B TECH in ELECTRONICS & COMMUNICATION ENGINEERING

THIRD SEMESTER

Year	Sub. Code	Subject Name	L	T	P	C
II	MAT 2152	Engineering Mathematics III	2	1	0	3
	ECE 2151	Analog Electronic Circuits	3	1	0	4
	ECE 2152	Computer Organization and Architecture	2	1	0	3
	ECE 2153	Digital System Design	3	1	0	4
	ECE 2154	Network Analysis	2	1	0	3
	ECE 2155	Signals and Systems	3	1	0	4
	ECE 2161	Digital System Design Lab	0	0	6	2
	ECE 2162	Signals & Circuits Simulation Lab	0	0	3	1
			15	6	9	24
		Total Contact Hours (L + T + P)			30	

FOURTH SEMESTER

Sub. Code	Subject Name	L	T	P	C
MAT 2257	Engineering Mathematics IV	2	1	0	3
ECE 2255	Digital Signal Processing	2	1	0	3
ECE 2252	Electromagnetic Waves	3	1	0	4
ECE 2253	Linear Integrated Circuits	3	1	0	4
ECE 2254	VLSI Design	3	1	0	4
****	Open Elective I	*	*	*	3
ECE 2261	Electronic Circuit Design Lab	0	0	6	2
ECE 2262	VLSI Lab	0	0	3	1
		13	5	9	24
	Total Contact Hours (L + T + P) + OE			27+3=30	

FIFTH SEMESTER

Year	Sub. Code	Subject Name	L	T	P	C
III	HUM 3151	Engg. Economics & Financial Management	3	0	0	3
	ECE 3151	Analog and Digital Communication	3	1	0	4
	ECE 3152	Linear Control Theory	3	1	0	4
	ECE 3153	Microprocessors	3	0	0	3
	ECE 3154	Microwave Engineering	3	1	0	4
	****	Open Elective II	*	*	*	3
	ECE 3161	DSP Lab	0	0	3	1
	ECE 3162	Microprocessor Lab	0	0	6	2
			15	3	9	24
		Total Contact Hours (L + T + P) + OE			27+3=30	

SIXTH SEMESTER

Sub. Code	Subject Name	L	T	P	C
HUM 3152	Essentials of Management	3	0	0	3
ECE 3251	Communication Networks	3	0	0	3
ECE 3252	Wireless Communication	4	0	0	4
ECE ****	Program Elective-I	3	0	0	3
ECE ****	Program Elective-II	3	0	0	3
****	Open Elective-III	*	*	*	3
ECE 3261	Communication Networks Lab	0	0	6	2
ECE 3262	Communication Systems Lab	0	0	6	2
		16	0	12	23
	Total Contact Hours (L + T + P) + OE			28+3=31	

SEVENTH SEMESTER

Year	Sub. Code	Subject Name	L	T	P	C
IV	ECE****	Program Elective-III	3	0	0	3
	ECE****	Program Elective-IV	3	0	0	3
	ECE****	Program Elective-V	3	0	0	3
	ECE****	Program Elective-VI	3	0	0	3
	ECE****	Program Elective-VII	3	0	0	3
	*********	Open Elective IV	*	*	*	3
			15	0	0	18
		Total Contact Hours (L + T + P) + OE			15+3=18	

EIGHTH SEMESTER

Sub. Code	Subject Name	L	T	P	C
ECE 4298	Industrial Training				1
ECE 4299	Project Work/Practice School				12
ECE 4296	Project Work (Only for B.Tech honour Students)				20
					13

Minor Specialisations

I. Computational Intelligence
ELE 4061: Artificial Intelligence
ECE 4051: Computer Vision
ECE 4052: Machine Learning
ELE 4062: Soft Computing Techniques

II. Control Systems
ICE 4051: Digital Control Systems
ICE 4052: Non-Linear Control Systems
ICE 4053: Robust Control
ICE 4054: System Identification

III. Embedded Systems
ECE 4053: Embedded System Design
ELE 4063: FPGA based system Design
ECE 4054: Internet of Things
ELE 4064: Real Time Systems

IV. Illumination Technology
ELE 4065: Integrated Lighting Design
ELE 4066: Lighting Controls: Technology & Applications
ELE 4067: Lighting Science: Devices and Systems
ELE 4068: Solid State Lighting

V. Sensor Technology
ICE 4055: Advanced Sensor Technology
ICE 4056: Micro Electro Mechanical Systems
ICE 4057: Multi Sensor Data Fusion
ICE 4058: Smart Sensor

VI. Signal Processing
ECE 4055: Advanced Digital Signal Processing
ELE 4073: Digital Image Processing
ECE 4056: Digital Speech Processing
ELE 4074: Linear Algebra for Signal Processing

VII. Telecommunication
ECE 4057: Mobile Communication
ECE 4058: Modern Wireless Technologies
ECE 4059: Optical Fiber Communication
ECE 4060: Satellite Communication

VIII. VLSI Design
ECE 4061: Analog & Mixed Signal Design
ECE 4062: Digital Design Verification
ECE 4063: Low power VLSI Design
ECE 4064: Semiconductor Device Theory

IX. Material Science
PHY 4051: Physics of Low Dimensional Materials
PHY 4052: Physics of Photonic & Energy Storage Devices
CHM 4051: Chemical Bonding
CHM 4052: Chemistry of Carbon Compound

X. Business Management
HUM 4051: Financial Management
HUM 4052: Human Resource Management
HUM 4053: Marketing Management
HUM 4054: Operation Management

XI. Computational Mathematics
MAT 4051: Applied Statistics and Time Series Analysis
MAT 4052: Computational Linear Algebra
MAT 4053: Computational Probability and Design of Experiments
MAT 4054: Graphs and Matrices

Program Electives
ECE 4065: Advanced MOS Devices
ECE 4066: Advanced Processors and Controllers
ECE 4067: Building Automation Systems
ECE 4068: CAD for VLSI Design
ECE 4069: Cipher Systems
ECE 4070: Data Structures and Algorithms
ECE 4071: Electronic Instrumentation
ECE 4072: Electronic System Design
ECE 4073: Error Control Coding
ECE 4074: Flexible Electronics
ECE 4075: Information Theory and Coding
ECE 4076: Low Voltage Analog Signal Processing
ECE 4077: Microwave Integrated Circuits
ECE 4078: Motion & Geometry based methods in Computer Vision
ECE 4079: Nano Technology
ECE 4080: Object Oriented Programming Using C++
ECE 4081: Operating Systems for Advanced Processors
ECE 4082: Optical Wireless Communication
ECE 4083: Power Electronics
ECE 4084: Radar and Navigation Systems
ECE 4085: RF Circuit Design
ECE 4086: Spread Spectrum Communication
ECE 4087: System on Chip Design
ECE 4088: Thin films & Nanostructures
ECE 4089: Time Frequency and Wavelet Transforms
ECE 4090: VLSI Process Technology
ECE 4091: Wireless Sensor Networks
ECE 4092: Analog IC Design

Open Electives
ECE 4301: Basics of Building Automation Systems
ECE 4302: Consumer Electronics
ECE 4303: Electronic Product Design & Packaging
ECE 4304: Introduction to Communication Systems
ECE 4305: Introduction to Nano science & Technology
ECE 4306: MEMS Technology

THIRD SEMESTER

MAT 2152: ENGINEERING MATHEMATICS - III [2 1 0 3]

Functions of complex variable. Analytic function, C-R equations, differentiation, Integration of complex function, Cauchy's integral formula. Taylor's and Laurent Series, Singular points, Residues, Cauchy's residue theorem. Periodic function, Fourier Series expansion. even and odd functions, functions with arbitrary periods, Half range expansions Fourier transform, Parseval's identity, PDE-Solution by method of separation of variables and by indicated transformations. One dimensional wave equation, One dimensional heat equation and their solutions. Vector differential operator, gradient divergence and curl. Line, surface and volume integrals. Green's theorem, Divergence and Stoke's theorem

References:
1. Grewal B.S., Higher Engineering Mathematics (40e), Khanna Publishers.
2. Kreyszig E., Advanced Engg. Mathematics, Wiley Eastern, 2010
3. Gerald C. F. and Wheatley P. O., Applied Numerical Analysis (7e), Pearson Education
4. Spiegel M. R., Lipschutz S. and Spellman D., Vector Analysis, Schaum's Outline Series, McGraw Hill
5. Narayanan S., Pillay T. K. M., and RamanaiahG., Advanced Mathematics for Engineering Students, S. Vishwanathan, 1993

ECE 2151: ANALOG ELECTRONIC CIRCUITS [3 1 0 4]

Introduction to MOSFET, Large and Small-Signal model. Biasing, Amplifier topologies, Analysis and Design of various amplifier configurations. Current mirror and active load, Cascode amplifier, Multistage Amplifiers. Analysis of MOS Differential pair. Frequency Response analysis of amplifier configurations. Basic principles and analysis of different types of oscillators. Negative feedback and advantages, analysis of different negative feedback amplifier topologies. Different classes of power amplifier and their analysis.

References:

1. Razavi B., *Fundamentals of Microelectronics*, Wiley, 2013.
2. Sedra. A.S. and Smith K. C., *Microelectronic Circuits*, Oxford University Press, 2011.
3. Franco S., *Analog Circuit Design: Discrete and Integrated*, McGraw Hill. 2014.
4. Boylestad R.L. and Nashelsky L., *Electronic Devices and Circuit Theory* (11e), PHI, 2012.
5. Millman J., Halkias C. C., and Parekh C. D., *Integrated Electronics*, McGraw Hill. 2010.

ECE 2152: COMPUTER ORGANIZATION AND ARCHITECTURE [2 1 0 3]

Processor organization: ALU, Registers, Stack, Instruction set & addressing modes. Processor design: ALU design, Register design, Multiplication & Division Algorithms, MAC. Accessing schemes for IO devices and memory. Memory hierarchy, cache, DMA, timers/counters. Micro-programmed and hard wired control unit design, pipelining and parallel processing. Types of architecture: RISC, CISC, SIMD, MIMD, VLIW. Fixed point and floating point DSP architectures.

References:

1. Rafiquzzaman M. and Chandra R., *Modern Computer Architecture*, Galgotia Publications, 1999.
2. Patterson D. A. and Hennessy J. L., *Computer Organization and Design*. The Hardware/Software Interface (3e), Elsevier, 2005.
3. Carter N., *Computer Architecture, Schaum's Outline*, McGraw-Hill, New Delhi. 2006
4. Heys J. P, *Computer Architecture and Organization*, McGraw-Hill International Editions, 1998.
5. Kuo S. M. and Gan W. S., *Digital Signal Processors-Architectures*, Implementations and Applications, Pearson Education, 2005.

ECE 2153: DIGITAL SYSTEM DESIGN [3 1 0 4]

Logic Design Fundamentals, Combinational Logic Design, Sequential Logic Design, Introduction to Verilog HDL, Structural modeling, Data-flow Modeling, BehavioralModeling, Switch Level Modeling, Tasks and Functions, Testing Verilog model, Digital Implementation Options and Design Flow, FPGA Architectures and Applications

References:

1. Kohavi Z., Jha N.K., *Switching and Finite Automata* Theory, Cambridge (3e), 2010.
2. Mano M. and Ciletti M. D., *Digital Design, Pearson Education*, 2007
3. Smith M. J. S., *Application Specific ICs*, Pearson 1997.
4. Palnitkar S., Verilog HDL: *A Guide to Digital Design and Synthesis*, Prentice Hall PTR, 2003.
5. Brown S. and Vranesic Z., *Fundamentals of Digital Logic with Verilog Design*, TMH, 2013.

ECE 2154: NETWORK ANALYSIS [2 1 0 3]

Network Theorems. Evaluation of initial and final conditions in RL, RC and RLC circuits. General and particular solutions of RL, RC and RLC circuits. Response of RC circuits to different excitations. Solution of RL, RC, RLC networks using Laplace transform.Two port Networks.Finding two port parameters,relationship between two port parameters. Interconnected two port networks. Network functions. Poles and Zeros of Network Functions.

References:

1. Valkenburg. M. E. V.,Network Analysis, Pearson Education, 2006.
2. Singh R. R., Network Analysis and Synthesis, McGraw Hill, 2013.
3. Nahvi M. and Edminister J., Electric Circuits, Schaum's Outline Series (6e), McGraw Hill.
4. Millman J. and Taub H., Pulse, Digital and Switching Waveforms (3e), McGraw Hill.

ECE 2155: SIGNALS AND SYSTEMS [3 1 0 4]

Signals and elementary operations on them. Fourier representation, Parseval's relations, Energy and Power spectral density. Systems and their properties. LTI systems and their characterization, analysis of LTI systems using convolution, Description of LTI systems using differential and difference equations, Frequency domain analysis of LTI systems, convolution and modulation of mixed class signals. Continuous time LTI system analysis using Laplace transform, discrete time LTI system analysis using Z-transform. Sampling theorem.

References:

1. Haykin S. and Veen B. V., *Signals and Systems*, John Wiley and Sons, 2008.
2. Oppenheim A. V., Willsky A. S. and Nawab A.,*Signals and Systems*, PHI, 2015.
3. Hsu H. and Ranjan R.,*Signals and Systems, Schaum's Outline Series*, McGraw Hill, 2006.
4. Lathi B. P., *Linear Systems and Signals*, Oxford University Press, 2005

ECE 2161: DIGITAL SYSTEM DESIGN LAB [0 0 6 2]

Measurement of performance parameters of digital ICs, transfer characteristic of inverter, verification of Boolean theorems and laws, implementation and verification of combinational and synchronous/ asynchronous sequential circuits using digital ICs, experiments based on HDL packages and simulation of digital circuits using open source software. Mini project based on digital hardware or software tool.

ECE 2162: SIGNALS AND CIRCUITS SIMULATION LAB [0 0 3 1]

KVL and KCL, RLC series and parallel Resonance, MOSFET characteristics, MOSFET amplifier, Characteristics of OPAMP, Maximum power transfer theorem, Norton's Theorem, Signals and systems and their properties, Fourier Analysis of signals, sampling and signal reconstruction, Analysis of LTI system and response.

FOURTH SEMESTER

MAT 2257: ENGINEERING MATHEMATICS - IV [2 1 0 3]

Finite sample spaces, conditional probability and independence, Baye's theorem, one dimensional random variable, mean, variance, Chebyshev's inequality. Two and higher dimensional random variables, covariance, correlation coefficient, least squares principles of curve

fitting. Binomial, Poisson, uniform, normal, gamma, chi-square and exponential distributions. Moment generating function, functions of one and two dimensional random variables, sampling theory, central limit theorem and applications. Stochastic processes. Difference Calculus, difference equations with constant coefficients, solutions. Finite difference expressions for first and second order derivatives. Solution of boundary value problems, numerical solutions of Laplace and Poisson equations by standard five point formula and heat and wave equations by explicit methods.

References:

1. Meyer P.L., Introduction to probability and Statistical Applications , Second Edn., American Publishing Co., 1979
2. Kreyszig E, Advanced Engineering Mathematics (5e), Wiley Eastern, 1985.
3. Hogg R.V. and Craig A.T., Introduction to Mathematical Statistics (4e)., MacMillan, 1975
4. Narayanan S., Ramaniah G. and Pillay M, Advanced Engineering Mathematics, Vol 3, S. Viswanathan Printers and Publishers.

ECE 2255: DIGITAL SIGNAL PROCESSING [2 1 0 3]

Review of Z - transform, stability analysis of LTI systems, unilateral Z - transform, solution of difference equations. DFT and its properties. Linear filtering using DFT. FFT algorithms. Structures for IIR and FIR filters. Digital filter design techniques. Linear phase FIR filters - symmetric and anti-symmetric impulse response. Power spectrum estimation.

References:

1. Proakis J. G, Manolakis D. G. and Mimitris D, Introduction to Digital Signal Processing, Prentice Hall, India, 2007.
2. Oppenheim A.V, Schafer R. W, Discrete Time Signal Processing, Pearson Education, 2004.
3. Ifeachor E. C. and Jervis B.W., Digital Signal Processing - A Practical Approach, Pearson Education, Asia, 2003.
4. Rabiner L. R, Gold D. J, Theory and Applications of Digital Signal Processing, Prentice Hall, India, 1998.
5. Mitra S. K., Digital Signal Processing - A Computer Based Approach, TMH, 2007.

ECE 2252: ELECTROMAGNETIC WAVES [3 1 0 4]

Review of coordinate systems and vectors, Gauss's law, Divergence theorem, electric potential and its gradient, current and its continuity equation, Biotsavart's law, Ampere's law, Stoke's theorem, Magnetic flux density, Electric and Magnetic field boundary conditions. Time varying fields & Maxwell's equations. Plane wave propagation in free space, lossy& lossless dielectrics, and in good conductors, Poynting theorem, Wave reflection and transmission, Rectangular and circular waveguides. Transmission lines, Smith Chart, applications of transmission lines.

References:

1. Hayt W. and Buck J., Engineering Electromagnetics, McGraw Hill, 2011
2. Shevgaonkar R. K., Electromagnetic Waves, Tata McGraw Hill, 2005
3. Sadiku M. N. O., Elements of Electromagnetics, Oxford University Press, 2014
4. Edminister J., Electromagnetics, Schaum's Outline series, McGraw Hill, 2010
5. Reddy G. J. and Prasad T. J., Basics of Electromagnetics and Transmission Lines, BS Publications, 2017

ECE 2253: LINEAR INTEGRATED CIRCUITS [3 1 0 4]

Op-amp and its characteristics, measurement of Op-Amp parameters, basic mathematical operations using Op-Amp. Current amplifiers. Design and analysis of various active filters. Linear and non-linear applications of op-amp. Special ICs:555 IC, 565 IC, and 566 IC and their applications. Data converters: design and analyses of various ADC and DAC

References:

1. Sergio F, Design with Op amps and Analog Integrated Circuits, McGraw Hill, 2002.
2. Gayakwad R.A., Op-Amps and Linear Integrated Circuits, Prentice Hall of India, 2000.
3. Roy D. C. and Jain S., Linear Integrated Circuits, Wiley Eastern

ECE 2254: VLSI DESIGN [3 1 0 4]

VLSI technology trends, MOS device operation, NMOS and CMOS inverter, NMOS and CMOS fabrication: N-well, P-well, twin-tub CMOS and SOI process, VLSI implementation of combinational and sequential circuits using switch and gate logic, Bi CMOS inverters and gates, Dynamic logic: gates, latches and registers, Memory: RAM, ROM, EPROM, EEPROM and flash memory, Stick diagrams, design rules and layouts, scaling, delay and power in NMOS and CMOS inverters, structured design approach and subsystem design, Alternatives to CMOS technology.

References:

1. Rabaey J.M., Digital Integrated Circuits, Prentice Hall India, 2003.
2. Weste N. and Eshraghian K, Principles of CMOS VLSI Design (2e), Addison Wesley Publication.
3. Kang. S. M and Leblebici Y., CMOS Digital Integrated Circuits Design and Analysis, (3e), Tata Mcgraw Hill.
4. Pucknell D. A. and Eshraghian K., Basic VLSI Design, PHI publication, 2009.
5. Mukherjee A., Introduction to NMOS and CMOS VLSI systems Design, Prentice Hall, 1986.

ECE 2261: ELECTRONIC CIRCUIT DESIGN LAB [0 0 6 2]

Amplifier design using discrete components, Oscillators, Power management Circuits, Op-amp linear applications, Op-amp nonlinear applications, Active filters using Op-amp, Timer applications using IC555, Study of special IC's (PLL and Data Converters).

ECE 2262: VLSI LAB [0 0 3 1]

Synthesis and implementation of digital circuits using Xilinx FPGA Kit, Layout generation for CMOS digital circuits and post-layout simulation using Microwind, Simulation of digital circuits using Cadence NC launch tool. Circuit simulations.

FIFTH SEMESTER

HUM 3151:ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]

Nature and significance, Micro & macro differences, Law of demand and supply, Elasticity & equilibrium of demand & supply. Time value of money, Interest factors for discrete compounding, Nominal & effective interest rates, Present and future worth of single, Uniform gradient cash flow. Bases for comparison of alternatives, Present worth amount, Capitalized equivalent amount, Annual equivalent amount, Future worth

amount, Capital recovery with return, Rate of return method, Incremental approach for economic analysis of alternatives, Replacement analysis. Break even analysis for single product and multi product firms, Break even analysis for evaluation of investment alternatives. Physical & functional depreciation, Straight line depreciation, Declining balance method of depreciation, Sum-of-the-years digits method of depreciation, Sinking fund and service output methods, Costing and its types – Job costing and Process costing, Introduction to balance sheet and profit & loss statement. Ratio analysis - Financial ratios such as liquidity ratios, Leverage ratios, Turn over ratios, and profitability ratios.

References:

1. Prasanna Chandra., Fundamentals of Financial Management, Tata Mc-Graw Hill Companies, New Delhi, 2005.
2. James L Riggs, David D Bedworth and Sabah U Randhawa., Engineering Economics, Tata McGraw – Hill Publishing Company Ltd, New Delhi, 2004.
3. T. Ramachandran., Accounting and Financial Management, Scitech Publications Pvt. Ltd. India, 2001.
4. Eugene F. B. & Joel F. H., Fundamentals of Financial Management, (12e), Cengage Learning Publisher, 2009.
5. M. Y. Khan & P. K. Jain., Financial Management, (5e), Tata McGraw Hill Publication, New Delhi, 2008.
6. Thuesen G.J., Engineering Economics, Prentice Hall of India, New Delhi, 2005.
7. Blank Leland T. Tarquin Anthony J. Engineering Economy, McGraw Hill, Delhi, 2002.
8. Chan S. Park, Fundamentals of Engineering Economics, (3e), Pearson Publication, 2013.

