Signal representation; Karhunen-Loeve series expansion method. Detection of signals and signal parameter estimation. Applications to binary digital communication systems. Signal detection in discrete time. Estimation of signal parameters; Detection of signals in colored noise. Filtering techniques, Wiener-Hopf equations.

References:

1. Vincent Poor H, An Introduction to Signal Detection and Estimation, Springer, Second Edition, 1994
2. Van Trees H L, Detection Estimation and Modulation Theory – Part I,JohnWiley, New York, 2002.
3. MouradBarkat,Signal Detection and Estimation, Artech House, Second Edition, 2005

ECE 5009 DIGITAL IMAGE PROCESSING [4 0 0 4]

Image Acquisition System, Image Sampling and Quantization; Color Models, Pseudo and Full-Color Image processing; Point Processing, Spatial operations, Smoothing and sharpening spatial filters. 2D DFT; Transform Operations, Smoothing and sharpening using frequency domain filters, Homomorphic Filtering. Image Degradation / Restoration Process, Detection of Discontinuities, Image Compression and standards, Wavelets and its applications in Image Processing.

References:

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson, 2008.
2. Anil K Jain, Fundamentals of Digital Image Processing, Pearson, 2001
3. W. K. Pratt, Digital Image Processing, Wiley 2010

ECE 5010 DIGITAL SPEECH PROCESSING [4 0 0 4]

Anatomy and Physiology of speech production, Acoustic theory of speech production, Uniform lossless tube model, Effects of losses in the vocal tract, Digital models for speech signals. Time-dependent processing of speech; Short time Auto-correlation, Pitch period estimation. Short Time Fourier Transform Analysis, Speech redundancies, Speech Synthesis, Feature Extraction; Artificial Neural Networks for speech recognition.

References:

1. Rabiner L.R, Schaffer R.W, Digital Processing of Speech Signals, Prentice Hall, NJ, 2007.
2. Thomas F. Quatieri, Discrete-time Speech Signal Processing-Principles and Practice, Pearson Education Inc, 2004.
3. Douglas O' Shaughnessy, Speech Communications: Human and Machine Reading, Addison-Wesley. 2nd edition, 1999.
4. Deller J.R, Proakis G.J and Hansen J.H.L, Discrete Time Processing of Speech Signals, IEEE Press. 2000.
5. Rabiner L.R and Jaung, Fundamentals of Speech Recognition, Prentice Hall. 1993.

ECE 5011 EMBEDDED SYSTEM DESIGN [4 0 0 4]

Characteristics, Classification, Model of embedded system. Embedded hardware; Embedded Firmware design and development. Hardware-Software Co-Design. Computational models, Unified modelling language, Hardware software trade-offs. Operating systems, Inter process communication, Task synchronization, Semaphores, Priority inversion, Device drivers, Scheduling algorithms. Packaging, Enclosure design and development. Embedded Product Development Life Cycle.

References:

1. Shibu K.V. Introduction to Embedded Systems, Tata McGraw Hill, 2009
2. Lyla.B.Das,Embedded Systems, An Integrated Approach, Pearson Ed, 2013
3. Abraham Silberschatz,Peter Baer Galvin and Greg Gagne, Operating System Concepts, 7th Edition Wiley Higher Education, 2005
4. Hermann Kopetz, Real-time systems: design principles for distributed embedded applications, Kluwer Academic publishers, 2002

ECE 5012 HIGH SPEED DIGITAL DESIGN [4 0 0 4]

High speed logic gates;Measurement Techniques. Transmission Lines: Shortcomings of ordinary point-to-point wiring, effects of source and load impedance, Ground Planes and Layer Stacking; Terminations and Vias; Power Systems: distribution problems. Connectors, Special Connectors, Ribbon Cable.Clock Distribution, Using canned clock oscillators, Clock jitter

References:

1. Howard Johnson, Martin Graham, High-Speed Digital Design, A handbook of black magic, Pearson Education, 2008.
2. Stephen H. Hall & Howard L. Heck, Advanced Signal Integrity for High-Speed Digital Designs, John Wiley & Sons, 2009
3. William J Dally & John W Poulton, Digital Systems Engineering, Cambridge University Press, 1998
4. Eric Bogatin, Signal and Power Integrity- Simplified, 2ndEdition, Prentice Hall, 2010

ECE 5014 MEMS TECHNOLOGY [4 0 0 4]

Background of MEMS, Bulk micromachining, surface micromachining, Micro-cantilevers, design of MEMS sensors, RF MEMS devises, Biosensors, MEMS device packaging

