INDIAN INSTITUTE OF TECHNOLOGY PATNA

Programme: B.Tech. in Computer Science and Engineering (Semester VI)

Sixth Semester		
HS3xx	HSS Elective	3-0-0-6
CS 302	Theory of Computation	3-0-0-6
CS 346	Compilers	3-0-0-6
CS 347	Compliers Laboratory	0-0-3-3
CS 348	Computer Networks	3-0-2-8
CS 362	Computer Graphics	3-0-2-8
CS 399	Seminar	0-0-3-3
	Total L-T-P-C	**15-0-10-40**

CS302 **THEORY OF COMPUTATION** **3-0-0-6**

Pre-requisites : CS203, CS301

Syllabus : Formal Logic: proof systems for propositional and first-order logic; consistency; completeness; compactness. Computability: primitive recursive functions; Godelization; Church's thesis. Review of models of computations, time and space bounded computations. Classes P, NP, polynomial reducibilities, NP-completeness.

Texts :

1. Lewis, H.R., Papadimitriou, C.H., Elements of the Theory of Computation, Prentice-Hall of India, 1996.

2. Garey, D.S., Johnson, G., Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, New York, 1979.

References :

1. Hopcroft, J.D. Ullman, Introduction to Automata Theory, Languages and Computation, Addison-Wesley, 1979.

2. Papadimitriou, C.H., Computational Complexity, Addison-Wesley Publishing Company, Inc., 1994.

3. Balcazar, Diaz, Gubarro, Structural Complexity, Volumes I, II, Springer-Verlag, 1988.

CS346 **COMPILERS** **3-0-0-6**

Pre-requisites : CS201, CS301

Syllabus : Overview of different phases of a compiler : front-end; back-end. Lexical analysis: finite automata; DFA construction and minimization; automatic tools. Syntax analysis: context free grammars; top down and bottom up parsing techniques; construction of efficient parsers; syntax-directed translation; automatic tools. Semantic analysis: declaration processing; type checking; symbol tables; error recovery. Intermediate code generation: run-time environments; translation of language constructs. Code generation: Flow-graphs; register allocation; code-generation algorithms. Introduction to code optimization techniques.

Texts :

1. Aho A., Sethi R., Ullman J.D., Compilers : Principles, Techniques and Tools, Addison Wesley, 1995.

References :

1. Holub, A.I.,Compiler Design in C, Prentice-Hall of India, 1993.

2. Tremblay, A.S., and Sorenson, P.G., The Theory and Practice of Compiler Writing, McGraw-Hill Int. Edition, 1985.

3. Fischer, C.N., Le Blanc, R.J., Crafting a Compiler. Benjamin/Cummings California, 1988.

CS347 COMPILERS LABORATORY 0-0-3-3

Pre-requisites : CS202

Syllabus *:* Programming assignments to build a compiler for a subset of a C-like programming language, using tools such as Lex and Yacc.

CS348 COMPUTER NETWORKS 3-0-2-8

Pre-requisites : CS201, CS343

Syllabus : 7 layer OSI/ISO model; evolution of computer networks. Data Link Layer: HDLC, PPP, sliding window protocols. Network Layer: IP, ICMP, X.25, Frame Relay, ATM, routing algorithms (EGP, RIP, OSPF etc.); Transport Layer: TCP, UDP, congestion control, flow control; Sockets interface, sockets programming; Application Layer: SNMP, Authentication, Encryption, electronic mail. WWW basics: http, html, CGI, Java, Firewalls.

Texts :

Tanenbaum A.S., Computer Networks, 3rd Edition, Prentice Hall of India, 1996.

References :

1. Stallings, W., Data and Computer Communications, 4/e, Prentice Hall of India,1996.

2. Stevens, D.L. et al., TCP/IP Illustrated, Volumes I, II and III, Addison Wesley, 1996.

CS362 COMPUTER GRAPHICS 3-0-2-8

Pre-requisites : CS204

Syllabus : Introduction: organization of an interactive graphics system. Scan conversion, filling, clipping, antialiasing, geometrical transformations, viewing, hidden line and hidden surface removal, representation of curves and surfaces, solid modeling, illumination and shading. Graphical user interfaces and Interactive input methods.

The laboratory work will involve programming with standard graphics libraries like OpenGL.

Texts :

1. J. D. Foley, A. van Dam, S. Feiner, and J. F. Hughes, Computer Graphics: Principles and Practice, 2nd Ed, Addison-Wesley, 1996**.**

References :

1. D. Hearn and M. P. Baker, Computer Graphics with OpenGL, 3rd Ed, Prentice Hall, 2004.

2. M. Woo, J. Neider, T. Davis and D. Shreiner, OpenGL?? Programming Guide: The Official Guide to Learning Open GL, 4th Ed, Addison Wesley, 2004.

Programme: B.Tech. in Electrical Engineering (Semester VI)

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**

EE 304 Design Laboratory 0-0-4-4

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.