ECE 3151: ANALOG AND DIGITAL COMMUNICATION [3 1 0 4]

Analog modulation and demodulation techniques, noise and effect of noise in communication. Digital Coding of Analog waveforms, Pulse Modulation, Quantization, Coding, Digital Formats, Regeneration, Inter-symbol Interference, Ideal andpractical solutions, Eye pattern, Detection and Estimation, Gram-Schmidt Orthogonalization, Matched filter and its properties, Coherent and non-coherent digital modulation techniques, Design goals of modulation techniques. Error and Spectral analysis, Digital signaling through band limited channels, basic information theory.

References:

1. Haykin S., An Introduction to Analog and Digital Communications, Wiley, 2008
2. Haykin S., Digital Communications, Wiley, 2008
3. Roddy D. and Coolen J., Electronic Communications, PHI, 2001.
4. Lathi B. P, Modern Digital and Analog Communication, Oxford University Press, 2005.
5. Ziemer R.E. and Tranter W.H, Principles of Communications (5e), Wiley India.

ECE 3152: LINEAR CONTROL THEORY [3 1 0 4]

Classification of control systems, Mathematical modeling of electrical circuits/mechanical systems (translational & rotary)/electro-mechanical systems/geared systems, reduction of sub-systems, signal flow graphs, Time domain response of 1st and 2nd order systems, RH criteria, Root Locus technique, Bode plots, Nyquist Plots, Frequency domain based compensator design and their realization through OPAMPS, Design/realization of active P, PI, PID controllers for LTI systems. State equation, state space modeling, Physical variable form of electrical/ mechanical/ electromechanical systems, Phase variable form of electrical/ mechanical/ electromechanical systems, State space models from transfer function, Solution of state equation for continuous time system, State transition matrix, Controllability criteria, Observability criteria

References:

1. NiseN. S., Control Systems Engineering, John Wiley & Sons, Inc, 2010
2. KuoB. C.,Automatic Control Systems, (7e), PHI.
3. Ogata K, Modern Control Engineering, Englewood Cliffs, NJ: Prentice Hall, 2010
4. Nagrath I. J. and Gopal M., Control Systems: Principles and Design, McGraw Hill, 2008

ECE 3153: MICROPROCESSORS [3 0 0 3]

Introduction to microprocessors, ARM7TDMI programmers model, Assembler directives, Instruction set, ARM assembly language programming, exceptions and interrupts, ARM APCS. Introduction to memory mapped peripherals LPC2104 and LPC2132. Introduction to ARM Cortex M3 and OMAP L138.

References:

1. Hohl W., ARM Assembly Language Fundamentals and Techniques, CRC press, 2009
2. Sloss A.N., ARM System Developer's Guide, Designing and Optimizing System Software, Elsevier, 2004
3. Gibson J. R., ARM Assembly Language-an Introduction, Dept. of Electrical Engineering and Electronics, The University of Liverpool, 2007.
4. Reay D., Digital Signal Processing and Applications with the OMAP-L138 Experimenter, Wiley.

ECE 3154: MICROWAVE ENGINEERING [3 1 0 4]

Microwave hybrid circuits, S-matrix. Microwave measurements. Cavity Resonators, Klystrons, TWT, Magnetron. Antennas – types, basic parameters, Review of electric & magnetic vector potentials, Dipole antenna, Circular loop antenna, Antenna arrays, Folded dipole, Helical antenna, Yagi – Uda array, log periodic antennas, Horn antenna, Microstrip antenna. Matching Techniques, Introduction to smart antennas, millimetre wave antenna & fractal antenna.

References:

1. Balanis C. A., Antenna Theory (3e), John Wiley and Sons, New Delhi
2. Kraus J.D., Antennas (2e), McGraw-Hill
3. Liao S., Microwave Devices and Circuits, PHI Ltd., 1990.
4. Pozar D.M., Microwave Engineering (3e), John Wiley and Sons, 1998
5. Balanis C. A., Introduction to Smart Antennas, Morgan and Claypool Publishers, 2007

ECE 3161: DSP LAB [0 0 3 1]

Spectral Analysis of discrete time signals and systems, Digital filter design, Introduction to Code Composer Studio, Digital filter implementation using DSP kits, Signal processing applications using DSP kits.

ECE 3162: MICROPROCESSOR LAB [0 0 6 2]

Experiments on ARM7: Programming system resources, Interfacing Basic IO devices like LEDs and Switches, Interfacing Display devices, Data converters, Motor controllers. Working on serial communication protocols, Experiments on ARM Cortex Processor, Experiments on OMAP processor. Study projects on other Microcontrollers.

SIXTH SEMESTER

HUM 3152: ESSENTIALS OF MANAGEMENT [2 1 0 3]
Definition of management and systems approach, Nature & scope, The functions of managers, Corporate social responsibility. Planning: Types of plans, Steps in planning, Process of MBO, How to set objectives, Strategies, Policies & planning premises, Strategic planning process and tools. Nature & purpose of organising, Span of management, factors determining the span, Basic departmentalization, Line & staff concepts, Functional authority, Art of delegation, Decentralisation of authority. HR planning, Recruitment, Development and training. Theories of motivation, Special motivational techniques. Leadership - leadership behaviour & styles, Managerial grid. Basic Control Process, Critical Control Points & Standards, Budgets, Non-budgetary control devices. Profit & loss control, Control through ROI, Direct, Preventive control. Managerial practices in Japan & USA & application of Theory Z. The nature & purpose of international business & multinational corporations, unified global theory of management. Entrepreneurial traits, Creativity, Innovation management, Market analysis, Business plan concepts, Development of financial projections

References:
1. Koontz D. Essentials of Management,McGraw Hill, New York, 2004
2. Peter Drucker.Management, Task and Responsibility, Allied Publishers, 2006
3. Peter Drucker.The practice of management, Butterworth Hein Mann, 2003

ECE 3251: COMMUNICATION NETWORKS [3 0 0 3]
Types of CNs, Network Hardware, Software, ISO:OSI, TCP/IP, ATM Reference Models. Physical Layer: Media, Line coding, channel capacity, Multiplexing, Multiple Access, switching. Design issues of DLL, Error Control, Flow Control, MAC: Random Access, Controlled Access, IEEE 802.3, 802.5, FDDI. Design issues of Network Layer, Shortest Path Routing, Distance Vector, Link State, Hierarchical Routing, Congestion Control, QoS, IP Addressing, NAT, ARP, RARP, Unicast Routing Protocols. TCP, UDP. Application Layer protocols. Mobile IP and TCP.

References:
1. Fourouzan B. A., Data Communications and Networking, (5e) McGraw Hill, 2013
2. Garcia A.L and Widjaja I., Communication Networks, McGraw Hill, 2006
3. Stallings W., Data and Computer Communication (7e), Prentice Hall.
4. Forouzan B.A, TCP/IP Protocol Suite (4e), Tata McGraw Hill 2010
5. Mir N.F., Computer and Communication Networks, Pearson Education, 2007

ECE 3252: WIRELESS COMMUNICATION [4 0 0 4]
Path loss models, shadowing, outage probability. Channel fading models, autocorrelation, power spectral density, power delay profile, coherence bandwidth and time. Capacity of fading channels, Digital Modulation for Wireless Communications. Receiver diversity, transmitter diversity, analysis based on moment generating functions. Linear Equalizers, MLSE, DFE. MIMO models, capacity of MIMO channels, MIMO diversity gain and introduction to space time modulation and coding.

References:
1. Goldsmith A., Wireless Communications, Cambridge University Press, 2009.
2. Rappaport T. S., Wireless Communication - Principles and Practice, Pearson, 2002.
3. Tse D. and Viswanath P., Fundamentals of Wireless Communication, Cambridge University Press, 2005.
4. Molisch A. F., Wireless Communications, John Wiley and Sons, 2010.

ECE 3261: COMMUNICATION NETWORKS LAB [0 0 6 2]
Simulate and evaluate the performance of Point-to-Point Networks, various Networks Topologies, Wired and Wireless LANs, Routing Protocols for Mobile-Ad hoc Networks and Wireless Sensor Networks. Implement the various MAC Protocols, Sliding Window Protocols. Execute and verify the Error Control Techniques, shortest Path Algorithms. Demonstrate the IoT based Home Automation System, Patient Monitoring System and Smart Agriculture. Mini project.

ECE 3262: COMMUNICATION SYSTEMS LAB [0 0 6 2]
Design, simulation and characterization of Microstrip components and antennas, LNA design and simulation, TDM of band-limited signals, ASK, FSK, PSK, DPSK, QPSK, PCM and MSK signal generation and detection. Pulse Shaping and Matched Filtering, Synchronization, Channel Estimation & Equalization, Frame Detection & Frequency Offset Correction, OFDM Modulation & Frequency Domain Equalization, Synchronization in OFDM Systems, Channel Coding in OFDM Systems.

SEVENTH SEMESTER

There are five program electives and one open elective with total of 18 credits to be taught in this semester.

EIGHTH SEMESTER

ECE 4298: INDUSTRIAL TRAINING
Each student has to undergo industrial training for a minimum period of 4 weeks. This may be taken in a phased manner during the vacation starting from the end of third semester. Student has to submit to the department a training report in the prescribed format and also make a presentation of the same. The report should include the certificates issued by the industry.

ECE 4299: PROJECT WORK/PRACTICE SCHOOL
The project work may be carried out in the institution/industry/ research laboratory or any other competent institutions. The duration of the project work shall be a minimum of 16 weeks which may be extended up to 24 weeks. A mid-semester evaluation of the project work shall be done after about 8 weeks. An interim project report on the progress of the work shall be submitted to the department during the mid-semester evaluation. The final evaluation and viva-voice will be conducted after submission of the final project report in the prescribed form. Student has to make a presentation on the work carried out, before the department committee as part of project evaluation.

PROGRAM ELECTIVES

ELE 4061: ARTIFICIAL INTELLIGENCE [3 0 0 3]
Foundation and History of AI, State of the art, Fields of application, Performance measures, Rationality, Specification and properties of task

environment, Structure of Agents, Problem solving by searching, Searching for solutions, uninformed search strategies, Informed search strategies, Heuristic functions, Local search algorithms, Online search agents, Knowledge based agents, The Wumpus World, Propositional logic – reasoning patterns, effective inference, First order logic - Syntax and semantics, Knowledge engineering, Inference rule, forward and backward chaining, Ontological engineering, categories and objects, Processes and intervals, reasoning systems, Truth maintenance systems, Uncertainty, Basic probability notation, Axioms, Baye's rule, Bayesian networks, Inference in Bayesian networks.

References:

1. Russell S. and Norvig P, Artificial Intelligence: A Modern Approach (3e), Pearson, 2012
2. Rich E., Knight K. and Nair S. B, Artificial Intelligence (3e), Tata McGraw Hill, 2012
3. Poole D. and Mackworth A, Artificial Intelligence: Foundations of Computational Agents (2e), Cambridge University Press, 2017
   http://nptel.ac.in/courses/106105077/

ECE 4051: COMPUTER VISION [3 0 0 3]

Image formation model using pinhole camera, Linear filters and convolution, Image derivatives, Features: corners, SIFT, HOG, textures. Segmentation using clustering (K-means, Mean-Shift, Watershed) and fitting model, Segmentation and fitting using probabilistic methods (EM algorithm), Geometry of two view and Camera calibration including radial distortion, Bayes Classifier: using class histograms, using class conditional density, Support Vector machine

References:

1. Forsyth D. A. and Ponce J, Computer Vision: A Modern Approach, Pearson Education, 2003
2. Szeliski R, Computer Vision: Algorithms and Applications, Springer, 2010
3. Hartleyand R. and Zisserman A., Multiple View Geometry in Computer Vision(2e), Cambridge University Press, 2004
4. Shapiro L. and Stockman G., Computer Vision, Pearson Education, 2001

ECE 4052: MACHINE LEARNING [3 0 0 3]

Machine learning basics, Naïve Bayesian Model. Non-Parametric Techniques: Density Estimation, Parzen Windows, k- Nearest-Neighbor Estimation, K- nearest neighbor classification, Radial Basis Function Network, Learning Vector Quantization, Clustering, K-Means clustering, Competitive learning, Self-Organizing Maps, Recurrent Neural Network, Hopfield Neural Network, Adaptive Resonance Theory, Support vector machines, Statistical Hypothesis testing- t-test, ANOVA, feature selection methods – Filter based techniques and wrapper methods, Principal Component Analysis, Applications of PCA, PCA ,Independent component analysis, Voting, Error correcting output codes, Bagging, Boosting

References:

1. Alpaydin E, Introduction to Machine Learning, (2e), MIT Press. 2010.
2. Duda R.O, Hart P.E. and Stork D.G., Pattern Classification, (2e), Wiley, 2001
3. Harrington P., Machine Learning in Action, Manning Publications, 2012.
4. Bishop C. M., Pattern Recognition and Machine Learning, Springer, 2007.
5. Jensen R. and Shen Q. Computational Intelligence and Feature

Selection: Rough and Fuzzy Approaches, Vol. 8, IEEE Press Series on Computational Intelligence, John Wiley and Sons, 2008

ELE 4062: SOFT COMPUTING TECHNIQUES [3 0 0 3]

Introduction to Soft computing, soft computing techniques, Artificial Neural Networks, Multilayer Perceptron, Gradient descent, Logistic discrimination, Single layer Perceptron, Training a perceptron, Multilayer perceptron, Back-Propagation Algorithm, Fuzzy Systems, Fuzzy Logic, Membership Functions, Fuzzy Controllers, Evolutionary Algorithms, Genetic Algorithms, Other Optimization Techniques, Metaheuristic Search, Traveling Salesman Problem, Introduction to hybrid systems, , Adaptive Neuro-Fuzzy Inference Systems, Evolutionary Neural Networks, Evolving Fuzzy Logic, Fuzzy Artificial Neural Networks

References:

1 Zurada M J, Introduction to Artificial Neural Systems, Jaico publication. 2016
2 Ross T J, Fuzzy Logic with Engineering Applications, Intl. edition, McGraw Hill publication, 2012.
3. Shukla A, Tiwari R, Kala R, Real Life Applications of Soft Computing, CRC Press, Taylor and Francis Group, London 2010
4. Sivanandam S.N and Deepa S.N , Principles of Soft Computing , Wiley India edition, 2009
5. Rajasekaran S. and Pai G. A. V., "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning, 2003

ICE 4051: DIGITAL CONTROL SYSTEMS [3 0 0 3]

Introduction, Sampling, Data acquisition, Quantization, sample and hold, zero order hold, frequency domain consideration in sampling and reconstruction. Difference equations, pulse transfer function, Block diagram analysis of sample data systems, time response of discrete time control systems, Steady State error analysis, Stability, Jury's stability test, bilinear transformation, Root locus technique, W transformation, Bode Plot. Nyquist Stability analysis, Design of Lag, Lead, Lag-lead compensator using root locus and Bode plot, Design of PID controller, Lyapunov Stability Analysis, State Space Analysis, Diagonalization, Solution of state equations, Controllability, Observability, Representation of the system in different canonical forms, Pole Placement- Ackermann's Formula, Dead beat Algorithm.

References:

1. Ogata K., Discrete time control systems (7e), PHI, 2011.
2. Gopal M., Digital control and state variable methods, Tata McGraw Hill, 2001.
3. Houpis C.H. and Lamont G.B., Digital Control Systems, McGraw-Hill,1995.
4. Franklin G.F., Powell D.J. and Workman M. L., Digital Control of Dynamic Systems (2e), Addison-Wesley, 1990.
5. George V. I. and Kurian C.P., Digital Control Systems, Cengage publishers, 2012.

ICE 4052: NON-LINEAR CONTROL SYSTEMS [3 0 0 3]

Introduction, Lyapunov stability usingKrasovskii's method, Variable Gradient method,L2 stability of state models, L2 gain, small gain theorem, Passivity, Memory less functions, L2 gain and Lyapunov stability, passivity theorems, passivity based control, Review of describing function method, Absolute Stability Circle criterions, Popov Criterion, stabilization via linearization and Integral control, Gain scheduling, Graphical Linearization Methods, Analytical Linearization Method, Evaluation of Linearization Coefficients by Least-Squares Method, Local linearization, Feedback linearization, Input-state

linearization, Input-output linearization, Internal dynamics, Zero dynamics, Model Reference Adaptive Control (MRAC).Slidingmode Control, sliding surfaces, continuous approximations of switching control laws, modeling performance trade off, Tracking regulation via Integral control, Lyapunov redesign, non-linear damping, back stepping, high gain observers.

References:

1. Khalil H.K., Nonlinear Systems (3e), Prentice Hall, 2002.
2. Marino R. and Tomei P., Nonlinear Control Design - Geometric, Adaptive and Robust, Prentice Hall, 1995.
3. Slotine J.J.E. and W.Li.,Applied Nonlinear control, Prentice Hall, 1998.
4. Isidori A., Non-linear Control Systems, Springer Verlag, 1999.
5.

ICE 4053: ROBUST CONTROL [3 0 0 3]

Introduction, Issues in Control System Design, Norms for signals and systems, Input- Output Relationships, Computing the Norm by State-Space Methods,Condition for Internal stability, sensitivity and complementary sensitivity function, Asymptotic Tracking, Performance, Sources of Model Uncertainties, Plant Uncertainty Model, Small Gain Theorem, Robust Stability, Robust Performance,Existence of Stabilizing Controllers, Parameterization of All Stabilizing Controllers, Coprime Factorization. Loop shaping with C, Shaping S, T, or Q, P-1 Stable, P-1 Unstable, The Modified Problem, Spectral Factorization, Case Studies-Robust Control for Mass Damper Spring Systems, Spacecraft and Inverted Pendulum.

References:

1. Doyle, J.C., Francis B.A. and Tannenbaum A., Feedback Control Theory, Macmillan Publishing co.,1990.
2. Zhou K, Doyle J. C and Glover K., Robust and Optimal Control, Prentice Hall, Inc New Jersey.1995.
3. Wolovich W. A, Automatic Control Systems, Saunders College Publishing.1994.
4. Zhou K. and Doyle J.C., Essential of Robust Control, Prentice Hall, 1998.
5. Dorf R.C. and Bishop R.H., Modern Control Systems (8e), Addison Wesly Longman Inc., 1998.

ICE 4054: SYSTEM IDENTIFICATION [3 0 0 3]

Introduction to system modeling, Types of system models, Importance of system models, Model development techniques – first principle based and data driven based, Introduction to System Identification, Procedure for identification, Concept of Identifiability, Signal to Noise Ratio, Overfitting, LTI System Modeling using time and frequency, Direct impulse response identification, Direct step response identification, Impulse response Identification using step response, Empirical Transfer function Identification, Correlation Methods, Linear Regression, Least Square Estimation, Equation Error Models – ARX Models, ARMAX Models, ARIMAX Models, OE Models, Box Jenkins Model,Model Validation Techniques

References:

1. Tangirala A.K., Principles of System Identification Theory and Practice, CRC Press, 2016.
2. Keesman K.J., System Identification – An Introduction, Springer, 2011.

ECE 4053: EMBEDDED SYSTEM DESIGN [3 0 0 3]

Typical embedded system: Core of the embedded system, memory, sensors & actuators, communication interface, Serial/Parallel Communication protocols, Hardware and software co-design: Data-path and controller design, Architecture design; Development Environment: OS and non-OS based firmware embedding techniques; Firmware Design and Development; operating system basics; Embedded development life cycle.

References:

1. VahidF andGivargis T, Embedded System Design, Wiley Publication, 2002.
2. Shibu K. V, Introduction to Embedded Systems, McGraw Hill Publication, 2013.
3. Chisholm P S R,HanleyD, JonesM, Lindner M, and Work L, C Programming: Just the FAQs, SAMs publishing, 1995.
4. Wolf W, Modern VLSI Design-IP based Design, Prentice Hall, (4e), 2008.

ELE 4063: FPGA BASED SYSTEM DESIGN [2 1 0 3]

Overview of Digital Systems – Implementation options, FPGA – Architecture, Programming technologies, Altera &Actel logic cells, I/O Blocks, Programmable interconnects, Logic implementation , Design verification- Test bench codes, Hardware testing, FPGA Architectural options; granularity of function and wiring resources, reconfigurable architectures- Fine grained, Coarse grained, Medium grained, Embedded multipliers, adders, MACs, processor cores, Configuring an FPGA ; Vendor specific issues, Logic block architecture, timing models-static and dynamic timing analysis, Input and Output cell characteristics , Power dissipation, Partitioning and placement, Routing resources ,Embedded system design using FPGAs, DSP using FPGAs, Multi FPGA systems, Reconfigurable systems, Application case studies

References:

1. Smith M.J.S., Application Specific Integrated Circuits, Pearson, 2000
2. Ashenden P, Digital Design using Verilog, Elsevier, 2007
3. Wolf W. , FPGA Based System Design, Pearson, 2004
4. Maxfield C, The Design Warriors Guide to FPGAs, Elsevier, 2004
5. Graham P S and Gokhale M, Reconfigurable Computing Accelerating Computation with Field-Programmable Gate Arrays, Springer, 2005.

ECE 4054: INTERNET OF THINGS [3 0 0 3]

Introduction to Internet of Things, Sensing, actuation, Basics of Networking, Sensor networks, Machine to Machine communication (M2M), IOT technologies and Architectures: Infrastructure and service discovery protocols for the IoT ecosystems; Realization of IoT ecosystem using wireless technologies; Interoperability in IoT , Data handling and analytics, cloud computing, Real world design constraints; IoT use Cases

References:

1. Raj P. and Raman A. C., The Internet of Things: Enabling Technologies, Platforms and Use Cases, CRC Press, 2017
2. Bagha A. and Medisetti V, Internet of Things: A Hands on Approach, University Press
3. Holler J., Tsiatsis V., Mulligan C., Karnouskos S., Avesand S., and Boyle D., From Machine to Machine to the Internet of Things: Introduction to a New Age of Intelligence, Academic Press, 2014
4. Vahid F, Givargis T., Embedded Systems Design: A Unified Hardware/Software Introduction, Wiley Publications, 2000
5. Axelson J, Parallel Port Complete, Penram Publications.