References:

1. Stephen D.Senturia Microsystem design, Kluwer Academic publications, 2001
2. Marc Madou, Fundamentals of Microfabrication, CRC Press, 1997
3. H.Bao, Micromechnanical Transducers: pressure sensors, accelerometers, and gyroscopes, Elsevier, NewYork 2000
4. Gabriel M Rebeiz, RF MEMS Theory, design and technology. Wiley Inter science,2003
5. Sergey Y. Yurish, Mearia Teresa S.R.Gomes, Smart sensors and MEMS, Kluwer Academic Publishers, 2003

ECE 5013 LARGE AREA MICRO ELECTRONICS [4 0 0 4]

Non-crystalline semi-conductor basics, Difference between, amorphous, polycrystalline and micro /nano crystalline hydrogenated silicon (a-Si:H), Thin Film transistor, LEDs, Large Area Image Sensor Arrays, Thin Film Position Sensitive Detectors. Field emission displays. Introduction to organic semiconductors - structure and geometry, stretchable and conformal electronics.

References:

1. Richard Zallen, The Physics of Amorphous solids, Wiley, 2007.
2. Sanjiv Sambandan, CIRCUIT DESIGN- Techniques for Non-CrystallineSemiconductors, CRC press, 2013.
3. Robert A. Street , Technology and Applications of Amorphous Silicon,. Springer-Verlag New York, LLC Series: Series in Materials Science, 2004.
4. A.Madan & M.P.Shaw, The Physics and Technology of Amorphous silicon, Elsevier Science & Technology books, 2012.
5. Takao Someya, Stretchable Electronics, Wiley-VCH; 1Edition, January 29, 2013.

ECE 5015 MICROWAVE AND MILLIMETER WAVE ANTENNA [4 0 0 4]

Millimeter Wave Technology, Microwave and Millimeter Wave Systems, Guiding Structures, Metamaterials. Millimeter Wave Antennas: Path Loss and Antenna Directivity, Antenna Beam width, Maximum Possible Gain-to-Q, Polarization, Beam Steering Antenna, Millimeter Wave Design Consideration, Millimeter Wave Propagation, Fifth-generation systems

References:

1. Duixian Liu, Ulrich Pfeiffer, JanuszGrzyb and Brian Gaucher, Advanced Millimetre-wave Technologies: Antennas, Packaging and Circuits , Wiley, 2009
2. Sergey M. Smolskiy, Leonid A. Belov and Victor N. Kochemasov, Handbook of RF, Microwave, and Millimetre-Wave Components, Artech House Microwave Library, 2013
3. Kao-Cheng Huang, Zhaocheng Wang, Millimetre Wave Communication Systems, Wiley, 2011
4. Shiban K. Koul, Millimetre Wave and Optical Dielectric Integrated Guides and Circuits, Wiley-Inter science, 1st edition, 200.
5. David M. Pozar, Microwave and RF Design of Wireless Systems, Wiley, 2000.

ECE 5016 NANO PHOTONICS [4 0 0 4]

Light generation by nanostructures, semiconductor quantum wells, nanocrystals, nanowires.

Light propagation in nano structures, Photonic crystals, dielectric periodic structures. Surface Plasmon, transmission through sub wave

length hole, sub wave length waveguides. Near-field optics, Nano-photonics.

References:

1. Lukas Novotny and Bert Hecht, Principles of Nano-Optics, Cambridge University Press, 2012.
2. HerveRigneault, Jean-Michel Lourtioz, Claude Delalande and Juan Ariel Levenson, Nanophotonics, Wiley, 2006.
3. Mark L. Brongersma and Pieter G. Kik, Surface Plasmon Nanophotonics, Springer, 2006.
4. P.N. Prasad, Nanophotonics, Wiley-Interscience, 2003
5. John D. Joannopoulos, Robert D. Meade and Joshua N. Winn, Photonic Crystals, MIT Press, 2007

ECE 5017 NONLINEAR FIBER OPTICS [4 0 0 4]

Nonlinear optical effects in crystals. Pulse propagation through optical fibers. Third order dispersion, dispersion management. SPM induced spectral broadening, higher order nonlinear effects, optical solitons, XPM. Stimulated Raman and Brillouin scattering. Parametric processes.

