INDIAN INSTITUTE OF TECHNOLOGY PATNA

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

Fifth Semester		
CS 301	Formal Language and Automata	3-0-0-6
CS 331	Programming Language	3-0-2-8
CS 341	Operating Systems	3-0-0-6
CS 342	Operating Systems Laboratory	0-1-3-5
CS 343	Data Communications	3-0-0-6
CS 344	Databases	3-0-0-6
CS 345	Databases Laboratory	0-1-3-5
	Total L-T-P-C	15-2-8-42

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

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

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

Fifth Semester		
ME 301	Manufacturing Technology I	3 – 1 – 0 – 8
ME 302	Mechanical Measurements	2 – 1 – 0 – 6
ME 303	Design of Machine Elements	3 – 1 – 0 – 8
ME 304	Kinematics of Machinery	2 – 1 – 0 – 6
ME 305	Heat and Mass Transfer	3 – 1 – 0 – 8
ME 310	Mechanical Engineering Laboratory- II	0 – 0 – 4 – 4
ME 321	Applied Thermodynamics I	2 – 1 – 0 – 6
	Total L-T-P-C	15-6-4-46

Detailed Syllabi for B.Tech fifth Semester

Programme: B.Tech. in Computer Science and Engineering

CS 301 FORMAL LANGUAGES AND AUTOMATA (3 0 0 6)

Pre-requisites: CS203

Basic concepts: alphabets, languages, and grammars. Regular Languages: regular expressions and algebraic laws thereof; deterministic and nondeterministic finite automata (DFAs and NFAs): equivalence of DFAs and NFAs, minimization of DFAs, Myhill-Nerode theorem; regular grammars; closure properties of regular languages; Pumping lemma; decidable properties of regular languages. Context free languages: context free grammars (CFGs): derivations, derivation trees, ambiguous grammars, inherently ambiguous languages, normal forms of CFGs: Chomsky Normal Form and Greibach Normal Form; pushdown automata (PDAs): deterministic and nondeterministic PDAs (DPDAs and NPDAs); deterministic CFLs, LL (k) and LALR grammars; closure properties of CFLs; Pumping lemma and Ogden's Lemma; decidable properties of CFLs. Context sensitive languages: context sensitive grammars; linear bounded automata. Recursively enumerable languages: unrestricted grammars; Turing machines: variants and equivalence thereof; random access machine and its equivalence with Turing machine.

Texts:

1. J. E. Hopcroft, R. Motwani and J. D. Ullman, *Introduction to Automata Theory, Languages and Computation*, Pearson Education India, 2001.
2. D. I. A. Cohen, *Introduction to Computer Theory*, John Wiley & Sons, 1997.

References:

1. J. C. Martin, *Introduction to Languages and the Theory of Computation*, 3rd Ed, Tata McGraw-Hill, 2002.
2. H. R. Lewis and C. H. Papadimitriou, *Elements of the Theory of Computation*, Prentice Hall, 1997.

CS 331 PROGRAMMING LANGUAGES (3 0 2 8)

Pre-requisites: CS201

Introduction to various programming paradigms and their implementation issues. Imperative programming: block structure; scoping rules; parameter passing etc. in languages like C, Pascal, Fortran. Object-oriented programming: abstraction, hiding; objects; classes; inheritance etc in languages like C++, Modula, Java. Functional programming: functions; recursion; types; polymorphism; storage allocation etc in languages like LISP, ML, Scheme. Logic

programming: Horn clauses; SLD-resolution etc in languages like Prolog. Introduction to concurrent programming: expressing parallelism; communication; synchronization etc in languages like Ada, CSP, Linda. Semantics of programming languages. (The course will include programming lab assignments in various languages.)

Texts:

1. R. Sethi, *Programming Languages: Concepts and Constructs*, 2nd Ed, Addison-Wesley, 1996.

References:

1. T. W. Pratt, M. V. Zelkowitz, *Programming Languages: Design and Implementation*, 4th Ed, Prentice Hall, 2001.
2. R. Stansifer, *The Study of Programming Languages,* Prentice Hall, 1994.