ELE 4064: REAL TIME SYSTEMS [3 0 0 3]

Introduction to real time embedded system, terminology, Real time design issues, characteristics. Types of real time systems, timing constraints, precedence constraints, dependencies, functional and resource parameters. Real time operating systems, kernels, queues, semaphores, Multi processing and multitasking, priority inversion, deadlock. Real time services, Real time standards, System resources, Processing, scheduling policies, Performance measures for real time systems. Scheduling algorithms, periodic and aperiodic, priority driven, frame size constraints, real time communication

References:

1. Liu J, Real Time Systems, Pearson Education, 2006
2. Siewert S., Real Time Embedded Systems and Components, Cengage Learning, 2007
3. Li Q., Real Time Concepts for Embedded Systems, CMP Books, Elsevier, 2003
4. Chattopadhyay S, Embedded System Design, PHI, 2011
5. Krishna C.M. and Shin K S, Real Time Systems, McGraw Hill, 1997

ELE 4065: INTEGRATED LIGHTING DESIGN [2 1 0 3]

Interior lighting design: Artificial illumination design techniques: quality and quantity aspects, Energy efficiency in illumination systems, lamp and luminaire selection, Energy conservation, visual comfort and thermal comfort. Design calculations. Exterior lighting design: Road Lighting, Sports lighting and flood lighting, Daylight -artificial light integration, Simulation assisted design of interior and exterior, lighting design standards – Subjective analysis in lighting design, daylight-artificial light integration and energy performance.

References:

1. National Lighting Code(SP 72: 2010), Bureau of Indian Standards, 2010.
2. I.E.S.N.A., New York, Lighting Hand Book(10e), IESNA, 2011.
3. Code of practice for interior illumination - IS 3646 (Part 1) 1992, IS 3646 (Part 2) 1966, IS 3646 (Part 3) 1968.
4. Code of practice for road lighting - IS 1944 (Part 1 to 6).
   Mark K., Spangler C. and Benya J.R., Lighting design basics (3e), John Wiley & Sons, 2017.

ELE 4066: LIGHTING CONTROLS: TECHNOLOGY & APPLICATIONS [2 1 0 3]

Strategies and technologies: occupancy sensing, switching controls, daylight adaptation and photo sensors, Commissioning and energy codes, Controller and control algorithms: Integral reset, open-loop and closed loop control, adaptive control, predictive control , inverse control with online adaptive learning, Camera based measurement, virtual scenario based intelligent lighting control, Protocols and Networking: architecture, standard lighting protocols, wired and wireless , centralized and distributed, WSAN lighting control application, connected lighting system, SoC solutions for lighting control system, Power-over-Ethernet, Commissioning of smart lighting system.

References:

1. Simpson R.S., Lighting control: technology and applications, Taylor & Francis, 2003.
2. DiLouie C., Lighting controls handbook, The Fairmont Press, Inc., 2008.

3. Cai H., Luminance gradient for evaluating lighting, Lighting Research & Technology 48.2, 2016: 155-175.
4. Serpanos D. and Wolf M., Internet-of-things (IoT) Systems: Architectures, Algorithms, Methodologies, Springer, 2017.
5. Yang S.H., Wireless sensor networks: Principles, Design and Applications, Springer, 2014.

ELE 4067: LIGHTING SCIENCE: DEVICES AND SYSTEMS [2 1 0 3]

Light & Vision: Human visual system, photoreceptors, colour perception -spectral, spatial, and temporal characteristics, chromatic adaptation and contrast sensitivity. Lighting technologies: Light sources and Luminaires, Generation, distribution and control, emerging sources and luminaires, optical, electrical and thermal characteristics. Photometry & Colorimetry: measurements and calculations, characterization of colors of lights and objects - experimental and simulation analysis, measuring instruments, testing, reliability and lifetime of luminaires, evaluation of lighting products .

References:

1. DiLaura D.L.,Lighting Handbook (10e), IESNA, 2011.
2. Mottier P., LED for Lighting Applications (1e), Wiley, 2009
3. Kitsinelis S., Light Sources: Technologies and Applications, CRC press, 2010.
4. Cayless M.A. and Marsdon A.M., Lamps and Lighting (4e), Oxford and IBH publishing company, 1996.
5. Lindsey J.L., Applied Illumination Engineering (2e), Fairmont Press, Inc., 1997.

ELE 4068: SOLID STATE LIGHTING [2 1 0 3]

General Characteristics of LEDs, Electrical and optical characteristics of high brightness LEDs, CIE Chromaticity coordinates, viewing angle, Binning, Mac dam ellipse, spectral tuning and optimization algorithms, Case study: Circadian rhythm, Daylight matching spectrum and its applications in healthcare - skin and Brain related therapies, Vitamin D synthesis, LED-on-the-Tip Endoscope, LEDs in Horticulture and Automotive lighting, LED drivers: power supply, dimming and controller, Thermal management and Heat sink design , lifetime and reliability.

References:

1. Schubert F.E., Light emitting Diodes(2e), Cambridge University press, 2006.
2. Khanna V.K., Fundamentals of Solid state Lighting, CRC press, 2014.
3. Zukauskus A., Shur M.S. and Gaska R., Introduction to solid state lighting, Wiley-Interscience, 2002.
4. Held G., Introduction to Light Emitting Diode Technology and Applications, CRC press, 2009.
5. Mohan N., Undeland T. M. and Robbins W. P., Power Electronic converters, Applications and Design (1e), John Wiley and sons, 1989.

ICE 4055: ADVANCED SENSOR TECHNOLOGY [3 0 0 3]

Sensor classifications, Advanced sensing materials, Properties of materials, Design and modeling issues,Fiber optic light propagation, Graded index fibers, Fiber optic communication driver circuits, Laser classifications, Driver circuits for solid state laser diodes, Radiation sensors and Optical combinations, Accelerometers, Thermal, Humidity and moisture sensor, Proximity detectors using polarized light, Semiconductor gas sensor, Fluidic and Micro-fluidic sensors, Gyroscope laser, Chemical sensor characteristics, Classification of Chemical sensing mechanism, Sensors based on direct and indirect sensing techniques.

References:
1. Fraden J., Handbook of Modern Sensors: Physics, Designs, and Applications, Springer, 2010.
2. Ripka P. and Tipek A., Modern Sensors Handbook (2e), Wiley Publication, 2007.
3. Webster J.G., Medical Instrumentation Application and Design, Houghton Mifflin Co., 2004.

ICE 4056: MICRO ELECTRO MECHANICAL SYSTEMS [3 0 0 3]

Overview of MEMS and NEMS, scaling laws, Rigid-body dynamics, Electrostatic and electro-magnetic forces, Materials, Photolithography, Ion implantation, Diffusion, Oxidation, Chemical Vapor Deposition, Physical vapor Deposition-Sputtering, Deposition by epitaxy, Etching, Bulk Micro manufacturing, Surface Micromachining, LIGA process, Microsystem Design- Process design, Mechanical design, Introduction to computer aided design using COMSOL Multiphysics, Electrostatic sensors and actuation, Thermal sensing and actuation, Piezoelectric sensing and actuation, Microsystem Packaging-Types, Interfaces, Technologies, Selection, Design and packaging case study.

References:
1. Hsu T.R., MEMS & Microsystems Design and Manufacture (1e), Tata McGraw-Hill Edition, 2002.
2. Liu C., Foundations of MEMS, Pearson International Edition, 2006.
3. Lyshevski S.E., MEMS and NEMS systems, Devices and Structures, CRC Press, 2002.
4. Kovacs G.T.A., Micro Machined Transducers Sourcebook, WCB McGraw-Hill, 1998.
5. Senturia S.D., Microsystem Design, Kluwer Academic Publishers, Springer, 2000.

ICE 4057: MULTI SENSOR DATA FUSION [3 0 0 3]

Concept and role of fusion, Fusion types, Sensor configuration, Architecture of fusion nodes, Fusion topologies, Benefits of fusion, Need for data refinement, Classification of data refinement, Spatial alignment, Temporal alignment, Semantic and radiometric alignment, Concept and need for data association and decision making, data registration, data association techniques, Decision making techniques, Information requirement for decision making.JDL framework, Revised JDL, Dasarathy's model, Thompolus framework, Luo-Key framework, Pau's framework, Waterfall and omnibus framework, Distributed black box, Esteban framework, Kalman filter, Baysien filter, extended information filter, Estimation, Approximate agreement, Optimization filter, Distributed dynamic fusion, Dynamic data flow analysis

References:
1. Hall D.L., Mathematical techniques in Multisensor data fusion (2e), Artech House, 2004.
2. Mitchell H. B., Data Fusion: Concepts and Ideas (2e), Springer Publishers, 2012.

ICE 4058: SMART SENSORS [3 0 0 3]

Introduction, Signal conditioning, Separate versus integrated signal conditioning, Digital conversion, MCU control, MCUs for sensor interface, Techniques and Systems Considerations for MCUs, DSP control, Sensor integration, IEEE standards, Plug and play, Automated/ Remote sensing, Process control over the Internet, Other communication standards with case studies,Wireless zone sensing, Surface acoustical wave devices, Intelligent transportation system, RF-ID, RF MEMS basics, Varactors, Micro optics, Micro grippers, Microprobes, Micro mirrors, FEDs,Data processing, Pattern recognition and classification, Centralized and decentralized system of the measurement chains, Practical examples of the intelligent sensors.

References:
1. Merjer G., Smart Sensor Systems, Wiley Publisher, 2008.
2. Frank R.,Understanding Smart Sensors (2e), Artech House Publications, 2000.
3. Chapman P.W.,Smart Sensors, ISA Press, 1996.
4. Iniewski K., Smart Sensors for Industrial Applications, CRC Press, 2013.
5. Fraden J.., Handbook of Modern Sensors-Physics, Designs, and Applications (4e), Springer, 2010.

ECE 4055: ADVANCED DIGITAL SIGNAL PROCESSING [2 1 0 3]

Multi-rate systems, decimation and interpolation, interpolated FIR approach, poly phase filter structure, filter banks, perfect reconstruction, Principles and applications of adaptive filters, Weiner filters, steepest descent algorithm, LMS and RLS algorithms. Homomorphic system, cepstrum, homomorphic systems for convolution and de-convolution, applications of homomorphic signal processing. Stochastic models, Maximum likelihood, expected maximization, Bayesian estimation, random signal detection. Sparse representation, regularization, Total Variation, Compressed Sensing

References:
1. Vaidyanathan P. P, Multirate Systems and Filter Banks, Prentice Hall, India, 1993.
2. Gadre V M, Abhyankar A S, Multiresolution and Multirate Signal Processing: Introduction, Principles and Applications, McGraw Hill, 2017.
3. Orfanidis S. J, Optimum Signal Processing, McGraw Hill , NJ, 2007.
4. Oppenheim A.V and Schafer R.W., Digital Signal Processing, PHI Learning, 2008.
5. Millar R B, Maximum Likelihood Estimation and Inference, John Wiley and Sons, Inc. 2011.

ELE 4073: DIGITAL IMAGE PROCESSING [3 0 0 3]

Image representation, relationship between pixels, Convolution and corrélation. Unitary 2D transforms, DFT, DCT, subband coding, multiresolution analysis, DWT, contourlet transform, SVD. Intensity transformations, histogram processing, spatial and frequency domain filters, noise types, Wiener filter, local and nonlocal filtering, Boundary detection, canny edge detector, segmentation, Otsu's thresholding, image compression standards, Morphological operations and algorithms, Hit or Miss transform, colour image representation. Applications.

References:
1. Jayaraman S., Esakkirajan S. and Veerakumar T., Digital Image Processing, TMH, 2012.
2. Gonzalez R. C. and Woods R. E, Digital Image Processing, Pearson Education (2e), 2003.
3. Pratt W. K., Digital Image Processing, John Willey, 2001.
4. Sonka M, Hlavac V. and Boyle R, Image Processing, Analysis, and Machine Vision, (4e), Cengage Learning.
5. Jain A.K., Fundamentals of Digital Image Processing, PHI, New Delhi, 1995..

ECE 4056: DIGITAL SPEECH PROCESSING [3 0 0 3]

Anatomy, physiology and modeling of speech production system. Time and frequency domain analysis of speech. Cepstral analysis of speech and its applications. Linear predictive modeling of speech and its applications. Speech coding and synthesis, automatic speech recognition. Speech enhancement in the presence of noise.

References:

1. Rabiner L. R and Schaffer R.W, Digital Processing of Speech Signals, Prentice Hall, NJ, 2007.
2. Quatieri T. F, Discrete.Time Speech Signal Processing—Principles and Practice, Pearson Education, Inc., 2004.
3. O' Shaughnessy D., Speech Communications: Human and Machine Reading, Addison Wesley, 1987.
4. Apte S. D, Speech and Audio Processing, Wiley India, 2012.
5. Rabiner L., Juang B. H, Yegnanarayana B, Fundamentals of Speech Recognition, Pearson, 2011.

ELE 4074: LINEAR ALGEBRA FOR SIGNAL PROCESSING [2 1 0 3]

Vectors, matrices, norms of vector and matrices, Lpnorms, Holder, Cauchy - Schwarz, and triangular inequalities, inner product spaces and their applications. System of linear equations and its solution sets, Gaussian elimination and back-substitution, echelon forms, matrix operations, LU - factorization, inverse matrices, Gauss-Jordan technique, transpose, elimination, and permutation matrices. Row space, column space, and null space of a matrix, bases and dimension, rank and nullity of a matrix, matrices as linear transformations, pseudo-inverse and applications, change of basis, affine transformations. Orthogonal subspaces, projections, Gram-Schmidt process, generalized Fourier series, QR factorization, least squares and their applications. Characteristic equation,diagonalization, Jordan canonical form, special matrices, positive definite matrices and applications. Symmetric, Orthogonal, Hermitian, Unitary, Jacobian, and Hessian matrices, singular value decomposition and related applications.

References:

1. Strang G, Linear Algebra and its Applications (3e), Thomson Learning Asia, 2003.
2. Lay D. C, Linear Algebra and its Applications (3e), Pearson Education (Asia) Pvt. Ltd, 2005.
3. Hoffman K. and Kunze R., Linear Algebra (3e), PHI, 2004.
4. Dianat S.A. and Saber E, Advanced Linear Algebra for Engineers with MATLAB (1e), CRC Press.

ECE 4057: MOBILE COMMUNICATION [3 0 0 3]

Cellular technologies, GSM Architecture, Cellular System Design, Coverage, Capacity improving techniques, Multiple Access Systems, Protocol for MAC. Mobile Radio Propagation: Large Scale Path Loss models, Link Budget Design. Outdoor and Indoor Radio Propagation Models, Small - Scale Fading and Multipath Measurements, Statistical Models of Mobile Multipath Channels, Types of Small-Scale Fading-Performance of Modulation for Mobile Radio in Fading and Multipath Channels. GPRS, CDMA, Mobile networks Layers, Future advancements.

References:

1. Rappaport T. S., Wireless Communications Principles and Practice, Pearson Education, 2009
2. Feher K., Wireless Digital Communications, Modulation and Spread Spectrum Applications, Prentice Hall, 1995
3. Lee W. C. Y., Mobile Cellular Telecommunications, Tata McGraw Hill, 2006
4. Schiller J. H, Mobile Communication, Pearson Education, 2008

ECE 4058: MODERN WIRELESS TECHNOLOGIES [3 0 0 3]

Principles of CDMA, DS-CDMA Model, Rake Rx, Multi-user CDMA systems, Multipath Diversity.MIMO Wireless Communication: MIMO systems, Receivers, Beam forming, Antenna Consideration, Channel Modelling, Measurement, Capacity, Space Diversity, SVD.OFDM Wireless Communication: Pulse shaping, Spectral Efficiency, Pilot insert, Cyclic Prefix, BER.Wireless LANs/IEEE 802.11x: Design Issues, Services, and MAC Layers. Wireless PANs/IEEE 802.15x Architecture. Broad Band Wireless MANs/IEEE 802.16x.

References:

1. Mullet G. J., Introduction to Wireless Telecommunications Systems and Networks, Cengage, 2005
2. Dalal U, Wireless Communication, Oxford University Press, 2009
3. Du K. L. and Swamy M. N. S., Wireless Communication System, Cambridge University Press, 2010
4. Glisic S. G, Advanced Wireless Networks: 4G Technologies, Wiley, 2006.

ECE 4059: OPTICAL FIBER COMMUNICATION [3 0 0 3]

Planar dielectric waveguides, step and graded index fibers, distortion of optical pulses propagating through fibers, dispersion compensation, fiber amplifiers, advanced modulation and demodulation formats for optical fiber communications, optical CDMA, optical modulators.

References:

1. Keiser G., Optical Fiber Communications, Tata McGraw Hill,2010.
2. Kumar M. S., Fundamentals of Optical Fiber Communication, PHI, 2014
3. Ghatak A. and Thyagarajan K., Introduction to Fiber Optics, Cambridge University Press, 1998
4. Ghatak A. and Thyagarajan K ,Optical Electronics, Cambridge University Press, 1989
5. Li G.L. and Yu P.K.L., Optical Intensity Modulators for Digital and Analog Applications, J.Lightwave Technology., vol 21, pp 2010 – 2013, 2003

ECE 4060: SATELLITE COMMUNICATION [2 1 0 3]

Orbits and Description, history, Frequency Bands, Applications, Orbital Period and Velocity, Kepler's laws, Look angles, Orbital Perturbations, Launching methods, Satellite in a Geo-Stationary orbit. Satellite Sub-Systems, Link design, Propagation effects, Multiple Access Systems, C/N ratio, Earth Station Technology, Navigation and GPS Principles, GPS Receivers, DBS TVs and Radio, Home Satellite TV, Digital DBS TV, DBSTV System Design, Link Budget, MCS and Uplink, DBSTV Antennas, Satellite Radio Broadcasting, DVB Standards, DVB-T.

References:

1. Pratt T, Bostian C. and Allnutt J., Satellite Communications, John Wiley and Sons, 2003.
2. Pritchard W. L, Suyderhoud H G, Nelson R A, Satellite Communication Systems Engineering, (2e) Pearson.
3. Ha T. T, Digital Satellite Communications, McGraw Hill, 1990.

ECE 4061: ANALOG AND MIXED SIGNAL DESIGN [3 0 0 3]

Analog circuit design issues, second order effects, current mirror circuits: Wilson, cascode and wide swing, voltage references, cascode and differential amplifier, Gilbert cell, operational transconductance amplifier, current conveyor, current feedback op-amp; Mixed signal circuit design: fully differential circuits, current mode signal processing ,OTA-C continuous-time filters, ladder filters, DAC architectures: current-mode R-2R, current steering and charge scaling. ADC, flash, successive approximation and noise shaping, Layouts, analog and mixed signal circuits.

References:

1. Johns D. A, Martin K, Analog Integrated Circuit Design, John Wiley and Sons, 2002.
2. Baker R. J., Li H W, Boyce D. E., CMOS Circuit Design, Layout, and Simulation, IEEE Press, PHI, 1998.
3. Razavi B., Design of Analog CMOS Integrated Circuits, Tata McGraw Hill, 2002.
4. Baker R. J., CMOS Mixed Signal Circuit Design, Volume II, Wiley Inter-science, 2002.
5. Mohan P. V. A., Current mode VLSI Analog Filters Design and Applications, Birkhauser, 2003.

ECE 4062: DIGITAL DESIGN VERIFICATION [3 0 0 3]

System Verilog: Introduction to System Verilog, Data types, scheduling semantics and assignment statements, Connecting test bench and DUT. Verification: Introduction, Verification Methodologies, Types of Verifications and approaches, Coverage-Driven functional verification, Assertion based verification (ABV), Verification Planning and Test Bench Architecture, System-Level Verification, Processor Integration Verification, Assertions for Formal tools.

References:

1. Padmanabhan T.R. and Sundari B.B.T., Design Through Verilog HDL,John Wiley & Sons, 2004.
2. Palnitkar S.,Verilog®HDL.A Guide to Digital Design and Synthesis IEEE1361-2001Compliant (2e),Prentice Hall,2003.
3. BhaskarJ., AVerilog HDL Primer, BS Publications,2005.
4. Brown S. and Vranesic Z.,Fundamentals of Digital Logic with Verilog Design (5e),TataMcGrawHill, 2005.
5. Ciletti M.D., Advanced Digital Design with the Verilog HDL, PHI,2005.

ECE 4063: LOW POWER VLSI DESIGN [3 0 0 3]

Power dissipation in digital ICs, low power methodologies and their design, Impact of device technology and scaling on power, dynamic power reduction techniques, Sources of leakage current and techniques for leakage power reduction, power analysis and power estimation methods,switching activity reduction in CMOS circuits, Low power clock distribution techniques with zero or tolerable clock skew, Power and performance management, Circuit and system level architectures for low power, low power architectures for arithmetic and memory circuits.

References:

1. Yeap G. K, Practical Low Power Digital VLSI Design, KAP, 2002.
2. Piguet C.,Low Power CMOS Circuits – Technology, Logic Design and CAD Tools, CRC Press, 2006.
3. Rabaey J. M, and Pedram M., Low Power Design Methodologies, Kluwer Academic, 1997.
4. Roy K. and Prasad S., Low Power CMOS VLSI Circuit Design, Wiley, 2000.

5. Yeo K. S., Rofail S. S. and Goh W. L., CMOS/BiCMOS ULSI: Low Voltage, Low Power, Pearson, 2002.

ECE 4064: SEMICONDUCTOR DEVICE THEORY [3 0 0 3]

Energy Bands in Solids, Electron and Hole Densities in Equilibrium, Excess carriers—Non-equilibrium Situation, Junctions and Interfaces, Charge Transport in Semiconductors, P-N Junctions and its applications. Junction Field Effect Transistor and Metal-Semiconductor, MIS Junction/capacitor - ideal C-V characteristics and deviations due to interface states/charges and work function differences, threshold voltage. Field Effect Transistor, MOSFETs.- operation and characteristics.

