INDIAN INSTITUTE OF TECHNOLOGY PATNA

Programme: Bachelor of Technology in Electrical Engineering

Curriculum

First Semester		
Course Number	**Course Title**	**L-T-P-C**
CH 101	Chemistry	3-1-0-8
CH 110	Chemistry Laboratory	0-0-3-3
EE 101	Electrical Sciences	3-1-0-8
MA 101	Mathematics – I	3-1-0-8
ME 111	Engineering Drawing	2-0-3-7
PH 101	Physics – I	2-1-0-6
ME 110	Workshop – I	0-0-3-3
HS 101	English	3-0-0-6
	Total L-T-P-C	**16-4-9-49**

Second Semester		
CH 102	Chemistry-II	3-0-0-6
CS 101	Introduction to Computing	3-0-0-6
CS 110	Computing Laboratory	0-0-3-3
EE 102	Basic Electronics Laboratory	0-0-4-4
MA 102	Mathematics-II	3-1-0-8
ME 101	Engineering Mechanics	3-1-0-8
PH 110	Physics Laboratory	0-0-3-3
PH 102	Physics – II	2-1-0-6
	Total L-T-P-C	**14-3-10-44**

Third Semester		
MA 201	Mathematics – III	3-1-0-8
CS 201	Object Oriented Programming and Data Structures	3-0-3-9
HS 2xx	HSS Elective	3-0-0-6
EE 200	Semiconductor Devices and Circuits	3-0-0-6
EE 201	Digital Circuits and Microprocessor	3-0-0-6
EE 202	Digital Circuits Laboratory	0-0-3-3
EE 220	Signal, System and Networks	3-1-0-8
	Total L-T-P-C	**18-2-6-46**

Fourth Semester		
HS 2xx	HSS Elective	3-0-0-6
XX 2xx	Science Elective	3-0-0-6
EE 203	Analog Integrated Circuits	3-0-0-6
EE 204	Analog Circuits Laboratory	0-0-3-3
MA 225	Probability and Random Processes	3-1-0-8
EE 230	Principles of Communication	3-1-0-8
EE 280	Electrical Machines	3-0-0-6
EE 281	Electrical Machines Laboratory	0-0-3-3
	Total L-T-P-C	**18-2-6-46**

Fifth Semester		
EE 310	Introduction to VLSI Design	3-0-0-6
EE 311	VLSI Laboratory	0-0-3-3
EE 320	Digital Signal Processing	3-0-0-6
EE 380	Electrical Power Systems	3-0-0-6
EE 331	Communication Laboratory	0-0-3-3
EE 350	Control Systems	3-0-0-6
EE 370	Electronic Instrumentation	3-0-0-6
EE 371	Instrumentation and Control Lab	0-0-3-3
	Total L-T-P-C	**15-0-9-39**

Sixth Semester		
HS 3xx	HSS Elective	3-0-0-6
EE 304	Design Laboratory	0-0-4-4
EE 321	DSP Laboratory	0-0-3-3
EE 340	Electromagnetic Theory	3-0-0-6
EE 351	Advanced Control Systems	3-0-0-6
EE 322	Mathematical Methods in Electrical Engineering	3-0-0-6
EE 360	Embedded Systems	3-0-0-6
EE 361	Embedded Systems Laboratory	0-0-3-3
	Total L-T-P-C	**15-0-10-40**

Seventh Semester		
XX 4xx	Open Elective - I	3-0-0-6
EE 498	Project-I	0-0-8-8*
EE xxx	Departmental Elective – I	3-0-0-6
EE xxx	Departmental Elective - II	3-0-0-6
EE 480	Electrical Power Systems Operation and Control	3-0-0-6
EE 481	Power Electronics and Drives	3-0-0-6
EE 482	Advanced Electrical Engineering Laboratory	0-0-3-3
EE400	Summer Training	0-0-0-2
	Total L-T-P-C	**15-0-11-43**

Eighth Semester		
XX 4xx	Open Elective - II	3-0-0-6
HS 4xx	HSS Elective	3-0-0-6
EE 499	Project – II	0-0-16-16*
EE xxx	Departmental Elective - III	3-0-0-6
EE xxx	Departmental Elective - IV	3-0-0-6
	Total L-T-P-C	**12-0-16-40**

Grand Total of L-T-P-C for all semesters:	**123-11-77-345**

* The work load for the courses of XX498 and XX499 are approximately equivalent to one theory course and two theory courses respectively.

Components of the Curriculum & their Total Credits											
HSS Part Component		Basic Sciences & Mathematics Component		Engineering Sciences Component		Professional Subject Component					Total Credits
Theory	Lab	Theory	Lab	Theory	Lab	Theory	Lab	Seminar	Project	Others	
30	0	56	6	44	16	138	31	-------	24	-----	345

Components of the Curriculum & their Total Credits				
Institutional Core	Institutional Electives	Departmental Core	Departmental Electives	Total Credits
110	42	169	24	345

Note: The first year curriculum, MA201 & CS201 in the third semester are common to all B.Tech. programmes.

Please remember the following rules.

- The credit requirements for a B.Tech. programme will be in the range of 340 - 360 credits. To get 340 credits, one has to plan 43 credits for each semester.
- Normally, the number of credits registered for during a semester should not be less than 36 credits and should not exceed 52 credits. The L-T-P loading for a semester should not exceed 32 contact hours per week.
- No semester will normally have more than six lecture based courses and four laboratory courses.
- The curriculum of an individual department may include industrial training for 8 weeks for every undergraduate student. Industrial training and/or fieldwork are to be satisfactorily completed before a student is declared eligible for the degree. The curriculum for an individual department may show a credit allocation for industrial training, if considered necessary. Normally industrial training will be arranged during the summer vacation following the sixth semester of studies.

B.Tech Courses

First Semester

EE101 Electrical Sciences

EE101	Electrical Sciences	3-1-0-8	Pre-requisites: Nil

Circuit Analysis Techniques, Circuit elements, Simple RL and RC Circuits, Kirchoff's law, Nodal Analysis, Mesh Analysis, Linearity and Superposition, Source Transformations, Thevnin's and Norton's Theorems, Time Domain Response of RC, RL and RLC circuits, Sinusoidal Forcing Function, Phasor Relationship for R, L and C, Impedance and Admittance.

Semiconductor Diode, Zener Diode, Rectifier Circuits, Clipper, Clamper, Bipolar Junction Transistors, Transistor Biasing, Transistor Small Signal Analysis, Transistor Amplifier, Operational Amplifiers, Op-amp Equivalent Circuit, Practical Op-amp Circuits, DC Offset, Constant Gain Multiplier, Voltage Summing, Voltage Buffer, Controlled Sources, Instrumentation Circuits, Active Filters and Oscillators.

Number Systems, Logic Gates, Boolean Theorem, Algebraic Simplification, K-map, Combinatorial Circuits, Encoder, Decoder, Combinatorial Circuit Design, Introduction to Sequential Circuits.

Magnetic Circuits, Mutually Coupled Circuits, Transformers, Equivalent Circuit and Performance, Analysis of Three-Phase Circuits, Electromechanical Energy Conversion, Introduction to Rotating Machines.

Texts/ References:

- C. K. Alexander, M. N. O. Sadiku, Fundementals of Electric Circuits, 3rd Edition, McGraw-Hill, 2008.
- W. H. Hayt and J. E. Kemmerly, Engineering Circuit Analysis, McGraw-Hill, 1993.
- Donald A Neamen, Electronic Circuits; analysis and Design, 3rd Edition, Tata McGraw-Hill Publishing Company Limited.
- Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, 5th Edition, Oxford University Press, 2004.M
- R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 6th Edition, PHI, 2001.
- M. M. Mano, M. D. Ciletti, Digital Design, 4th Edition, Pearson Education, 2008.
- Floyd, Jain, Digital Fundamentals, 8th Edition, Pearson.
- A. E. Fitzgerald, C. Kingsley Jr., S. D. Umans, Electric Machinery, 6th Edition, Tata McGraw-Hill, 2003.
- D. P. Kothari, I. J. Nagrath, Electric Machines, 3rd Edition, McGraw-Hill, 2004.

Second Semester

EE102 Basic Electronics Laboratory

EE102	Basic Electronics Laboratory	0 0 4 4	Pre-requisites: Nil

Experiments using diodes and bipolar junction transistor (BJT): design and analysis of half -wave and full-wave rectifiers, clipping circuits and Zener regulators, BJT characteristics and BJT amplifiers; experiments using operational amplifiers (op-amps): summing amplifier, comparator, precision rectifier, astable and monostable multivibrators and oscillators; experiments using logic gates: combinational circuits such as staircase switch, majority detector, equality detector, multiplexer and demultiplexer; experiments using flip-flops: sequential circuits such as non-overlapping pulse generator, ripple counter, synchronous counter, pulse counter and numerical display.

References:

- A. P. Malvino, Electronic Principles. New Delhi: Tata McGraw-Hill, 1993.
- R. A. Gayakwad, Op-Amps and Linear Integrated Circuits. New Delhi: Prentice Hall of India, 2002.
- R.J. Tocci: Digital Systems; PHI, 6e, 2001.

Third Semester

EE200 Semiconductor Devices and Circuits

EE200	Semiconductor Devices and Circuits	3 0 0 6	Pre-requisites: Nil

Energy bands; semiconductors; charge carriers: electrons and holes, effective mass, doping. Carrier concentration: Fermi level, temperature dependence of carrier concentration. Drift and diffusion of carriers: excess carriers; recombination and life time, Five equations of carrier transport. p-n Junction: depletion region, forward and reverse- bias, depletion and diffusion capacitances, switching characteristics; breakdown mechanisms; SPICE model. BJT:

carrier distribution; current gain, transit time, secondary effects; SPICE model. Metal-semiconductor junctions: rectifying and ohmic contacts. MOSFET: MOS capacitor; Cv-Iv characteristics; threshold voltage; SPICE model. Single stage amplifiers: CE-CB-CC and CG-CD-CS modes of operation, large signal transfer characteristics of BJT and MOSFET, Different types of biasing for BJT and MOSFET, Small signal parameters, Body effect in MOSFET, Parasitic elements, frequency response of CE and CS amplifiers. Analog ICs: DAC, ADC, VCO, PLL and 555-timer.

Texts:

- R. Pierret, Semiconductor Device Fundamentals, PHI, 2006
- P. R. Gray, Paul Hurst, S.H. Lewis and R. G. Meyer, Analysis and Design of Analog Integrated Circuit, John Wiley, 2001.
- S. Sedra and K. C. Smith, Microelectronic Circuits, Oxford University Press, 1997.

References:

- M. S. Tyagi, Introduction to Semiconductor Materials and Devices, John Wiley & Sons Inc.
- Michael Shur, Introduction to Electronic Devices, John Wiley & Sons Inc., 2000
- R. T. Howe and C. G. Sodini, Microelectronics: An Integrated Approach, Prentice-Hall Inc. 1997.
- Ben G. Streetman, Solid State Electronic Devices, PHI, 5/e, 2001.
- J. Singh, Semiconductor Devices - Basic Principles; John Wiley & Sons Inc., 2001.

EE201 Digital Circuits and Microprocessor

EE201	Digital Circuits and Microprocessor	3 0 0 6	Pre-requisites: Nil

Digital logic families: TTL, MOS, interfacing between logic families; Combinational circuits: multiplexer/ demultiplexer, encoder/ decoder, adder/ subtractor, comparator and parity generators; Sequential circuits: latches and flip-flops (RS, JK, D, T, and Master Slave); Registers; Counters: ripple, ring, and shift register counters; Design and analysis of synchronous sequential finite state machine; Programmable logic devices; Introduction to HDL. Microprocessors: 8085 addressing modes, memory interfacing, interrupts, instructions, timing diagram; Introduction to 8086; Peripheral chips: I/Os, timer, interrupt controller, USART, DMA.

Texts:

- C. H. Roth Jr., “Fundamentals of Logic Design”, 4/e, Jaico Publishers, 2002.
- J. F. Wakerly, “Digital Design - principles and practices”, 4/e, Pearson Education; 2006.
- Z. Kohavi, “Switching and Finite Automata Theory”, 2/e, Tata McGraw-Hill, 2008.
- R. K. Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, Penram International Publishing (India), 2000.

References:

- M. D. Ercegovac, T. Lang, and J.H. Moreno, “Introduction to Digital Systems”, John Wiley, 2000.
- V. P. Nelson, H. T. Nagle, B. D. Carroll & J. D. Irwin, “Digital Logic Circuit Analysis and Design”, Prentice-Hall, 1995.
- D. V. Hall, “Microprocessors and Interfacing: programming and hardware”, TMH, 1995.

EE202 Digital Circuits Laboratory

EE202	Digital Circuits Laboratory	0 0 3 3	Pre-requisites: Nil

Combinational Logic design using decoders and multiplexers; design of arithmetic circuits using adder ICs; Flip flop circuit (RS latch, JK & master slave) using basic gates; Asynchronous Counters, Johnson & Ring counters; Synchronous counters; Sequential Circuit designs (sequence detector circuit), DAC circuit; Assembly language programming of 8085: a) sorting and code conversion, b) matrix multiplication; 8085 interfacing: a) parallel port interface (square wave generation), b) counter and timer interface (polling and using interrupts); ADC/DAC interfacing with 8085.

Texts/References:

- Niklaus Wirth, Digital Circuit Design: An Introductory Textbook, Sringer, 1995.

- D. P Leach, A. P. Malvino and G. Saha, Digital Principles and Applications, 2/e, Tata McGraw-Hill, 2006
- R. S. Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, Penram International Publishing (India), 2000.
- TTL IC Data Sheets (www.datasheetarchive.com/).

EE220 Signal, System and Networks

EE220	Signal, System and Networks	3 1 0 8	Pre-requisites: Nil

Signals: classification of signals; signal operations: scaling, shifting and inversion; signal properties: symmetry, periodicity and absolute integrability; elementary signals. Systems: classification of systems; system properties: linearity, time/shift-invariance, causality, stability; continuous-time linear time invariant (LTI) and discrete-time linear shift invariant (LSI) systems: impulse response and step response; response to an arbitrary input: convolution; system representation using differential and difference equations; Eigen functions of LTI/ LSI systems, frequency response and its relation to the impulse response. Signal representation: signal space and orthogonal bases; Fourier series representation of continuous-time and discrete-time signals; continuous-time Fourier transform and its properties; Parseval's relation, time-bandwidth product; discrete-time Fourier transform and its properties; relations among various Fourier representations. Sampling: sampling theorem; aliasing; signal reconstruction: ideal interpolator, zero-order hold, first-order hold; discrete Fourier transform and its properties. Laplace transform and Z- transform: definition, region of convergence, properties; transform-domain analysis of LTI/LSI systems, system function: poles and zeros; stability. Review of network theorems: superposition, Thevenin's, Norton's, reciprocity, maximum power transfer, Millman's and compensation theorems; Network topology: definition of basic terms, incidence matrix, tie-sets, cut-sets; Two port networks: characterization in terms of impedance, admittance, transmission, hybrid parameters and their relationships, interconnection of two port networks; Symmetrical two port network: T and π equivalents, image impedance, characteristic impedance and propagation constant.

Texts:

- M. J. Roberts, "Fundamentals of Signals and Systems", Tata McGraw Hill, 2007.
- B. P. Lathi,"Signal Processing and Linear Systems", Oxford University Press, 1998.
- M. E. Van Valkenburg, “Network Analysis”, 3/e, Prentice Hall of India, 2003.
- C. A. Desoer and E. S. Kuh, “Basic Circuit Theory”, McGraw-Hill, 1985.

References:

- A.V. Oppenheim, A.S. Willsky and H.S. Nawab, "Signals and Systems", Prentice Hall of India, 2006.
- R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4/e, Prentice Hall, 1998.
- Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons, 1998.
- F. F. Kuo, “Netwok Analysis and Synthesis”, 2/e, Weily India, 2007.
- K. S. Suresh Kumar, “Electric Circuits and Networks”, Pearson Education, 2009.

Third Semester HSS Electives

HS201 INTRODUCTORY MICROECONOMICS

HS201	INTRODUCTORY MICROECONOMICS	(3-0-0-6)	NILL

Introduction: Why Economics, The Central Economic Problem, Production Possibility Curve (PPC)
Overview of Markets: Demand and Supply, Elasticity, Efficiency and Equity, Markets in Action
Determinants of Demand and Supply: Utility and Demand, Production and Costs
Markets for Goods and Services: Competition, Monopoly, Monopolistic Competition and Oligopoly
Markets and Government: Externalities, Public Goods and Taxes, Factor markets, Income distribution
Texts:

- Paul A. Samuelson and William Nordhaus , Economics, Tata M.Hill, 2005.

References:

- A.Koutsoyiannis, Modern Microeconomics, Macmillan, 2008.
- Richard G.Lipsey and Alec Chrystals, Oxford, 2007.