CS 341 OPERATING SYSTEMS (3 0 0 6)

Pre-requisites: CS201, CS222

Process Management: process; thread; scheduling. Concurrency: mutual exclusion; synchronization; semaphores; deadlocks. Memory Management: allocation; protection; hardware support; paging; segmentation. Virtual Memory: demand paging; allocation; replacement; swapping; segmentation; TLBs. File Management: naming; file operations and their implementation. File systems: allocation; free space management; directory management; mounting. I/O Management: device drivers; disk scheduling; block I/O; character I/O. (Unix will be used as a running example, while examples will drawn also from DOS and NT.)

Texts:

1. A. Silberschatz, P. B. Galvin and G. Gagne, *Operating System Concepts*, 7th Ed, John Wiley & Sons, 2004.

References:

1. A. Silberschatz, P. B. Galvin and G. Gagne, *Operating System Concepts with Java*, 6th Ed, John Wiley & Sons, 2003.
2. A. S. Tenenbaum, *Modern Operating Systems*, 2nd Ed, Prentice Hall of India, 2001.
3. H. M. Deitel, P. J. Deitel and D. R. Choffness, *Operating Systems*, 3rd Ed, Prentice Hall, 2004.
4. W. Stallings, *Operating Systems: Internal and Design Principles*, 5th Ed, Prentice Hall, 2005.
5. M. J. Bach, *The Design of the UNIX Operating System*, Prentice Hall of India, 1994.
6. M. K. McKusick et al, *The Design and Implementation of the 4.4 BSD Operating System*, Addison Wesley, 1996.

CS 342 OPERATING SYSTEMS LABORATORY (0 1 3 5)

Pre-requisites: CS201, CS222, CS223, CS242

Programming assignments to build parts of an OS kernel. Use of a teaching package such as Nachos.

CS 343 DATA COMMUNICATIONS (3 0 0 6)

Pre-requisites: CS222

Basics of Digital Communications: signals, noise, Nyquist's rate, Fourier transforms of signals, harmonics. Baseband and broadband transmission: modulation techniques; fundamentals of modems; local loop implementation. Digital transmission of voice: PCM, ADPCM, time division multiplexing; T1, T3 formats. Fibre optics: basic principles; SONET; technologies. VSAT technology: TDMA, DAMA; point-to-point wireless communication (microwave). Local Area Networks: Ethernet (CSMA/CD operation; parameters, specifications, limitations); cabling (Ethernet, Fast-Ethernet, Gigabit Ethernet; hubs, patch panels, wiring closets); bridges; switches; virtual LANs; 100BaseT; 100BaseVGANY; gigabit Ethernet; FDDI; token ring; wireless networks; ISDN, B-ISDN.

Texts:

1. W. Stallings, *Data and Computer Communications*, 7th Ed, Prentice Hall, 2004.

References:

1. A. S. Tenenbaum, *Computer Networks*, 4th Ed, Prentice Hall PTR, 2003.
2. B. A. Forouzan, *Data Communications and Networking*, 3rd Ed, McGraw Hill, 2004.
3. J. F. Kurose and K. W. Ross, *Computer networking: A Top-down Approach Featuring the Internet*, 3rd Ed, Addison-Wesley, 2005.
4. T. Ramteke, *Networks*, 2nd Ed, Prentice Hall, 2001.
5. G. Held, *Ethernet Networks: Design, Implementation, Operation, Management*, 4th Ed, John Wiley & Sons, 2002.

CS 344 DATABASES (3 0 0 6)

Pre-requisites: CS201, CS203

Data models: entity-relationship, relational, network, hierarchical, and logic data models, with the emphasis on the relational model. Query languages: relational algebra, relational calculus, SQL, QBE. Theory of database design: functional dependencies; normal forms: 1NF, 2NF, 3NF, Boyce-Codd NF; decompositions; normalization; multivalued

dependencies, join dependencies, 4NF, 5NF. Data storage and indexing: disks, files, file organizations, indexes; tree structured indexing (ISAM, B-trees), hash based indexing. Query processing: evaluation of relational operators, query optimization; transcation management, Concurrency control; error recovery; security. Case studies: ORACLE, Microsoft access etc. Introduction to Open Database Connectivity, Client-Server environment etc.