References:

1. Achuthan M. K. and Bhat K. N., Fundamentals of Semiconductor Devices, Tata McGraw Hill, New Delhi, 2011.
2. Streetman B. G. and Banerjee S., Solid State Electronic Devices, PHI, New Delhi, 2011.
3. Gupta N.D and Gupta A.D, Semiconductor Devices. Modelling and Technology, PHI, New Delhi, 2004.

ECE 4065: ADVANCED MOS DEVICES [3 0 0 3]

Long channel, short channel and ultra-small MOSFETs, Si MOSFET device scaling - threshold voltage, channel length, sensitivity of performance factors to device parameters, MOS memory, CCDs and CMOS imagers, Silicon on insulator (SOI) CMOS, partially depleted and fully depleted SOI MOSFETs, thin silicon SOI bipolar, double gate MOSFETs, FINFET:Fabrication, types, I-V characteristics, circuit design, Modern nanoscale devices: Quantum well devices, nanowires and tunnel FETs, nanotube and semiconductor nanowire FETs, memresistors, graphene FET, Introduction to semiconductor TCAD.

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References:

1. Achuthan M. K. and Bhat K. N., Fundamentals of Semiconductor Devices, Tata McGraw Hill, 2011.
2. Taur Y. and Ning T. H., Fundamentals of Modern VLSI Devices (2e), Cambridge University Press, 2009.
3. Veendrick H., Deep Submicron CMOS ICs (2e), Kluwer Academic Publishers, 2000.
4. Jha N.K., Nanoelectronic Circuit Design, Springer, 2011.
5. Colinge J.P., FinFETs and Other Multi Gate Transistors, Springer, 2008.

ECE 4066: ADVANCED PROCESSORS AND CONTROLLERS [3 0 0 3]

Introduction to ARM, ARM thumb model. ARM Thumb Programming, ARM C Programming, Architectural support for system development: AMBA specifications, JTAG, Debug Architecture, ARM Processor cores, ARM embedded applications, Introduction to PSoc.

References:

1. Sloss A.N., Symes D. and Wright C., ARM System Developer's Guide, Elsevier, 2004.
2. Furber S., ARM System-on- Chip Architecture (2e), Pearson Education, 2000.
3. Gibson J. R., ARM Assembly Language-an Introduction (2e), Dept. of Electrical Engineering and Electronics, The University of Liverpool, 2007 .
4. Ashby R., Designers Guide to the Cypress PSoC, Elsevier, 2005.
5. PSoC Technical Reference Manual, Cypress Semiconductors.

ECE 4067: BUILDING AUTOMATION SYSTEMS [3 0 0 3]

Overview of Digital Controllers, Network and Communication protocols, Introduction to Building Management Systems, General BMS architecture, Communication Systems and standards for BMS. Application of internet for Automation and Management. Introduction to HVAC and Optimal control methods for HVAC Systems. Lighting Control Systems and protocols. Security and Safety Control Systems such as Access Control and Fire Alarm Systems. System Integration and Convergence. Energy Management, Green Building (LEED) concept and examples.

References:

1. Jain V. K., Automation Systems in Smart and Green Buildings, Khanna Publishers, 2009
2. Norman T.L., Integrated Security Systems Design: Concepts, Specifications, and Implementation, CPP PSP CSC, 2007.
3. Benantar M., Access Control Systems: Security, Identity Management and Trust Models, Springer, 2005
4. Auvil R. J., HVAC Control Systems, American Technical Publishers, 201

ECE 4068: CAD FOR VLSI DESIGN [3 0 0 3]

Basic of Graph Theory- Types of graph. Graph optimization problems and algorithms. Overview of PLDs and FPGAs - Types of PLDs and FPGAs, Boolean logic implementation, Switching technology. Cell library binding - Subject graph, pattern graph and simple library design. Tree based covering using dynamic programming and Automata. State diagram, state flow sequencing graph, Architectural synthesis: - strategies for architectural optimizations, Area/ Latency, Cycle-time/ Latency and Cycle-time/ Area optimizations. Scheduling and resource binding: model for scheduling problems, scheduling with resource and without resource constraints. Two level combinational logic synthesis and optimization-Exact and Heuristic method, Sequential logic optimization. Fault simulation techniques, automatic test pattern generation (ATPG), Fault collapsing technique, Design for testability (DFT) techniques.

References:

1. Michelli G. D., Synthesis and Optimisation of Digital CircuitsTata-McGraw Hill, New Delhi,1994.
2. Hachtel G.D. and Somenzi F., Logic Synthesis and Verification AlgorithmKluwer Academic Publication, Boston, 2002.
3. Trimberger S., Introduction to CAD for VLSI Kluwer Academic publisher, 2002.
4. Gerez S. H., Algorithms for VLSI Design Automation John Wiley & Sons, 2002.
5. Sherwani N. A., Algorithms for VLSI Physical Design Automation Kluwer Academic Publishers, 2002.

ECE 4069: CIPHER SYSTEMS [2 1 0 3]

Security goals, cryptographic attacks, services and mechanism. Time estimation, Euclidian algorithm, congruences, Chinese remainder theorem, Euler function, modular exponentiation. Shift, linear and affine transformation, Hill cipher, Vigenere and Beufort cipher systems. Modern block, stream, Fiestel cipher, simplified DES, DES, RC5, Blowfish. Galois field, AES algorithm, block cipher modes. Merkle - Hellman, RSA, Rabin, Elgamal and elliptic curve cryptography. MD hash function, SHA.512, Whirlpool algorithms, digital signatures and authentication protocols.

References:

1. Koblitz N.,A Course in Number Theory and Cryptography (1e), Springer, 1987.
2. Forouzan B.A. and Mukhopadhyay D., Cryptography and Network Security (2e), Tata McGrawHill, 2010.
3. Stallings W.,Cryptography and Network Security (1e),Pearson Education, 2006.
4. Beker H. and Piper F., Cipher Systems: the Protection of Communications, NorthwoodBooks,1982.

ECE 4070: DATA STRUCTURES AND ALGORITHMS [3 0 0 3]

Overview of C++, introduction to algorithms, performance analysis and measurements. Arrays, Array as abstract data type, sparse matrix, Stacks, Evaluation of arithmetic, Queues. Singly linked lists, doubly linked lists. Introduction, binary trees, binary tree representations, binary tree traversal algorithms. Binary tree applications - Huffman coding, threaded binary trees, heaps, binary search trees. Height balanced tree. The graph abstract data type- definitions and representations. Breadth first search, linear and binary search. Insertion sort, Quick sort, Merge sort, Heap sort, Radix sort.

References:

1. Horowitz E., Sahni S. and Mehta D., Fundamentals ofData StructuresinC++, GalgotiaPublications,2004.
2. Weiss M.A., Data Structures and Algorithm Analysisin C++, Pearson Education, 2005.
3. Lipschutz S., Data Structures with C++, Schaum's Outline Series, 2006.
4. Goodrich M.T., Tamassia R. and Mount D.,Data Structures and Algorithmsin C++ (2e), John Wiley & Sons,2011.

ECE 4071: ELECTRONIC INSTRUMENTATION [3 0 0 3]

Transducers and their classification. Generalized measurement system Temperature and pressure measurement techniques Flow measurement techniques. Applications: pH and force measurement, LDR, Biomedical instruments for measurement of ECG, EEG, EMG, EGG.

References:

1. Murthy D.V.S.,Transducers & Instrumentation (1e),PHI,1999.
2. Sawhney A. K., Electrical & Electronic Measurements and Instrumentation, Dhanpat Rai,2002.
3. DoeblinE.O., Measurement Systems, Application and Design, McGrawHill, 2001.
4. Khandpur R.S., Hand Book of Biomedical Instrumentation (2e),McGraw Hill,2003.

ECE 4072: ELECTRONICSYSTEMDESIGN [3 0 0 3]

Electronic product design and product development process, Ishikawa diagram, design stages, reverse engineering. Signal acquisition and conditioning. Thermal Management: Introduction to thermal sources, heat calculations, heat transfer methods, heat sink selection, cooling methods in electronic systems. Power Section: Power supplies, packaging details for power components. I/O Devices, Displays & Debugging: Push button switches, touch screen, display board, LEDs, laser diodes, LCD, mother board. Quality control, SMD components, Soldering and manufacturing.

References:

1. Otto K.N. and Wood K.L.,Product Design techniques in Reverse Engineering and New product Development, Pearson Education,2001.
2. Storey N., Electronics System Approach, Pearson Education, 2011.
3. Brooks D., Signal Integrity Issues and Printed Circuit Board Design, PrenticeHall,2003.

4. Archambeault B., PCB Design for Real-World EMIControl, Kluwer Academic Publishers,2002.
5. Strauss R., Surface Mount Technology, Butterworth- Heinemann Ltd, Oxford,1994.

ECE 4073: ERROR CONTROL CODING [2 1 0 3]

Groups, rings and fields, vector spaces, matrices. Linear block codes and cyclic codes, BCH codes, R.S codes and burst error correction techniques. Convolution codes, and decoding algorithms. Turbo codes and LDPC codes.

References:
1. Lin S.and Costello D.J.Jr., Error Control Coding Fundamentals and Applications,Prentice Hall,1983.
2. MacWilliams F.J.and Sloane. N. J. A, Theory of Error Correcting Codes, North Holland PublishingCo,2006.
3. Peterson W.W. and Weldon E.J., Error Correcting Codes,(2e), John Wiley, 1972.
4. Berlekamp E.R.,AlgebraicCodingTheory,AegeanParkPress, 1984.
5. Blahut, R. E., Theory and Practice of Error Control Codes, Addison-WesleyPublishingCompany,1983.

ECE 4074: FLEXIBLE ELECTRONICS [3 0 0 3]

Electron states and metal insulator transitions, disorder induced localization, Anderson transition. Semiconductor, organic and polymeric materials, gravure printing, inkjet printing, digital lithography. Low temperature amorphous and nano-crystalline silicon growth, doping, defect densities, TFT, PIN devices, LEDs. Flexible organic materials and devices, Optoelectronic devices, solar cells, photodiodes, LEDs organic TFT device, flexible devices based on CNT. Field emitter arrays, novel cold cathode materials. Introduction to TCAD.

References:
1. Street R.A., Hydrogenated amorphous silicon (1e), Cambridge University Press, 1991.
2. Zallen R., The Physics of Amorphous Solids, Wiley-Interscience Publication, 1983.
3. Klauk H., Organic Electronics, Wiley, 2006.
4. Zhu W., Vacuum Microelectronics, John Wiley & Sons, 2001.

ECE 4075: INFORMATION THEORY AND CODING [2 1 0 3]

Information, entropy, discrete sources and channels. Memoryless sources, extension of sources, Markov sources, entropy of Markov source, adjunct of a source and its entropy. Mutual information. Noiseless and deterministic channels, channel capacity. Instantaneous and uniquely decodable codes, Kraft's inequality, compact codes, Shannon-Fano and Huffman coding, adaptive Huffman coding & decoding, Shannon's theorem code efficiency & redundancy. Error probability, maximum likelihood decisions, Fano bound Shannon's second theorem and random coding.

References:
1. Cover T.M. and Thomas J.A., Elements of Information Theory, John Wiley and Sons, 2004.
2. Abrahamson N., Information Theory and Coding, McGraw Hill, 1963.
3. Blahut R.E., Principles and Practice of Information Theory, Addison-Wesley,1987.
4. Sayood K, Data Compression(3e), Elsevier.

ECE 4076: LOW VOLTAGE ANALOG SIGNAL PROCESSING [3 0 0 3]

Low voltage issues in MOS operation, Current mode low voltage design, self cascode MOSFETs and level shifter techniques, analog circuits in weak inversion. Current mirrors, CC, OTA, CFOA, CDTA, OTRA, FTFN and FVF. Overview of low voltage architectures and circuit non idealities, floating gate topologies. Low voltage MOS trans-linear analog signal processing, design procedures, biasing strategies based on flipped voltage followers and floating batteries. Noise and distortion analysis of OTA C filters, dynamic range, performance evaluation based on speed, noise.

References:
1. Kumar A., Sharma G.K and Rajput S.S., Design of Low Voltage Analog Signal Processing Blocks, LAP Lambert Academic Publishing, 2014.
2. Cuautle E. T., Integrated Circuits for Analog Signal Processing, Springer, 2013.
3. Wang A., Calhoun B.H. and Chandrakasan A.P., Sub Threshold Design for Ultra Low Power Systems, 2006.
4. Wouter S.A., Low Voltage Low Power Analog Integrated Circuits, Springer, 1995.
5. Lo T.Y. and Hung C.C., 1V CMOS Gm- C Filters: Design and Applications, Springer, 2009.

ECE 4077: MICROWAVE INTEGRATED CIRCUITS [3 0 0 3]

Introduction: MIC, Analysis of different types of microstrip line, Impedance transformation, Coupled microstrips, Resonators and narrow band filters, Filter design: Image parameter method, Insertion loss method, Filter synthesis, Kuroda's Identity, Impedance Matching Circuits for Amplifiers, Mason's rule, Power gain equations, Amplifier Gain Stability, Noise, DC Biasing, Oscillator Design, Fabrication technology of MIC.

References:
1. Gupta K.C.andSingh A.,MicrowaveIntegratedCircuits, WileyEastern PvtLtd,1974.
2. Garg R., Bahl I., and Bozzi M..,MicrostripLinesandSlot Lines (3e), ArtechPublishers,2013.
3. Pozar D.M., MicrowaveEngineering (2e),JohnWiley&Sons, 1998.
4. Liao S.,MicrowaveDevicesandCircuits,PHILtd.,1990.
5. Balanis C., Antenna Theory: Analysis and Design,JohnWiley,2002.

ECE 4078: MOTION AND GEOMETRY BASED METHODS IN COMPUTER VISION [3 0 0 3]

Geometric primitives, 2D/3D transformations, image features, Image registration (2D/3D) of rigid and deformable objects, Tracking by detection, Tracking using optical flow and KLT, Tracking linear dynamical models with Kalman filters, Epipolar geometry, Binocular reconstruction, Local and global methods for binocular fusion, Structure from motion: Internally calibrated perspective cameras, Uncalibrated weak perspective cameras, Uncalibrated perspective cameras, Active range sensors, Range image registration

References:
1. Forsyth D.A., and Ponce J, Computer Vision: A Modern Approach, Pearson Education, 2003.
2. Szeliski R, Computer Vision: Algorithms and Applications, Springer, 2010
3. Hartley R. and Zisserman A., Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, 2004

ECE 4079: NANO TECHNOLOGY [3 0 0 3]

Introduction: Classical particles, waves and wave particle duality, Black body radiation, photoelectric effect, diffraction. Wave mechanics: Schrodinger wave equation, wave mechanics of particles. Electrons in low-dimensional systems: Quantum well, quantum wire and quantum dots. Materials for nano-electronics: Crystal lattices, bonding in crystals, metals, direct and indirect band gap semiconductors, semiconductor alloys, semiconductor hetero-structures, organic semiconductors, carbon nano-structures.Graphene preparation techniques bottom-up and top-down techniques. Characterization techniques - STM, AFM, NSOM, TEM, SEM. Nano devices: Resonant tunneling diodes, nanomaterial based field effect transistors.

References:

1. Kuno M., Introduction to Nanoscience and Nanotechnology: A Workbook, CreateSpace Independent Publishing Platform, 2014.
2. Mitin V.V., Kochelap V.A., Stroscio M.A., Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications, Cambridge University Press, 2012.
3. Neamen D. A., Semiconductor Physics and Devices-Basic Principles, McGraw-Hill, 2012.
4. Pradeep T., A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education Pvt. Ltd., 2012.
5. Nalwa H.S., Nanostructured Materials and Nanotechnology, Academic Press, 2002.

ECE 4080: OBJECT ORIENTED PROGRAMMING USING C++ [3 0 0 3]

User-defined functions and overloading, recursive functions. Class specification, class objects, constructors, destructors, friend functions. Base class, inheritance and protected members, types of inheritance, virtual base classes. Virtual function, inheritance of virtual functions, hierarchical virtual functions, pure virtual functions. C++ stream classes hierarchy, stream I/O, file s and string streams, file operations, error handling, formatted I/O. Benefits of exception handling, throwing an exception, try block, catching an exception, throwing an exception, catching all exceptions.

References:

1. Schildt H., The Complete Reference C++, Tata McGrawHill,2003.
2. Lafore R., Object-Oriented Programming in C++, Pearson Education, Reprint 2011.
3. Lippmann S.B., Lajore J.,C++Primer,Pearson Education,2005.
4. Deitel P.J., Deitel H.M., C++for Programmers, Pearson Education, 2009.
5. Venugopal K. R., Buyya R., T. Ravi Shankar, Mastering C++, Tata McGraw Hill, 2011.

ECE 4081: OPERATING SYSTEMS FOR ADVANCED PROCESSORS [3 0 0 3]

ARM cortex M-processor architecture. The Cortex Microcontroller Software Interface Standard (CMSIS), The FreeRTOS distribution, Heap memory management, Task management, Queue management, Software timer management, Interrupt & Resource management, Event groups & Task notifications

References:

1. Barry R., Mastering the FreeRTOS Real Time Kernel – A Hands on Tutorial Guide, Real Time Engineers LTD., 2016.
2. Valvano J.W., Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers, Volume3, (4e), Self Published in 2017.
3. Yiu J, The Definitive Guide to ARM Cortex-M0 and Cortex-M0+ Processors, Newnes Publisher, 2015.
4. Wang K.C., Embedded and Real-Time Operating Systems, Springer, 2017.

ECE 4082: OPTICAL WIRELESS COMMUNICATION [3 0 0 3]

Introduction to optical wireless communication, optical devices for optical wireless communication, factors affecting optical signal propagation in atmosphere, atmospheric turbulence models, modulation techniques, free space optical link performance under the effect of atmospheric turbulence

References:

1. Ghassemlooy Z., Popoola W., Rajbhandari S., Optical Wireless Communications: System and Channel Modelling with MATLAB, CRC Press, 2012
2. Andrews L. C. and Phillips R. L., Laser Beam Propagation through Random Media, 2nd ed. Bellingham, Washington: SPIE Press, 2005.
3. Bandele O. J., Desai P. N., Woolfson M. S., and Phillips A. J., Saturation in Cascaded Optical Amplifier Free-Space Optical Communication Systems, IET Optoelectronics, vol. 10, no. 3 pp. 71-79, 2016
4. Mbah A. M., Walker J. G., Phillips A. J., Outage Probability of WDM Free-Space Optical Systems Affected by Turbulence-Accentuated Interchannel Crosstalk, IET Optoelectronics, vol. 11, no. 3 pp. 91-97, 2016

ECE 4083: POWER ELECTRONICS [2 1 0 3]

Power Electronics Devices, controlled rectifiers, single phase and three phase converters for different loads, dual converters and cyclo converters. DCDC switched mode converters: Buck, Boost, Buck-Boost, Cuk, Flyback, forward. DC-AC switched mode inverters: Half bridge and full bridge single phase inverters, three phase inverters with 120o and 180o conduction. Applications: Switched mode power supplies, power conditioners, UPS, automotive electronics.

References:

1. Hart D.W.,IntroductiontoPowerElectronics,McGrawHill, 2010.
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall of India,NewDelhi,2004.
3. Mohan N., Power Electronics Converters, Applications and Design, JohnWiley andSons.INC,1995.
4. Singh M.D., Power Electronics,Tata McGraw Hill,2007.

ECE 4084: RADAR AND NAVIGATION SYSTEMS [3 0 0 3]

Simple form of radar equation, radar frequencies, millimeter and sub millimeter waves. Prediction of range performance, minimum detectable signal, receiver noise, radar clutter, pulse repetition frequency. Reflector, phased array and loop antennas for radar. Doppler Effect, CW radar, FMCW radar. Moving target indicator (MTI) and pulse Doppler radar, delay line cancellers, range gated Doppler filters. Radar receivers, displays and duplexer, impact of noise, synthetic aperture radar. Radio altimeter, LORAN, DECCA, OMEGA, inland shipping aids, SONAR.

References:

1. Skolnic M.,IntroductiontoRADARSystems,McGraw-Hill.
2. PeytonZ. and Peebles Jr., Radar Principles, WileyIndia,2009.
3. Raju G.S.N., Radar Engineering and Fundamentals of Navigational Aids, I.K. International Publishers, 2008.
4. Waite A. D., SONAR for Practicing Engineers, Wiley Publications.
5. Nagaraja N. S., Elements of Electronic Navigation, TMH, 2001.

ECE 4085: RF CIRCUIT DESIGN [3 0 0 3]

Introduction to RF systems and RF design parameters, Passive IC components and Passive RLC Networks, RF CMOS Circuit Design: RF Filters, High Frequency Amplifiers, RF Power Amplifiers, Noise in RF Systems, LNA, RF Mixers, RF modulators, RF Oscillators, RF synthesizers, Radio architectures.

References:

1. Razavi B., RF Microelectronics, Pearson Publisher, 2012.
2. Lee T.H., The Design of CMOS Radio-Frequency Integrated Circuits, Cambridge University Press Publisher, 2006.

ECE 4086: SPREAD SPECTRUM COMMUNICATION [3 0 0 3]

Digital modulation and spectral efficiency, direct sequence and frequency hopping spread spectrum principles, PN sequences, their properties and generation techniques. DS/BPSK system analysis and performance evaluation. DS/QPSK system and other advanced schemes. MSK spread spectrum, hybrid spread spectrum.Slow and fast hopping systems, FH/BFSK system analysis and performance evaluation. Code acquisition and synchronization. Antijamming, low probability detection, multipath rejection, CDMA.

References:

1. Peterson R. L. and Ziemer R. E., Introduction to Spread Spectrum Communication, PHI, 1995.
2. George R. and Cooper C. D., Modern Communications and Spread Spectrum, McGraw Hill(2e), 1986.
3. Dixon R. C., Spread Spectrum Communication, IEEE press, John Wiley and Sons, 1976.
4. Sklar B, Digital Communication Fundamentals and Applications, Pearson Education, 2001.