Text/References:

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

EE 321 DSP Laboratory 0-0-3-3

Familiarisation 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:

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

EE 340 Electromagnetic Theory 3-0-0-6

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:

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

References:

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

EE 351 Advanced Control Systems 3-0-0-6

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.

Text/References:

1. G. F. Franklin, J. D. Powel and A. E. Emami-Naeini: Feedback Control of Dynamic Systems, Prentice Hall Inc. 2002.
2. M. Gopal: Control Systems, 3/e, Tata McGraw Hill, 2008.
3. M. Gopal: Digital Control and State Variable Methods, Tata McGraw Hill, 2003.
4. K. J. Astrom and T. Hagglund: Advanced PID Control, ISA, Research Triangle Park, NC 27709, 2005.

EE 322 Mathematical Methods in Electrical Engineering 3-0-0-6

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.

Texts/References:

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

EE 360 Embedded Systems 3-0-0-6

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.

Texts:

1. W. Wolf, "Computers as components: Principles of embedded computing system design", 2/e, Elsevier, 2008.

2. A. N. Sloss, D. Symes, and C. Wright, "ARM system developer's guide: Designing and optimizing system software", Elsevier, 2008.

References:

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

EE 361 Embedded Systems Laboratory 0-0-3-3

Familiarization w

ith 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:

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

Programme: B.Tech. in Mechanical Engineering (Semester VI)

Sixth Semester		
HS3xx	HSS Elective	3-0-0-6
ME 306	Manufacturing Technology II	3 – 1 – 0 – 8
ME 307	Machine Design	3 – 0 – 2 – 8
ME 308	Dynamics of Machinery	2 – 1 – 0 – 6
ME 309	Control Systems	3 – 1 – 0 – 8
ME 311	Mechanical Engineering Laboratory III	0 – 0 – 4 – 4
ME 322	Applied Thermodynamics II	2 – 1 – 0 – 6
	Total L-T-P-C	**16–4–6–46**

ME-306 Manufacturing Technology-II (3 1 0 8)

Pre-requisites: Nil

Metal Cutting: mechanics, tools (material, temperature, wear, and life considerations), geometry and chip formation, surface finish and machinability, optimization; Machine tool: generation and machining principle s, Setting and Operations on machines : lathe, milling (including indexing), shaping, slotting, planing, drilling, boring, broaching, grinding (cylindrical, surface, centreless), thread rolling and gear cutting machines; Tooling: jigs and fixtures, principles of location and clamping; Batch production: capstan and turret lathes; CNC machines, Finishing: microfinishing (honing, lapping, superfinishing); Unconventional methods: electro-chemical, electro-discharge, ultrasonic, LASER, electron beam, water jet machining, Rapid prototyping and rapid tooling.

Texts:

1. G Boothroyd, *Fundamentals of Metal Cutting Machine Tools*, Tata McGraw Hill, 1975

2. *Production Technology*, H M T Publication Tata McGraw Hill, 1980.

3. P C Pandey and C K Singh, *Production Engineering Sciences*, Standard Publishers Ltd. 1980.

4. A Ghosh and A K Mallik, *Manufacturing Science*, Wiley Eastern, 1986.

ME 307 Machine Design (3 1 0 8)

Pre-requisites: Nil

Design of Gears; Lubrication and Wear consideration in Design; Design and selection of Bearings: Hydrodynamic lubrication theory, Hydrostatic and Hydrodynamic bearings (e.g., journal), Rolling Element Bearings; Systems Approach to Design: Decision Making, Simulation of mechanical systems using CAD tools, Sensitivity analysis of design parameters, Value Analysis and Value Addition to designed components and systems; Exercises of mechanical systems design with examples; Overview of Optimization in Design; Reliability and Robust Design; Communicating the Design;

Texts:

1. J. E. Shigley, *Mechanical Engineering Design*, IS Metric ed., McGraw Hill, 1986.

2. *Design Data,* PSG Tech, Coimbatore, 1995

3. M. F. Spotts, *Design of Machine Elements*, 6th ed., Prentice Hall, 1985

4. V. Ramamurti, *Computer Aided Mechanical Design and Analysis*, 3rd ed., Tata McGraw Hill, 1996

5. A. H. Burr and J. B. Cheatham, *Mechanical Analysis and Design*, 2nd ed., Prentice Hall, 1997.

6. John R Dixon*, Design Engineering: Inventiveness, Analysis and Decision Making*, TMH, New Delhi, 1980.

ME308 Dynamics of Machinery (2 1 0 6)

Pre-requisites: Nil

Static and dynamic force analysis; Flywheel; inertia forces and their balancing for rotating and reciprocating machines; Gyroscope and gyroscopic effects; Governers: types and applications; Cam dynamics: analysis of cam and follower, jump phenomenon; Vibrations of one degree of freedom systems; Free and Force vibrations;

Transverse and torsional vibrations of two and three rotor systems; critical speeds; Vibration isolation and measurements; two-degree of freedom systems; Geared system; Introduction to Multi-degree of Freedom System :normal mode vibration, coordinate coupling, forced harmonic vibration, vibration absorber (tuned, and centrifugal pendulum absorber), vibration damper; Properties of vibrating system, flexibility matrix, stiffness matrix, reciprocity theorem, eigenvalues and eigenvectors, orthogonal properties of eigenvectors, modal matrix, Rayleigh damping, Normal mode summation.