- Microeconomics: An Integrated Approach, David Besanko and Ronald R. Braeutigam ,John Wiley and Sons, 2002

HS221 FUNDAMENTALS OF LINGUISTICS SCIENCE

HS221	FUNDAMENTALS OF LINGUISTICS SCIENCE	(3-0-0-6)	NILL

Introduction: Language; Linguistics; Language Learning
Phonetics (Sound Systems): Mechanism of Speech Production, Consonants, Vowels , Phonotactic Rules, Phonology: Phonemes
Morphology: Morphemes, Structure of Words
Syntax: Constituents of a Sentence, Structure of a Sentence; Grammar; Acceptability and Grammaticality; Principles and Parameters; Prescriptive, Descriptive, and Explanatory Adequacy, Syntactic Tools; Principles of modern linguistics with special reference to English and Hindi syntax
Use of language: Language in Literature, Media, Language in Advertisement
Sociolinguistics: Language is Social Context; Multilingualism
Language and Politics: Language in Constitution; Language and Dialect
Psycholinguistics: Language Acquisition; Universal Grammar
Semantics 2: Language Change and Language Variation, Language and Computers
Text and References:

- Bloomfield, L. 1933 Language, pp. 21-41. Holt, Rinehart and Winston
- Chomsky, N. 1965 Aspects of the Theory of Syntax, pp. 3-15, 18-27, 47-59. MIT Press
- Farmer, Ann and Richard Demers 2001 A Linguistics Workbook MIT Press

HS231 INTRODUCTORY SOCIOLOGY

HS231	INTRODUCTORY SOCIOLOGY	(3-0-0-6)	NILL

Introduction: Sociological Imagination; Subject matter of Sociology
Theoretical Practice: Durkheim (Foundations of the Science of Society), Weber (Economy and Society),Marx (Political Economy), Foucault (Practices and Knowledge), Butler (Gender Performativity), & Burawoy (Public Sociology).
Methodology and Methods: Qualitative, Quantitative, and Mixed
Indian Society: Eminent Indian Sociologists; Caste, Class, and Tribe; Women and Children; Health and Education; Science, Technology and Society; Media and Migration; Globalization and Social Change; Diaspora; Bihar- a case study.
Text and References:

- Alex Inkeles, What is Sociology? An Introduction to the Discipline and Profession New Delhi: Prentice-Hall of India, 1997
- Anthony Giddens, Sociology (Sixth Edition) Cambridge: Polity Press, 2009
- M.N.Srinivas, Social Change in Modern India, New Delhi: Orient Longman, 1985
- S. C. Dube, Indian Village London: Routledge, 1955

HS241 General Psychology

HS241	General Psychology	(3-0-0-6)	NILL

Aim of the Course
This course covers some of the biological, psychological, and individual factors which influence human thinking, beliefs, and behaviour. This knowledge will help students in understanding their own behaviours and behaviours of others. They can also apply psychological theories and principles in their workplace and practical life.
Course Contents
Introduction: Brief History of Psychology; Human Mind and Human Behaviour; Definition; Methods; Scope and Subject Matter.
Perception: Process; Determinants of Perception; Gestalt Theory; Extra-Sensory Perception; Intuitive Judgement.
Intelligence: Concept of Intelligence; Factors and Measurement of Intelligence; Successful Intelligence and Emotional Quotient (EQ).

Learning: Process of Learning, Retention and Recall; Theories of Learning; Effective Methods of Learning.
Remembering and Forgetting: Information Processing Approach; Sensory Information Stage; Short-Term and Long-Term Memory; Process of Forgetting.
Thinking: Nature of Thinking; Concept Formation; Problem Solving; Creative Thinking; Day Dreaming.
Personality: Definition; Determinants of Personality; Theories of Personality; Assessment of Personality.
Abnormality: Normal and Abnormal; Cause and Significance of Symptoms and Mental Diseases; Mental Health; Spiritual Counselling.
Books Recommended

- McConnell, J.V. Understanding Human Behaviour (6th Ed.). New York: Holt, Rinehart and Winston.
- Myers, D.G. (2010). Psychology (9th Edition). New York: Worth Publishers.
- Griggs, R.A. (2010). Psychology: A Concise Introduction. New York; Worth Publishers.
- Brown, J.F. & Mogan, C.T. (2011). The Psychodynamics of Abnormal Behaviour. New York: Literary Licensing, LLC.

Fourth Semester-Core Courses

EE203 Analog Integrated Circuits

EE203	Analog Integrated Circuits	3 1 0 8	Pre-requisites: nil

Frequency response of amplifiers: high frequency device models, frequency response, GBW, methods of short circuit and open circuit time constants, dominant pole approximation; Feedback amplifiers: basic feedback topologies and their properties, analysis of practical feedback amplifiers, stability; Power amplifiers: class A, B, AB, C, D, E stages, output stages, short circuit protection, power transistors and thermal design considerations; Differential amplifiers: DC and small signal analysis, CMRR, current mirrors, active load and cascode configurations, frequency response; case study: 741 op-amp - DC and small signal analysis, frequency response, frequency compensation, GBW, phase margin, slew rate, offsets; CMOS realizations: current source, sink and mirrors, differential amplifiers, multistage amplifiers; Signal generation and waveform shaping: sinusoidal oscillators- RC, LC, and crystal oscillators, Schmitt trigger; Analog subsystems: analog switches, voltage comparator, voltage regulator, switching regulator, bandgap reference voltage source, analog multiplier, filter approximations: Butterworth, Chebyshev and elliptic, first order and second order passive/active filter realizations.

Texts:

- S. Smith, "Microelectronics Circuits", 5/e, Oxford, 2005
- P. Gray, P. Hurst, S. Lewis, and R. Meyer, "Analysis & Design of Analog Integrated Circuits," 4/e, Wiley, 2001.

References:

- B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill 2001.
- D. Johns, K. Martin, "Analog Integrated Circuit Design," Wiley, 1997.
- R. A. Gayakwad, Op-Amps and Linear Integrated Circuit, Prentice Hall of India, 2002.
- B. Razavi, RF Microelectronics, Prentice-Hall, 1998.
- P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, 2/e, Oxford University Press, 1997.

EE204 Analog Circuits Laboratory

EE204	Analog Circuits Laboratory	0-0-3-3	Pre-requisites: nil

Experiments using BJTs, FETs, op-amps and other integrated circuits: Multistage amplifiers, automatic gain controlled amplifiers, programmable gain amplifiers; frequency response of amplifiers; voltage regulator with short circuit protection; phase-locked loop; waveform generators; filters.

Texts/References:

- A. P. Malvino, Electronic Principles, Tata McGraw-Hill, 1993.
- R. A. Gayakwad, Op-Amps and Linear Integrated Circuits, Prentice Hall of India, 2002.

EE230 Principal of Communication

EE230	Principal of Communication	3-1-0-8	Pre-requisites: nil

Basic blocks in a communication system: transmitter, channel and receiver; baseband and passband signals and their representations; concept of modulation and demodulation. Continuous wave (CW) modulation: amplitude modulation (AM) - double sideband (DSB), double sideband suppressed carrier (DSBSC), single sideband suppressed carrier (SSBSC) and vestigial sideband (VSB) modulation; angle modulation - phase modulation (PM) & frequency modulation (FM); narrow and wideband FM. Pulse Modulation: sampling process; pulse amplitude modulation (PAM); pulse width modulation (PWM); pulse position modulation (PPM) ; pulse code modulation (PCM); line coding; differential pulse code modulation; delta modulation; adaptive delta modulation. Noise in CW and pulse modulation systems: Receiver model; signal to noise ratio (SNR); noise figure; noise temperature; noise in DSB-SC, SSB, AM & FM receivers; pre-emphasis and de-emphasis, noise consideration in PAM and PCM systems. Basic digital modulation schemes: Phase shift keying (PSK), amplitude shift keying (ASK), frequency shift keying (FSK) and Quadrature amplitude modulation (QAM); coherent demodulation and detection; probability of error in PSK, ASK, FSK & QAM schemes. Multiplexing schemes: frequency division multiplexing; time division multiplexing.

Texts:

- J. G. Proakis and M. Salehi, Communication system engineering, 2/e, Pearson Education Asia, 2002.
- R. E. Ziemer, W. H. Tranter, Principles of Communications: Systems, Modulation, and Noise, 5/e, John Wiley & Sons, 2001.
- Simon Haykin, Communication Systems, 4/e, John Wiley & Sons, 2001.

References:

- K. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley and Sons, 1979.
- A. B. Carlson, Communication Systems,3/e, McGraw Hill, 1986.
- B. P. Lathi, Modern Analog and Digital Communication systems, 3/e, Oxford University Press, 1998.
- H. Taub and D. L. Schilling, Principles of Communication Systems, 2/e, McGraw Hill, 1986.

EE280 Electrical Machines

EE280	Electrical Machines	3-0-0-6	Pre-requisites: nil

Magnetic circuits and transformer including 3-phase transformers; modeling of D.C. machines; phasor diagram of cylindrical rotor and salient pole machines- electromagnetic and reluctance torque, response under short circuit conditions; modeling of induction machines- derivation of equivalent circuits, dynamics under load change, speed reversal and braking, unbalanced and asymmetrical operation; single phase induction motor and applications in domestic appliances; modeling of synchronous machines - equivalent circuit, d-q transformations, short circuit studies in synchronous machines; variable reluctance, permanent magnet, stepper motors and their applications.

Texts:

- S. Chapman, Electric Machinery Fundamentals, McGraw-Hill, 4/e, 2003.
- A. E. Fitzgerald, C. Kingsley, Jr. and S. D. Umans, Electric Machinery, 6/e, Tata McGraw-Hill, 2003.

References:

- I. L. Kosow, Electrical Machinery and Transformers, 2/e, Prentice- Hall of India Pvt. Ltd., 2003.
- D. P. Kothari and I. J. Nagrath, Electric Machines, 3e, Tata McGraw-Hill, 2004.
- B. S. Guru and H. R. Hiziroglu, Electrical Machinery and Transformers, 3/e, Oxford University Press, 2003.
- R. K. Rajput, Electrical Machines, 3/e, Laxmi Publications (P) Ltd., 2003.

EE281 Electrical Machines Laboratory

EE281	Electrical Machines Laboratory	0-0-3-3	Pre-requisites: nil

Open circuit and short circuit tests of single phase transformer, three phase transformer connections, open circuit test and load characteristics of DC generator, speed control and output characteristics of DC motor, no load, blocked rotor and load tests on induction motor, open circuit and short circuit tests of an alternator.

Text/References:

- Stephen Chapman, Electric Machinery Fundamentals, 4/e, McGraw-Hill, 2003.
- C. S. Indulkar, Laboratory Experiments in Electrical Power Engineering, Khanna Publishers, 2003.

GREEN CHEMISTRY AND TECHNOLOGY

CH201	GREEN CHEMISTRY AND TECHNOLOGY	3-0-0-6	Pre-requisites:Nil

Principles and Concepts of Green Chemistry: Sustainable development, atom economy, reducing toxicity. Waste: production, problems and prevention, sources of waste, cost of waste, waste minimization technique, waste treatment and recycling. Catalysis and Green Chemistry: Classification of catalysts, heterogeneous catalysts heterogeneous catalysis, biocatalysis. Alternate Solvents: Safer solvents, green solvents, water as solvents, solvent free conditions, ionic liquids, super critical solvents, fluorous biphase solvents. Alternative Energy Source: Energy efficient design, photochemical reactions, microwave assisted reactions, sonochemistry and electrochemistry. Industrial Case Studies: Greening of acetic acid manufacture, Leather manufacture (tanning, fatliquoring), green dyeing, polyethylene, ecofriendly pesticides, paper and pulp industry, pharmaceutical industry. An integrated approach to green chemical industry.

Texts:

- V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
- M. M. Srivastava, R. Sanghi, , Chemistry for Green Environment, Narosa, New Delhi, 2005.

References:

- 1. P. T. Anastas and J.C. Warner, Green Chemistry, Theory and Practice Oxford, 2000.
- 2. M. Doble and A. K. Kruthiventi, Green Chemistry and Engineering, Academic Press, Amsterdam, 2007.
- 3. Mike Lancaster, Green Chemistry: An Introductory Text, Royal Society of Chemistry, 2002.
- 4. R.E. Sanders, Chemical Process Safety: Learning from Case Histories, Butterworth Heinemann, Boston, 1999.

Algebra and Number Theory

MA212	Algebra and Number Theory	3-0-0-6	Pre-requisites:Nil

Algebra: Semigroups, groups, subgroups, normal subgroups, homomorphisms, quotient groups, isomorphisms. Examples: group of integers modulo m, permutation groups, cyclic groups, dihedral groups, matrix groups. Sylow's theorems and applications. Basic properties of rings, units, ideals, homomorphisms, quotient rings, prime and maximal ideals, fields of fractions, Euclidean domains, principal ideal domains and unique factorization domains, polynomial rings. Finite field extensions and roots of polynomials, finite fields.

Number Theory: Divisibility, primes, fundamental theorem of arithmetic. Congruences, solution of congruences, Euler's Theorem, Fermat's Little Theorem, Wilson's Theorem, Chinese remainder theorem, primitive roots and power residues. Quadratic residues, quadratic reciprocity. Diophantine equations, equations $ax+by=c$, $x^2+y^2=z^2$, $x^4+y^4=z^2$ Simple continued fractions: finite, infinite and periodic, approximation to irrational numbers, Hurwitz's theorem, Pell's equation. Partition functions: Formal power series, generating functions and Euler's identity, Euler's theorem, Jacobi's theorem, congruence properties of p(n). Arithmetical functions: $\Phi(n)$, $\mu(n)$, $d(n)$, $\sigma(n)$. A particular Dirichlet series for Riemann Zeta Function.

Texts:

- I. N. Herstein. Topics in Algebra, Wiley, 2006
- I. Niven, H.S. Zuckerman, H.L. Montgomery. An introduction to the theory of numbers, Wiley, 2000

References:

- D.S. Dummit & R.M. Foote. Abstract Algebra, Wiley, 1999
- G.H. Hardy, E.M. Wright. An introduction to the theory of numbers, OUP, 2008
- T.M. Apostol. Introduction to Analytic Number Theory, Springer, UTM, 1998

INTRODUCTION TO COMPUTATIONAL TOPOLOGY

MA214	INTRODUCTION TO	3-0-0-6	Pre-requisites:Nil

COMPUTATIONAL TOPOLOGY

1. Introduction and general notions of point set topology : Open and Closed Sets, Neighbourhoods, Connectedness and Compactness, Separation, Continuity.
2. An overview of topology and classification of surfaces : Surfaces – orientable and non-orientable, their topology, classification of closed suraces
3. Combinatorial Techniques : Simplicial complexes, and simplicial maps, triangulations, Euler characteristics, Maps on
surfaces.
4. Homotopy and Homology Groups: Introducing Groups and concept of Homotopy, fundamental group and its calculations, Homology.
5. Calculating Homology : Computation of homology of closed surfaces.
6. Topics in Geometry : Delauny triangulations, Voronoi diagrams, Morse functions

Texts:

- Afra Zomordian: Topology for Computing, CUP, 2005
- H. Edelsbrunner and J. Harer. Computational Topology. An Introduction. Amer. Math. Soc., Providence, Rhode Island, 2009
- J. J. Rotman: An introduction to Algebraic Topology, GTM- 119, Springer, 1998

References:

- Tomasz K., K. Mischaikow and M. Mrozek, Computational Homology, Springer, 2003
- H.Edelsbrunner, Geometry and Topology for Mesh Generation, CUP, 2001
- D. Kozlov, Combinatorial Algebraic Topology, Springer, 2008
- V. A. Vassiliev, Introduction to Topology, AMS, 2001
- R. Messer and P. Straffin, Topology Now, MAA, 2006

INTRODUCTION TO NUMERICAL METHODS

MA231	INTRODUCTION TO NUMERICAL METHODS	3-0-0-6	Pre-requisites:Nil

Number Representation and Errors: Numerical Errors; Floating Point Representation; Finite Single and Double Precision Differences; Machine Epsilon; Significant Digits.

Numerical Methods for Solving Nonlinear Equations: Method of Bisection, Secant Method, False Position, Newton-Raphson's Method, Multidimensional Newton's Method, Fixed Point Method and their convergence.

Numerical Methods for Solving System of Linear Equations: Norms; Condition Numbers, Forward Gaussian Elimination and Backward Substitution; Gauss-Jordan Elimination; FGE with Partial Pivoting and Row Scaling; LU Decomposition; Iterative Methods: Jacobi, Gauss Siedal; Power method and QR method for Eigen Value and Eigen vector.

Interpolation and Curve Fitting: Introduction to Interpolation; Calculus of Finite Differences; Finite Difference and Divided Difference Tables; Newton-Gregory Polynomial Form; Lagrange Polynomial Interpolation; Theoretical Errors in Interpolation; Spline Interpolation; Approximation by Least Square Method.

Numerical Differentiation and Integration: Discrete Approximation of Derivatives: Forward, Backward and Central Finite Difference Forms, Numerical Integration, Simple Newton-Cotes Rules: Trapezoidal and Simpson's (1/3) Rules; Gaussian Quadrature Rules: Gauss-Legendre, Gauss-Laguerre, Gauss-Hermite, Gauss-Chebychev.

Numerical Solution of ODE & PDE: Euler's Method for Numerical Solution of ODE; Modified Euler's Method; Runge-Kutta Method (RK2, RK4), Error estimate; Multistep Methods: Predictor-Corrector method, Adams-Moulton Method; Boundary Value Problems and Shooting Method; finite difference methods, numerical solutions of elliptic, parabolic, and hyperbolic partial differential equations.