Texts:

1. R. Ramakrishnan and J. Gehrke, *Database Management Systems*, 3rd Ed, McGraw Hill, 2002.

References:

1. A. Silberschatz, H. F. Korth and S. Sudarshan, *Database System Concepts*, 4th Ed, McGraw Hill, 2001.
2. T. Connolly and C. Begg, *Database Systems*, 3rd Ed, Pearson Education, 2002.
3. R. Elmasri, S. B. Navathe and R. Sunderraman, *Fundamentals of Database Systems / Oracle 9i Programming*, 4th Ed, Benjamin Cummings Publishing Company, 2004.
4. H. Garcia-Molina, J. D. Ullman and J. D. Widom, *Database Systems: The Complete Book,* Prentice Hall, 2002.
5. C. J. Date, *An Introduction to Database Systems*, 6th Ed, Addison Wesley, 1995.
6. J. Melton, *Understanding the New SQL: A Complete Guide*, 2nd Ed, Morgan Kaufmann Publishers, 2000.

CS 345 DATABASES LABORATORY (0 1 3 5)

Pre-requisites: CS201

Familiarization with various databases packages like Microsoft Access, ORACLE, SQL Server, DB2 etc. Client-server and 3 tier web enabled database programming. Use of Application servers. Design and implementation of a Database application using a multi-user DBMS.

EE 310	Introduction to VLSI Design	3-0-0-6

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:

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

References:

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

EE 311	VLSI Laboratory	0-0-3-3

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.

Text/References:

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

EE 320	Digital Signal Processing	3-0-0-6

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:

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

References:

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

EE 380	Electrical Power Systems	3-0-0-6

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/• 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:

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

References:

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

EE 331	Communication Laboratory	0-0-3-3

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:

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

EE 350	Control Systems	3-0-0-6

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.

Texts:

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

References:

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

EE 370	Electronic Instrumentation	3-0-0-6

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.

Texts:

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

References:

1. B. E. Jones, Instrumentation, measurement, and Feedback, Tata McGraw-Hill, 2000.
2. R. P. Areny and T. G. Webster, Sensors and Signal Conditioning, John Wiley, 1991.

3. B. M. Oliver and J. M. Cage, Electronic Measurements and Instrumentation, McGraw-Hill, 1975.
4. C. F. Coombs, Electronic Instruments Handbook, McGraw-Hill, 1995.
5. R. A. Witte, Electronic Test Instruments, Pearson Education, 1995.
6. B. G. Liptak, Instrument Engineers' Handbook: Process Measurement and Analysis, Chilton Book, 1995.

EE 371	Instrumentation and Control Lab	0-0-3-3

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:

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

Programme: B.Tech. in Mechanical Engineering

ME-301 Manufacturing Technology-I (3 1 0 8)

Introduction to manufacturing processes: Moulding materials and their requirements. Patterns: types and various pattern of materials. Casting processes: Various foundry casting methods: viz. sand casting Investment casting, pressure die casting, centrifugal casting, continuous casting, thin roll casting, single crystal growth. Solidification of

casting and flow properties of molten metal; Gating and risering systems, directional solidification, use of chills and chaplets, Casting defects and their remedies; Metal joining processes: brazing, soldering and welding; Solid state

welding methods: resistance welding, arc welding; submerged arc welding, inert gas welding: Welding defects,

inspection. Metal forming Processes: Various metal forming techniques and their analysis, viz Forging, rolling,

Extrusion and wire drawing, Sheet metal working, Spinning, Swaging; super plastic deformation. Powder

metallurgy and its applications

Texts:

1. James S Campbell, *Principles of Manufacturing Materials and Processes*, Tata McGraw Hill, 1995.

2. F.C. Flemmings, *Solidification processing*, Tata McGraw Hill, 1982

3. M J Rao, *Manufacturing Technology: Foundry, Forming and Weldin*g, Tata McGraw Hill, 1987.

4. G E Linnert, *Welding Metallurgy*, AWS, 1994.

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

6. R W Heine, C R Loper, and P C Rosenthal, *Principles of Metal Casting*, 2nd ed, Tata McGraw Hill, 1976.

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

ME 302 Mechanical Measurements (2 1 0 6)

Pre-requisites: Nil

Fundamental of Measurement: Elements of a generalized measurement system, standards, and types of signals.