Texts:

1. J. E. Shighley and J.J. Uicker, *Theory of Machines and Mechanisms*, McGraw Hill, 1995

2. J. S. Rao and R. V. Dukkipati, *Mechanism and Machine Theory*, New Age International, 1992.

3. S. S. Rattan, *Theory of Machines*, Tata McGraw Hill, 1993.

4. T. Bevan. *Theory of Machines*, CBS Publishers and Distributors, 1984

5. L. Meirovitch, *Elements of Vibration Analysis*, McGraw Hill, 1998.

6. W. T. Thomsom and Dahleh, M. D., *Theory of Vibration with Applications*, 5th ed., Pearson Education, 1999

ME-309 Control Systems (3 1 0 8)

Pre-requisites: Nil

Feedback systems, mathematical modelling of physical systems; Laplace transforms, block diagrams, signal flow graphs, state-space models; Time domain analysis: performance specifications, steady state error, transient response of first and second order systems; Stability analysis: Routh-Hurwitz stability criterion, relative stability; proportional, integral, PI, PD, and PID controllers; Lead, lag, and lag-lead compensators; Root-locus method: analysis, design; Frequency response method: Bode

diagrams, Nyquist stability criterion, performance specifications, design; State-space methods: analysis, design; Physical realizations of controllers: hydraulic, pneumatic, and electronic controllers.

Texts:

1. K Ogata, *Modern Control Engineering*, 4th ed, Pearson Education Asia, 2002.

2. B C Kuo and F. Golnaraghi, *Automatic Control Systems*, 8th ed, John Wiley (students ed.), 2002.

3. M Gopal, *Control Systems*: Principles and Design, 2nd ed, TMH, 2002.

4. M Gopal, *Modern Control System Theory*, 2nd ed., New Age International, 1993.

5. R. C. Dorf and R. H. Bishop, *Modern Control Systems*, 8th ed., Addison Wesley, 1998.

6. P. Belanger, *Control Engineering: A modern approach*, Saunders College Publishing, 1995.

ME-311 Mechanical Engineering Laboratory – III (0 0 4 4)

Theory of machines: Static and dynamic balancing (multi-plane) of rotary systems, gyroscope, governors, whirling of shafts, simple and compound pendulums, determination of moment of inertia using trifilar suspension, torsional vibration; Metrology: Use of various metrological tools like slip, angle gauge, feeler, taper, fillet, thread gauges, estimation of internal dimensions; CNC machine trainer, CNC coding; Turbomachinery: Centrifugal and positive displacement pumps, Pelton and propeller turbines.

ME-322 Applied Thermodynamics – II (2 1 0 6)

Pre-requisites: Nil

I. C. Engines: Classification - SI, CI, two-stroke, four-stroke etc., operating characteristics – mean effective pressure, torque and power, efficiencies, specific fuel consumption etc., air standard cycles – Otto, Diesel and dual, real air-fuel engine cycles, Thermochemistry of fuels – S.I. and C.I. engine fuels, self ignition, octane number, cetane number, alternate fuels etc., combustion – combustion in S.I. and C.I. engines, pressure-crank angle diagram, air-fuel ratio, chemical equation and conservation of mass in a combustion process etc., Air and fuel inje ction – injector and carburetor, MPFI etc., ignition, lubrication, heat transfer and cooling; *Gas Power Cycles*: Simple gas turbine cycle – single and twin shaft arrangements, intercooling, reheating, regeneration, closed cycles, optimal performance of various cycles, combined gas and steam cycles; Introduction to Axial-Flow Gas Turbine; Introduction to Centrifugal and Axial-Flow Compressors; Combustion Chambers; *Jet Propulsion*: turbojet, turboprop, turbofan, ramjet, thrust and propulsive efficiency; *Rocket Propulsion*; *Direct Energy Conversion*: thermionic and thermoelectric converters, photovoltaic generators, MHD generators, fuel cells.

Texts:

1. G F C Rogers and Y R Mayhew**,** *Engineering Thermodynamics* Work and Heat Transfer 4e, Pearson, 2001.

2. H I H Saravanamuttoo, G F C Rogers and H. Cohen, *Gas Turbine Theory* 4e, Pearson, 2003

3. T D Eastop and McConkey, *Applied Thermodynamics* for Engineering Technologists 5e, Pearson, 1999.

4. W W Pulkrabek, Engineering Fundamentals of the *Internal Combustion Engine* , PHI, 2002.

5. C R Fergusan and A T Kirkpatrick, *Internal Combustion Engines*, John Wiley & Sons, 2001.

Department of Humanities and Social Sciences
HSS Elective – 6th Semester

HS331 Sociology of Development 3-0-0-6

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.)

Text and 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