Exposure to software package MATLAB.

Texts:

- K. E. Atkinson, Numerical Analysis, John Wiley, Low Price Edition (2004).

- S. D. Conte and C. de Boor, Elementary Numerical Analysis - An Algorithmic Approach, McGraw-Hill, 2005.

References:

- J. Stoer and R. Bulirsch, Introduction to Numerical Analysis, 2nd Edition, Texts in Applied Mathematics, Vol. 12, Springer Verlag, 2002.
- J. D. Hoffman, Numerical Methods for Engineers and Scientists, McGraw-Hill, 2001.
- M.K Jain, S.R.K Iyengar and R.K Jain, Numerical methods for scientific and engineering computation (Fourth Edition), New Age International (P) Limited, New Delhi, 2004.
- S. C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill 2008.

OPTIMIZATION TECHNIQUES

MA251	OPTIMIZATION TECHNIQUES	3-0-0-6	Pre-requisites:Nil

Introduction to linear and non-linear programming. Problem formulation. Geo- metrical aspects of LPP, graphical solution. Linear programming in standard form, simplex, Big M and Two Phase Methods. Revised simplex method, special cases of LP. Duality theory, dual simplex method. Sensitivity analysis of LP problem. Transportation, assignment and traveling salesman problem. Integer programming problems-Branch and bound method, Gomory cutting plane method for all integer and for mixed integer LP. Theory of games: Computational complexity of the Simplex algorithm, Karmarkar's algorithm for LP. Unconstrained Optimization, basic descent methods, conjugate direction and Newton's methods. Acquaintance to Optimization softwares like TORA.

Texts:

- Hamdy A. Taha, Operations Research: An Introduction, Eighth edition, PHI, New Delhi (2007).
- S. Chandra, Jayadeva, Aparna Mehra, Numerical Optimization with Applications, Narosa Publishing House (2009).
- A. Ravindran, Phillips, Solberg, Operation Research, John Wiley and Sons, New York (2005).
- M. S. Bazaraa, J. J. Jarvis and H. D. Sherali, Linear Programming and Network Flows, 3rd Edition, Wiley (2004).

References:

- D. G. Luenberger, Linear and Nonlinear Programming, 2nd Edition, Kluwer, 2003. S. A. Zenios (editor), Financial Optimization, Cambridge University Press (2002).
- F. S. Hiller, G. J. Lieberman, Introduction to Operations Research, Eighth edition, McGraw Hill (2006).

Optics & Lasers

PH201	Optics & Lasers	3-0-0-6	Pre-requisites:Nil

Review of basic optics: Polarization, Reflection and refraction of plane waves. Diffraction: diffraction by circular aperture, Gaussian beams.

Interference: two beam interference-Mach-Zehnder interferometer and multiple beam interference-Fabry-Perot interferometer. Monochromatic aberrations. Fourier optics, Holography. The Einstein coefficients, Spontaneous and stimulated emission, Optical amplification and population inversion. Laser rate equations, three level and four level systems; Optical Resonators: resonator stability; modes of a spherical mirror resonator, mode selection; Q-switching and mode locking in lasers. Properties of laser radiation and some laser systems: Ruby, He-Ne, CO_2, Semiconductor lasers. Some important applications of lasers, Fiber optics communication, Lasers in Industry, Lasers in medicine, Lidar.

Texts:

- R. S. Longhurst, *Geometrical and Physical Optics*, 3rd ed., Orient Longman, 1986.
- E. Hecht, *Optics*, 4th ed., Pearson Education, 2004.
- M. Born and E. Wolf, *Principles of Optics*, 7th ed., Cambridge University Press, 1999.
- William T. Silfvast, *Laser Fundamentals*, 2nd ed., Cambridge University Press, 2004.
- K. Thyagarajan and A. K. Ghatak, *Lasers: Theory and Applications*, Macmillan, 2008.

Vacuum Science and Techniques

PH203	Vacuum Science and Techniques	3-0-0-6	Pre-requisites:Nil

Fundamentals of vacuum, units of pressure measurements, Gas Laws (Boyles, Charles), load-lock chamber pressures, Partial and Vapor Pressures, Gas flow, Mean free path, Conductance, Gauges, Capacitance Manometer, Thermal Gauges, Thermocouple, Pirani Gauge, Penning Gauge, High Vacuum Gauges, Leak Detection, Helium Leak Detection, Cold Cathode Gauge, Roughing (Mechanical) Pumps, Pressure ranges, High Vacuum Pumps: Oil Diffusion Pump, Tolerable fore line pressure System configuration, Oils, Traps Crossover pressure calculations, Pump usage and procedures, Turbomolecular pump, Cryopumps, Pump usages, Out gassing and Leak Testing.

Introduction to Deposition, Anti Reflection (AR) Coatings, Mono-dimensionally modulated (MDM) Filters, Vacuum Coatings, High reflectors, e-Beam deposition systems, Film Stoichiometry, Sputtering, Itching and Lithography, Chemical Vapour deposition and Pulse Laser deposition, Mass Flow control, Reactive sputtering, Film growth control.

Texts:

- K.L. Chopra and S.R. Das, *Thin Film Solar Cells*, Springer, 1983.
- Nagamitsu Yoshimura, *Vacuum Technology: Practice for Scientific Instruments*, Springer, 2008.
- Milton Ohring**,** *Materials Science of Thin Films*, Second Edition, Academic Press, 2001.

References:

- A. Roth, *Vacuum Technology*, North Holland, 1990.
- Donald Smith, *Thin-Film Deposition: Principles and Practice*, McGraw-Hill Professional, 1995.
- Krishna Shesan, *Handbook of Thin Film Deposition*, William Andrew, 2002.

Fourth Semester-HSS Electives

INTRODUCTORY MACROECONOMICS

HS202	INTRODUCTORY MACROECONOMICS	3-0-0-6	Pre-requisites:Nil

Introduction: Alternative Economic Systems, Government and the Markets, Supply and Demand in Macroeconomics, Aggregate Demand and Supply, Macroeconomic Issues: Measuring the Economy, Economic Growth, Macroeconomics and Income, Aggregate Expenditures, Fiscal Policy, Inflation, Unemployment and Employment, Money and Banking: Money Creation, Monetary Policy, Role of Money in Macroeconomics, Commercial and Central Bank ,International Trade: International Trade, Trade and International Currency, Balance of payments and exchange rate, Exchange Rates and Their Effects

Texts:

- P. A. Samuelson and W. Nordhaus , Economics, Tata M.Hill, 2005
- M.L. Jhingan, Macroeconomic Theory, Konark Publishers Pvt. Ltd, 2008

References:

- A. B. Abel, B.S. Bernanke, Macroeconomics, Addison Wesley, 2000
- P.R. Krugman & M. Obstfeld, International Economics: Theory and Policy, Pearson Education (Singapore) Indianbranch,Delhi,2008

LITERATURE: VOICES AND CULTURES

HS211	LITERATURE: VOICES AND CULTURES	3-0-0-6	Pre-requisites:Nil

Identity and diversity of culture, Concepts - ideology, power, hegemony. The voice of suppressed women in Charlotte Bronte's 'Jane Eyre', the appearance of the independent woman in 'Jane Eyre', woman-woman relationship in 'Kamala', challenging patriarchy in 'Kamala', Violence and Racism in Alice Walker's 'The Colour Purple', Disruption of traditional roles in 'The Colour Purple', The voice of the underdogs in 'Untouchable', the female voice in 'Untouchable', laws and human behaviour in 'The God of Small Things', hierarchies in 'Indian Society' in 'the God of Small Things', the voice of the Black women in Phillis Wheatley's 'On Being Brought from

Africa to America' and A. Ruth's 'A Black Woman, Nothing Else', the voice of the powerless in Langston Hughes 'Ballad of the Landlord'.

Texts:

- Charlotte Bronte,Jane Eyre, Macmillan India, 2000
- Krupabai Satthianadhan, Kamala, OUP, 1998
- Alice Walker,The Colour Purple, Houghton Miffin Harcourt, 2006
- Mulk Raj Anand, Untouchable, Penguin Classics, 1990
- Arundhati Roy, The God of Small Things, Penguin, 2002
- Phillis Wheatley,On Being Brought From Africa to America. (Phillis Wheatley, Poems on Various Subjects,Religious and Moral (London: by A. Bell, for Cox and Berry, Boston, 1773): 18)
- A.Ruth, A Black Woman, Nothing Else, Author's Den, 2002
- Hughes Langston, Ballad of the Landlord, The Langston Hughes Reader, George Braziller, New York, 1958
- (The poems mentioned shall be provided in the class)

References:

- Meenakshi Mukherjee, Elusive Terrain: Culture and Literary Memory, OUP, New Delhi, 2008
- Malashri Lal,Signifying the Self – Women and Literature, Macmillan India, New Delhi, 2004
- Sachchidanand Mohanty, Gender and Cultural Identity, Orient Black Swan, New Delhi, 2008
- Nandy Bhatia,Acts of Authority/ Acts of Resistance, OUP, 2004
- N Krishnaswamy, Contemporary Literary Theory, Macmillan, New Delhi, 2005

LANGUAGE, HUMAN MIND, AND INDIAN SOCIETY

HS222	**LANGUAGE, HUMAN MIND, AND INDIAN SOCIETY**	**3-0-0-6**	**Pre-requisites:Nil**

Language: Form and function (Competence vs. Performance), Language as a rule-governed system, Language constitutive of being human; Languages of India: Language families (Genealogical classification of languages), India as a linguistic Area; Human mind: Cognitive language faculty, Biological foundations of language, Language acquisition, Human and non-human systems of communication, Construction of knowledge, Language processing, comprehension and production, Bilingualism and cognitive growth; Indian Society: Multilingualism vs. Bilingualism, India as a multilingual nation, Identities and language, Implications for pedagogy (Multilingual approaches to education), Language and dialect, Politics of language in India

Texts:

- M. Montgomery, An introduction to language and society, Routledge, 1986
- N.Chomsky, Language and Mind, Cambridge University Press, 2006
- V. Evans and M.C. Green, Cognitive linguistics: an introduction, Edinburgh University Press, 2006

References:

- J.R. Searle, Mind, language and society: philosophy in the real world, Basic Books, 1999
- A. Akmajian , R.A. Demers, A.K. Farmer, R.M. Harnish, Linguistics: an introduction to language and communication, Mass:MIT Press, 2001
- N.Chomsky, New horizons in the study of language and mind Cambridge University Press, 2000
- W. Corft and D. Alan Cruse, Cognitive linguistics Cambridge University Press, 2004

COGNITION: LANGUAGE AND COMPUTATION

HS223	**COGNITION: LANGUAGE AND COMPUTATION**	**3-0-0-6**	**Pre-requisites:Nil**

Language: Study of language as a rule governed system (Structure of Language), Acquisition of language, Universal Grammar, Knowledge of Language; Cognitive Science: Introduction, Study of Human Mind, Language and Human Mind, Language as a Cognitive Behavior; Cognitive Computation: Formal Models of Computation, Church-Turing Thesis, Chomsky/Machine Hierarchy; Human Cognition as Computation: Cognitive Architecture, Production System Architecture, Problem Spaces, Protocol Analyses; Artificial Intelligence and the Design of Intelligent Systems: Physical Symbol System Hypothesis, Representation and Semantics, General Models of Search, Knowledge & Search, Computational Limits and Rationality.

Texts:

- N. Chomsky, New horizons in the study of language and mind, Cambridge University Press, 2000
- N. Chomsky, Knowledge of language: its nature, origin, and use Convergence Greenwood Publishing Group, 1986
- P. Thagard, Mind: Introduction to Cognitive Science, MIT Press, 2005
- W. Croft and D.A. Cruse, Cognitive linguistics, Cambridge University Press, 2004
- S. Jonathan Russell Artificial intelligence: a modern approach, Prentice-Hall Of India Pvt. Ltd., 2008
- R. Morelli, W .Miller Brown, D. Anselmi, K. Haberiandt, and D Lloyd (Eds.) Minds, Brains and Computers: Perspectives in Cognitive Science and Artificial Intelligence, Intellect Books, 1992

References:

- W. Bechtel, G. Graham (Eds.) , A Companion to Cognitive Science, Wiley-Blackwell, 1999
- J. Friedenberg and G. Silverman, Cognitive Science: An Introduction to the Study of Mind, SAGE, 2005
- J .P. Heuristics, Intelligent Search Strategies for Computer Problem Solving, Addison-Wesley Pub. Co., 1984

Fifth Semester

EE310 Introduction to VLSI Design

EE310	Introduction to VLSI Design	3 0 0 6	Pre-requisites: nil

Issues and Challenges in Digital IC Design: general overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles; MOSFET fabrication: basic steps of fabrication, CMOS p-well and n-well processes, layout design rules, Bi-CMOS fabrication process; Latch-up immune designs; CMOS Inverter: MOS Device Model with Sub-micron Effects, VTC Parameters (DC Characteristics), CMOS Propagation Delay, Parasitic Capacitance Estimation, Layout of an Inverter, Switching, Short-Circuit and Leakage Components of Energy and Power; Interconnects: Resistance, Capacitance Estimation, delays, Buffer Chains, Low Swing Drivers, Power Distribution, and Performance Optimization of Digital Circuits by Logical Effort Sizing; Combinational Logic Design: Static CMOS Construction, Ratioed Logic, Pass Transistor, Transmission Gate Logic, DCVSL, Dynamic Logic Design Considerations, noise considerations in dynamic design Power Dissipation in CMOS Logic, Domino and NORA designs; Sequential Circuits Design: Classification, Parameters, Static Latches and Register, Race Condition, Dynamic Latches and Registers, Two Phase vs. Single Phase clock designs, Pulse Based Registers; Design of arithmetic building blocks like adders (static, dynamic, Manchester carry-chain, look-ahead, linear and square-root carry-select, carry bypass and pipelined adders) and multipliers (serial - parallel, Booth's and systolic array multipliers); Semiconductor memories: non-volatile and volatile memory devices, flash memories, SRAM Cell Design, Differential Sense Amplifiers, DRAM Design, Single Ended Sense Amplifier; Testing in VLSI: Defects, Fault Models, Path Sensitization, Scan, Built-in-self Test (BIST), IDDQ.

Texts:

- J.M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits- A Design Perspective, 2/e, Prentice Hall of India, 2003.
- N. Weste and D. Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 3/e, Pearson Education India, 2007.

References:

- D. A. Hodges, H. G. Jackson, R. Saleh, Analysis and Design of Digital Integrated Circuits in Deep submicron Technology, 3/e, McGraw Hill, 2004.
- Kang and Leblevici, CMOS Digital Integrated Circuits Analysis and Design, 3/e, McGraw Hill, 2003.
- J. P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & Sons (Asia), 2002.
- W. Wolf, Modern VLSI Design - System on Chip design, 3/e, Pearson Education, 2004.

EE311 VLSI Laboratory

EE311	VLSI Laboratory	0-0-3-3	Pre-requisites: nil Model

Parameter extraction for a diode and MOSFET; NMOS and PMOS characteristics; Inverter characteristics; Characterization of CMOS Ring Oscillator; Layout of discrete components; Basic gates using different design styles; Design of a 1-bit Shift Register, 4-bit sign magnitude adder, 4-bit Multiplier cells; Basic memory cells; FPGA implementation and testing; Differential amplifier design and characteristics; Current and voltage references,

comparator.

Texts/References:

- Muhammad H. Rashid, Introduction to PSpice Using OrCAD for Circuits and Electronics, 3/e, PHI, 2006
- Charles H Roth Jr., Digital systems design using VHDL, 8/e, Thomson Learning Inc, 2006
- Charles H Roth Jr., Fundamentals of Logic Design, 5/e, Thomson Learning Inc, 2007.
- J.M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits- A Design Perspective, 2/e, PHI, 2003.
- P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, 2/e, Oxford University Press, 1997.

EE320 Digital Signal Processing

EE320	Digital Signal Processing	3-0-0-6	**Pre-requisites: nil** Review

of discrete time signals, systems and transforms: Discrete time signals, systems and their classification, analysis of discrete time LTI systems: impulse response, difference equation, frequency response, transfer function, DTFT, DTFS and Z-transform. Frequency selective filters: Ideal filter characteristics, lowpass, highpass, bandpass and bandstop filters, Paley-Wiener criterion, digital resonators, notch filters, comb filters, all-pass filters, inverse systems, minimum phase, maximum phase and mixed phase systems. Structures for discrete-time systems: Signal flow graph representation, basic structures for FIR and IIR systems (direct, parallel, cascade and polyphase forms), transposition theorem, ladder and lattice structures. Design of FIR and IIR filters: Design of FIR filters using windows, frequency sampling, Remez algorithm and least mean square error methods; Design of IIR filters using impulse invariance, bilinear transformation and frequency transformations. Discrete Fourier Transform (DFT): Computational problem, DFT relations, DFT properties, fast Fourier transform (FFT) algorithms (radix-2, decimation-in-time, decimation-in-frequency), Goertzel algorithm, linear convolution using DFT. Finite wordlength effects in digital filters: Fixed and floating point representation of numbers, quantization noise in signal representations, finite wordlength effects in coefficient representation, roundoff noise, SQNR computation and limit cycle. Introduction to multirate signal processing: Decimation, interpolation, polyphase decomposition; digital filter banks: Nyquist filters, two channel quadrature mirror filter bank and perfect reconstruction filter banks, subband coding.