ECE 4087: SYSTEM ON CHIP DESIGN [3 0 0 3]

Introduction to the System Approach, System Architecture, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, Memory Design for SOC, Interconnect Customization and Configuration, Application Studies / Case Studies

References:

1. Flynn M.J.,andLuk W., Computer System Design System on Chip, Wiley India Pvt. Ltd., 2011.
2. Furber S., ARM System on Chip Architecture, Addison Wesley Professional, 2000.
3. Reis R., Design of System on a Chip-Devices and Components, Springer, 2004.
4. Rashinkar P., Paterson P. and Singh L.L, System on Chip Verification Methodologies and Techniques, Kluwer Academic Publishers, 2001.

ECE 4088: THIN FILMS AND NANOSTRUCTURES [3 0 0 3]

Vacuum technology, transport phenomenon in gas flow, Gas flow at low pressures: Flow regimes. Physics & Technology of different thin film techniques- Thermal, e-beam evaporation, Molecular beam epitaxy-Sputtering technique, Pulse laser deposition. CVD techniques, physics & technology of thermal CVD, PECVD, MOCVD and their variants. Substrate surfaces and thin film nucleation, atomic view of substrate surface, thermodynamics of nucleation, kinetic processes, experimental techniques. Ultra-thin films, methods and applications: Plasmonics, Solar cells etc

References:

1. Roth A., Vacuum Technology, Elsevier 1990.
2. Ohring M., Material Science of Thin films: Deposition & Structure, Academic Press 2002.
3. Singh J., Physics of Semiconductors and their Heterostructures, McGraw- Hill, 1993.
4. Mitin V. V, Kochelap V A. and Stroscio M.A., Quantum Hetero structures, Cambridge University Press. 1999.

ECE 4089: TIME FREQUENCY AND WAVELET TRANSFORMS [3 0 0 3]

Time frequency analysis and wavelet transforms, STFT. Continuous wavelet transforms and their properties. Discrete wavelet transforms and their properties. DWT and its relation to filter banks, Multi-rate sampling fundamentals, Haar filter bank. Designing orthogonal and bi-orthogonal wavelet systems. Two-dimensional wavelet system.

References:

1. Addison P. S, The Illustrated Wavelet Transform Handbook, Institute of Physics Publishing, 2002.
2. Rao R.M., Bopardikar A.S., Wavelet Transforms- Introduction to Theory and Applications, Pearson Education, 2008.
3. Soman K. P. and Ramachandran K. I., Insight into Wavelets from Theory to Practice, Prentice Hall of India, 2005.
4. Narasimhan S. V., Basumallick N., S. Veena, Introduction to Wavelet Transform: A Signal Processing Approach, Narosa Publishing House, 2012.
5. Vaidyanathan P. P., Multirate Systems and Filter Banks, Pearson, 2012.

ECE 4090: VLSI PROCESS TECHNOLOGY [2 1 0 3]

Material properties: crystal structure and defects; crystal growth: silicon crystal growth. Czochralski technique, material characterization; silicon oxidation-thermal oxidation model and its kinetics, Photolithography-optical lithography, resolution enhancement techniques, other lithography techniques, Etching- wet chemical etching and dry etching, Diffusion: basic diffusion process, Fick's first and second law, Ion implantation: range of implanted ions and ion distribution and related process, Film deposition and metallization- different types of epitaxial growth technique - CVD, molecular beam epitaxy, Device and circuit fabrication: isolation, self-alignment, gettering..

References:

1. May G. S. and Sze S. M, Fundamentals of Semiconductor Fabrication, Wiley Student edition,2003.
2. Gandhi S. K., VLSI Fabrication Principles, John Wiley and Sons, 2009.
3. Ruska W. S, Microelectronic Processing, McGraw Hill, 1997.
4. Zant P. V., Microchip Fabrication, McGraw Hill, 2013.
5. Campbell S., The Science and Engineering of Microelectronic Fabrication, Oxford Press, Cambridge, 2013.

ECE 4091: WIRELESS SENSOR NETWORKS [3 0 0 3]

AdHoc Networks and their issues, routing, Ad Hoc Wireless Internet. Unique constraints and challenges, sensor network architecture, data dissemination and gathering. MAC Protocols for sensor network, design goals, S-MAC, IEEE 802.15.4. Routing Protocols, classification, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols. QoS and Energy Management, QoS frameworks, system

power management schemes. Sensor Network Platforms and Tools, Sensor Node Hardware, Programming Challenges

References:
1. Murthy S.R.., and Manoj B. S., AdHoc Wireless Networks, Pearson Education, 2008.
2. Karl H. and Willig A., Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005.
3. Zhao F and Guibas L.J., Wireless Sensor Networks - An Information Processing Approach, Elsevier, 2007.
4. Sohraby K., Minoli D., & Znati T, Wireless Sensor Networks-Technology, Protocols, and Applications, John Wiley, 2007.
5. Hac A., Wireless Sensor Network Designs, John Wiley, 2003.

ECE 4092 ANALOG IC DESIGN [2 1 0 3]

Integrated circuit design philosophy, Recent trends and challenges in IC design, Review of MOS device, Circuit simulators, Current mirrors, Biasing circuits, Single stage amplifiers, Frequency response of amplifiers, Cascode amplifiers, Analysis and design of two stage CMOS op-amp and OTA, Performance parameters of OTA, Stability and frequency compensation of amplifiers, Voltage reference and regulator, Temperature independent biasing, PTAT and CTAT voltage devices, beta multiplier, Band-gap reference and Low dropout voltage regulator.

References:
1. Behzad Razavi (2002), Design of Analog CMOS Integrated Circuits, Tata McGraw-Hill. ISBN: 0-07-238032-2
2. R. Jacob Baker (2012), CMOS Circuit Design, Layout and Simulation, Wiley-India Edition, ISBN: 978-81-265-2037-4
3. Phillip E. Allen and Douglas R. Holberg (2014), CMOS Analog Circuit Design, 2nd Edition, Oxford University Press, ISBN:0-19-809738-7
4. Adel S. Sedra and Kenneth C. Smith (2006), Microelectronic Circuits, Oxford University Press, ISBN: 0-19-514252-7

OPEN ELECTIVES

ECE 4301: BUILDING AUTOMATION SYSTEMS [3 0 0 3]

Overview of Digital Controllers, Network and Communication protocols, Introduction to Building Management Systems, General BMS architecture, Communication Systems and standards for BMS. Application of internet for Automation and Management. Introduction to HVAC and Optimal control methods for HVAC Systems. Lighting Control Systems and protocols. Security and Safety Control Systems such as Access Control and Fire Alarm Systems. System Integration and Convergence. Energy Management, Green Building (LEED) concept and examples.

References:
1. Jain V. K., Automation Systems in Smart and Green Buildings, Khanna Publishers, 2009
2. Norman T.L., Integrated Security Systems Design: Concepts, Specifications, and Implementation, CPP PSP CSC, 2007.
3. Benantar M., Access Control Systems: Security, Identity Management and Trust Model's, Springer, 2005
4. Auvil R. J., HVAC Control Systems, American Technical Publishers, 2013

ECE 4302: CONSUMER ELECTRONICS [3 0 0 3]

Microphones, head phones, hearing aids, and loud speakers. Digital disc storage technologies, iPods, MP4 players, home audio systems. TV communication system, composite video signal, need for synchronizing and blanking pulses, LCD, LED and plasma TV, cable TV and DTH. Basics of telephone system, caller ID telephone, intercoms, cordless telephones, cellular mobile systems. Automatic teller machines, facsimile machines, digital diaries, safety and security systems. Digital camera system, ovens, washing machines, air conditioners and refrigerators.

References:
1. Bali S.P.,ConsumerElectronics, PearsonEducation,2005.
2. Gulati R. R., Monochrome and Color Television, New Age InternationalPublisher,2001.
3. Dhake A. M., TV and Video Engineering, TataMcGraw-Hill,2001.

ECE 4303: ELECTRONIC PRODUCT DESIGN & PACKAGING [3 0 0 3]

Product planning, creativity, product life cycle and reliability, aesthetics, ergonomics, control panel, product detailing and finishing. Thermal sources, heat calculations, heat transfer methods, heat sinks, cooling methods. Packaging technologies, ball grid arrays, flip chip, chip-scale packaging. First level, second level packages and third level packages. Design of low noise circuits. Interfacing of analog and digital systems. PCB design. Sources of EMI, shielding of signal lines, ground loops, reduction techniques, reflections and cross talk in digital circuits.

References:
1. Flurshiem C.H., Industrial Design and Engineering, Springer Verilog,2007.
2. Horowitz P.andHill W.,TheArtofElectronics,Cambridge,1995.
3. Ott H.W., Noise Reduction Techniques in Electronic Systems, Wiley,1989.
4. Bosshart W.C., Printed Circuit Boards: Design and Technology, TataMcGrawHill,2000.
5. Ginsberg G.L., Printed Circuit Design, McGrawHill,1991

ECE 4304: INTRODUCTION TO COMMUNICATION SYSTEMS [3 0 0 3]

Model of communication systems and types of electronic communication. Telephone system, signaling tones, DTMF. Optical fibers, numerical aperture. Attenuation and dispersion, optical sources and detectors. Principles of satellite orbits and positioning, Earth station technology, multiple access techniques, Application of satellites. Frequency reuse, cell splitting, sectoring, macro cell and micro cell, Architecture of GSM systems. Pulse radar, duplexer, MTI Radar. Wireless LAN, PAN, bluetooth, ZigBee, RFID and NFC.

References:
1. Frenzel L.E., Communication Electronics-Principles and Applications,TMH,2004.
2. Pratt T., Satellite Communication Systems, John Wiley and Sons,2006.
3. Stallings W., Wireless Communication and Networks, Pearson Education,2006.
4. Keiser G.,OpticalFiberCommunication,McGrawHill,1991.
5. Kennedy G. and Davis B., Electronic Communication Systems, Tata McGraw Hill, 1999..

ECE 4305: INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY [3 0 0 3]

Classical particles, waves and wave particle duality. Black body radiation, photoelectric effect, interference, diffraction. Schrodinger wave equation. Atoms and atomic orbitals. Quantum structures. Crystal lattices, bonding in crystals, metals, semiconductors, direct and indirect

band gap semiconductors, semiconductor alloys, hetero-structures, organic semiconductors, carbon nano-structures. Graphene preparation techniques. Characterization.

References:
1. Mitin V. V.,Kochelap V.A. and Stroscio M. A., Introductionto Nanoelectronics, Science, Nanotechnology, Engineering and Applications, Cambridge University Press,2008.
2. Dressellhaus M.S., Dressellhaus GandEklund P. C., Scienceof Fullerenes and CarbonNanotubes, SanDiego, CA, Academic Press,1996.
3. MitinV. V., Kochelep V. A. and Stroscio M. A., Quantum Heterostructures, New York, Cambridge University Press,1999.
4. Feynman R.P., Lectureson Physics,Vol3,New York, Addison Wesley,1964.
5. Saxon D.,ElementaryQuantumMechanics,SanFranscisco, CA, Holden. DayInc., 1968.

ECE 4306: MEMS TECHNOLOGY [3 0 0 3]

Historical background of MEMS. Bulk micromachining, MEMS transduction and actuation techniques, Micro sensing for MEMS, Basic Bio-MEMS fabrication technologies. RF MEMS, Microfluidic devices and components for Bio-MEMS, sensing technologies for Bio-MEMS, Applications. Introduction to MEMS simulation tool.

References:
1. Liu C.,Foundationsof MEMS, Prentice Hall,2011.
2. Bao M., Analysis and Design Principles of MEMS Devices, ElsevierScience,2005.
3. Senturia S.D., Microsystem Design, Springer,2001.
4. Wang W., Soper S.A., Bio-MEMS-Technologiesand Applications, CRC Press,2007.
5. Rebeiz G.M., RF MEMS: Theory, Design, and Technology, JohnWiley & Sons,2003.

OPEN ELECTIVES

MCA 4301: INTRODUCTION TO DATABASE SYSTEMS WITH MYSQL [3 0 0 3]

Modeling and Designing Databases, Database Design Process, Entity-Relationship Model, Basic Concepts, Constraints, Design of ER database schema, Reduction of ER to schema, Relational model, Super, candidate, primary ,foreign key, Schema Diagram, Relational Database design, Functional dependencies, Normal forms, Creating a MySQL Database, Table, Modifying table, constraints, indexes, Basic SQL, Inserting Data, Selecting Data, Updating Data, Deleting Data, MySQL Functions, Numeric, String, Date /Time, Advanced Queries, Sorting, Multiple tables, Inner Join, Left Join, Right Join, Natural Join, Nested queries, Generating summaries, COUNT(), MIN(), MAX(), SUM(), AVG(), Group By, Statistical techniques, Calculating Descriptive statistics, Per-Group Descriptive Statistics, Generating frequency distribution, Calculating correlation coefficients, assigning ranks, Stored routines, stored procedure, stored function, Triggers, Events to schedule Database actions, Managing users and privileges, Importing and Exporting data, importing data with LOAD data and mysql import, importing csv files, exporting query results, tables, importing XML.

References:
1. Paul Dubois, MySQL Cookbook, O'REILLY, First Edition, 2007.
2. Larry Ullman, Visual Quick Start guide MySQL, Pearson Education, 2nd Edition, 2007.
3. Seyed M. M, Saied Tahaghoghi and Hugh Williams, Learning MySQL, O'Reilly, 2006.
4. Russell J.T. Dyer, MySQL in a Nutshell, O'REILLY, 2nd Edition, 2008.

MCA 4302: INTRODUCTION TO VR AND AR TECHNOLOGIES [3 0 0 3]

Introduction: Input Devices, Output Devices, Displays, Computing Architectures for VR, The Rendering Pipeline, PC Graphics Architecture, Workstation-Based Architectures, Distributed VR Architectures, Modeling, Geometric Modeling, Physical Modeling, Behavior Modeling, Model Management, VR Programming and other Toolkits. Introduction to Unity 3D Engine, 2D Game concepts and basic scripting, 3D Game concepts and environment creation, Advanced game concepts. Introduction to Unity AR: Foundation and Vuforia, working with Vuforia in Unity, ARCore in unity, Mini project on AR. Introduction to VR, Unity for Google cardboard, Basic VR app development for Cardboard, Develop for a specific VR platform.

References:
1. Jonathan Linowers, Krystian Banbilinski, Augmented Reality for Developers,Packt Publishers, 2017.
2. Edward Lavieri, Getting started with Unity 5, Packt publishing, 2015.
3. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley-IEEE Press, 2003.
4. Sherman, W.R. & A. Craig, Understanding, Virtual Reality: Interface, Application and Design, Morgan Kaufmann, San Francisco, CA, 2003.
5. Philippe Fuchs, Guillaume Moreau, Pascal Guitton, Virtual Reality: Concepts and Technologies, CRC, Taylor and Francis, 2011.

MCA 4303: INTRODUCTION TO LINUX AND SHELL SCRIPTING [3 0 0 3]

Introduction to UNIX/LINUX Operating System: OS concepts, Linux overview, key features of Linux, pros and cons of Linux. Processes: Processes and Files, I/O redirection and pipes, process creation, process attributes standard process file descriptors. File and Process commands. File systems: Files and directories, file naming and wildcards, file attributes, file permissions. Regular Expressions & filters: find, grep, cut, sort, grep patterns. AWK and SED. Shell and Shell Scripting: The need for shell, types of shells, interactive uses of shell, using shell for creating user commands, functions. Bash shell features: Statements, data structure, built-in commands, environment customization primitives. Linux Editors.

References:
1. Richard Blum and Christine Bresnahan, Linux Command Line Shell Scripting BIBLE, 3rd Edition, Wiley, 2015.
2. Mark Sobel. A Practical Guide to Linux commands Editor and shell programming, Prentice Hall, 2nd Edition, 2010.
3. Stephen G. Kochan. Unix Shell Programming, 3rd Edition, SAMS Publications, 2003.
4. Bash Reference Manual Download able from GNU Project.
5. Brian W Kerningham and Rob Pike. The Unix Programming Environment, PHI Learning Pvt. Ltd., 2009.

MCA 4304: INTRODUCTION TO DATA ANALYTICS [3 0 0 3]

Introduction - data science, need for analytics, steps in data analysis projects, Data- sources of data, data sets, data warehouses, data types, privacy and confidentiality, samples vs. population. Data summarization and visualization – tables and graphs. Data Preprocessing- cleaning, transformation, dimensionality reduction. Data Analysis and Visualization – descriptive, inferential statistics, uni-variate and multi-variate analysis. Grouping – Cluster Analysis- distance measures, partitioning, hierarchical, density based methods. Market Basket Analysis, Association Analysis, Market Basket Analysis. Classifiers-Bayesian, k-nearest neighbor, neural network, Support Vector Machine, Decision Trees. Prediction- Regression models, Evaluating Classification and Predictive performance, ensemble methods. Anomaly Detection. Forecasting models.

References:
1. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.
2. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications, John Wiley & Sons Publication, 2009.
3. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, Data Mining for Business Intelligence, John Wiley & Sons, 2014.
4. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2011.
5. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Addison Wesley, 2005.

Minor Specialization: Computational Mathematics

MAT 4051: APPLIED STATISTICS AND TIME SERIES ANALYSIS [2 1 0 3]

Stochastic and deterministic dynamic mathematical models – forecasting and control, transfer function models, models for discrete control systems. Basic ideas in model building- linear and multiple linear regression. Basic concepts in stochastic processes and Markov chains, Mean square distance, mean square error prediction, prediction of covariance stationary process, ergodic theory and stationary process, applications of ergodic theory, spectral analysis of covariance stationary processes, Gaussian systems, stationary point processes, level crossing problems. ARIMA models, Autoregressive models, moving average models, duality, model properties, parameter estimates, forecasts.Volatility models: ARCH and GARCH modelling, testing strategy for heteroscedastic models, volatility forecasts, Black Scholes model.

References:

1. G.E.P. Box, G. M. Jenkins, G. C. Reinsel and G M Ljung, *Time Series Analysis-Forecasting and Control*, (5e), Wiley Series, 2016.
2. Anderson T W, *The Statistical Analysis of Time Series*, John Wiley, New York, 1994
3. Samuel Karlin, Howard M Taylor, *First Course in Stochastic process*, Academic Press, New York,
4. C. Chatfield, *The Analysis of Time Series – An Introduction*, Chapman and Hall / CRC, (4e), 2004
5. David Ruppert, *Statistics in Finance*, Springer Publications, 2004

MAT 4052: COMPUTATIONAL LINEAR ALGEBRA [2 1 0 3]

Matrix Analysis: Basic Ideas from Linear algebra, vector norms, matrix norms, orthogonality and SVD, Projections and CS decomposition, the sensitivity of square linear systems. General Linear Systems: Triangular systems, The LU factorization, Round off analysis of Gausian elimination, Pivoting, Improving and estimating accuracy. Orthogonalization and least squares: Householder and Givens matrices, The QR factorization, The full rank LS problem, Other orthogonal factorizations, The rank deficient LS problem, Weighing and iterative improvement, square and underdetermined systems.The symmetric Eigen value problem: Eigen values properties and decompositions, Power iterations, the symmetric QR algorithm, Jacobi methods, Tridiagonal Methods, Computing the SVD, some generalized eigen value problems.

References:

1. Gene H. Golub and Charles F. Van Loan, *Matrix Computations*, (4e), Johns Hopkins University Press, 2013.
2. Gilbert Strang, *Linear Algebra and its applications*, (4e), Wellesley Cambridge press, 2009.
3. David S. Watkins, *Fundamentals of Matrix Computations*,(3e), Wiley, New York, 2010.
4. Roger a Horn, *Matrix Analysis*, (2e), Cambridge University Press, 2013.

MAT 4053: COMPUTATIONAL PROBABILITY AND DESIGN OF EXPERIMENTS [2 1 0 3]

Sampling and sampling distributions, Most powerful tests, Uniformly most powerful tests, Likelihood ratio tests, The sequential probability ratio test, Randomized Designs, Inferences about the differences in Means, Paired Comparison Designs, Inferences about the variance of normal distributions, Monte Carlo estimation methods.The analysis of variance, RCBD, LSD and Related Designs, The Graeco - Latin square Design, Balanced Incomplete Block Designs, PBIBD Introduction to Factorial Designs, The Two Factor factorial design, Blocking in a factorial design, 2^k Factorial Design, Blocking and Confounding in the 2^k Factorial Design, Partial Confounding. Two level fractional factorial designs, three level and mixed level factorial and fractional factorial designs, 3^k Factorial Design, Confounding in the 3^k Factorial Design, Fractional replication of the 3^k Factorial Design, Factorials with mixed levels.

References:

1. Robert V Hogg and Allen Craig, *Introduction to Mathematical Statistics*, (4e), Macmillan
2. M N Murthy, *Sampling Theory and Methods*, Statistical Publishing Society, 1967
3. C Radhakrishna Rao, *Linear Statitical Inference and its applications*, (2e), Wiley Series.
4. Douglas C Montgomery, *Design and Analysis of Experiments*, (8e), Wiley Series, 2012,
5. D D Joshi, Linear Estimation and Design of Experiments, New Age International Publishers, 2009

MAT 4054: GRAPHS AND MATRICES [2 1 0 3]

Graphs and subgraphs, walks, paths and connectedness, distance as a metric, degrees, regular graphs, cubic graphs, bipartite graphs, self-complementary graphs, operations on graphs, extremal graphs, cut points, bridges and blocks, block graphs and cut point graphs.Trees and their characterizations, centres and centroids, block-cut point trees, spanning trees, independent cycles and cocycles, connectivity and line connectivity, graphical variations of Menger's theorem. Traversability: Eulerian graphs and Hamiltonian graphs. Line graphs and total graphs. Line graphs and traversability, coverings and independence, critical points and lines. Planarity: Plane and planar graphs, outer planar graphs, Kuratowski's theorem, vertex colouring.Incidence Matrix: Rank, minors, path matrix, 0-1 incidence matrix. Adjacency Matrix: Eigen values of some graphs, determinant, bounds, energy of a graph, antiadjacency matrix of a directed graph, non-singular trees. Laplacian Matrix: Basic properties, computing Laplacian eigen values, matrix tree theorems, bounds for Laplacian spectral radius, edge-Laplacian of a tree.