References:

1. G. P. Agarwal, Nonlinear Fiber Optics, Academic Press, 2007.
2. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, 2007
3. G. P. Agarwal, Applications of Nonlinear Fiber Optics, Academic Press 2008.
4. R. W. Boyd, Nonlinear Optics, Academic Press 2008

ECE 5018 QUANTUM INFORMATION SCIENCE [4 0 0 4]

Classical Computation, Turing Machines and Circuits, Information, Erasure, Reversibility.

Single Quantum Bits. Multiple Quantum Bits, Entanglement. Measurements, EPR-Bell Theorem. Quantum Transformations: Reversible Gates, Quantum Circuit Model. Quantum Algorithms: Deutch-Jozsa's and Simon's Problems, Subsystems. Error Corrections.

References:

1. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2014 (Paperback edition).
2. Giuliano Benenti, Giulio Casati, and Giuliano Strini, Principles of Quantum Computation and Information, Volumes I and II,World Scientific, 2004.
3. Kaye, Laflamme, and Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
4. Nielsen and Chuang, Quantum Computation and Quantum Information, 10th Anniversary Edition, Cambridge University Press, 2011.

ECE 5019 RADAR SYSTEMS [4 0 0 4]

Radar theory, range equation, transmitters, antennas. Tracking radar, detection and extraction, SNR. Duplexers, Doppler effect, High resolution radars. Electronic counter measure, Case studies.

References:

1. M.I.Skolnik, Introduction to Radar Systems, 3rd Ed., McGraw Hill, 2003.
2. Peyton Z. Peebles Jr., Radar Principles, John Wiley, 2004.
3. Edde Byron, Radar: Principles, Technology, Applications, Prentice-Hall education, 2004.
4. David Barton, Radar system analyses and Modeling, Artech house, 2005.

ECE 5020 RF MICROELECTRONICS CHIP DESIGN [4 0 0 4]

RF circuit design, Basic RF modules, Passive and active RF components, RF power amplifier, impedance matching, low noise amplifier (LNA), RF Filters, oscillators, mixers, modulators, detectors, and synthesizers.

References:

1. Thomas H. Lee Design of CMOS Radio-Frequency Integrated Circuits Cambridge University press, 2003.
2. Behzad Razavi RF Microelectronics, Prentice Hall International Publisher, 1998.
3. W. Alan Davis, Krishna K. Agarwal, Radio Frequency Circuit Design, John Wiley & Sons Inc., 2001. Cotter W. Sayre
4. Complete Wireless Design, McGraw-Hill Professional Publisher, 2008.
5. John M. W. Rogers, John W. M. Rogers, Calvin Plett, Radio Frequency Integrated Circuit Design ,Artech House Publishers, 2010.

ECE 5021 SEMICONDUCTOR DEVICE PHYSICS [4 0 0 4]

Review of Quantum mechanics, crystalline solids and energy bands, Fundamentals of semiconductor physics, Device Physics - Diode, Schottky diode, Tunnel diode, Transistors; MOS Structures, Semiconductor measurements.

References:

1. S. Selberherr, Analysis and Simulation of Semiconductor Devices, Springer-Verlag, 1984.
2. J. P. McKelvey, Introduction to Solid State and Semiconductor Physics, Harper and Row and John Weathe Hill, 1966.
3. D.K. Schroder, Semiconductor Material and Device Characterization, John Wiley, 1990.
4. S. M. Sze, Physics of Semiconductor Devices, 2nd edition John Wiley, 1981.
5. M AAchuthan& K N Bhat, Fundamentals of Semiconductor Devices Tata Mc Graw Hill.

ECE 5022 SPREAD SPECTRUM COMMUNICATION [4 0 0 4]

Direct sequence and frequency hop spread spectrum systems. Hybrid direct sequence/frequency hop spread spectrum. Sequence generators. Spread spectrum communication system model, diversity reception in fading channels, cellular radio concept, single and multicarrier CDMA.

References:

1. R. L. Peterson, R. E. Zeimer and D. E. Borth, Introduction to Spread Spectrum Communications, Pearson, 1995.
2. J. D. Proakis & M. Salehi, Digital Communication, McGraw Hill, 2008.
3. A. J. Viterbi, CDMA: Principles of Spread Spectrum Communications, Addision Wesley, 1995.
4. S. Verdu, Multiuser Detection, Cambridge University Press, 1998

ECE 5023 SYSTEM ON CHIP DESIGN [4 0 0 4]

SoC architecture, design issues; SoC design flow; logic cores, memory and analog cores; Design validation, Testing, embedded memories, analog and mixed signal core. Low power architecture, Subsystem design principles, Floor planning, Off- chip connections, RTL design, High level synthesis, System on –chips Embedded CPUs, Hardware/ Software Co –Design.