Texts:

- A. V. Oppenheim and R. W. Shafer, Discrete-Time Signal Processing, PHI, 2/e, 2004.
- J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, PHI, 1997.
- S. K. Mitra, Digital Signal Processing: A computer-Based Approach, TMH, 2/e, 2001.

References:

- V.K. Ingle and J.G. Proakis, “Digital signal processing with MATLAB”, Cengage, 2008.
- T. Bose, Digital Signal and Image Processing, John Wiley and Sons, Inc., Singapore, 2004.
- L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall India, 2005.
- A. Antoniou, Digital Filters: Analysis, Design and Applications, Tata McGraw-Hill, New Delhi, 2003.
- T. J. Cavicchi, Digital Signal Processing, John Wiley and Sons, Inc., Singapore, 2002.
- E. C. Ifeachor and B. W. Jervis, Digital Signal Processing, Pearson Education, 2006.

EE380 Electrical Power Systems

EE380	Electrical Power Systems	3-0-0-6	**Pre-requisites: nil**

Generation of electrical energy: Basic structure of power system; demand of electrical system - base load, peak load; controlling power balance between generator and load, advantages of interconnected system; Thermal power plant - general layout, turbines, alternators, excitation system, governing system, efficiency; Hydel power plant - typical layout, turbines, alternators; Nuclear power plant - principle of energy conversion, types of nuclear reactors; brief overview of renewable energy sources. Transmission of electrical energy: Evaluation of Transmission line parameters- types of conductors, representation of transmission line, inductance calculation of single/three phase lines, concept of GMD and GMR, transposition of lines, bundled conductors, skin effect, proximity effect, capacitance calculation of single/three phase lines, effect of earth on calculation of capacitance, line resistance, line conductance; Analysis of transmission lines - representation, short/medium/long transmission lines, nominal T/π network, ABCD parameters, surge impedance, Ferranti effect, power flow through a transmission line, reactive power compensation of transmission line; corona loss; Insulators for overhead transmission lines - types of insulators, string efficiency, methods to improve string efficiency; Insulated cables - insulating material, grading of cables, capacitance of single/three core cable, dielectric loss; methods of grounding; Transient analysis - travelling

waves, reflection and refraction, lattice diagram; mechanical design of transmission line. Distribution of Electrical Energy: D.C and A.C. distribution, radial and ring main distribution, medium voltage distribution network, low voltage distribution network, single line diagram, substation layout, substation equipments.

Texts:

- J. D. Glover, M. S. Sarma and T. J. Overbye, Power System Analysis and Design, 4/e, Thomson Learning Inc., 2007.
- J. J. Grainger and W. D. Stevenson, Jr., Power System Analysis, Tata Mc-Graw Hill, 2003.
- H. Saadat, Power System Analysis, Tata Mc-Graw Hill, 2002.

References:

- L. M. Faulkenberry and Walter Coffer, Electrical Power Distribution and Transmission, 2/e, Pearson Education Inc., 2007.
- James Green and R. Wolson, Control and Automation of Electric Power Distribution System, Taylor and Francis, 2006.
- B. Sorensen, Renewable Energy, Academic Press, 2/e, 2000.
- Tarun Gonen, Electric Power Distribution System, McGraw-Hill, 1986.
- W. D. Stevenson, Elements of Power System Analysis, McGraw-Hill, 4/e, 1982.
- D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, McGraw-Hill, 2006.
- S. N. Singh: Electric Power Generation, Transmission and Distribution, Prentice-Hall, 2007.

EE331 Communication Laboratory

EE331	Communication Laboratory	0-0-3-3	Pre-requisites: nil

Amplitude modulation and demodulation (AM with carrier & DSBSC AM); frequency modulation and demodulation (using VCO & PLL); automatic gain control (AGC); pulse width modulation (PWM); pulse code modulation (PCM); pseudo-random (PN) sequence generation; binary phase shift keying (BPSK); binary frequency shift keying (BFSK).

Text/References:

- W. Tomasi, Electronic Communications Systems - Fundamentals through advanced, 4/e, Pearson, 2003.
- J. G. Proakis and S. Salehi: Communication Systems Engineering; Pearson, 2006.
- H. Taub and D. L. Schilling: Principles of Communication Systems; Tata McGraw-Hill, 2008.

EE350 Control Systems

EE350	Control Systems	3-0-0-6	Pre-requisites: nil

Modeling of physical systems: time-domain, frequency-domain and state-variable models; block diagram, signal flow graph and Mason's gain formula; time and frequency response of first and second order systems; control system characteristics: stability, sensitivity, disturbance rejection and steady-state accuracy; stability analysis: Routh-Hurwitz test, relative stability, root locus, Bode and Nyquist plots; controller types: lag, lead, lag-lead, PID and variants of PID; controller design based on root-locus and frequency response plots; modern design techniques: canonical state-variable models, equivalence between frequency and time-domain representations, diagonalisation, controllability and observability, pole placement by state feedback, state feedback with integral control, observer and observer based state feedback control.

Text:

- K. Ogata, Modern Control Engineering, Prentice Hall India, 2002.
- G. F. Franklin, J. D. Powell and A. E. Emami-Naeini, Feedback Control of Dynamic Systems; Prentice Hall Inc., 2002.

References:

- M. Gopal: Control Systems; Tata McGraw Hill, 3/e, 2008
- B. C. Kuo, Automatic Control Systems, 8/e, Wiely, 2002.

EE370 Electronic Instrumentation

EE370	Electronic Instrumentation	3-0-0-6	Pre-requisites: nil

Definition of instrumentation. Static characteristics of measuring devices. Error analysis, standards and calibration. Dynamic characteristics of instrumentation systems. Electromechanical indicating instruments: ac/dc current and voltage meters, ohmmeter; loading effect. Measurement of power and energy; Instrument transformers. Measurement of resistance, inductance, capacitance. ac/dc bridges. Measurement of non electrical quantities: transducers classification; measurement of displacement, strain, pressure, flow, temperature, force, level and humidity. Signal conditioning; Instrumentation amplifier, isolation amplifier, and other special purpose amplifiers. Electromagnetic compatibility; shielding and grounding. Signal recovery, data transmission and telemetry. Data acquisition and conversion. Modern electronic test equipment: oscilloscope, DMM, frequency counter, wave/ network/ harmonic distortion/ spectrum analyzers, logic probe and logic analyzer. Data acquisition system; PC based instrumentation. Programmable logic controller: ladder diagram. Computer controlled test systems, serial and parallel interfaces, Field buses. Smart sensors.

Text:

- A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measuring Techniques, Pearson Education, 1996.
- M. M. S. Anand, Electronic Instruments and Instrumentation Technology, PHI, 2006.
- E. O. Deobelin, Measurement Systems - Application and Design, Tata McGraw-Hill, 1990.

References:

- B. E. Jones, Instrumentation, measurement, and Feedback, Tata McGraw-Hill, 2000.
- R. P. Areny and T. G. Webster, Sensors and Signal Conditioning, John Wiley, 1991.
- B. M. Oliver and J. M. Cage, Electronic Measurements and Instrumentation, McGraw-Hill, 1975.
- C. F. Coombs, Electronic Instruments Handbook, McGraw-Hill, 1995.
- R. A. Witte, Electronic Test Instruments, Pearson Education, 1995.
- B. G. Liptak, Instrument Engineers' Handbook: Process Measurement and Analysis, Chilton Book, 1995.

EE371 Instrumentation and Control Lab

EE371	Instrumentation and Control Lab	0-0-3-3	Pre-requisites: nil

Development of circuits for signal conditioning, signal recovery, telemetry; PC based instrumentation; Computer controlled test systems; Experiments using modern electronic test equipment, Programmable logic controller. Modeling of physical systems, open-loop and closed-loop control of systems, design of classical controllers, closed loop control of servo systems and regulatory systems, state-feedback based design of modern controllers.

Text/References:

- C. D. Johnson, Process Control Instrumentation Technology, Prentice Hall, 2003.
- R. P. Areny and T. G. Webster, Sensor and Signal Conditioning, John Wiley, 1991.
- C. F. Coombs, Electronic Instruments Handbook, McGraw-Hill, 1995.
- K. Ogata, Modern Control Engineering, Prentice Hall India, 2002.
- G. F. Franklin, J. D. Powell and A. E. Emami-Naeini, Feedback Control of Dynamic Systems; Prentice Hall Inc., 2002.

Fifth Semester - Open Electives

ENTREPRENEURSHIP

HS351	ENTREPRENEURSHIP	3-0-0

Topic: Introduction
Understanding Entrepreneurship: Entrepreneurship & Economic Growth. The Entrepreneurial Method –Effectual & Casual, Myths of Entrepreneurship Idea, Generation Exercise

Topic: Accounting and Finance
Form of Business Organization
Generally accepted Accounting Principles (GAAP)
Rules of Double-Entry Accounting
Type of Financial Statement & Relationship of Financial Statements
Preparation of Accounting Statements
Preparing Final Plan

Valuation of New Ventures
Venture Capital Financing

Topic: Sales and Marketing
What is Marketing? Marketing Concepts, Framework of Marketing? 4Ps of Marketing, Socio-cultural, Legal and Regulatory, Economics, Ethical, Political and Social Responsibility Dimension to Marketing
Understanding target markets, segmentation
Marketing Research
Consumer Behaviour: includes consumer behaviour, models, motivation, perception, attitudes and the influences of family, society and cultural
Product
Understanding Innovation
Sales Forecasting Pricing
Strategies Promotion and
Advertising
Marketing Strategies and Marketing Plans

Topic: Business Plan Project
Starting-up: Who do you start with (Apple), When to start (Lemon Tree), Talking the Plunge (Affordable loss Principle), Bootstrapping (Bird in Hand), Partnership (R & R), Start-up Problems
The Business Plan: Need for a Business Plan, What stake-holders look for, Making a Business Plan. Presenting Business Plan
Early Growth: Scaling-up, Legal Issues, Financial Issues, Human Issues, Adoption Model – Crossing the Chasm, Marketing or Entrepreneurs
The High Growth Venture: From effectuation to causation, Problems of Growth, Ownership & Control, Harvesting
Entrepreneurship and related Issues: E-commerce, Franchising, Family Business, Entrepreneurship within corporate

Industrial Waste Treatment and Management

CE315	**Industrial Waste Treatment and Management**	**3-0-0-6**	**Pre-requisites:Nil**

Introduction to Industrial Waste: Types of industries and industrial pollution, Types of industrial wastes - solid, liquid and gaseous wastes, Hazardous waste - definition and concept, Characteristics of industrial wastes, Effects of industrial wastes on environment and human health, Environmental standards and legislations;

Pollution Prevention and Cleaner Production: Waste minimization, Source reduction, Use of alternate raw materials, Process modifications, Recycle, reuse and byproduct recovery, Opportunities and barriers to cleaner production;

Waste Treatment Techniques: Physico-chemical and biological treatment of wastewater, Concept of common effluent treatment plant (CETP), Concept of zero discharge, Industrial sludge management, Industrial air pollution, Control of gaseous emissions.

Environmental Performance: Environmental audit and performance, Environmental management plan, Introduction to ISO and ISO 14000.

Pollution Control in Major Industries – Case Studies: Manufacturing processes and flow sheets, Sources and characteristics of wastes, Waste treatment and disposal methods – Computer & IT industry and electronic waste (e-waste), Thermal power plants, Iron and steel, Metal plating, Fertilizer, Refinery, Tannery, Food industry, etc.

Text / Reference Books:

- de Nevers, N., Air Pollution Control Engineering, 2nd Edition, McGraw-Hill, 1999.
- Eckenfelder Jr., W.W., Industrial Water Pollution Control, 3rd Edition, McGraw-Hill, 2000.
- Ghassemi, A. (ed.), Handbook of Pollution Control & Waste Minimization, 2nd Edition, Marcel Dekker, 2002.
- Metcalf & Eddy, Wastewater Engineering - Treatment and Reuse (Revised by Tchobanoglous, G., Burton, F.L. and Stensel, H.D.), 4th Edition, Tata McGrawHill, 2004.
- Wise, D.L. and Trantolo, D.J. (eds.), Process Engineering for Pollution Control and Waste Minimization, 1st Edition, Marcel Dekker, 1994.

Introduction to Infotainment

CS381	Introduction to Infotainment	3-0-0-6

Introduction to Infotainment Systems – Overview, Components
Information based Services – Localization and Context based Advertisements, Online Social Networking, Crowdsourcing. Information retrieval, Context awareness, Information dissemination and Information diffusion in these systems.
Entertainment based Services – Audio and video conferencing, Video-on-Demand, Video Streaming etc, Mobile multimedia applications, Online Games.
Architectural Support – Deployment strategies for these multimedia services, Content delivery networks, peer-to-peer based deployment, Performance metrics, Strategies for improving performance.
Implementation Tools – Tools for animation designing, movie making, Introduction to Android programming. Reading mobile sensor information, group formation and handling data services on Android Platforms.
Case Studies – In-vehicle Infotainment Systems, In-flight Infotainment Systems etc.

Text / Reference Books:

- Stefan Steiniger, Moritz Neun and Alistair Edwardes, Foundations of Location Based Services. http://ftp.jaist.ac.jp/pub/sourceforge/j/project/ju/jump-pilot/w_other_freegis_documents/articles/lbs_lecturenotes_steinigeretal2006.pdf
- X.-S. Hua, T. Mei, and A. Hanjalic, Online Multimedia Advertising: Techniques and Technologies. IGI Global, 2011
- Social Network Data Analytics, Ed. Charu C. Agarwal, Kluwer Academic Publisher.
- Gediminas Adomavicius and Alexander Tuzhilin, Context Aware Recommender Systems, http://ids.csom.umn.edu/faculty/gedas/nsfcareer/CARS-chapter-2010.pdf
- F. Thouin and M. Coates, Video-on-Demand Networks: Design Approaches and Future Challenges, *Network, IEEE , vol.21, no.2, pp.42,48, March-April 2007*
- Novella Bartolini, Emiliano Casalicchio and Salvatore Tucci, A Walk through Content Delivery Networks, *Performance Tools and Applications to Networked Systems*, *Lecture Notes in Computer Science* *Volume 2965, 2004, pp 1-25*
- Xiangyang Zhang, Hossam Hassanein, A survey of peer-to-peer live video streaming schemes – An algorithmic perspective, *Computer Networks, Volume 56, Is, sue 15, 15 October 2012*
- Android Programming http://developer.android.com/training/index.html
- Papers from reputed journals and conferences.

Sixth Semester-Core Courses

EE304 Design Laboratory

EE304	Design Laboratory	0-0-4-4	Pre-requisites: nil

A student has to do an electronic hardware mini-project in broad areas like communication, electronic systems design, control and instrumentation, computer, power systems and signal processing. The project involves laying down the specifications, design, prototyping and testing. The project must have major hardware modules involving active discrete components and integrated circuits.

Texts/References:

- P. Horowitz and W. Hill, Art of Electronics, Cambridge University Press, 2nd Edition, 1989.
- M. M. Mano, Digital Design, Pearson Education, 2002.
- The ARRL Handbook for Radio Communications- American Radio Relay League, 2008.
- C. F. Coombs, Electronic Instruments Handbook. McGraw-Hill, 2000.
- T. Williams, The Circuit Designer's Companion, Newnes, 2005.
- R. Pease, Troubleshootting Analog Circuits, Newnes, 1991.

EE321 DSP Laboratory

EE321	DSP Laboratory	0-0-3-3	Pre-requisites: nil

Familiarization of DSP development environments, basic experiments on signal addition, multiplication, vector operations; sampling and quantization; periodic waveform generation; pseudo-random sequence and white noise generation; correlation and convolution; design and implementation of finite impulse response (FIR) and infinite impulse response (IIR) filters. Real-time filtering of signals like speech/audio/biomedical, implementation of basic digital modulation schemes.

The experiments are to be done on ADSP 21XX/TMS320C6XXX DSP Trainer Kit.

Texts/References:

- ADSP 21XX Family User's Manual (www.analog.com)
- TMS320C6XXX CPU and Instruction Set Reference Guide, Texas Instruments, 2000 (www.ti.com)
- V. K. Ingle and J. G. Proakis, Digital signal processing using MATLAB, Thompson Brooks/Cole, Singapore, 2007.
- MATLAB and Signal Processing Toolbox User's Guide (www.mathworks.com)

EE340 Electromagnetic Theory

EE340	Electromagnetic Theory	3-0-0-6	Pre-requisites: nil

Static fields: Coulomb's and Gauss' laws for electrostatics, Poisson's and Laplace's equations, Method of images and boundary value problems; Equation of continuity, Kirchoff's voltage and current laws, Boundary conditions for current density; Biot-Savart's law, Gauss's and Ampere's laws for magnetostatics, Magnetic vector potential; Magnetic dipoles, Magnetization and behavior of magnetic materials. Maxwell's equations: Faraday's law of electromagnetic induction, Maxwell's discovery, Maxwell's equations and boundary conditions, Time-harmonic fields. Wave equation and plane waves: Helmholtz wave equation, Solution to wave equations and plane waves, Wave polarization, Poynting vector and power flow in em fields. Plane waves at a media interface: Plane wave in different media, Plane wave reflection from a media interface, Plane wave reflection from a complex media interface. Finite-difference time-domain method: 1-, 2- and 3-dimensional simulations, Absorbing boundary conditions and perfectly matched layer, Applications. Antennas & radiating systems: Radiation fundamentals, Antenna patterns and parameters, Hertz dipole, Wire antennas, Loop antennas, Antenna arrays. Method of moments: Introductory example from electrostatics, Basic steps of the method of moments, Linear operator equation, Applications.