References:

1. F. Harary, *Graph Theory*, Narosa Publishers, 1988.
2. J.A Bondy and U.S.R Murthy, *Graph Theory with Applications*, (5e), Elsevier Publishing Co., 1982.
3. D.B. West, *Introduction to Graph Theory*, Pearson Education, Inc., 2001.
4. R.B Bapat, *Graphs and Matrices*, Hindustan Book Agency, 2010.
5. Lowell W Beineke and Robin J Wilson, *Topics in Algebraic Graph Theory*, Cambridge University Press, 2005.

OPEN ELECTIVES
MAT 5301: APPLIED GRAPH THEORY [2 1 0 3]

Graphs and applications of the theorems by Havel and Hakimi, Erdos and Gallai. Cut points, bridges and blocks, block graphs and cut point graphs. Trees and their characterizations, centre and centroids, block-cut points trees, spanning trees, independent cycles and cocycles, connectivity and line connectivity, Whitney's theorem. Traversability-Eulerian, Hamiltonian, line graphs and total graphs. Traversability, coverings and independence, theorem of Gallai, critical points and lines. Planarity, genus, thickness, crossing number. Colorability, chromatic number and its bounds, Nordhaus Gaddum theorems, the four and five colour theorems, chromatic polynomial. Matrix Representation -Incident matrix, Adjacency matrix, cycle matrix, cutset matrix, path matrix, Digraphs, Matrix - tree theorem on number of spanning trees. Tournament. Graph theoretic Algorithms: Computer representation of graphs-Input and output, Algorithms for connectedness, Spanning Tree, Fundamental Circuits, Directed Circuits and Shortest paths.

References:
1. F. Harary, *Graph theory*, Narosa Publishers
2. Narsingh Deo, *Graph theory with applications to Engineering and Computer Science*, Prentice Hall.
3. Robin J.Wilson, *Introduction to Graph theory*, Logman

MAT 5302: APPLIED LINEAR ALGEBRA [2 1 0 3]

Finite dimensional vector spaces, subspaces, linear independence, basis and dimension. Sum and intersection of subspaces. Algebra of linear transformations, range and null space of a linear transformation, Inner-product spaces, metric spaces and banach spaces, Gram Schmidt orthogonalization, linear operators and their adjoint, self adjoint, unitary and normal transformations, polar decomposition. Matrix algebra, simultaneous equations, Eigen values, characteristic vectors, Cayley-Hamilton theorem, minimal polynomial, Application of eigen values to solve simultaneous difference and differential equations. Quadratic forms and their classification, constrained optimization. Somecomputational methods of linear algebra.

References:
1. Gantmocher F.R., *The Theory of Matrices*, Cheisea.
2. Gilbert Strang , *Linear Algebra and its applications*,Thomson learning
3. David C. Lay, *Linear Algebra and its applications*, Pearson Education

MAT 5303:APPLIED NUMERICAL METHODS [2 1 0 3]

Matrix Algebra : Solution for linear system of equations – Direct methods: Gauss elimination method, Gauss Jordon method, Crouts (LU decomposition) method. Iterative methods, Jacobi Gauss Seidal and successive over relaxation methods. Computation of inverse of a matrix: Jordan method, Triangularization method, Choleski's method, partition method. Eigen value & Eigen vectors: Given's method for real symmetric matrices, Jocobi's method for real symmetric matrices, Power method. Numerical Solution of Ordinary Differential Equations: Single step methods, Runge- Kutta method, Adam Bashforth's predictor corrector method, Milne's predictor and corrector method. Numerical Solution of Partial Differential Equations: Finite difference approximation to derivatives of Parabolic, Elliptic. Explicit finite difference method, implicit method.

References:
1. Jain, Iyengar and Jain: *Numerical methods for Scientific and Engineering Computations*, New Age Publishers
2. Carnahan, Luther and Wikes: *Applied Numerical Methods*, John Willey
3. Conte S.D and Be Door, *Introduction to Numerical analysis*, McGraw Hill.

MAT 5304:MATHEMATICAL MODELLING [2 1 0 3]

Introduction, Techniques, classification and characteristics of mathematical models, mathematical modeling through algebra, ordinary differential equations of first order. Mathematical modeling through systems of ordinary differential equations of first order, Prey- Predator model Mathematical modeling through systems of ordinary differential equations, modeling in medicine A model for diabetic mellitus. Modelling on population dynamics Mathematical modelling through difference equations. Some simple models. Modelling of economics and finance through difference equations, population dynamics and generation of models through difference equations, modeling in probability theory, examples. Optimization models: Mathematical modeling through linear programming. Mathematical modelling through graphs: elements of graphs, digraphs. Mathematical models for blood flow. Mathematical model for Peristaltic transport of two layered.

References:
1. J N Kapur, *Mathematical Modelling*, New age international publishers,(2e), 2015.
2. J N Kapur *Mathematical Models in biology and medicine*, East- West press.
3. J N Kapur *Mathematical models of environment*, INS Academy, New Delhi

MAT 5305:OPTIMIZATION TECHNIQUES [2 1 0 3]

Formulation, Linear programming-simplex method, Penalty coase methods, 2-phase method. Dual Simplex method. Duality theory .Transportation problem-Volgel's approximation method, MODI method, Assignment problem-Hungarian method.Project Management - Networks, Project planning and control using PERT and CPM. Project crashing. Game theory - 2persons zero sum games, Minimax principle, games with mixed strategies. Dominance theory, solution using Linear programming.

References:
1. Bronson Richard - *Theory and Problems of Operations Research*-Schaum series- MGH
2. P.K.Gupta& Man Mohan - *Operations Research* - Sultan Chand & Sons
3. HamdyA.Taha - *Operations Research* PHI

MAT 5306: STOCHASTIC PROCESSES AND RELIABILITY [2 1 0 3]

Static probabilities: Review and prerequisites generating functions, difference equations.Dynamic probability: definition and description with examples. Markov chains, transition probabilities, Chapmen Kolmogrov equations. Classification of states, chains of Markov process. Stability of Markov systems, limiting behaviour, random walk. Poisson Processes : assumptions and derivations, related distributions, birth and death processes. Queueing System, general concepts, Model M/M/1 and M/M/S, steady state behaviour, transient behaviour. Wiener processes and Gaussian processes. Differential equations of a wiener process, Kolmogrov equations, Ornstein – Unlenbeck Process. White note. Reliability Theory : Definition of Reliability, types of failure, Hazard rate, Laws of failure - normal, exponential & Weibull failure laws - System reliability - in series, in parallel series - parallel system, Paralled - series system & related problems.

References:
1. Medhi. J., *Stochastic Processes*, Wiley Eastern.
2. Bhat U R, *Elements of Applied Stochastic Processes*, John Wiley.
3. A Papoulis, *Probability, Random Variables and Stochastic Procesess*, McGraw Hill.

HUM 4051: FINANCIAL MANAGEMENT [2 1 0 3]

Introduction and objectives of financial management, Evolution of corporate finance, responsibilities. Types of accounts, Golden rules of accounting, Preparation of Journal, Ledger, Trial balance and final accounts. Sources of long term finance, Characteristics of equity capital, Preference capital, Debenture capital & Term loans. Valuation of securities, Concepts, Bond valuation and related models, Bond value theorems, Yield to maturity. Equity valuation; Dividend capitalization approach, Leverage, Operating leverage, Financial leverage, Total leverage, Indifference point analysis. Working capital management, Capital budgeting: appraisal criteria, pay-back period, Average rate of return, Net present value, Benefit cost ratio and Internal rate of return. Risk analysis in capital budgeting, Cost of capital: introduction, cost of debt capital, Preference capital and Equity capital, Weighted average cost of capital, Determination of proportions, Cash management, Dividend decisions.

References:

1. Prasanna Chandra., Fundamentals of Financial Management, Tata McGraw Hill Education Pvt Ltd., New Delhi, 2006.
2. I M Pandey, Financial Management, Vikas Publishing House Pvt Ltd.,, New Delhi, 2015.
3. N Ramachandran & Ram Kumar Kakani, Financial Accounting for Management, 3/e, Tata McGraw Hill Education Pvt Ltd., New Delhi, 2011.
4. Eugene F Brigham & Michael C E, Financial Management: Theory and Practice. 12e, Cengage Learning, India, 2008.
5. Maheshwari S.N., Financial Management, Sultan Chand & Co., New Delhi, 2002.

HUM 4052: HUMAN RESOURCE MANAGEMENT [2 1 0 3]

Introduction, Scope of HRM, Objectives of HRM, Functions, Activities, Roles, HRD organization and responsibilities. Evolution of HRM, Influence of various factors on HRM. Human resource planning: Introduction, Strategic considerations, Nature and scope, Human Resources Inventory, Job analysis, Job design, Job description, Job specification and Job evaluation. Employee Recruitment & Selection: Policy, Process, Tests, modern methods, Interview, Provisional selection, Medical/Physical examinations, Placement, Induction programs and socialization. Training and development: Basic concepts, Employees training Process, Planning, Preparation of trainees, Implementation, Performance evaluation and Follow-up training. Competency Mapping and Career development programmes. Performance appraisal and Merit rating, Promotion, transfers and separations, Wages and salaries administration, Discipline and grievances. Industrial and labour relations and Trade Unionism Overview: Collective bargaining and maintaining Industrial health.

References:

1. Michael Armstrong ., A Handbook of Human Resource Management Practice: 10th Edition, New Delhi, Kogan Page India,2006
2. Gary Dessler& BijuVarkey .,Human Resource Management:12th Edition Dorling Kindersley(India),Noida,2011
3. T.V. Rao and Pereira D F., Recent experiences in Human Resources Development, Oxford and IBH Publishing, 1986.
4. Subbrao A., Essentials of Human Resource Management and industrial Relations, Himalaya Publishing House, 1999.
5. Aswathappa K,Human ResourceManagement,Text&Cases McGrawHill 7th Edition,2006
6. N G Nair and Latha Nair., Personnel Management and Industrial Relations, S. Chand Company, 1995.

HUM 4053: MARKETING MANAGEMENT [2 1 0 3]

Marketing definition, scope and concepts, Adapting marketing to the New Economy, Marketing strategic planning. Market Demand, Marketing Environment, Marketing Information System, Marketing Research. Segmentation, Targeting and Positioning, Buying Behaviour: Consumer Markets and Business Markets, Competition: Identifying competitors, analysing competitors. Product Life Cycle: Product life-cycle marketing strategies. New Market Offerings: New product development and challenges, Branding. Designing and Managing Services, Price Strategies, Retailing, Wholesaling, Integrated Marketing Communications, Digital Marketing and Trends, International Marketing

References:

1. Philip Kotler, Kevil Keller, Abraham Koshy & Mithileshwar Jha, Marketing Management – A South Asian Perspective, Pearson Education Inc, New Delhi, 2012.
2. Arun Kumar & N Meenakshi, Marketing Management, Vikas Publishing House Pvt Ltd, New Delhi, 2011.
3. Varshney R L and Gupta S L., Marketing Management, Sultan Chand & Sons, New Delhi, 2004.
4. Adrian Palmer., Principles of Marketing, Oxford University Press, New York, 2000.

HUM 4054: OPERATIONS MANAGEMENT [2 1 0 3]

Introductions to operations management – process view and supply chain view, types of production activities, competitive priorities and capabilities. Break-even analysis, evaluating services or products, evaluating processes - make or buy decision, decision making under risk, and decision trees. Introduction to forecasting, importance and uses of forecasting, demand patterns, demand management options, judgement methods, causal methods - linear regression, time series method – naïve method, moving average, weightage moving average, and exponential smoothing curve. Planning long-term capacity, measures of capacity and utilization, economies of scale, diseconomies of scale, capacity timing and sizing strategies, sizing capacity cushions, timing and sizing expansion – expansionist strategy, wait and see strategy, and a systematic approach to long term capacity decision. Levels inoperations planning and scheduling across the organization, sales and operation planning strategies- chase strategy, level strategy, operations planning using linear programming technique, scheduling job and facility scheduling, and work for scheduling. Theory of constraints, managing bottle necks in manufacturing and service processes, identifying bottle necks, relieving bottle necks, drum buffer rope system, and managing constraints in a line system. Supply chain design across the organization, supply chains for services and manufacturing, measures of supply chain performance - inventory measures, financial measures, inventory and supply chains - pressures for small inventories, pressures for large inventories, types of inventory, inventory reduction tactics, and inventory placement. Costs of quality, total quality management, acceptance sampling, statistical process control - control charts, and process capability. Continuous improvement using lean systems, different types of wastes, strategic characteristics of a lean system, designing lean system layout, and Kanban system.

References:

1. Krajewski L. J., Ritzman L. P., Malhotra M., and Srivastava S. K., *Operations Management*, 11th edition, Pearson Education (Singapore) Pvt. Ltd., Delhi, 2016.
2. Heizer J. and Render B., *Operations Management*, 11th edition. Pearson Education India, 2016.
3. Khanna R. B., *Production and Operations Management*, 2nd edition, PHI Learning Private Limited, 2015.

<u>**OPEN ELECTIVES**</u>

HUM 4301: COMMUNICATIVE ENGLISH [3 0 0 3]
(Offered for Lateral Entry Students only)

Common Errors in English: Subject Verb Agreement; Uses of Tenses / Sequence of Tense; Prepositions; Articles; Special Usages; Creative Writing Essay: Types of Essays, Argumentative Essay, Descriptive/ Expository/Narrative Essays; Reading Comprehension; Dynamic text; Critical Evaluation; Group Discussions; Presentation Skills; Essay writing.; Audio texts/speeches -Practice listening skills- summary, commentary, listening exercises. Video Speeches -T h e m e b a s e d s p e e c h e s - motivational, informative, technical, and persuasive, discussions. Speech - Elements of a good speech, types of speeches, model speech, Speech exercises, individual presentations, peer and facilitator feedback. Formal/Informal communication. Communication Styles- formal and informal, standard English and variations in usages, examples and analysis of faulty usages; Correspondence: formal/informal letters and emails .

References:

1. Green David., *Contemporary English Grammar, Structures and Composition* Chennai: Macmillan Publications.
2. Thompson AJ & Martinet AB., *A Practical English Grammar*, OUP.
3. Turton N D , Heaton J B., *Longman Dictionary of Common Errors*, 1998.
4. Meenakshi Raman & Sangita Sharma., *Technical Communication; Principles and Practice*, Oxford University Press, 2011.

HUM 4302: FILM STUDIES [2 1 0 3]

History of invention of motion pictures - Daguerre, Muybridge, Edison, SkaldanowskyBrothers,Lumieres; Evolution of film – Lumieres, Melies, Porter, Griffith, Basic techniques – Mise-en-scene, Mise-en-shot, Deepfocus Photography, Longtake, Continuity, Editing, Montage, German Expressionism; French Impressionism; Soviet Montage cinema; Hollywood cinema, Italian Neo-realism; French Nouvelle Vague, Documentary, Directors – Eisenstein, Kurosawa, Godard, Chaplin, Bergman; Mohsen Makmalbakf, Majid Majidi, Keislowski, Zhang Yimou, Kim Ki Duk, "New Wave" Cinema in India - Bengali; Malayalam; Kannada; Hindi, To be screened- Bicycle Thieves, The 400 blows, Rashomon, Wild strawberries, Battleship Potemkin, Cabinet of Dr.Caligari, The kid, Children of heaven, Hero, Ghatashraddha, PatherPanchali, Mathilukal.

References:

1. Bordwell, David and Thompson, Kristin., *Film Art: an Introduction, 7th ed*. New York: McGraw-Hill Co., 2004.
2. Kawin, Bruce., *How Movies Work*. Berkeley and Los Angeles: University of California Press, 1992.
3. Cook, David A., *A History of Narrative Film*, 4th ed. New York: W.W. Norton & Co., 2004.

HUM 4303:GERMAN FOR BEGINNERS [3 0 0 3]

Text selections, dialogue and exercises which have been designed to give the absolute beginner grounding in the rudiments of the German language, as well as providing background information about the history, life and culture in Germany.Introduction to the German alphabet and the German language – dialogues & conversations – pronunciation, basic vocabulary lists - key points of grammar - background information about the history and culture of Germany - exercises on vocabulary, grammar and German culture - reading & listening comprehension.

References:

1. Sally Johnson, Natalie Braber., *Exploring the German Language*, (2E), Cambridge University Press. 2008.
2. Charles Russ., *The German Language Today: A Linguistic Introduction*, Routledge. 1994.

HUM 4304: BUILDING BRIDGES: INDO-EUROPEAN INTERCULTURAL DYNAMICS [3 0 0 3]

The challenges of Intercultural communication - interacting in a diverse world, understanding cultures, alternative views of reality, cultural stereotyping. Foundational Theories in Intercultural Communication - Edward Hall, Samovar, G Hofstede, Understanding cultural Dimensions and Cultural Stereotyping- collectivism/ individualism, power distance, masculine/feminine, cultural metaphors, Intercultural Business Communication Competence - The Role of Language in Intercultural Business Communication , Nonverbal Language in Intercultural Communication, Cultural influence on interpersonal communication, Intercultural Dynamics in the multicultural organizations.

References:

1. Dodd, Carley H. *Dynamics of Intercultural Communication*, McGraw-Hill, Boston. 1998.
2. Gannon M J and Pillai R. *Understanding Global Cultures*, Sage Publications, California. 2010.
3. Hall, E. T. *The dance of life: The other dimension of time*, Random House, New York. 1983.
4. Hofstede, Geert., *Cultures' Consequences, Comparing Values, Behaviors, Institutions, and Organizations across Nations*, Sage Publications, Thousand Oaks, CA. 2001.
5. Martin, J.N. & Nakayama, T.K., *Intercultural communication in contexts*. 4th Edition. Mountain View, CA: Mayfield. 2007.
6. Samovar, L A and Porter, R., *Communication between Cultures*, Cengage Learning, Wadsworth, CA. 2007.

HUM 4305: INTERPRETATION OF LITERARY TEXTS [3 0 0 3]

Texts-static, dynamic, cryptic and delphic ; Language of literature; Form and structure; Literature verses popular fiction; Text and discourse; Authors and critics; Theories and approaches to literary texts; Formalism, Structuralism, Marxism, Feminism, Deconstruction; Ideational functions and textual Functions; Class, gender and texuality; Race and nationality; Genre, phonological deviations –sound patterns and figures of speech ; Pragmatic approach to literature; Understanding syntax, Lexical and syntactic analysis of literary texts; Point of view in literary texts and foregrounding; Prediction and making sense of a text; Stylistic analysis of a novel; Kinds of meaning, Rhetorical structure; Pragmatics and   discourse analysis; Interpreting cohesive devices and complex functional values; Stylistic approach to literature ; Elements of literary style; Stylistic analysis of selected short stories, Poems, Novels and Plays; Genre, the plot setting,   characterization, tone and themes; Stylistics and its implications on narrative techniques; Intertextuality and conceptual blending; Identifying patterns in the texts; Meaning making process in literature; Imagery, metaphor as a mode of thought; Coherence and Cohesion; Context, turn taking and Adjacency Pair; Pro-forms, Discourse markers, Lexical cohesion and presupposition; Recognizing text organization; Critical texts, Shared assumptions on critical texts; The role of schema and the concept of speech acts in literary texts.

References:

1. Austin, J.L., *How to do Things with Words*, Longman, London, 1992.
2. Barthes. R., *Introduction to the Structural Analysis of Narratives*, Fontana, London, 1977.
3. Blake.N.F., *An Introduction to the Language of Literature*, Macmillan, London. .1990.
4. Carter, R. (ed.)., *Language and Literature: An introductory Reader in Stylistics*, Allen and Unwin, London, 1982.
5. Cook, G., *Discourse and Literature*, Oxford University Press, London, 1994.
6. Harold, C.M.(ed.)., *Style in Prose Fiction*, Columbia University Press, New York.
7. Leech, G.N., *A Linguistic Guide to English Poetry*, Longman, London, 1969.

HUM 4306: PUBLIC SPEAKING [3 0 0 3]

Public Speaking -Introduction to Public speaking- Voice modulation, Sounds/accent (basics), Articulation, Anxiety management, Logical arguments, Concept of purpose, Audience, Smart use of Body language. Types of speech-Informative speeches - designing and delivery- Persuasive speeches – designing and delivery- Impromptu speeches – designing and delivery -Special occasion speeches- designing and delivery, Presentations - planning and execution -Types of presentation - Informative-Planning and delivery - Persuasive - Planning and delivery - Motivational - Planning and delivery, Other forms of speaking – Debates, Seminars, Panel Discussion, Group Discussion, Tall Tales, Turn Coat, Art of Evaluation-Providing feedback- planning, designing and delivering constructive feedback - Receiving feedback – making use of relevant feedback -Techniques of providing feedback- Speech analysis –Role of the Evaluator.

References:

1. Duarte Nancy., *Resonate: Present Visual Stories that Transform Audiences*, John John Wiley and Sons, 2010.
2. Minto Barbara., *The Pyramid Principle: Logic in writing, thinking and Problem Solving*, Financial Times Prentice Hall, 2002.
3. Berkun Scott., *Confessions of a Public Speaker*, O'Reily Media, 2009.
4. Goodale Malcolm., *Professional Presentations*, Cambridge University Press, 2005.
5. Carnegie Dale., *The Art of Public Speaking*, 1905.