References:

1. RochitRajsuman, System – on – a – Chip Design and test, Artech House, Bosten , London, ed., 2000
2. Peter J. Ashenden, Jean P. Mermet, Ralf Seepold, System-on-chip

methodologies & design languages, Boston: Kluwer Academic Publishers, 2001
3. Wayne Wolf, Modern VLSI Design: System - on- Chip Design, Pearson, 2005
4. Michael Keating, Pierre Bricaud, Reuse methodology manual for system-on-a- chip designs, Boston: Kluwer Academic Publishers, 2001
5. Steve Furber, ARM System-on-Chip Architecture, 2nd Edition, Additon-Wesley professional, 2001.

ECE 5024 TIME-FREQUENCY AND WAVELET TRANSFORMS [4 0 0 4]

Time-frequency analysis and wavelet transforms. STFT. Two-channel filter bank and analysis, Quadrature mirror and conjugate quadrature filters, Haar transforms. Daubechies four-coefficient wavelet. Sampling. CWT, DWT, filter banks: Signal decomposition. parametric wavelets, Orthogonality conditions and parameterization, poly phase matrix and recurrence relation. Biorthogonal wavelets, Applications.

References:

1. P. S Addison, The illustrated Wavelet transform Handbook, Institute of Physics Publishing, 2002.
2. C S Burrus, A Gopinath, and HaitaoGuo, Introduction to wavelets and wavelet transforms, Prentice-Hall, 1998.
3. K P Soman and K. I. Ramachandran, Insight into Wavelets from theory to practice, Prentice-Hall of India, 2005.

ECE 5025 VLSI PHYSICAL DESIGN AND VERIFICATION [4 0 0 4]

ASICs, design flow, Transistor resistance and capacitance, timing analysis; Synopsys Prime time tool for STA, Clock tree Synthesis, Power grid analysis. Physical design, Algorithms for design automation, Clustering, System partitioning. Chip planning, Floor Planning, Placement & Routing, Algorithms, Transmission line effects and Interconnect modeling. Verification, Verilog scheduling and execution semantics. Combinational equivalence checking, modeling sequential systems, model checking, Simulator architectures.

References:

1. Weste N. and Harris D, CMOS VLSI Design: A Circuits and Systems Perspective, 4th ed. Pearson, 2010.
2. S. Sait, H. Youssef, VLSI Physical Design Automation: Theory and Practice, World Scientific, 1999
3. William K. Lam, Hardware Design Verification: Simulation and Formal Method-Based Approaches, Prentice hall PTR, 2005
4. Pallab Dasgupta, A Roadmap for Formal Property Verification, Springer, Neetherland, 2006
5. Smith M.J.S, Application Specific Integrated Circuits, Addison Wesley, 1997

ECE 5026 VLSI TESTING & TESTABILITY [4 0 0 4]

Digital and analog testing, Controllability and observability, Design-for-test, Test process and ATE, Fault modeling. Testing of combinational and sequential circuits. Test optimization and fault coverage. Testability - adhoc and structured approaches, Boundary scan. Signatures and Built-in self test, Reed-Muller and spectral coefficients, Signature analysis and Onlineself test.

References:

1. M. L. Bushnell and V. D. Agrawal, Essentials of testing for digital, memory and mixed-signal VLSI circuits, Boston: Kluwer Academic Publishers, 2013.
2. Miczo, Digital Logic Testing and simulation. New York: Harper & Row, 2003.
3. P. K. Lala, Fault Tolerant & Fault Testable hardware Design, BS Publications, 2013
4. Stanley L. Hurst, VLSI Testing: digital and mixed analogue digital techniques, Inspec/IEEE, 1999.
5. M. Abramovici, M. A. Breuer, and A.D. Friedman, Digital Systems Testing and Testable Design, IEEE Press, 1994

OPEN ELECTIVES

ECE 5051 ARM PROCESSOR AND APPLICATIONS [3 0 0 3]

ARM Embedded systems, Processor Fundamentals, Instruction Set, Thumb Instruction Set. Cortex-M0 architecture- Memory System, MMU, Interrupts and Exceptions. Cortex-M0 OS support features; Cortex-M0 fault handling; Application programming.