Texts:

- A. Elsherbeni and V. Demir: The **Finite-difference time-domain method for Electromagnetics with MATLAB Simulations; Scitech, 2009, 1/e**.
- R. K. Shevgaonkar: Electromagnetic Waves; McGraw Hill, 2006, 1/e.
- M. N. O. Sadiku: Elements of Electromagnetics; Oxford University Press, 2000, 3/e.

References:

- K. E. Lonngren & S. V. Savov: Fundamentals Electromagnetics with MATLAB, PHI, 2005, 1/e.
- C. A. Balanis: Antenna Theory: Analysis and Design, John Wiley, 2005, 3/e.
- D. K. Cheng: Field and Wave Electromagnetics; Pearson, 2001, 2/e.
- R. F. Harrington: Time-Harmonic Electromagnetic Fields, Wiley-IEEE, 2001, 2/e.
- N. Ida, Engineering Electromagnetics, Springer, 2000, 1/e.
- D. M. Sullivan: Electromagnetic Simulation using the FDTD Method, Wiley-IEEE, 2000, 1/e.
- J. Griffiths: Introduction to Electrodynamics, PHI, 1999, 3/e.
- B. S. Guru & H. R. Hiziroglu: Electromagnetic Field Theory Fundamentals, Thomson, 1997, 1/e.

EE351 Advanced Control Systems

EE351	Advanced Control Systems	3-0-0-6	Pre-requisites: nil

Frequency response design: Design of lag, lead, lag-lead and PID controllers, the Nyquist criterion, analysis and design, relative stability and the Bode diagram, closed-loop response, sensitivity, time delays; Root locus design: construction of root loci, phase-lead and phase-lag design, PID controller design; Modern design: controllability and observability, state feedback with integral control, reduced order observer; Optimal control design: Solution-time criterion, Control-area criterion, Performance indices, Zero steady state step error systems; Modern control performance index: Quadratic performance index, Ricatti equation; Digital controllers: Use of z-transform for closed loop transient response, stability analysis using bilinear transform and Jury method, deadbeat control, Digital control design using state feedback; On-line identification and control: On-line estimation of model and controller parameters.

Texts/References:

- G. F. Franklin, J. D. Powel and A. E. Emami-Naeini: Feedback Control of Dynamic Systems, Prentice Hall Inc. 2002.
- M. Gopal: Control Systems, 3/e, Tata McGraw Hill, 2008.
- M. Gopal: Digital Control and State Variable Methods, Tata McGraw Hill, 2003.

- K. J. Astrom and T. Hagglund: Advanced PID Control, ISA, Research Triangle Park, NC 27709, 2005.

EE322 Mathematical Methods in EE

EE322	Mathematical Methods in EE	3-0-0-6	Pre-requisites: nil

Topics in matrix theory: Elementary canonical forms: digitalisation, triangulation, primary and secondary decompositions, Jordan canonical forms and applications. Introduction to optimization theory: The optimization problem and illustrative examples; necessary and sufficient conditions for optima; convex sets, convex functions, optima of convex functions; constrained minimization- linear and non-linear constraints, equality and inequality constraints, optimality conditions, Karush Kuhn Tucker optimality conditions; unconstrained optimization- steepest descent, Newton and quasi Newton methods, conjugate direction methods. Calculus of variation- The method of variations in problems with fixed boundaries, Variation of a functional, Euler's equation, functionals involving derivatives of higher order, optimal control as a problem of variational calculus.

Text/References:

- K. Hoffman and R. Kunz, Linear Algebra, Prentice Hall India, 2001.
- J.Luenberger D.G. Introduction to Linear and Nonlinear Programming, 2/e, Addison Wesley, 1984.
- J. L. Troutman, Variational Calculus and Optimal Control: Optimization with Elementary Convexity, 2/e, Springer Verlag, 1996.

EE360 Embedded Systems

EE360	Embedded Systems	3-0-0-6	Pre-requisites: nil

Introduction: Introduction to embedded systems with examples, embedded system design & modeling with unified markup language (UML). ARM processor fundamentals: Introduction to microprocessors and microcontrollers, 8-bit and 16- bit, von Neumann and Harvard architectures, CISC and RISC architectures, open source core (LEOX), ARM versions, ARM instruction set: programming model, assembly language, Thumb instruction set, memory organization, data operations and flow control. CPUs: Input/output mechanisms, isolated and memory mapped IO; interrupts and real time operations, ARM interrupts vectors, priorities and latency; supervisor modes, exceptions, traps, co-processors; cache memory and memory management. Embedded Platforms: CPUs: bus protocols, system bus configuration, USB and SPI buses, DMA, ARM bus; memory devices: memory device configuration, ROM, RAM, DRAM; I/O devices: timers, counters, ADC & DAC, keyboards, displays and touch screens. Processes and Operating Systems: multiple tasks and multiple processes; process abstraction; context switching: cooperative multitasking, preemptive multitasking, process and object-oriented design; operating systems and RTOS; scheduling polices; inter-process communication. Networks: distributed embedded architectures: networks abstractions, hardware and software architectures; networks for embedded systems:I2C bus, CAN bus; examples. Case studies: Inkjet printer, telephone exchange, etc

Text:

- W. Wolf, "Computers as components: Principles of embedded computing system design", 2/e, Elsevier, 2008.
- A. N. Sloss, D. Symes, and C. Wright, "ARM system developer's guide: Designing and optimizing system software", Elsevier, 2008.

References:

- Product data sheet LPC 2141/42/44/46/48. NXP Semiconductors.
- ARM7TDMI Technical Reference Manual, ARM Limited.
- Jack Ganssle, "The art of designing embedded systems", 2/e, Elsevier, 2008.
- Michael Barr, “Programming Embedded Systems in C and C++, O'Really, 1999.
- Kirk Zurell, “C Programming for Embedded Systems:, CMP Books, 2000.

EE361 Embedded Systems Laboratory

EE361	Embedded Systems Laboratory	3-0-0-6	Pre-requisites: nil

Familiarization with ARM microcontroller development environment, assembler, compiler, simulator, debugger and JTAG; Experiments on simple I/O, registers and memory usage; Experiments on waveform generation, switch based I/O, polled and interrupt I/O, finite state machine for embedded systems (switch debounce filter, elevator, sequence detector etc.). Experiments are to be performed on ARM microcontroller kit.

Text/References:

- A. N. Sloss, D. Symes, and C. Wright, "ARM system developer's guide: Designing and optimizing system software", Elsevier, 2008.
- Product data sheet LPC 2141/42/44/46/48. NXP Semiconductors.
- Michael Barr, “Programming Embedded Systems in C and C++”, O'Really, 1999.
- Kirk Zurell, “C Programming for Embedded Systems”, CMP Books, 2000.

Sixth Semester-HSS Elective

Diasporic Literature

HS311	Diasporic Literature	3-0-0-6	Pre-requisites: nil

This course will deal with one of the most popular tools of contemporary theory- the notion of diaspora and its presence in literature:

Diaspora, exile, migration, old and new diaspora, identity formation, cultural assimilation, notion of home and homelessness, ideology of home and nation, homesickness, memory, nostalgia, politics of multiculturalism, the heterogeneity of diasporic groups, especially by gender, class, sexuality, caste, religion, the role of language and other cultural practices in migratory experiences; the significance of memory for the production of "imaginary homelands", Films and Indian diaspora.

Texts:

- Amitava Kumar, Please prove Your Identity and The Long Distance Nationalists in *Husband of a Fanatic*, India: Penguin Books, 2004.
- Bharti Mukherjee, *Jasmine*, New York: Grove Press, 1989.
- Derek Walcott, A Far Cry from Africa and Midsummer, *Collected Poems 1948-1984*. New York, Farrar, Straus, Giroux, 1986.
- Jhumpa Lahiri, *Unaccustomed Earth*, India: Random House, 2008.
- V S Naipaul, *A House for Mr Biswas*, André Deutsch, 1961.
- Sujata Bhatt, A Different History and Search for my Tongue, *Brunizem*, Carcanet Press, 2008

References:

- Janmejay Kumar Tiwari, From Routes to Roots: diaspora in the novels of Salman Rushdie, The Criterion: An International Journal in English, Vol.2 No. 2, June 2011.
- John McLeod, Diaspora Identities, *Beginning Postcolonialism*, Viva Books 2010.
- Manjit Inder Singh (ed.) *Contemporary Diasporic Literature: Writing History, Culture, Self*, New delhi: Pencraft International, 2007.
- Satendra Nandan, The Diasporic Consciousness: From Biswas to Biswasghat in Harish trivedi and M. Mukherjee (ed.) *Interrogating Post-colonialism: Theory, Text and context*, IIAS, Shimla, 1996.
- Vijay Mishra, Diasporic Imaginary: Theorizing the Indian Diaspora from *Textual Practice 10 (3)*, 1996, 421-447

Sociology of Development

HS331	Sociology of Development	3-0-0-6	Pre-requisites: nil

Introduction: Scientific Study of Social Life, Concept and Context of Development, Comparative Perspectives, Systems of Governance, Role of the State, Public- Rights and Responsibilities, Indian Society- Structure and Change
Theories of Development: Classical, Modernization, World System, Dependency, Structure-Agency Integration, Colonial, and Third-World Perspectives
Themes and Perspectives: Rural Development, Gender and Development, Public Health, Sustainable Development, Action Research, (Mal)development- Anomie, Alienation, and Fragmented Identities, Urban Migration, Social Movements, Humanizing Development through Right-Based Approach (Right to Education, Information, Food, etc.)

Texts/References:

- Gupta, D. (2010) The Caged Phoenix: Can India Fly? Palo Alto: Stanford University Press
- Oommen, T.K. (2004) Development Discourse: Issues and Concerns New Delhi: Regency

- Sen, A. (1999) Development as Freedom New York: Oxford
- Shiva, V. (1988) Staying Alive: Women, Ecology and Survival in India London: Zed Press.
- Webster, A. (1984) Introduction to the Sociology of Development London: Macmillan

Seventh Semester - Core Courses

EE400 Summer Training

EE400	Summer Training	0-0-0-2	Pre-requisites: nil

Training for a minimum period of 8 weeks in a reputed industry / R&D lab / academic institution except IIT Patna. The student is expected to submit a report and present a seminar after the training.

EE480 Electrical Power System Operation and Control

EE480	Electrical Power System Operation and Control	3-0-0-6	Pre-requisites: nil

Power system analysis: modeling of power system components - integrated operation of power systems, load flow studies, economic load dispatch, load frequency control, automatic generation control (AGC), power system stability; Power system protection: Symmetrical components, fault analysis, switchgear, fuses, circuit breakers and relays. Economics of power supply systems: Economic choice of conductor size and voltage level, maximum demand and diversity factor, tariffs, power factor correction; Introduction to high voltage DC transmission (HVDC), flexible AC transmission system (FACTS), supervisory control and data acquisition (SCADA).

Texts:

- D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, McGraw-Hill, 2006.
- P. Kundur, Power System Stability and Control, McGraw-Hill, 1995.

References:

- Narain G. Hingorani and Laszlo Gyugyi, Understanding FACTS, Wiley-IEEE Press, 1999.
- Jos Arrillaga, High voltage direct current transmission, IEE Power Engineering Series, 2/e, 1998.
- A. J. Wood and B. F. Wollenberg, Power Generation Operation and Control, John Wiley and Sons, 2/e, 1996.
- A. Wright and C. Christopoulos, Electrical Power system protection, Chapman & Hall, 1993.

EE481 Power Electronics and Drives

EE481	Power Electronics and Drives	3-0-0-6	Pre-requisites: nil

Power Semiconductor Devices: Diode, BJT, MOSFET, SCR, Triac, GTO, IGBT, MCT and their V-I characteristics, ratings, driver circuits, protection and cooling; AC-DC Converters (Rectifiers): Diode rectifier, thyristor based rectifier, effect of source inductance, single/three phase rectifiers, semi/full rectifiers, power factor, harmonics; DC-AC Converters (Inverters): Concept of switched mode inverters, PWM switching, voltage and frequency control of single/ three phase inverters, harmonics reduction, other switching schemes - square wave pulse switching, programmed harmonic elimination switching, current regulated modulation switching - tolerance band control, fixed frequency control; voltage source inverter (VSI), current source inverter (CSI); DC-DC Converters (Chopper): Principle; buck, boost and buck-boost converters; AC Voltage Controllers: Principle of ON-OFF control and phase control, single/three phase controllers, PWM AC voltage controller, cycloconverters; Electric drives: introduction and classification. DC motor drives: speed-torque characteristics of shunt, series, PMDC motors; dynamic models; speed and position control methods; AC motor drives: d-q model of induction motor; constant flux speed control structure; vector control model; vector control structure.

Texts:

- N. Mohan: Power Electronics- Converters, Applications and Design, 3/e, John Wiley & Sons, 2003.
- G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2003

References:

- Muhammad Rashid, Power Electronics- Circuits, Devices and Applications, 3/e, Prentice Hall, 2004.
- B. K. Bose, Modern Power Electronics and AC Drives, Pearson Education, 2003.
- Andrzej M. Trzynadlowski, Introduction to Modern Power Electronics, John Wiley & Sons, 1998.

- Muhammad Rashid, Power Electronics Handbook, Academic Press-Elsevier, 2001.

EE482 Advanced Electrical Engineering Laboratory

EE482	Advanced Electrical Engineering Laboratory	0-0-3-3	Pre-requisites: nil

Reactive power compensation, synchronization of alternators, load angle characteristics of transmission line, ABCD parameters of transmission lines, fault analysis based on over-current and differential relays, design of simple inverters and voltage controllers, speed control of electric drives.

Texts/References:

- C. S. Indulkar, Laboratory Experiments in Electrical Power Engineering, Khanna Publishers, 2003.
- G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2003.
- S. N. Singh: Electric Power Generation, Transmission and Distribution, Prentice-Hall, 2007.
- R. K. Rajput, Electrical Machines, Laxmi Publications (P) Ltd, 3/e, 2003.
- P. Kundur, Power System Stability and Control, McGraw-Hill, 1995.

EE498 Project

EE498	Project	0-0-10-10	Pre-requisites: nil

Seventh Semester - Departmental Electives

Introduction to VLSI CAD

EE410	Introduction to VLSI CAD	3-0-0-6	Pre-requisites: Nil

Objective:

Modeling and optimization has always been a matter of great theoretical and practical interest. These techniques have found application in a variety of areas like Physics, Engineering Design, Electronic Design Automation (EDA), Bioinformatics, Operations Research, Economics and Social Sciences. The present course aims at exposing our students to some of these techniques focusing on some aspects of EDA. An important segment of EDA is Computer Aided Design (CAD) of Very Large Scale Integration (VLSI) circuits and systems. The present course aims at introducing the students to algorithms and optimization techniques employed by CAD tools for design of VLSI circuits and systems.

Course Content:

Introduction: Motivation behind CAD tools, Components on a single chip, Brief illustration of the design flow employed by VLSI CAD tools, Algorithmic background for VLSI CAD; **High Level Synthesis**: Operator DAG Formation, Scheduling, ASAP and ALAP Scheduling, Resource Constrained Scheduling, Time Constrained Scheduling,Register Minimization and Functional Unit Allocation, Binding; **Combinational Logic Synthesis**: Karnaugh Map, Quine-McClausky, Espresso; **Sequential Logic Synthesis**: State Encoding, State Assignment; **Physical Design**: Partitioning using K-L,F-M method, Placement and Floor-planning using ILP and Constraint solving methods, Horizontal and vertical constraint graphs for routing, 2-layer and 3-layer routing algorithms.

Texts:

1. “High-Level Synthesis: Introduction to Chip and System Design” by D. D. Gajski, N. D. Dutt, A.C.-H. Wu and S.Y.-L. Lin, Springer, 1st edition, 1992.
2. “Synthesis and Optimization of Digital Circuits” by Giovanni De Michelli, McGraw-Hill Higher Education ©1994
3. “Algorithms for VLSI Physical Design Automation” by N. A. Sherwani, Bsp Books Pvt. Ltd., 3rd edition, 2005.

Lecture notes and handouts will be provided.