HUM 4307: INTRODUCTION TO PSYCHOLOGY [3 0 0 3]

Psychology - Meaning, Nature and Scope, Defining Psychology, Meaning of the term Behavior, Nature of Psychology, Scope of Psychology: Branches and fields of Psychology. Development of Psychology - Historic Sketch of Psychology, Modern Age of Psychology, Gestalt Psychology, Psycho Analysis, Contemporary Psychology. Systems of Psychology- The Nervous System, Nature V/s Nurture, Sensation and perception, States of Consciousness. Methods of Psychology - Classical Conditioning, Introspection Method, Naturalistic Method, Experimental Method, Differential Method, Clinical Method, Psycho Physical Method. Personality- Personality types, Personality Disorders, Abnormal psychology, Treatment of personality disorders. Thinking - Nature of Thinking, Types of Thinking, Language and Intelligence. Discussion, Presentation and Assignments.

References:

1. Boring, E.G., Langfield,H.S. &Weld,H.P., *Foundations of Psychology, Asia* Publishing House, Calcutta, 1963.
2. Carson, R.C., Butcher, J.N. & Coleman, J.C., *Abnormal Psychology & Modern Life*, (8th ed) Scoff, Foresman& Co. 1988.
3. Lahey, B.B.,Psychology: *An Introduction*, 6th Ed., Tata McGraw Hill, New York, 1965.
4. Olson, M.; Hergenhahn, B.R., *Introduction to the Theories of Learning*, Prentice-Hall India, 2009.

HUM 4308: INTRODUCTION TO PHILOSOPHY, RELIGION AND CULTURE [3 0 0 3]

Notions of Philosophy; The Origin and Development of Philosophy; Ancient Philosophy; Medieval Philosophy; Modern Philosophy; Contemporary Philosophy; Indian Philosophy; Comparative Religion; Western Philosophy; The Relevance of Philosophy; Branches of Philosophy; Methods of Philosophy; Philosophy and other Branches of Study; Some Problems of Philosophy; Themes of Philosophy; Mind and Body, and the Problem of Universal; Change/Movement time and place; Existence of God and Evolution; Indian Culture; Social Ethics; Logic and Scientific Methods; Philosophy of Language.

References:

1. Aquinas, Thomas., *On Being and Essence. Trans. Armand Maurer*. Canada: Pontifical Institute of Mediaeval Studies, 1968.
2. John-Terry, Chris., *For the Love of Wisdom: An Explanation of the meaning and Purpose of Philosophy*. New York: Alba House, 1994.
3. Maritain, Jacques., *An Introduction to Philosophy*, London: Sheed and Ward. 1979.
4. Radhakrishnan, S. (Ed)., *History of Philosophy Eastern and Western Vol.II* George Allen and Unwin Ltd., London, 1953.
5. Wallace, William., *The Elements of Philosophy*. New York: Alba House, 1990.

HUM 4309: CREATIVE WRITING [3 0 0 3]

Various literary/prose forms and their characteristics; techniques and strategies for reading; nuances of language and meaning in reading and writing; Writing Exercises - techniques and strategies of writing creatively; Critical Concepts and Terms in Literary Writing; Writing Exercises; creative writing output.

References:

1. Milan Kundera ., *The Art of the Novel*.
2. The Art of Fiction: Illustrated from Classic and Modern Texts, David Lodge

HUM 4310: GRAPHIC NOVELS: HISTORY, FORM AND CULTURE [3 0 0 3]

Part I:The History of Comic Books, Part 1: Developing a Medium Defining comic books as a medium-Relationships between comic books and other forms of sequential art-The (continental) roots of comics as an art form -The ways in which comic strips and pulps contributed to the emergence of the comic book. The History of Comic Books, Part 2: The Maturation of the Medium-Influence of underground movement, ways in which mainstream publishers began to address more relevant topics, proliferation of independent comics, the increase in the profile and prominence of the medium due to ambitious projects. Part II: Creating the Story: Graphic Storytelling and Visual Narrative-Some narrative structures commonly found in comic books -The types and techniques of encapsulation-The nature of the relationship between the pictorial and linguistic elements of comic books Experiencing the Story: The Power of Comics -   About diegetic images that show the world of the story-About interpretive images that comment on the story-The impact art style has on the emotional reactions of the reader; and how the   meaning of each image is affected by the relationship to other images in that particular book, in other texts, and in the reader's personal experience-Part III: Comic Book Genres-the definition of genre and the role it plays in shaping the creation of comics products- the characteristics of genres, including character types, narrative patterns, themes, and other conventions-how the example genres of teen humor, romance, funny animals, horror, and memoir developed in comics, and what characterizes each-how the hybridization of genres helps experimentation and expansion of narrative possibilities.

References:

1. Roger Sabin., *Comics, Comix and Graphic Novels*.
2. Robert Petersen, Allan Moore., *Comics, Manga and Graphic Novels: A History of Graphic Narrative3. Comics as Performance*, Fiction as Scalpel.
3. JeetHeer, Kent Worcester., *Arguing Comics: Studies in Popular culture*.

HUM 4311: MANAGEMENT INFORMATION SYSTEMS [3 0 0 3]

Management information system: Introduction to management, information and system. System concepts, general model of a system and types of systems. Evolution of MIS , models and resources used in the MIS model. Structure of MIS, operating elements of an information system, synthesis of the structure. Information systems for different applications: Transaction processing systems, Human resource management systems and Marketing-application areas. Production planning and Office automation systems. Role of management information in decision making: Concepts of decision making, Decision making process and information needs at different levels of management. Herbert. A. Simon model. Phases in the decision making process, Programmed vs non-programmed decisions, General model of human as an information processor, Allen Newell Simon model. Decision support systems -structure, elements and working. Information as a strategic resource. MIS as a technique for making programmed decisions: Behavioral models of the decision maker and methods. MIS support for decision making. Role of MIS in Organizations -recent trends and e-commerce applications. Development of customized management information system approaches: SDLC -phases in SDLC, Strategic and project planning for MIS, conceptual design and detailed design phases: general business planning and MIS response. MIS Planning and planning cycle. Conceptual system design and Detailed System design. MIS System Implementation, and Pit falls: Pit Falls in MIS development, Fundamental weaknesses, soft spots in planning, design problems and review.

References:

1. Gordon B. D. and Margrethe H. O., (2005), "Management Information Systems", McGraw-Hill, New York.
2. Kenneth L. and Price J. P., (2003), "Management Information Systems", Macmillan.
3. Jawadekar W. S., (2000) "Management Information System", Tata McGraw Hill.
4. Senn J. A., (2003), "Analysis & Design of Information System", McGraw Hill International Student Edition.
5. Mudrick; Ross (1997) "Information Systems for Modern Management " Prentice Hall of India.
6. James A. O.Brien (1995)"Management Information Systems, Galgotia Publications.

HUM 4312: ENTREPRENEURSHIP [3 0 0 3]

Entrepreneur: Meaning of entrepreneur, evolution of the concept, functions of an entrepreneur, types of entrepreneur, and intrapreneur. Concept of entrepreneurship - evolution of entrepreneurship, development of entrepreneurship, stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India, barriers for entrepreneurship. Small scale industry: Definition, characteristics, need and rationale. Objectives, scope, role of Small Scale Industries (SSI) in economic development, advantages of SSI, steps to start an SSI - government policy towards SSI, different policies of SSI, impact of liberalization, privatization, and Globalization. Effect of WTO/GATT and supporting agencies of government for SSI. Institutional support: Different Schemes: TECKSOK, KIADB; KSSIDC; KSIMC; DIC Single Window Agency: SISI, NSIC, SIDBI, and KSFC, New schemes and support for start-ups and new venture under Govt. of India. Preparation of Business plan and project report: components of a successful plan. Meaning of project, project identification, project selection, project report, need and significance of report, contents, formulation, guidelines by planning commission for project report. Network analysis, errors in project report, project appraisal. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study and documentation and evaluation.

References:

1. Vasant Desai., Dynamics of Entrepreneurial Development & Management, Himalaya Publishing House, 2007.
2. David H. Holt Entrepreneurship: New Venture Creation, Published by prentice Hall,1991.
3. Poornima. M. Charantimath., Entrepreneurship Development, Pearson Education, 2006.
4. S.S. Khanka., Entrepreneurship Development, S.Chand& Co, 2007.

Minor Specialization: Material Science

PHY 4051: PHYSICS OF LOW DIMENSIONAL MATERIALS [3 0 0 3]

Thin films: Thick and Thin Film Materials, preparation by physical and chemical methods. Thickness measurement techniques. Theories of nucleation - Capillarity and atomistic theory, effect of deposition parameters on nucleation and growth of thin films. Epitaxial growth. Reflection and Transmission at interface between isotropic transparent media. Reflectance and Transmittance in thin films. Antireflection coatings. Electrical conduction in discontinuous metal films - Quantum mechanical tunneling model. Conduction in continuous metal and semiconducting films. Thermoelectric power in metal films. thin film resistors, thermopiles. Quantum well devices.

Nanomaterials: Chemical Synthesis of Nanoparticles: Bottom up approach. Functionalized nanoparticles in different medium. Size control. Self assembly. Nanoparticle arrays. Semiconductor nanoparticles- synthesis, characterization and applications of quantum dots. Magnetic nanoparticles- assembly and nanoastructures. Manipulation of nanoscale biological assemblies. Carbon nanotubes and fullerene as nanoclustures. Nanostructured films. Physical Methods of Nanostructure Fabrication: Top down approach. Nanopatterning-Lithography- Optical, X-ray and Electron beam lithography. Ion- beam lithography.

References:

1. Chopra K. L., *Thin Film Phenomena*, Mc Graw Hill, 1969
2. Milton Ohring, *Materials Science of Thin Films*, Elsevier, 2001
3. Heavens O. S., *Optical Properties of Thin Solid Films*, Dover, 1955
4. Liz-Marzan L. M. and Kamat P. V. (Eds), *Nanoscale Materials*, Kluwer, 2003
5. Nalwa H. S. (Ed), *Nanostructured Materials and Nanotechnology*, Academic, 2002

PHY 4052: PHYSICS OF PHOTONIC AND ENERGY STORAGE DEVICES [3 0 0 3]

Semiconductors: Direct and indirect band gaps. Carrier concentrations at thermal equilibrium. Fermi level. Degenerate and non-degenerate semiconductors. Semiconductor Crystal growth techniques Contact phenomenon- semiconductor-semiconductor, metal-semiconductor contacts. Schottky and Ohmic contacts. Preparation of semiconductor devices. IC technology, elements of lithography.

Photonic Devices: LED and semiconductor lasers: Radiative and non-radiative transitions, diode laser, population inversion, laser operating characteristics, efficiency, photoconductor, photodiode, avalanche photodiode, phototransistor, material requirement for solar cells, theory and types of solar cells.

Fuel cells: Hydrogen energy – merits as a fuel – production of hydrogen, Hydrogen Fuel cells – introduction – difference between batteries and fuel cells, components of fuel cells, principle of working of fuel cell, fuel cell stack, fuel cell power plant: fuel processor, fuel cell power section, power conditioner, Advantages and disadvantages of fuel cell power plant. Types of fuel cells. Application of fuel cells – commercially available fuel cells.

References:

1. Neamen Donald A., *Semiconductor Physics and Devices, basic principles*, Tata McGraw-Hill, 2002
2. Sze S. M., *Physics of Semiconductor Devices*, John Wiley & Sons, 2007
3. Larminie J. and Dicks A., *Fuel Cell Systems Explained*, Wiley, 2003
4. Xianguo Li, *Principles of Fuel Cells*, Taylor and Francis, 2005
5. S. Srinivasan, *Fuel Cells*: From Fundamentals to Applications, Springer, 2006

OPEN ELECTIVES

PHY 4301: FUNDAMENTALS OF ASTRONOMY AND ASTROPHYSICS [3 0 0 3]

Introduction to astronomy and astrophysics. Properties of ordinary stars: Brightness of starlight; the electromagnetic spectrum; Colours of stars; stellar distances; absolute magnitudes; HR diagram. Stellar evolution: Formation of star; the main sequence; stellar structure; evolution off the main sequence; planetary nebulae; white dwarfs. The death of high mass stars: Supernovae; neutron stars; pulsars; stellar black holes. Normal Galaxies: Types of galaxies; Dark matter in galaxies. Cosmology: The scale of universe; expansion of the universe; open or closed universe; the big bang; the cosmic background radiation; big bang nucleosynthesis. Astronomical instruments.

References:

1. Marc L Kutner, *Astronomy: A physical Perspective (2e)* Cambridge University Press, 2003
2. BaidyanathBasu, *An Introduction to Astrophysics (2e)*, PHI Learning Pvt. Ltd, 2011.
3. Michael Zeilik, *Introductory Astronomy and Astrophysics (4e)*, Saunders College Pub. 1992.

PHY 4302: PHYSICS OF ENGINEERING MATERIALS [3 0 0 3]

Types of magnetism, ferromagnetic domains, soft and hard magnetic materials, ferrites, magnetic storage, Superconducting materials, Applications of superconductors, Nano-materials, bottom-up and top-down methods, Quantum dots and nano-carbon tubes, Composite materials, micromechanics of composites - Density, Mechanical and Thermal properties, Semiconductors, Metals, semiconductors and insulators, Direct and indirect band-gap semiconductors, Intrinsic and extrinsic semiconductors, Diffusion and drift processes, Crystal growth techniques, Preparation of semiconductor devices.

References:

1. William F. Smith, *Principles of Materials Science and Engineering (2e)*, McGraw-Hill International Edition, 1990.
2. Nalwa H.S., *Nanostructured Materials and Nanotechnology (2e)*, Academic, 2002.
3. Chawla K. K. *Composite Materials- Science & Engineering (3e)*, Springer-Verlag, 2012.
4. Streetman Ben G. and Banerjee Sanjay Kumar, *Solid State Electronic Devices (6e)* PHI learning Private Limited, 2012.

PHY 4303: RADIATION PHYSICS [3 0 0 3]

Radiation Sources: Fast electron sources-Heavy charged particle sources-Sources of electromagnetic radiation-Neutron sources. Radiation Interaction: Photoelectric and Compton process -pair production. Interaction of heavy charged particles-stopping power-Energy loss characteristics- Bragg curve-Particle range-range straggling- stopping time-energy loss in thin absorbers-Interaction of fast electrons-absorption of beta particles-interaction of gamma rays-gamma ray attenuation-Interaction of neutrons-neutron cross section-neutron induced nuclear reactions. Radiation Detectors and Instrumentation: Semiconductors diodes-JFET-MOSFET-Integrated Circuits-OPAMP and their characteristics-Differential Amplifier-Operational amplifier systems-Pulse Amplifiers. Principles of radiation detection and measurements-Gas filled detectors-Ionisation chambers-Proportional counters-GM counters-Scintillation detectors-Semiconductor detectors-Thermo luminescent Dosimeters-Radiation spectroscopy with scintillators-Gamma spectroscopy-Multichannel pulse analyzer-Slow neutron detection methods-Reactor instrumentation. Industrial uses of nuclear measurements: Radiation detection in industrial environments-Measuring systems for industrial problems-Determination of physical material characteristics by nuclear measurements-Level height determination-Density measurements-Quantity measurements-Thickness measurement-coating thickness measurement.

References:

1. Knoll G. F., *Radiation Detection and Measurement (3e)*, Wiley 2010
2. Boylestad R. L., *Electronic Devices and Circuit theory (11e)*, Pearson Education 2016
3. Malvino A. P., *Electronic Principles (7e)*, TMH 2010
4. Foldiak G., *Industrial Applications of Radioisotopes*, Elsevier Science Ltd 1986

PHY 4304: SOLID STATE PHYSICS [3 0 0 3]

Review of Crystal structure: Lattice, basis and unit cell, crystal system, symmetry, crystal planes and miller indices, reciprocal lattice, Bragg's law, experimental methods of x-raydiffraction, types of crystal binding, analysis of stress and strain in crysals. Electrical conduction: Free electron gas model, Sommerfield quantum theory, Fermi energy, parameters of free electron gas at absolute zero, electrical conductivity, Drude-Lorentz theory and Sommerfield theory of electrical conductivity, Band theory of solids, electrical conduction in metals, insulators and semiconductorsDielectrics: Static dielectric constant, polarization and polarizability, local field, ferro electricity, piezo electricity, frequency dependence of polarizability (electronic, ionic and dipolar), dielectric losses, requirements of insulating materials, applications of dielectric materialsMagnetism: Classification of magnetic materials, classical theory of diamagnetism and paramagnetism, Weiss theory of ferromagnetism, ferrites, hard and soft magnetic materials, garnets, magnetic bubbles, ceramic magnets, applications of magnetic materials

References:

1. Kittel C., *Introduction to Solid State Physics (7e)*, Wiley 1996.
2. Rao A., *A first course Solid State Physics*, Asiatech publications 2000.
3. Pillai S.O., *Solid State Physics (6e)*, New age international publications 2006.
4. Wahab M. A., *Numerical problems in Solid State Physics*, Alpha science international publications 2011.
5. Gupta H. C., *Solid State Physics*, Vikas publishing house Pvt. Ltd. 1996.

PHY 4305: MODERN OPTICS [3 0 0 3]

Optics: Review of geometrical and physical optics, Dual nature of light, Electromagnetic spectrum, Optical devices, mirrors, lenses, prisms, grating, beam splitters, zone plate, polaroids. Light sources, emission profile. Elements of lasers: Basic requirements in a laser, characteristic properties of lasers. Q-switched and mode locked lasers. CO2, Nd: YAG lasers. Applications. Introduction to Non-linear optics. Optoelectronic devices and its application: Photo diodes, solar cells, LED, and diode lasers. DBR and DFB lasers, CCD. Optical Communication: Conceptual picture of the optical communication system, Modulation and Detection Schemes, properties of optical fibers, discussion on device requirements, OEICS. Optical storage devices: Data recording and read out from optical discs. Holographic data storage systems.

References:

1. Ghatak A., *OPTICS (4e)*, Tata McGraw Hill Publishing Company Ltd. 2009.
2. Singh J., *Optoelectronics: An Introduction to Materials and Devices*, TATA McGraw- Hill Companies, Inc. 2014.
3. Wilson & Hawkes, *LASERS*, Prentice-Hall of India Pvt. Ltd. 1987.
4. Hugh Bennett, *Understanding Recordable & Rewritable DVD*, OSTA.org.
5. Hugh Bennett, *Understanding CD-R & CD-RW*, OSTA.org.

PHY 4306: INTRODUCTORY QUANTUM MECHANICS [3 0 0 3]

Review of certain basics : Limitations of classical physics, wave-particle duality, De Broglie's hypothesis, matter as wavepacket, Heisenberg's uncertainty principle, Mathematical Formalism : operators; commutation relation; orthonormal functions; eigenvalues and eigenfunctions; the Dirac notation; the postulates of quantum mechanics.The Schrödinger Equation : Introduction, wavefunctions , time dependent Schrödinger equation, conservation of probability, expectation values, Ehrenfest's theorem, time independent Schroedinger equation, stationary states, Schroedinger equation in one dimension : the infinite square potential well; the finite square potential well; the potential barrier; tunneling; the harmonic oscillator.Quantum mechanics in three dimensions: Schrödinger equation in spherical coordinates, separation of variables, the angular equation, the radial equation, Applications (energy eigenvalues and eigenfunctions): the rigid rotator; the hydrogen atom; angular momentum. Identical Particles.Some applications of quantum mechanics in nuclear physics, condensed matter physics, and spectroscopy: alpha decay, nanostructures, STM, vibrational and rotational spectra of molecules etc.

References:

1. Verma H.C., *Quantum Physics (2e)*, Surya Publications. 2016.
2. Gasiorowicz S., *Quantum Physics (3e)*, Wiley India Pvt Limited. 2007.
3. Jain M. C., *Quantum Mechanics: A Textbook for Undergraduates*, PHI Learning Private Limited 2012.
4. Griffiths D. J., *Introduction to Quantum Mechanics (2e)*, Pearson Education.
5. Eisberg R. and Resnick R., *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles (2e)*, Wiley-India Pvt Limited. 2009.

CHM 4051: CHEMICAL BONDING [3 0 0 3]

Introduction to bonding, Classification. Ionic bond- Lattice energy, Born Haber cycle, Radius-ratio rules, Properties of ionic compounds, Covalent character in ionic bonds. Covalent bond-Covalency, Valence bond theory, Sigma and pi bond, Hybridization, VSEPR Theory, Molecular orbital theory, Bond order, Properties of covalent compounds. Coordination bond - Primary and Secondary valencies, ligands, Valence bond theory of complexes, Crystal field theory of octahedral and tetrahedral complexes, Low and high spin complexes. Metallic bond- Band theory of metals, Conductors, semiconductors and insulators. Secondary bonding- Hydrogen bonding, London forces and dipole-dipole interactions.

References:

1. J D Lee, "Concise Inorganic chemistry", Wiley India, 2012
2. B R Puri , L R sharma and K C Kalia, "Principle of Inorganic chemistry", Vishal Publishing Co., Punjab, 2017.
3. D F Shriver, P W Atkins, "Inorganic chemistry", Oxford India, 2014
4. A F Cotton, "Basic Inorganic chemistry", Wiley Publishers, 2007

CHM 4052: CHEMISTRY OF CARBON COMPOUNDS [3 0 0 3]

Introduction to Organic Compounds: Classification, Nomenclature; Alkanes: Homologous series, Preparation; Cycloalkanes: Ring size and strain, Applications; Alkenes: Markovnikov and anti-Markovnikov addition reactions, Reduction, applications; Alkynes: Acidity, preparation, Reduction of alkynes, applications; Alkyl halides: SN1, SN2, E1 and E2 reaction mechanisms; Alcohols: Classification, Acidity, organo-metallic reagents; Aromatic compounds: Electrophilic and nucleophilic substitution reactions; Mechanism of some named reactions; Carbonyl compounds: aldehydes and ketones, carboxylic acids and carboxylic acid derivatives; Heterocyclic compounds: Nomenclature, synthesis and reactivity of thiophene, pyrrole and furan; Carbon materials: Fullerenes, carbon thin films, nanotubes and carbon fibers; Carbon nanotubes: SWNT, MWNT, synthesis, properties and applications; Carbon nanomaterials applications.