References:

1. Andrew Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide: Designing and Optimizing System Software, Elsevier, Morgan Kaufmann publisher, 2004.
2. Steve Furber, ARM System-on-Chip Architecture, 2nd Edition, Additon-Wesley professional, 2001.
3. Joseph Yiu,The Definitive Guide to the ARM Cortex-M0, Elsevier, Newnes, 2011.
4. Dr Alexander G. Dean, Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach, ARM Education Media, 2017.

ECE 5052 NANO ELECTRONICS [3 0 0 3]

Nanomaterials, Nanostructured materials, Capabilities, physical fundamentals. Scaling principles, limits to scaling, power constrained scaling limits. Electronic transport in 1,2 and 3 dimensions- Quantum confinement. Electronic and optoelectronic properties of molecular materials. Spin tunneling devices, Ferroelectric random access memory, semiconductor sensor array. Nanotechnology for biological system & bio-sensor applications.

References:

1. V. Mitin, V. Kochelap, M. Stroscio, Introduction to Nano-electronics, Cambridge University Press, 2008.
2. Rainer Waser, Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH,2003.
3. Karl Goser, Peter Glosekotter, Jan Dienstuhl, Nano-electronics and Nano-systems, Springer, 2004.
4. SadamichiMaekawa, Concepts in Spin Electronics, Oxford University Press, 2006.
5 Edward L. Wolf, Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Wiley-VCH, 2006.

ECE 5053 NEURAL NETWORKS & FUZZY LOGIC [3 0 0 3]

Biological neurons, Mc-culloch Pitt's model, Feed forward and Feedback network, Supervised and unsupervised learning. learning rules. Classifiers; Discrete time and gradient type, Hopfield networks, Unsupervised learning methods; cluster discovery network, Counter propagation networks. kernel methods. Fuzzy Logic: fuzzy systems, membership functions, classical sets and fuzzy sets, fuzzy set rules. Fuzzy relations, Approximate reasoning. Fuzzy inference engine, Fuzzifiers, Defuzzifiers, Neuro fuzzy systems, with GA optimization

References:

1. Jacek M Zurada, Introduction to artificial Neural Systems, Jaico publication. 2006
2. Simon Haykin, Neural Networks and Learning Machines, PHI edition private Limited,3rd edition, New Delhi, 2009
3. Li Xin Wang, Introduction to fuzzy systems and control, Prentice Hall publication, 1997
4. Timothy J Ross, Fuzzy Logic with Engineering Applications, Intl. Edition, McGraw Hill publication, 2008

ECE 5027 PRINTED ELECTRONICS [4 0 0 4]

Introduction to Printed Electronics and their Materials Systems, Emerging technologies, General applications, Carrier transport, doping, band structure, thin-film electronic devices.

Printed Electronics: Nanowire and nanoparticle synthesis, transition metal oxides, amorphous thin films, polymeric semiconductors, paper-based electronics, textile substrates, barrier materials. Thin-film Deposition techniques.

Device structure and performance: I-V characteristics, Mechanics of Thin films and Flexible Transistors: thin-film mechanics models, neutral plane, conformal electronics, mechanical modelling.

Solution-based Patterning Processes: Ink-jet printing, gravure, Roll-to-Roll printing, imprint lithography, spray pyrolysis, surface energy effects, multilayer patterning Contacts and Interfaces to Organic andInorganic Electronic Devices: Schottky contacts, defects, carrier recombination, effect ofApplied mechanical strain.

Displays, sensor arrays, memory devices, lab-on-chip, and photovoltaics.

References:

1. Wong, William S., Salleo, Alberto (Editors), Flexible Electronics: Materials and Application, Springer, U.S./India , 2009.
2. Guozhen Shen, Zhiyong Fan (Editor) - Flexible Electronics: From Materials to Devices World Scientific, U.S. 2016
3. Takao Someya (Editor) – Stretchable Electronics – Wiley International, U.S. – 2013

ECE 6098 PROJECT WORK [0 0 0 25]

Students are required to undertake innovative and research oriented projects, which not only reflect their knowledge gained in the previous two semesters but also reflects additional knowledge gained from their own effort. The project work can be carried out in the institution/ industry/ research laboratory or any other competent institutions. The duration of project work should be a minimum of 36 weeks. There will be a mid-term evaluation of the project work done after about 18 weeks. An interim project report is to be submitted to the department during the mid-term evaluation. Each student has to submit to the department a project report in prescribed format after completing the work. The final evaluation and viva-voice will be after submission of the report. Each student has to make a presentation on the work carried out, before the departmental committee for project evaluation. The mid-term & end semester evaluation will be done by the departmental committee including the guides.