EE430 Fiber Optic Transmission Systems and Networks

EE430	Fiber Optic Transmission Systems and Networks	3-0-0-6	Pre-requisites: nil

Introduction to optical fiber communications. Optical Fibers: Ray and Mode theories, Multimode and Single-mode fibers, Fiber Loss, Dispersions, and Fiber manufacturing. Power coupling: splices, connectors, coupler. Optical transmitters: Light Emitting diode and Laser diodes, Laser modes. Optical Receivers: PIN and APD. Optical Amplifier. Noises and Sensitivity. System Performance: Link analyses. Multiplexing schemes: WDM systems. Introduction to optical network. Circuit switched paradigm, Packet switched paradigm. Client layer: IP, MPLS. WDM network constructions: Broadcast-and-Select WDM network, Wavelength-Routed Optical Network. Formulation of network optimization problem, Heuristic solution. WDM network elements: Optical line terminals, Optical add/drop multiplexers, Optical crossconnects. Survivability in WDM networks, 1+1, 1:1, 1: N protection, Dynamic Restoration. Overview of optical Packet Switching. Overview of Optical Access Networks, Passive Optical Network standards.

Texts:

- Gerd Keiser, Optical Fiber Communications, 4th Ed, McGrawHill, 2010.
- Joseph C. Palais, Fiber Optic Communications, 5th Ed, Pearson, 2009.
- Govind Agrawal, Fiber-Optic Communication Systems, 3rd Ed, Wiley.
- Rajiv Ramaswami, Kumar N. Sivarajan and Galen H. Sasaki, Optical Networks; A Practical Perspective, 3rd Ed, Elsevier, 2010.

References:

- Amnon Yariv, Pochi Yeh, Photonics: Optical Electronics in modern communications, 6th Ed, Oxford.
- John M. Senior, Optical Fiber Communications Principles and Practice, 3rd Ed, Pearson.
- Biswanath Mukherjee, Optical WDM Networks, Springer, 2006.
- C. Siva Ram Murthy, WDM Optical Networks: Concepts, Design and Algorithms, PHI Learning, 2001.
- Jun Zheng, Hussein T. Mouftah, Optical WDM Networks: Concepts and Design Principles, Wiley-interscience, 2004.

EE440 Microwave Engineering

EE440	Microwave Engineering	3-0-0-6	Pre-requisites: nil

Transmission lines and waveguides: Distributed elements concept, Telegrapher's equations, Lossless and lossy lines, Line impedance and junction, Smith chart, TEM, TE and TM Waves, Coaxial cable, Rectangular and circular waveguides. Narrowband and broadband impedance matching: L-section impedance matching, single and double stub matching, Quarter wave transformer, Theory of small reflections, Multi section matching transformer, Tapered lines. Microwave networks: N-port microwave networks, Impedance, admittance, transmission and scattering matrix representations, Reciprocal and lossless networks, Network matrices transformations, Equivalent circuit extraction. Microwave passive circuits: RLC, microstrip and waveguide cavity resonators; Periodic structures and microwave filters; Hybrid junctions, directional couplers and power dividers; Ferrite devices and circulators. Microwave integrated circuits: Planar transmission lines, characteristics of microwave integrated circuits; design of single stage amplifier and oscillator using transistor; PIN diode based control circuits. Microwave tubes: Limitations of conventional tubes in the microwave frequency ranges, Klystron amplifier, Reflex klystron oscillator, Magnetrons, Traveling wave tubes. Microwave solid-state devices: Characteristics of microwave bipolar transistors and FET, Transferred electron devices, avalanche diode oscillators. Printed microstrip antennas: Basic characteristics, types and feeding methods of microstrip antennas, analysis of rectangular microstrip antennas using simplified models.

Texts:

- D. M. Pozar, Microwave Engineering; 3/e, John Wiley & Sons Inc, 2004.
- R. E. Collin, Foundations for Microwave Engineering; 2/e, Wiley-IEEE Press, 2000.
- A. Das and S. K. Das, Microwave Engineering; 1/e, Tata McGraw-Hill, 2005.

References:

- G. Kumar and K. P. Ray, Broadband Microstrip Antennas; 1/e, Artech House, 2002.
- R. C. Booton, Computational methods for Electromagnetics and Microwaves; 1/e, Wiley, 1992.
- G. Gonzalez, Microwave Transistor Amplifiers: Analysis and Design; 2/e, Prentice Hall of India, 2007.
- S. M. Liao, Microwave devices and Circuits;3/e, Prentice Hall of India, 2004.
- P. A. Rizzi, Microwave Engineering Passive Circuits; 1/e, Pearson, 1998.

EE490 Image Processing

EE490	Image Processing	3-0-0-6	Pre-requisites: nil

Human visual system and image perception; monochrome and colour vision models; image acquisition and display: video I/O devices; standard video formats; image digitization, display and storage; 2-D signals and systems; image transforms- 2D DFT, DCT, KLT, Harr transform and discrete wavelet transform; image enhancement: histogram processing, spatial-filtering, frequency-domain filtering; image restoration: linear degradation model, inverse filtering, Wiener filtering; image compression: lossy and lossless compression, entropy coding, transform coding, subband coding, image compression standards, video compression- motion compensation, video compression standards; image analysis: edge and line detection, segmentation, feature extraction, classification; image texture analysis; morphological image processing: binary morphology- erosion, dilation, opening and closing operations, applications; basic gray-scale morphology operations; colour image processing: colour models and colour image processing Experiments are based on MATLAB implementation of algorithms covered in the course.

Texts/References:

- A. K. Jain, Fundamentals of Digital Image processing, Pearson Education, 1989.
- R. C. Gonzalez and R. E. Woods: Digital Image Processing, Pearson Education, 2001
- R. C. Gonzalez , R. E. Woods and S. L. Eddins: Digital Image Processing using MATLAB, Pearson Education, 2004.
- G. A. Baxes: Digital Image Processing; John Wiley, 1994
- R.J. Schalkoff: Digital Image Processing and Computer Vision; John Wiley, 1989.
- Sid Ahmed: Image Processing; McGraw -Hill, 1994.
- S.J. Solari: Digital Video and Audio Compression; McGraw-Hill, 1996.

EE534 WIRELESS COMMUNICATION

EE534	WIRELESS COMMUNICATION	3-0-0-6	

Random Signal Theory: Joint Probability, Statistical independence, Cumulative Distribution function and Probability Density function, Error function, Rayleigh and Gaussian Probability Density, Stationary and Ergodic Process, Power Spectral Density of digital data.
Base band Data Transmission: Base band Signal receiver, Probability of error, Optimum filter, Matched filter, Coherent reception, ISI and Turbo Equalization. Digital Modulation Techniques: Performance Analysis of BPSK, DPSK, QPSK, Mary PSK, BFSK, M-ary FSK, MSK, QAM,OFDM for wireless transmission.
Propagation & Fading: Propagation path loss, Free-space propagation model, Outdoor propagation models (Okumura model & Hata model), Indoor propagation models (Partition Losses in the same floor and between floors), Multipath fading, time dispersive and frequency dispersive channels, delay spread and coherence bandwidth, LCR and ADF.
Mobile Radio Interferences & System Capacity: Co-channel Interference and System Capacity, Channel planning for Wireless Systems, Adjacent channel interferences, Power control for reducing interference, Inter-symbol Interference; The Cellular Concept: Frequency Assignment and Channel Assignment, Frequency Reuse, Handoff, Sectoring, Microcell zone, Spectral efficiency,
Multiple Access techniques: FDMA, TDMA, CDMA, OFDMA, OFDM-CDMA, MIMO-OFDM and QOS issues.
Multiuser Detection: Linear and Non-Linear Multiuser Detectors, BER Analysis, Turbo Multiuser Receiver, Iterative Interference Cancellation, Capacity Analysis, BER Analysis, Multiuser Detection for 4G wireless Systems.

Texts/References:

- D. Tse, P. Viswanath, Fundamentals of Wireless Communications, Cambridge Press, (2005)
- G. L. Stuber, Principles of Mobile Communication, Kluwer Acdemic, (1996)
- J. G. Proakis, Digital Communications, McGraw-Hill, (1995)
- T. S. Rappaport, Wireless Communications: Principles and Practice, Prentice Hall, (1996)
- A. J. Viterbi, CDMA Systems: Principles of Spread Spectrum Communication, Addison Wesley, (1995)
- S. Verdu, Multiuser Detection, Cambridge University Press, (1998)
- H. Wymeersch, Iterative Receiver Design, Cambridge University Press, (2007)

EE535 COMMUNICATION NETWORKS

EE535	COMMUNICATION NETWORKS	3-0-0-6	

Introduction; Protocol hierarchies: OSI and TCP/IP reference models; Physical layer: Transmission media and topology, circuit switching and packet switching, Telephone network; Data link layer: Framing, error control, simplex stop and wait, sliding window protocol, SONET/SDH, ISDN switches, Medium access protocols: Aloha, slotted aloha, CSMA, CSMA CD, and collision - free protocols, FDDI, token ring, wireless LAN protocol, IEEE standard 802 for LANs and MANs, Bridges, Network layer: Routing algorithms, IP protocol, ICMP, ARP, RARP,

Mobile IP; Transport layer: Establishing and releasing connection, TCP and UDP, Sockets interface, sockets programming; Application Layer: SNMP, Authentication, Encryption, electronic mail, WWW; Admission control in Internet, Concept of Effective bandwidth, Measurement based admission control, Differentiated Services in Internet; MPLS switching, MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS, Lamda Switching, DWDM Networks.

Texts/References:

- W. Stallings, Data and Computer Communications, 7th Ed, Prentice Hall, 2004.
- Alberto Leon Garcia, I. Widjaja, Communication Networks, 2nd Ed., Tata McGraw Hill, 2010
- J. F. Kurose and K. W. Ross, Computer networking: A Top-down Approach Featuring the Internet, 3rd Ed, Addison-Wesley, 2005.
- A. S. Tenenbaum, Computer Networks, 4th Ed, Prentice Hall PTR, 2003.
- B. A. Forouzan, Data Communications and Networking, 3rd Ed, McGraw Hill, 2004.
- T. Ramteke, Networks, 2nd Ed, Prentice Hall, 2001.
- G. Held, Ethernet Networks: Design, Implementation, Operation, Management, 4th Ed, John Wiley & Sons, 2002.
- Stevens, D.L. et al., TCP/IP Illustrated, Volumes I, II and III, Addison Wesley, 1996.

EE536 WIRELESS COMMUNICATION INTEGRATED CIRCUITS

EE536	**WIRELESS COMMUNICATION INTEGRATED CIRCUITS**	**3-0-0-6**	**Pre-requisites:Basic Electronics and Basic Electromagnetic Engineering.**

Introduction to RF and Wireless technology; Basic concepts in RF & Wireless Integrated Circuits Design; Receiver and Transmitter Architectures.
Low Noise RF Amplifiers – LNA basic topologies, Linearity and Noise in amplifiers, Stability, Matching Considerations, Differential and Broadband Amplifier;
Mixers – Mixer Operation, Passive and Active Mixers, Single & Double-Balanced Mixers, Noise in Mixers, Image Reject and Single Sideband Mixers;
Oscillators – Voltage Controlled-Oscillator, Negative Resistance Oscillator, Oscillator as a Feedback System, Oscillator Analysis, Colpitts, Hartley, Clapp, Pierce crystal Oscillators, Noise in Oscillators, Quadrature Oscillators, Tunable Oscillator;
Frequency Synthesizers – Phase Locked Loop (PLL), Analysis of PLL Synthesizers, Phase Noise in PLL Synthesis, PLL Frequency Synthesizers, Integer-N and Fractional-N PLL Synthesizers, PLL System Frequency Response and Bandwidth;
RF Power Amplifiers – Efficiency, Matching Considerations, Analysis of Basic Classes – A, AB, B, C, Class B Push-Pull Arrangements, Switch mode Classes – D, E, F Amplifiers, Doherty Power Amplifier.

Texts/References:

- Behzad Razavi, RF MicroElectronics, 3/e, Pearson India.
- John W M Rogers and Calvin Plett, Radio Frequency Circuit Design, Artech House, Boston.
- Les Besser and Rowan Gilmore, Practical RF Circuit Design for Modern Wireless Systems, vol. 2, Artech House, Boston
- David M Pozar, Microwave and RF Design of Wireless Systems, John Wiley and Sons
- Thomas H Lee, The Design of CMOS Radio Frequency Integrated Circuits, Cambridge University Press
- Guillermo Gonzalez, Microwave Transistor Amplifier- Analysis and Design, Prentice Hall, New Jersey.
- Richard C-H Li, RF Circuits Design, John Wiley

Seventh Semester - Open Electives

Foundations of Computer Science

CS401	**Foundations of Computer Science**	**3-0-0-6**	**Pre-requisites: Nil**

Probabilitic arguments: Expectation, 2nd moment, large deviation bounds, balls and bins. Hashing: Isolation Lemma and Universal hashing. Linear programming and duality theorem as a proof technique, rounding, semi-definite programming, Interior point method, Simplex for solving linear programs. Yao's Min-max theorem and applications. Algebraic methods: The dimension argument, Eigenvalues and Eigenvectors. Coding and information theory: Introduction. Fourier analysis, discrete fourier transform and its uses. Basic algorithmic tricks. Introduction to high-

dimensional geometry, volume estimation, metric embedding and Johnson Lindenstrauss. Sampling techniques and random walks.

Texts:
Sanjeev Arora and Boaz Barak,Computational Complexity: A Modern Approach, Cambridge University Press.

References:

- Lecture notes and handouts will be provided

Graphs, Groups and Network

MA410	Graphs, Groups and Network	3-0-0-6

Preliminaries in graphs, Mappings of Graphs, Matrices associated with graphs, Degree Sequence, Walks, Cut-Edges and Cut vertices, Weighted graphs, Directed Graphs, Shortest paths. Tree, Spanning Trees, Equivalent definitions, Prims & Kruskal Algorthim, Tree, Distance between spanning tree of a connected graph, eccentricity, Centre(s) of trees and connected graph, diameter of tree and connected graph. Cut-sets, Fundamental cut set, Edge and vertex Connectivity, Separability, Mengers theorem. Paths, circuits, Eulerian and Hamiltonian Graphs, Fleury algorithm, operation on graphs, Travelling salesman Problem, k-Connected graphs. Cliques and Minors in a Graph. Detection of planarity, Dual of a planar graph and map coloring Maximal independent sets, Vertex coloring and Chromatic Number, Vizing theorem, Chromatic Partitioning, Minimal dominating set, knights tour, Chromatic Polynomial, coverings, Number of a connected graph, matching in Bipartite graphs Flows in networks, Max-Flow-Min-Cut Theorem and its applications. Groups as Groups of Symmetries of a graph, Normal Subgroups, Isomorphism Theorems, Cyclic groups, Dihedral Groups. Permutation groups, finitely presented groups.

Texts:

- Bondy, J. A. and Murthy, U.S.R.: Graph Theory, Springer, 2008
- Deo N.: Graph Theory with Appl. to Engineering & Computer Science, PHI 1993
- West D.B.: Introduction to Graph Theory, Prentice-Hall of India, 2009
- Harary, F.: Graph Theory, Narosa, 1988

Introduction to Biomechanics

ME- 481	Introduction to Biomechanics	3-0-0-6	Pre-requisites: nil

Introduction to Biological System; Cell, Tissues and Connective Tissues and their Phenomenological Models: Bone, Tendon, Cartilage, Smooth Muscle cells: Musculo-Skeletal system as a tensigrity structure, Gait Analysis: Locomotion and Control, Modeling of Humanoid Robots, Physiology and mechanical properties of muscles- Viscoelastic model of muscle,Tentanization pulse in muscle fibers, Physiology and mechanical properties of bones- Bones as bidirectional fibers-nets and its stress response; **Circulation system**: Composition and rheological properties of blood, Construction of RBC, Composition of Artery and Venus walls, Operation of heart as a pump and electrical potential;

Neural system and control: Central nervous system, Auxiliary nervous system; **Experiment on Biological system**:experiment on RBC like system, viscocity measurement Blood-like liquid, ECG, Blood pressure, Pressure distribution of Human walk on the foot; **Growth, Remodeling and Residual Stresses**: Mathematical model of growth,Mathematical model of tumor, Remodeling of biological tissues like skin, artery- Wrinkle of skin, ageing of artery , Modeling of Residual stress,**Experiment on Biological system**- Determination of residual stress in artery-like tissue, Determination of ageing affect on arterial tissue; **Instrumentation Technique in Biomechanics**: Measurement of Biopotential – ECG, EMG, ENG, Test on Respiratory Mechanism, Ultrasonic measurement of Blood flow, Drug Delivery Systems; **Application of Biomechanics**: Sports Biomechanics, Artificial Limbs and organs, Occupational Biomechanics- consideration in Machine Control and Workplace Design, Injury Biomechanics – Analysis and optimal design; **Biomaterial**.

Texts:

- Jay D. Humphrey and Sherry DeLange, An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, Springer; 1st Experiment Edition, 2004.
- Roger Bartlett, Introduction to Sports Biomechanics: Analysing Human Movement Patterns, Routledge; 2nd Edition, 2007.
- Stephen C. Cowin and Jay D. Humphrey, Edt. Cardiovascular Soft Tissue Mechanics, Kluwer Academic Publishers, 2000.
- Walter D. Pilkey, Dmitry V. Balandin and Nikolai N. Bolotnik, Injury Biomechanics and Control: Optimal Protection from Impact, 1st Edition. Wiley 2009.

- Don B. Chaffin, Gunnar B. J. Andersson and Bernard J. Martin, Occupational Biomechanics, Wiley-Interscience 3rd Edition, 1999.
- John G. Webster, Medical Instrumentation: Application and Design, Wiley; 3rd Edition, 1997.