References:

1. B S Bahl and Arun Bahl, "Advanced Organic Chemistry", S Chand, New Delhi, 2012.
2. Robert T. Morrison and Robert N. Boyd, "Organic Chemistry", Pearson, New Delhi, 2016.
3. P.S. Kalsi, "Organic Reactions and Their Mechanisms", New Age International Private Limited, New Delhi, 2017.
4. Ashutosh Tiwari and S. K. Shukla, "Advanced Carbon Materials and Technology", John Wiley & Sons, 2013.
B. Bhushan ed., "Springer Handbook of Nanotechnology", Springer Publishers, Berlin, 2004.

OPEN ELECTIVES

CHM 4301: ANALYTICAL METHODS AND INSTRUMENTATION [3 0 0 3]

Spectroscopic methods of analysis: Properties of EMR, General features of spectroscopy, Types of molecular spectra, Interaction of EMR with matter, Instrumentation, Applications, Theory, Instrumentation and applications of Microwave, Raman, Infrared, UV-Visible, NMR spectroscopic techniques. Chromatographic Techniques: General concepts, Classification, Principles, Experimental techniques of CC, HPLC, TLC, GC and their applications. Electroanalytical methods: Basic principles and applications of conductometric, potentiometric titrations.

References:

1. D.A. Skoog, J. Holler, F.T.A. Nieman, *Principles of Instrumental Analysis*, 5thEdn, Saunders, Philadelphia, 1992
2. D. A. Skoog, D. M. West and F. J. Holler, *Fundamentals of Analytical Chemistry*, 5thEdn, Saunders College Publishing, Philadelphia, 1988
3. *Vogel's Textbook of Quantitative Chemical Analysis*, GH Jeffery, John Wiley & Sons Inc, 5thEdn, 1989

CHM 4302: FUNDAMENTALS OF INDUSTRIAL CATALYTIC PROCESSES [3 0 0 3]

Adsorption & Catalysis: Physisorption and chemisorption, Adsorption isotherms, Factors influencing adsorption, Adsorption of gases by solids, Adsorption from solution, Introduction to catalysis, Energetics, Catalytic cycles Solutions & Solubility: Ideal and non-ideal solutions, Raoult's law, Thermodynamics of ideal solutions, Vapor pressure and boiling point composition curves, Distillation behaviour of completely miscible & immiscible liquid systems, Azeotropes Colligative Properties: Determination of molar masses from vapor pressure lowering, Osmotic pressure, Boiling point elevation and Depression of freezing point, Vant Hoff's factor Colloids: Types, Preparation and purification of sols, General properties, Optical, Electrical & Kinetic properties of sols, stability of sols, Application of colloids, Emulsions & Gels- Types, Preparation, Properties and their applications.

References:

1. *Principles of Physical Chemistry*, B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal Publications, New Delhi, (23e), 2008
2. *Principles of Physical Chemistry*, S.H. Maron, C.F. Prutton, IBH Publishing co. New Delhi, (4e), 1985
3. *Fundamentals of Analytical Chemistry*, D.A. Skoog, D.M. West, F.J. Holler, R. Crouch, (4e),Thomson-Brooks, 2007

CHM 4303: SUSTAINABLE CHEMICAL PROCESSES AND PRODUCTS [3 0 0 3]

Introduction and principles of green chemistry, Examples, Atom economy, carbon efficiency, life cycle analysis, sustainable products, process and synthesis catalysis and green chemistry, examples of fine and bulk chemicals production, catalysts for clean technology. Application of ecofriendly approach to waste treatment. Cleaner production processes, clean synthesis in lab Scale, industrial examples, use of ecofriendly energies. Bio-pesticides, polymers & pharmaceutical products. Electrochemical synthesis, Alternate reaction media using water and other green solvents, ionic liquids & supercritical fluids; phase transfer catalysis.

References:

1. P.T. Anastas, J. C. Warner, *Green Chemistry: Theory and Practice*, Oxford Univ. Press, Oxford, 2008
2. A.S. Matlack, *Introduction to Green Chemistry*, Marcel Dekker, New York, 2001
3. P. T. Anastas, R. H. Crabtree, *Handbook of Green Chemistry and Catalysis*, Wiely-VCH, Weinheim, 2009

Inter Institute Open Electives

Centre for Creative and Cultural Studies (CCCS), Manipal

IIE 4301: ART APPRECIATION [3 0 0 3]

How to read a visual, how to enjoy or feel an art form, what is Creative Thinking? Indian Art: Heritage & Culture; Art Appreciation: Western Art, Artist & Art Movements: Raja Ravi Verma, Tagore, Da Vinci, Van Gogh; Aesthetics: Beauty, Feel & Expression; Art & Science; Art & Film; Art: Freedom & Society, to be an art literate. A journey to immerse in the world of Art.

IIE 4302: INDIAN CULTURE AND CINEMA - AN INTRODUCTION [3 0 0 3]

Introduction to Idea of Culture, Identity and tradition, Indian Cultural History, Indian cultural history, Time and space, Indian Art and heritage, Indus valley civilization – Indian Independence, Post-colonial India, Modern India, Indian Cinema, Body, language and feel, Film and culture, Evolution, Interpretation and Reflection, Indian Cinema, Media and the medium, Pioneers and classical films, Culture and art of cinema, Culture, Cinema and Society, Revolutions, ideas, innovations, Culture, Cinema and Peace, Message, purpose and the challenge.

Manipal Institute of Management, Manipal

IIE 4304: CORPORATE FINANCE [3 0 0 3]

Introduction to Corporate Finance, Financial Goal, Agency Problems, Managers vs Shareholders Goals, Concepts of Value and Return, Capital Budgeting Decisions, Cost of Capital, Calculation of the Cost of Capital in Practice, Financial and Operating Leverage, Capital Structure, Relevance of Capital Structure, Irrelevance of Capital Structure, Relevance of Capital Structure, Dividend Theory, Dividend Relevance, Dividend Relevance, Dividend and Uncertainty, Dividend Irrelevance, Principles of Working Capital Management.

References:
1. Brealey, R., Myers, S., Allen, F., & Mohanty, P. (2014). Principles of Corporate Finance (11e). New Delhi : Mc Graw Hill Education (India) Private Limited,.
2. Pandey, I. M. (2014). Financial Management (10e). New Delhi: Vikas publishers.
3. Ross, S. A., Westerfield, R. W., Jaffe, J., & Kakani, R. K. (2014). Corporate Finance (10e). New Delhi: Mc Graw Hill Education (India) Private Limited.
4. Parasuraman, N. R. (2014). Financial Management - A Step-by-Step Approach (1e.). New Delhi: Cengage Learning India Private Limited.

IIE 4305: INTERNATIONAL BUSINESS MANAGEMENT [3 0 0 3]

Historical perspective of international business, International business environment, Modes of entering international business, Cross-Culture and dynamic market understanding, Differences in Culture, Theories of international business, World Bank, World trade organization, Multinational Corporations and their involvement in International Business, Tariffs and quotas, Balance of Payment Account.

References:
1. Hill Charles, W. L., & Jain Arun, K. (2011). International Business: Competing in the Global Marketplace. (8e), Tata McGraw Hill.
2. Kumar, S. P., & Sanchari, S. (2012). International Business Management-A Global Perspective. New Delhi: Excel Books.

IIE 4306: BRAND MANAGEMENT [3 0 0 3]

Introduction to brand management, Developing a brand strategy, Brand resonance and brand value chain, Designing and implementing brand marketing programs to build brand equity, Measuring and interpreting brand performance, Designing and implementing brand architecture strategies, Managing brands.

References:
1. Keller, K. L., Parameswaran, M. G., Jacob, I. (2015). Strategic Brand Management (4e). Noida, India: Pearson Prentice Hall Publication.
2. Rowles, D., (2014). Digital Branding (1e.). UK: Kogan Page Limited.
3. Kapferer, J. N., (2012). The New Strategic Brand Management: Advanced Insights and Strategic Thinking (5e). UK: Kogan Page Limited

Centre for Integrative Medicine & Research (CIMR)

IIE 4307: YOGA [3 0 0 3]

Aim, Objectives, Meanings and Definitions of Yoga, History of Yoga, Concepts and misconcepts of Yoga, Schools of Yoga, Ashtanga Yoga

Subjects by Industry Experts

IIE 4308: HEALTH ECONOMICS [3 0 0 3]

Economics: Understanding Economics, Efficiency, Rational decision making, Opportunity costs, Supply and demand, Price discovery, Health economics: Defining health, Human capital, what does supply and demand mean in the context of health? Arrow on the uncertainty and welfare economics, The Moral hazard, DALY and QALY, Efficiency: The Production possibility frontiers. The production function for health care. Health policy, Defining equity, Standards of healthcare provision Epidemiology, The Healthcare sector, The demand for health, Disease prevalence, The pharmaceuticals market, Cross country case studies.

References:
1. Sloan, Frank A., and Chee-Ruey Hsieh. Health economics. MIT Press, 2012
2. Annemans, L. Health economics for non-economists. An introduction to the concepts, methods and pitfalls of health economic evaluations. Academia Press, 2008
3. Jeffery, Roger. The politics of health in India. University of California Press, 1988.

IIE 4309: DIGITAL MEDICINE [3 0 0 3]

Present day practice of medicine. Limitations of scalability in the present framework. Introduction to computing, algorithms, big data, semantic web, mobility. Communication-WAN/LAN, 3G/4G and 5G. Patient/Electronic Health records. Experience with these records elsewhere Wearables, the physics of data capture. Practical demonstration of wearables Genomics, an introduction. Computational genomics including the software. Imaging –an introduction-ionizing and non-ionizing. Imaging software and science of diagnosis. How all the four 4 pillars-PHR/EHR, Wearables, Genomics and Imaging come together with software as the glue to change the world of medicine.

References:
1. David Mount. Bioinformatics: Sequence and Genome Analysis. CSHL, 2001
2. Durbin, Richard, Sean Eddy, Anders Krogh, and Graeme. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press, 1999

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IIE 4310: MEDICAL EMERGENCY AND FIRST AID [3 0 0 3]

Principles of First Aid, First aid kit and equipment, emergency drugs, scene assessment, safety and identifying hazards, patient assessment, Basic Life Support and AED, triage, extrication/stretchers, ambulance. Describe the causes, signs and symptoms and management of respiratory emergencies, acute gastro-intestinal emergencies, musculoskeletal emergencies, dental, ENT and eye emergencies, renal emergencies, nervous system emergencies, hematological emergencies, endocrine emergencies, toxicological emergencies, environmental emergencies, pediatric emergencies, psychiatric emergencies, obstetrical emergencies

References:
1. Pollak, A.N. (2005). Emergency care and transportation of the sick and injured. Massachusetts: Jones and Bartlett publishers.
2. Keen, J. H. (1996). Mosby's Critical Care and Emergency Drug Reference. Missouri: Mosby's year book.
3. Walsh, M. (1990). Accident and emergency nursing. A new approach. Oxford: Butterworth Heinemann Ltd.
4. Sbaih, L. (1992). Accident and emergency Nursing. A nursing model. London: Chapman and Hall.
5. Sbaih, L. (1994). Issues in accident and emergency Nursing. London: Chapman and Hall.
6. Bourg, P., & Rosen, S. P. (1986). Standardized nursing care plans for emergency departments. Missouri: The C. V. Mosby Company.
7. Howard, P.K., &Steinmann, R. A. (2010). Sheehy's Emergency Nursing principles and practice. Missouri: Mosby Elsevier.
8. Sira.S, (2017). First Aid Manual for Nurses (First ed.), New Delhi: CBS Publishers & Distributors Pvt. Ltd.

IIE 4311: LIFE STYLE MODIFICATION AND COMPLEMENTARY AND ALTERNATIVE THERAPIES [3 0 0 3]

Principles and concepts of life style modification and various complementary and alternative therapies, Demonstrate skill in performing different yoga aasanas, guided imagery/Progressive muscle relaxation, meditation & Pranayama, reflexology, massage therapy, aerobics, laughter therapy

References:
1. Bhat Krishna K. The power of yoga. Suyoga publications; DK, 2006
2. M.M.Gore. Anatomy & Physiology of yogic practices; (5e), New age book.
3. K N Udupa. Stress and its management by yoga. (2e). Motilal Banarsidas publishers Pvt. Ltd, Delhi, 2007.
4. Yoga and total health. A monthly journal on the yoga a way of life.
5. Swami Satyananda Saraswati. Dynamics of yoga. (2e), Bihar school of yoga, Bihar 1997.

Welcomegroup Graduate School of Hotel Administration, Manipal

IIE 4312: INDIAN CUISINE AND CULTURE PRACTICAL [3 0 0 3]

Introduction to Indian cuisine, Basic Indian gravies, Rice cooking, Preparation of various rice products, Tandoor Cooking, Indian sweets, Comfort Food, Regional and sub-regional cuisine.

IIE 4313: FOUNDATION COURSE IN BAKING AND PATISSERIE PRACTICAL [3 0 0 3]

Introduction to Patisserie and Baking Principles, Special emphasis placed on the study of ingredient functions, Students will have the opportunity to apply basic baking techniques, Understanding fundamentals of yeast dough production, Emphasis on the application of ingredient functions, product identification and recipe interpretation occurs throughout the course, Pastry Basics and Pie dough, The fundamental production of classical European pastry based desserts are included, Techniques of Cake Making, Techniques of Cookie making, The course emphasizes the preparation and makeup techniques of various cookies.

References:
1. Wayne Gisslen – Professional Baking, (5e), John Wiley USA.
2. Haneman L.J. Bakery: Flour Confectionery HEINMAN.
3. Mermaid Books The Book Of Ingredients DOWELL PHILIP.
4. John Wiley Understanding Baking AMENDOLA JOSEPH.
5. New Age International, A Professional Text to Bakery and Confectionery, KINGSLEE JOHN.
6. Virtue And Company Ltd., The New International Confectioner: WILFRED J. FRANCE.
7. Charrette Jacques, Great Cakes and Pastries, TEUBNER CHRISTIAN.
8. Joseph Amendola, Baker's Manual, (5e), NICOLE REES.
9. Joseph Amendola, Understanding Baking, (3e), NICOLE REES.
10. Culinary Institute Of America, Baking and Pastry: Mastering the Art and Craft, JOHN WILEY.

IIE 4314: GLOBAL CUISINE & CULTURE- PRACTICAL [3 0 0 3]

European Cuisine: Familiarization of ingredients, recipes and preparation of different countries. North American Cuisine: Familiarization of ingredients, recipes and preparation of different countries. South American Cuisine: Familiarization of ingredients, recipes and preparation of different countries. Asian Cuisine: Familiarization of ingredients, recipes and preparation of different countries. Australian Cuisine: Familiarization of ingredients, recipes and preparation of different countries. African Cuisine: Familiarization of ingredients, recipes and preparation of different countries. Molecular Gastronomy: Additives, Tools, and Recipes. Processed Food: Comparison and Critiquing. Mediterranean and European cuisine: Familiarization of ingredients, recipes and preparation of different countries.

References:
1. The Professional Chef - The Culinary Institute of America
2. Practical Cookery - Kinton, Ceserani and Foskett
3. Food Production Operation - Parvinder S. Bali
4. Professional Cooking - Wayne Gisslen
5. Cookery for the Hospitality Industry - Dodgshun Peters
6. Modern Cookery - Thangam E Phillips

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IIE 4315: REPORTING AND WRITING [3 0 0 3]

Introduction to news writing news in different media, news, definition of news, news values; types of news other theoretical issues relating to news writing. News Reporting Basic of news writing: structure of news reports; writing the lead; the changes in the composition of the lead; techniques of news gathering; sources of news. Reporting various types of reporting (Objective, Interpretative, Investigative,) General assignment reporting/working on a beat. Reporting for news agency, periodicals and magazines. Interviewing: doing the research, conducting the interview, types and formats of interviews, writing interviews

References:
1. Mencher, Melvin (2006): News Reporting and Writing, Mac-Graw Hill, Boston.
2. Scalnan, Christopher (2000): Reporting and Writing: Basics for the 21st Century, Harcourt College Publishers.
3. Harrington Walt (1997) Intimate Journalism: The Art and Craft of Reporting Everyday Life, Sage Publications.
4. Carole, Rich (2007), Writing and Reporting News: A Coaching Method, Thomson Learning Inc.Kamath, K.V. (1993): Journalists' Handbook, Vikas Publishing House.
5. Aggarwal, Vir Bala (2006): Essentials of Practical Journalism, Concept Publishing Company.

IIE 4316: INTRODUCTION TO ADVERTISING & PUBLIC RELATIONS [3 0 0 3]

Introduction to advertising; Evolution and history of advertising; Influence of advertising on society and ethics. Advertising as part of marketing mix; Structure and types of ad agencies; Advertising planning; creative strategy and implementation (media strategy). The essentials of advertising on different media platforms – print, broadcast, internet and new media; discuss the difference in planning and execution using examples or campaign case studies. Public Relations-scope; definition; evolution; establish difference between PR and advertising; Identifying stakeholders and various Public Relation tools. Steps in developing a PR program/campaign-stating the problem, planning and programming, action and evaluation; Crisis communication; Ethical issues in Public Relations.

References:
1. Butterick, K (2012): Introducing Public Relations: Theory and Practice. New Delhi: SAGE Publications India Pvt. Ltd.
2. Cutlip, Center & Broom, (2000): Effective Public Relations.USA: Prentice Hall International.
3. Jaishri Jethwaney and Shruti Jain, (2012): Advertising Management. New Delhi: Oxford University Press
4. Reddi, C.V.N. (2009): Effective Public Relations and Media Strategy. New Delhi: PHI Learning Pvt. Ltd.
5. Sharma, S. & Singh, R. (2009): Advertising Planning and Implementation. New Delhi: PHI Learning Pvt. Ltd.

IIE 4317: BASIC PHOTOGRAPHY [3 0 0 3]

Photo Journalism: History of Photography and Photo Journalism. Photo Journalism: Definition, Nature, Scope and Functions of Photo Journalism – Qualification and Responsibilities of Photo Journalists, News Photographers and News Value, Types and Sources. Selection, Criteria for News Photographs – Channels of News Pictures – viz., Wire, Satellite, Agency, Stock, Picture Library, Freelancer, Photo Editing, Caption Writing, Photo – Presentation. Legal and Ethical aspects of Photography – Professional Organizations – Camera – Components and Types of Camera – Types of Lens, Types of Films, Types of Filters – Importance of Light and Lighting Equipments – Camera Accessories – Picture appreciation. Digital Camera – Digital Technology and its future – Darkroom Infrastructure – Film developing and Printing

References:
1. Basic Photography – Newnes
2. The Hamlyn Basic Guide to Photography – Hamlyn
3. Hamlyn Encyclopedia of Photography – Hamlyn
4. Photographing People – Guglielmezei
5. History of Photography – Cyernshem G R
6. Photo Journalism – Rothsteline
7. Techniques of Photo Journalism – Milten Feinberg
8. Freelance Photography – Jechsend Gedsey
9. Picture Editing – Stanley E Kalish and Clifton C Edom
10. News Photography – Jack Price
11. 1000 Ideas for better News Picture – High Sidley and Rodney Fox

IIE 4318: MEDIA PRODUCTION TECHNIQUES [3 0 0 3]

Print design elements – typography, colours, spacing, pictures, logos, graphics, principles of layout and design – basic writing skills. Photography – SLR camera, Lenses, Apertures and Shutter speeds, Exposure, Understanding light, Filters and assessories, composing a picture, developing and printing, creating special effects. Digital photography – digital camera – digital technology and its future. Television – Introduction to AV Media-pre-production, production, post-production. Show packaging-Camera-characteristics, parts and functions; Mounting accessories and movements. Shots-Types and Uses; Basic composition. Practical video recording process. Radio – Introduction to Radio-Microphone types, characteristics and uses; Cables and Connectors. Recording device-Types and Characters, Audio editing, Programme formats-news, drama, feature and PSA's and Advertising.

References:
1. Gerald Millerson, "Effective TV production"
2. Peter Jarvis, "The Essential TV director's Handbook
3. Hamlyn "Basic guide to photography"
4. Ralph Milton "Radio programming – a basic training manual"
5. Tomlinson Holman "Sound for film and television"
6. Reporting and writing by Melwin Mencher

IIE 4319: GRAPHIC & SKETCHING [3 0 0 3]

Basic Art Principles: Element of Art & Design, Contour Drawing, Composition Principles, Pencil shading, creating geometry model and shading. Basic Perspective: Still life sketching & Drawing, Styles of shading, Introduction to colors, color still life painting, Layout Design, Creating concepts for Design. Skeleton System, Body Proportions, Upper Body, Lower Body, Back, Hands and Legs. Text: Human Anatomy by Victor Perard, Dynamic Anatomy by Burne Hogarth. Gesture Drawing Tips, Line of Action, Dynamic Poses, Body Weight and Gravity, Clothing. Text: Figure Drawing by Anthony Ryder.

List of Practical's:
- 10 Drawings of Human Anatomy Study In Pencil
- 50 Drawings of Gesture Drawing In Pencil
- 5 Contour Drawing
- 2 Still Life Pencil Shading
- 2 Color Still Life
- 2 Layout Design

References:
1. Mastering Composition: Techniques and Principles to Dramatically Improve Your Painting (Mastering (North Light Books)) Hardcover – 25 Jan 2008 by Ian Roberts
2. Layout Essentials: 100 Design Principles for Using Grids (Design Essentials) Paperback – 1 by Beth Tondreau
3. Pencil Drawing: Learn how to develp drawings from start to finish with techniques for shading, contrast, texture, and detail (Artist's Library) Paperback – 1 Jan 1988 by Gene Franks
4. Drawing the Head and Figure – Jack Hamm
5. Dynamic Anatomy – Burne Hogarth
6. The artists complete guide to Human figure Drawing – Anthony Ryder
7. Human Anatomy – Victor Perard