Introduction to Nanomaterials

PH401	Introduction to Nanomaterials	3-0-0-6	Pre-requisites: nil

Introduction: Overview of Nanotechnology, Quantum effect, Naotechnology in nature.

Properties: Physical, Chemical and biological properties of nanomaterials, Effects on structure, ionization potential, melting point, and heat capacity Electronic structure at nanoscale, Magnetism at Nanoscale.

Metal and Semiconductor Nanoparticles: Surface Plasmon Resonance, Theory, Stability of metal particles, metamaterials, Nanowires and Nanotubes.

Synthesis of Nanomaterials: Chemical, Physical, Biological and hybrid Methods of synthesis, Assembly. Carbon Nanotubes, Lithographic methods, Scanning Probe Microscopic Methods, Physical and Chemical Vapor Deposition Methods. MEMS fabrication technique.

Nanotribology and Nanomechanics: Micro/Nanotribology and Materials Characterization Studies using Scanning Probe Microscopy, Surface Forces and Nanorheology of Molecularly Thin Films, Scanning Probe Studies of Nanoscale Adhesion Between Solids in the Presence of Liquids and Monolayer Films, Friction and Wear on the Atomic Scale, Nanoscale Mechanical Properties, Nanomechanical Properties of Solid Surfaces and Thin Films, Mechanics of Biological Nanotechnology, Mechanical Properties of Nanostructures, Micro/Nanotribology of MEMS/NEMS Materials and Devices.

Applications of Nanomaterials: Materials, Sensors and Actuators, Catalysis Medical Applications, Advanced Electronic Materials and Novel Devices. MEMS/NEMS Devices and Applications, Current Challenges and Future Trends.

Texts:

- Introduction to Nanotechnology; Charles P. Poole, Jr. and Frank J. Owens, Wiley – Interscience, 2003.
- Introduction to Nanoscience; Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, A. K. Rao, CRC Press, Taylor and Francis Group, 2008.

References:

- Springer Handbook of Nanotechnology; Bharat Bhusan (Ed.), Springer-Verlag, Berlin, Heidelberg, 2004.
- Fundamentals of Microfabrication: Science of Miniaturization; M.J. Madou, CRC Press, 2ndEdition, 2002.
- Nanostructures & Nanomaterials: Synthesis, Properties and Aplications; Guozhong Cao, Imperial College Press, 2004.
- Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices; Rainer Wasser (Ed.); WILEY-VCH Verlag GmbH & Co. KgaA, Weinheim, 2003.

Solid State Devices

PH402	Solid State Devices	3-0-0-6	Pre-requisites: nil

Semiconductor Devices: Basic introduction, principles of device fabrication and operation–heterojunction bipolar transistors (HBTs), heterostructure field effect transistors (HFETs),modulation doped field effect transistors (MODFETs), high electron mobility transistors (HEMTs), resonant tunneling diodes (RTDs), single electron transistors (SETs), negative conductance in semiconductors, transit time devices, IMPATT, TRAPATT, THz devices, micro and mm wave devices;

Optical Devices: Optical absorption in a semiconductor, photoconductors, photovoltaic effect, semiconductor lasers, quantum well lasers, longwavelength detectors, Optical waveguides, waveguide fabrication techniques, losses in optical waveguides, Optical sensors, integrated optical devices,

Ferroic Phenomena & Devices: Electrical & optical properties of linear and non-linear dielectrics, Ferroelectrics, Pyroelectric, Piezoelectric and electro-optic devices, non-volatile memory; Magnetic memory and superconducting devices, shape memory effect, Spintronic devices,

Energy Storage/Conversion Devices: Portable power sources, Solar cell, Fuel cells, Secondary batteries, Supercapacitors,

Sensors & Actuators: Elementary concepts of sensors, actuators and transducers, an introduction to Microsensors and MEMS, Evolution of Microsensors & MEMS, Microsensors & MEMS applications, Biosensors.

Texts:

- Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, 2nd Edition, Rainer Waser (ed.), Wiley – VCH Publishers, 2003.
- Physics of Semiconductor Devices, S. M. Sze, John Wiley & Sons, 2nd edition, 1981.
- Microwave Devices & Circuits, Sammuel Y. Liao, 3rd Edition, Pearson Education, 2003.
- Ferroelectric Devices, K. Uchino, 2nd edition, CRC Press, 2009.
- Semiconductor LASERS I: Fundamentals, E. Kapon, Academic Press (Indian edition), 2006.
- Optical Materials, John H. Simmons and Kelly S. Potter, Academic Press (Indian edition), 2006.
- Electronic Properties of Materials, Rolf E. Hummel, Springer (3rd edition)
- Energy Storage, R. A. Huggins, Springer, 2010.

References:

- Batteries for Electric Vehicles, R. Woods, D. A. J. Rand & R. M. Dell, Research Studies Press Pvt. Ltd., 1998.
- Fuel Cell Engines, Matthew M. Mench, John Wiley & Sons, 2008..
- Fuel Cell Technology, Nigel Sammes (ed.), 1st edition, Springer, 2006.
- Electrochemical Supercapacitors: Fundamentals & Technological Applications, B. E. Conway, Academic Press, 1998.
- Clean Energy, R. M. Dell & D. A. J. Rand, Royal Society Publications, 2004
- Hydrogen Energy: Challenges & Prospects, R. M. Dell & D. A. J. Rand, Royal Society Publications, 2008.
- Fundamentals of Photovoltaic Modules and their Applications, G. N. Tiwari, S. Dubey & Julian C. R. Hunt, RSC Energy Series, 2009.

Large Scale Scientific Computation

MA511	Large Scale Scientific Computation

Introduction to sparse matrices, Storage Schemes, Permutations and Reorderings, , Sparse Direct Solution Methods. Iterative methos and Preconditioning Convergence Krylov Subspaces, Arnoldi's Method, GMRES, Symmetric Lanczos Algorithm, Conjugate Gradient Algorithm, Convergence Analysis, Block Krylov Methods, Preconditioned Conjugate Gradient, Preconditioned GMRES, Jacobi, SOR, and SSOR Preconditioners, ILU Factorization Preconditioners, Block Preconditioners, Types of Partitionings,
Techniques, Direct Solution and the Schur Complement, Schur Complement Approaches, Full Matrix Methods, Graph Partitioning: Geometric Approach, Spectral Techniques.

Newton's method and some of its variations, Newton method in several dimension, continuation methods, conjugate direction method and Davidon-Fletcher-Powell Algorithms, Introduction to Non-linear Multigrid with applications.

HPC kernels (BLAS, multicore and GPU computing)

Texts/References:

- O. Axelsson, Iterative Solution Methods Cambridge Univ. Press, 1994.
- W. Hackbusch, Multigrid Methods and Applications. Springer-Verlag, 1985.
- J.M. Ortega and W.C. Rheinboldt, Iterative Solution of Nonlinear Equations in Several Variables.Academic Press, NY, 1970.
- C.W. Ueberrhuber, Numerical Computation : Methods, Software and Analysis. Springer-Verlag,Berlin, 1997.
- P. Wesseling, An Introduction to Multigrid Methods. John Wiley & Sons, 1992.
- Yousef Saad, Iterative Methods for Sparse Linear Systems, SIAM 2003.

ME581 Biomechanics and Biomechatronics

ME581	Biomechanics and Biomechatronics	3-0-0-6

Course Objective: After completion of this course the student should be able to

- Recognize different forces and couples acting on a Biological systems
- Should be able to unify the biological system as a Continuum and demarcate the different elements of Biological system such as Bone, Tendon, Cartilage, Smooth Muscle cells
- Analyze the growth, remodelling and residual stress- Application to Artery and Tumour
- Able to identify Instrumentaion technique - Biopotential (ECG, EEG, ENG) Measurement of Blood Flow, Blood pressure, Measurement of Respiratory System, Medical imaging (Colour X ray, Colour Doppler, MRI, CT, PET)
- Identification of Specialized Instrumentation Technique- Drug Delivery, Infant Incubators, Ventilators, Hemodialysis
- **Project Based Leaning**- a) select and apply appropriate design methodology b) generate a variety of conceptual designs c) demonstration of feasibility of the conceptual design with special emphasis on Biomedical Application.

Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction to Biological System**	1
2.	**Cell, Tissues and Connective Tissues and their Phenomenological Models: Bone, Tendon, Cartilage, Smooth Muscle cells,** • Musculo-Skeletal system as a tensigrity structure • Gait Analysis: Locomotion and Control • Modeling of Humanoid Robots • Physiology and mechanical properties of muscles- Viscoelastic model of muscle • Tentanization pulse in muscle fibers • Physiology and mechanical properties of bones- Bones as bidirectional fibers-nets and its stress response **Circulation system** • Composition and rheological properties of blood • Construction of RBC • Composition of Artery and Venus walls • Operation of heart as a pump and electrical potential **Neural system and control** • Central nervous system • Auxiliary nervous system • Physiological Effects of Electricity- Macro-Micro Shock Hazards	15
3.	**Growth, Remodeling and Residual Stresses** • Mathematical model of growth • Mathematical model of tumor • Remodeling of biological tissues like skin, artery- Wrinkle of skin, ageing of artery • Modeling of Residual stress	6
4.	**Instrumentation Technique** • Measurement of Biopotential (ECG, EEG, ENG) • Measurement of Blood Flow • Blood pressure measurement • Measurement of Respiratory System	9

	• Medical imaging (Colour X ray, Colour Doppler, MRI, CT, PET)	
5.	**Therapeutic and Prosthetic Devices and Instrumentation** • Drug Delivery • Infant Incubators • Ventilators • Hemodialysis • Surgical Instrumentation- Application to Trauma	**8**
6.	**Introduction to Biosensor** • Blood Glucose Sensors • Preliminary concepts of Enzyme and DNA based Biosensor	**3**
7.	Experimental Demonstration, Project evaluation and Guest lecture by Medical Professionals	**3**
	Total	**45**

Suggested Books:

S. No.	Name of Authors / Books / Publisher	Year of Publication
1.	Jay D. Humphrey and Sherry DeLange "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer; 1st Edition	2004
2.	Carl-Fredrik Mandenius and Mats Bjorkman "Biomechatronic Design in Biotechnology: A Methodology for Development of Biotechnological Products", Wiley; 1st Edition	2011
3.	*Stephen C. Cowin* and *Jay D. Humphrey* Edt. , "Cardiovascular Soft Tissue Mechanics ", Kluwer Academic Publishers	2000
4.	L. Gorton Edt. "Biosensors and Modern Biospecific Analytical Techniques" Elsevier Science; 1st. Edition	2005
5.	Y.F. **Al-Obaid**, F.N. **Bangash** and T.**Bangash**, "Trauma - An Engineering Analysis" Springer; 1st Edition	2007
6.	John G. Webster Edt. "Medical Instrumentation: Application and Design", Wiley; 3rd Edition	1997

Eighth Semester - Core Courses

Project-II

EE499	**Project-II**	**0-0-14-14**	**Pre-requisites: Nil**

Each student will undertake a sizeable project involving survey of literature, development of new techniques and/or implementation of systems, writing of reports etc. under the guidance of one or more faculty members.

Eighth Semester - Departmental Electives

Distributed Energy Resources

EE483	**Distributed Energy Resources**	**3-0-0-6**	**Pre-requisites:Nil**

General Overview of electricity demand and supply, and industry structure: Vertically integrated electricity supply industry, Restructuring, Electric energy management in restructured environment, Electricity markets.

Distributed generation technologies for increased efficiency: Distributed generation technologies, Integration issues, Future network architectures with DGs, Microgrids, Economics of distributed resources.

Wind turbine generation systems: Types, Power in the wind, Impact of tower height, Rotor efficiency, Wind turbine generators, Speed control, Performance of grid connected WTG, Economics, Environmental impacts.

Solar resources and photovoltaic (PV) systems: Solar spectrum, Insolation measurement, Photovoltaic systems and its engineering aspects, Standalone and grid connected PV systems.

Other renewable energy sources: Elementary concepts of fuel cell, Biomass, Tidal energy, Microturbines and their analysis for engineering application.

Energy Storage: Lead acid batteries, Ultra capacitors, Fly wheels, Superconducting magnetic storage, Pumped hydro electric storage, Compressed air energy storage.

Demand side management: Application of smart devices, Distribution automation, Demand Optimization.

Texts:

- N. Jenkins, J.B. Ekanayake, G. Strbac, *Distributed Generation*, IET, Renewable Energy Series, 2010
- Gilbert M. Masters, *Renewable and Efficient Electric Power Systems*, Wiley, 2004.

References:

- A. Keyhani, M.N. Marwali, *Integration of Green and Renewable Energy in Electric Power Systems*; Wiley, 2010.
- F.A. Farret, M. Godoy Simoes, *Integration of Alternative Sources of Energy*; IEEE Press, 2006.
- L. Freris, D. Infield, *Renewable Energy in Power Systems*; Wiley, 2008.
- D. Pimentel, *Biofuels, Solar and Wind as Renewable Energy Systems*; Springer, 2008.
- P. A. Rizzi, *Wind and Solar Power Systems: Design, Analysis and Operation*; 2/e, Taylor & Francis, 2006.

Visual Surveillance Systems

EE491	Visual Surveillance Systems	3-0-0-6	Pre-requisites:Image Processing

Basics of Image and Video Processing: Introduction to Image Processing methods, Image Transforms, Color spaces, An overview of Video Compression Standards: H. 261, H. 263, MPEG-1, MPEG-2, MPEG-4, MPEG-7, and MPEG-21, Video shot boundary detection, motion modeling and segmentation techniques.

Object Detection and Classification- Shape based object classification, motion based object classification, Silhouette-Based Method for Object Classification, Haar like feature based object detection, Viola Jones object detection framework, Multiclass classifier boosting.

Multi-Object Tracking- Classification of multiple interacting objects from video, Region-based Tracking, Contour-based Tracking, Feature-based Tracking, Model-based Tracking, Hybrid Tracking, Particle filter based object tracking, Mean Shift based tracking, Tracking of multiple interacting objects.

Human Activity Recognition- Template based activity recognition, Sequential recognition approaches using state models (Hidden Markov Models), Human Recognition Using Gait, HMM Framework for Gait Recognition, View Invariant Gait Recognition, Syntactic and Statistical approaches, Description based approaches, Human interactions, group activities, Applications and challenges.

Camera Network Calibration - Types of CCTV (closed circuit television) camera- PTZ (pan-tilt zoom) camera, IR (Infrared) camera, IP (Internet Protocal) camera, wireless security camera, Multiple view geometry, camera network calibration, PTZ camera calibration, camera placement, smart imagers and smart cameras

Security and Privacy of visual surveillance- Reliable visual data protection technique without sacrificing perceptual utility, secure authentication and privacy of visual surveillance.

Implementation of algorithms based on OpenCV (or Matlab) is covered in the course.

Texts:

- Murat A. Tekalp, "*Digital Video Processing*", Prentice Hall, 1995.
- Y. Ma and G. Qian (Ed.), "*Intelligent Video Surveillance: Systems and Technology*", CRC Press, 2009.
- Q. Huihuan, X. Wu, Y. Xu, "*Intelligent Surveillance Systems*", Springer Publication, 2011.
- H. Aghajan and A. Cavallaro (Ed.), *Multi-Camera Network: Principles and Applications*", Elsevier, 2009.
- A senior (Ed.), "*Privacy Protection in Video Surveillance*", Elsevier, 2009.

References:

- Dr. Richard Szeliski, "*Computer Vision: Algorithms and Applications*", Springer Publication, 2010.

Visual Surveillance Systems

EE508	**Visual Surveillance Systems**	**3-0-0-6**	**Pre-requisites:Image Processing**

Basics of Image and Video Processing: Introduction to Image Processing methods, Image Transforms, Color spaces, An overview of Video Compression Standards: H. 261, H. 263, MPEG-1, MPEG-2, MPEG-4, MPEG-7, and MPEG-21, Video shot boundary detection.
Motion Analysis: Real versus apparent motion, Optical Flow Methods, Block Based Methods, Pel Recursive Methods, Mesh-based methods, Region-based (parametric), motion modeling, Categorization of motion segmentation technique.
Object Classification and Tracking- Shape based object classification, motion based object classification, Haar like feature based object detection, Viola Jones object detection framework, Multiclass classifier boosting.
Multi-Object Tracking- Video monitoring for detection and tracking of multiple interacting objects, Classification of multiple interacting objects from video, Region-based Tracking, Contour-based Tracking, Feature-based Tracking, Model-based Tracking, Hybrid Tracking, Particle filter based object tracking, Mean Shift based tracking.
Human Activity Recognition Techniques- Template based activity recognition, Hidden Markov Models (HMMs), Dynamic Time Warping (DTM), Finite-State Machine (FSM), Nondeterministic-Finite-State Automaton (NFA), Time-Delay Neural Network (TDNN), and Syntactic/Grammatical Techniques.
Camera Network Calibration - Types of CCTV (closed circuit television) camera- PTZ (pan-tilt zoom) camera, IR (Infrared) camera, IP (Internet Protocal) camera, wireless security camera, Multiple view geometry, camera network calibration, PTZ camera calibration, camera placement, smart imagers and smart cameras.
Security and Privacy of visual surveillance- Reliable visual data protection technique without sacrificing perceptual utility, secure authentication and privacy of visual surveillance.
Implementation of algorithms based on OpenCV (or Matlab) is covered in the course.
Text Books

- Murat A. Tekalp, "Digital Video Processing", Prentice Hall, 1995.
- Y. Ma and G. Qian (Ed.), "Intelligent Video Surveillance: Systems and Technology", CRC Press, 2009.
- H. Aghajan and A. Cavallaro (Ed.), Multi-Camera Network: Principles and Applications", Elsevier, 2009.
- A senior (Ed.), "Privacy Protection in Video Surveillance", Elsevier, 2009

Reference Books

- Dr. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Publication, 2010

Eighth Semester - Open Elective

Matrix Computation

MA412	**Matrix Computation**	**3-0-0-6**	**Pre-requisites:Nil**

Introduction to Direct Methods: Diagonalization, Jordan Canonical Forms, SVD and POD, Direct Method for solving linear systems and Application to BVP, Discritization of PDE's, Sparse Matrices.

Basic iterative methods: Iterative method for solving linear systems: Jacobi, Gauss-Seidel and SOR and their convergence, projection method: general projection method, steepest descent, MR Iteration, RNSD method.

Krylov subspace methods: Introduction to Krylov subspace, Arnoldi's method, GMRES method, Conjugate gradient algorithm, Lanczos Algorithm.

Convergence & Preconditioners: Convergence check for Krylov subspace methods, Preconditioned CG, ILU preconditioner, Approximate inverse preconditioners, Multigrid methods.

Parallel implementation: Architecture of parallel computers, introduction to MPI & openMP, parallel preconditioners, domain decomposition method.

Texts:

- Yousef Saad, *Iterative Methods for Sparse Linear Systems*, SIAM 2003.

- Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, *Introduction to Parallel Computing*, Addison-Wesley, 2003.
- Gene H. Golub, Charles, F. Van Loan, *Matrix Computation*, John Hopkins University Press, 1996.

References:

- W. H. Press, Teucolsky, S. A., Vetterling, W. T., Flannery, B. P. *Numerical Recipes in C, Fortran*, Cambridge University Press, 1996.
- R. S. Varga, *Matrix iterative Analysis*, Prentice Hall 1962.
- Gilbert W. Stewart, *Introduction to matrix computation*, Academic Press 1973.
- James M. Ortega, *Introduction to Parallel and Vector Solution of linear Systems*, Plenum Press 1984.
- S. D. Conte and Carlde Boor, *Elementary Numerical Analysis*, McGraw-Hill Pub. Com Ltd 2005.
- K Atkinson, W Han, *Elementary Numerical Analysis*, Willay India Pvt. Ltd. 200.
- William F. Ames, *Numerical Methods for Partial Differential Equation*, Academic Press 1977, 3rd edition.
- L.N. Trefethen, D. Bau, *Numerical Linear Algebra*, SIAM, 1997.

Photovoltaics & Fuel Cell Technology

PH403	Photovoltaics & Fuel Cell Technology	3-0-0-6	Pre-requisites:Nil

Photovoltaics: Global energy scenario and impending energy crisis, Basic introduction of energy storage/conversion devices, State-of-the art status of portable power sources, Solar/photovoltaic (PV) cells, PV energy generation and consumption, fundamentals of solar cell materials, Elementary concept of solar cell and its design, solar cell technologies (Si-wafer based, Thin film and concentrator solar cells), Emerging solar cell technologies (GaAs solar cell, dye-sensitized solar cell, organic solar cell, Thermo-photovoltaics), Photovoltaic system design and applications, Analysis of the cost performance ratio for the photovoltaic energy and problems in wide-spread commercialization of the technology.

Fuel Cells: Fuel cells and its classification; Transport mechanism in fuel cells and concept of energy conversion; Fuels and fuel processing, Fuel cell design and its characterization; Technological issues in Solid oxide fuel cells (SOFC); PEM fuel cells; Direct methanol fuel cells (DMFC), Molten carbonate fuel cell (MCFC), Power conditioning and control of fuel cell systems.

Texts:

- **1.** Energy Storage, R. A. Huggins, Springer, 2010.
- Fundamentals of Photovoltaic Modules and their Applications, G. N. Tiwari, S. Dubey & Julian C. R. Hunt, RSC Energy Series, 2009.
- Solar Photovoltaics: Fundamentals, Technologies and Applications (2^{nd} ed.), C. S. Solanki, Prentice Hall of India, 2011.
- Solar Cell Device Physics, Stephen Fonash (2^{nd} ed.), Academic Press, 2010.
- Fuel Cell Technology, Nigel Sammes (ed.), 1^{st} edition, Springer, 2006
- Clean Energy, R. M. Dell & D. A. J. Rand, Royal Society Publications, 2004
- Hydrogen Energy: Challenges & Prospects, R. M. Dell & D. A. J. Rand, Royal Society Publications, 2008.
- Fuel Cell Engines, Matthew M. Mench, John Wiley & Sons, 2008.

References:

- Fuel Cell Technology Handbook, G. Hoogers (ed.), CRC Press, 2003.
- Fuel Cell Technologies: State & perspectives; N. Sammes, A. Smirnova and O. Vasylyev (eds.), Springer, 2004.
- Electrochemical Impedance in PEM Fuel Cells: Fundamentals and applications; Xiao-Zi Yuan, C. Song, H. Wang and J. Zhang; Springer-Verlag, 2010.
- Electrochemical Nanotechnology, T. Osaka, M. Dutta, Y. S. Diamand (eds.), Springer, 2010.

Applied FEM for Industries

CE 504	Applied FEM for Industries	3-0-0-6	Pre-requisites:Nil

Introduction: Continuum Mechanics, Conservation laws, Riemannian Geometry and stress- strain tensors, Constitutive equation, Potential-, Strain-, and Kinetic energies, Functionals and variational formulation, mathematical programming and weak solutions; Displacement method of FEM analyses.

Field equations: Elasticity, Structural Dynamics, Fluid Mechanics, electromagnetic fields

Alternative approaches: Hybrid FEM, Mixed FEM, Boundary Element Method, Boundary Error Element, Mesh-less methods, Galerkin's approach of error orthogonalization.

Error analyses: Algebraic and Integral inequalities; estimate of error; error bounds; Convergence, super-convergence,

Computer Packaging: Pre-, Post-processing and Turbo C, Analysis Programs in FRORTAN;

Applications (as per request): Rigid-flexible assembly (ME and Bio-Mechanics); Two-phase flow (ME & CE); Electro-magnetic application to wave-guides, MOSFET analyses (ECE); magnetic levitation (electrical), Vibration and control of quartz substrate using smart material; Stochastic FEM, etc.

Text / Reference Books:

- The Finite Element Method: Its Basis and Fundamentals, C. Zienkiewicz, R. L. Taylor, J.Z. Zhu; 6th Edition, 2005.
- Concepts and applications of finite element analysis, Robert Davis Cook.
- Lecture Notes.

Industrial Waste Treatment and Management

CE 442	Industrial Waste Treatment and Management	3-0-0-6	Pre-requisites:Nil

Introduction to Industrial Waste: Types of industries and industrial pollution, Types of industrial wastes - solid, liquid and gaseous wastes, Hazardous waste - definition and concept, Characteristics of industrial wastes, Effects of industrial wastes on environment and human health, Environmental standards and legislations;
Pollution Prevention and Cleaner Production: Waste minimization, Source reduction, Use of alternate raw materials, Process modifications, Recycle, reuse and byproduct recovery, Opportunities and barriers to cleaner production;
Waste Treatment Techniques: Physico-chemical and biological treatment of wastewater, Concept of common effluent treatment plant (CETP), Concept of zero discharge, Industrial sludge management, Industrial air pollution, Control of gaseous emissions;
Environmental Performance: Environmental audit and performance, Environmental management plan, Introduction to ISO and ISO 14000;
Pollution Control in Major Industries – Case Studies: Manufacturing processes and flow sheets, Sources and characteristics of wastes, Waste treatment and disposal methods – Computer & IT industry and electronic waste (e-waste), Thermal power plants, Iron and steel, Metal plating, Fertilizer, Refinery, Tannery, Food industry, etc.

Text / Reference Books:

- de Nevers, N., Air Pollution Control Engineering, 2nd Edition, McGraw-Hill, 1999.
- Eckenfelder Jr., W.W., Industrial Water Pollution Control, 3rd Edition, McGraw-Hill, 2000.
- Ghassemi, A. (ed.), Handbook of Pollution Control & Waste Minimization, 2nd Edition, Marcel Dekker, 2002.
- Metcalf & Eddy, Wastewater Engineering - Treatment and Reuse (Revised by Tchobanoglous, G., Burton, F.L. and Stensel, H.D.), 4th Edition, Tata McGrawHill, 2004.
- Wise, D.L. and Trantolo, D.J. (eds.), Process Engineering for Pollution Control and Waste Minimization, 1st Edition, Marcel Dekker, 1994.

Mobile Robotics

ME 512	Mobile Robotics	3-0-0-6	Pre-requisites:MA102 at

Objectives:

Mobile robots are now enabling human beings to physically reach and explore unchartered territories in the Universe. Be a place as distant as Mars, in abysmal depths of ocean, or shrouded by thick glaciers of Antarctic, mobile robots help exploring everything; yet this is just the beginning. Even in day to day life autonomous cars hold a potential to revolutionize transportation and domestic mobile robots help humans in cleaning, elderly help, etc. National defense is an area replete with the use of mobile robots. This course will present various aspects of design, fabrication, motion planning, and control of intelligent mobile robotic systems. The focus of the course is distributed equally on the computational aspects and practical implementation issues and thereby leads to a well rounded training. The course will give students an opportunity to design and fabricate a mobile robotic platform and program it to apply learned theoretical concepts in practice as a semester long class project.

Syllabus:

Robot locomotion: Types of locomotion, hopping robots, legged robots, wheeled robots, stability, maneuverability, controllability;
Mobile robot kinematics and dynamics: Forward and inverse kinematics, holonomic and nonholonomic constraints, kinematic models of simple car and legged robots, dynamics simulation of mobile robots.
Perception: Proprioceptive/Exteroceptive and passive/active sensors, performance measures of sensors, sensors for mobile robots like global positioning system (GPS), Doppler effect-based sensors, vision based sensors, uncertainty in sensing, filtering;
Localization: Odometric position estimation, belief representation, probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, positioning beacon systems.
Introduction to planning and navigation: path planning algorithms based on A-star, Dijkstra, Voronoi diagrams, probabilistic roadmaps (PRM), rapidly exploring random trees (RRT), Markov Decision Processes (MDP), stochastic dynamic programming (SDP).

Robotics Project: Students will work on a semester long project consisting of design, fabrication, and programming a mobile robotic platform.

Text / Reference Books:

- Melgar, E. R., Diez, C. C., Arduino and Kinect Projects: Design, Build, Blow Their Minds, 2012.
- R. Siegwart, I. R. Nourbakhsh, “Introduction to Autonomous Mobile Robots”, The MIT Press, 2011.
- Peter Corke , Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer Tracts in Advanced Robotics, 2011.

Application of Probabilistic Methods in Engineering

CE 502	**Application of Probabilistic Methods in Engineering**	**3-0-0-6**	**Pre-requisites:MA225 / basic knowledge in Probability and Statistics**

Introduction:

Concept of risk, and uncertainty in engineering analysis and design; Fundamental of probability models.
Analytical models of random phenomena: Baysian Analysis, Analysis of variance (ANOVA); Application of central limit theorem, confidence interval, expected value, and return period.
Application of Monte Carlo simulation (MCS): Determination of function of random variables using MCS methods; Application of MCS in various engineering problems.
Probabilistic analysis and determination: i) Forces induced by earthquakes, ii) Forces induced by wind, iii) Forces induced by sea waves, iv) Load on vehicles induced through surface roughness of roads.
Methods of risk Analysis: Composite risk analysis; Direct integration method; Method using safety margin, reliability index and safety factor.
Introduction to reliability analysis: Application of Bayes theorem in real life problem; Reliability analysis of simple systems: serial, parallel and combined systems; First order uncertainty and reliability analysis (FORM), First

order second moment (FOSM) and Advanced FOSM methods; Applications of risk and reliability analysis in engineering systems.

Application of probabilistic methods:i) Fluid-structure interaction, ii) Soil-structure interaction iii) Railways iv) Automobile industry, v) Offshore structure, vi) Hydraulic structure

Text / Reference Books:

- Scheaffer, R. L., Mulekar, M. S. and McClave, J. T., (2011): Probability and statistics for Engineers, Fifth Edition, Brooks / Cole, Cengage Learning.

- Ang, A. H-S., and Tang, W. H., (2006): Probability Concepts in Engineering, Volumes 1. John Wiley and Sons.
- Halder, A and Mahadevan, S., (2000): Probability, Reliability and Statistical Methods in Engineering Design, John Wiley and Sons.
- Rao, S.S., (1992): Reliability-Based Design, McGraw Hill, Inc.
- Harr, M.E., (1987): Reliability-Based Design in Civil Engineering. McGraw Hill, Inc.
- Ang, A. H-S, and Tang, W. H., (1975): Probability Concepts in Engineering Planning and Design, Volumes 2. John Wiley and Sons

- Benjamin, J., and Cornell. A., (1963): Probability, Statistics, and Decision for Civil Engineers. McGraw Hill.

Eighth Semester - HSS Elective

Fundamentals of Cognitive Science

HS421	Fundamentals of Cognitive Science	3-0-0-6	Pre-requisites:Nil

Cognitive Science: nature, history, and major findings and applications; Philosophy of language and mind; Psycholinguistic approach to the child language and cognitive development; Linguistics and the study of language in society: language, dialects, and varieties, native speakers and language acquisition, language as a mental phenomenon vs. language as behavior; multilingualism; Artificial Intelligence: Turing Test and Chinese-Room Argument, Natural language vs. artificial language; fuzzy logic; Culture as cognitive construction, culture and society, culture and language, cognition and human evolution.

Texts and References:

- **Wilson, Robert A., & Keil, Frank C. (eds.) , The MIT Encyclopedia of the Cognitive Sciences, Cambridge, MA: MIT Press, 2001.**

- **Bechtel, William, & Graham, George (eds.), A Companion to Cognitive Science, Malden, MA: Blackwell, 1998.**
- **Cummins, Robert, & Cummins, Denise Dellarosa (eds.), Minds, Brains, and Computers: The Foundations of Cognitive Science, Malden, MA: Blackwell, 2000.**
- **Rapaport, William J., "Cognitive Science", in Anthony Ralston, Edwin D. Reilly, & David Hemmendinger (eds.),** ***Encyclopedia of Computer Science***

- **, 4th edition (New York: Grove's Dictionaries): 227-233, 2000.**

Industrial and Organizational Psychology

HS441	Industrial and Organizational Psychology	3-0-0-6	Pre-requisites:Nil

Aim of the Course:

Today, many of the engineering students after passing out are joining some kind of organization. Therefore, they need to know how they will be successful as job applicants, trainees, employees, team players, and managers. This course will help them in knowing about all these and applying psychological principles in industries and organizations.

Course Contents:

Introduction:

Psychology as a science of Behaviour and Mental Processes: Nature, Scope and Subject Matter of Industrial and Organizational Psychology; Time and Motion Study, Classical Hawthorne Studies.

Employer Selection: Recruitment Process; Selection Process - Job and Worker Analyses, Matching Job with the Person; Selection Methods - Application Blank, Biographical Inventories, References and Recommendation Letters, Interviews.

Psychological Testing: Characteristics of Psychological Tests; Types of Psychological Tests; Tests of Knowledge, Skills and Abilities - Interest, Aptitude and Personality Tests; Limitations of Psychological Testing Programmes.

Training and Learning: Need Identification; Psychological Factors in Learning; Training Methods in the Workplace; Effective Training Programme; Career Planning and Development.

Motivation: Needs, Incentives and Motives; Financial and Non-financial Motives; Theories of Motivation; Management of Motivation; Organizational Commitment and Job Satisfaction.

Leadership: Changing Views of Leadership; Theories of Leadership; Leadership Styles; Pole of Power in Leadership; Charismatic and Effective Leaders.

Group Behaviour: Formal and Informal Organizations in Industry; Conflicts in Organization; Resolution of the Conflicts; Decision Making Process.

Characteristics of the Workplace: Working Conditions - Physical and Psychological; Accident, Safety and Health; Management of Stress; Spirituality at Work.

Organizational Communication: Process of Communications; Upward, Downward and Horizontal Communications; Barriers to Communication; Effective Communication.

Texts and References:

- **Schultz, D. & Schultz, S. E., Psychology & Work Today: An Introduction to Industrial and Organizational Psychology, 10th Ed., New Jersy: Prentice Hall, 2009.**
- **Landy, F. J. & Conte, J. M., Work in the 21st Century: An Introduction to Industrial and Organizational Psychology, 3rd Ed., New York: Wiley- Blackwell, 2009.**
- **Robins, S. P. & Judge, T. A., Organizational Behaviour, 14th Ed., New Jersey, Prentice Hall, 2010.**
- **Pierce G.F, Spirituality at Work: 10 Ways to Balance Your Life on the Job, 1ST Ed., Illinois, Loyola Press, 2005.**