Static performance characteristics. Dynamic performance, instrument types - zero, first and second order instruments, transfer function representation, system response to standard input signals - step, ramp, impulse, and frequency response.

Treatment of uncertainties: error classification, systematic and random errors, statistical

analysis of data, propagation and expression of uncertainties.

Measurement of various physical quantities: Linear and angular displacement, velocity, force, torque, strain, pressure, flow rate and temperature. Transfer functions of some standard measuring devices. Data Acquisition and processing: Digital methods, digitization, signal conditioning, interfacing, standard methods of data analysis – quantities obtainable

from time series. Fourier spectra, DFT, FFT. Data acquisition parameters - sampling rate, Nyquist sampling frequency, aliasing & leakage errors. Metrology: measurement of angles, threads, surface finish, inspection of straightness, flatness and alignment, gear testing, digital readouts, coordinate measuring machine**.**

Texts:

1. Doebelin E.O., *Measurement systems- Applications and Design*, 4e, Tata McGraw-Hill, 1990.

2. Beckwith T. G., Marangoni, R. D., and Lienhard, J. H., *Mechanical Measurements*, 5e, Addison Wesley, 1993.

3. Figiola, R.S. and Beasley, D.E., *Theory and design for mechanical measurements*, 2(e), John Wiley, 1995.

4. Dally, Riley, and McConnell, *Instrumentation for engineering measurements*, 2e, John Wiley & Sons, 1993.

5. Doebelin E.O., *Engineering Experimentation*, McGraw-Hill, 1995.

6. Jain R.K., *Engineering Metrology*, Khanna Publishers, New Delhi, 1997.

ME 303 Design of Machine Elements (3 0 2 8)

Pre-requisites: Nil

Principles of mechanical design; Factor of safety, strength, rigidity, fracture, wear, and material considerations; Stress concentrations; Design for fatigue; Limits and fits; Standardization; Design of riveted, bolted, and welded joints; Rigid and flexible couplings; Belt and chain drives; Power screws; Shafts; Keys; Clutches; Brakes; Axles; Springs.

Texts:

1. J. E. Shigley, *Mechanical Engineering Design*, McGraw Hill, 1989.

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

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

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

ME-304 Kinematics of Machinery (2 1 0 6)

Pre-requisites: Nil

Elements of kinematic chain, mechanisms, their inversions, mobility (Kutzhbach criteria) and range of movements (Grashof's law); Miscellaneous mechanisms: straight line generating mechanism, intermittent motion mechanism;

Displacement, velocity and acceleration analysis of planar mechanisms by graphical, analytical and computer aided methods; Dimensional synthesis for motion; function and path generation; Cam profile synthesis and determination of equivalent mechanisms; Gears (spur, helical, bevel and worm); gear trains: simple, compound and epicyclic gearing.

Texts

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

2. A. K. Mallik, A. Ghosh, G. Dittrich, *Kinematic analysis and synthesis of Mechanisms*, CRC, 1994.

3. A. G. Erdman and G. N. Sandor, *Mechanism Design, Analysis and Synthesis Volume 1,* PHI, Inc., 1997.

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

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

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

ME-305 Heat and Mass Transfer (3 1 0 8)

Pre-requisites: Nil

Modes of heat transfer; Conduction: 1-d, 2-d, and 3-d steady conduction, 1-d unsteady conduction – analytical /numerical / graphical solution methods, fins; Convection: fundamentals, order of magnitude analysis of momentum and energy equations, hydrodynamic and thermal boundary layers, dimensional analysis, free and forced convection, external and internal flows, heat transfer with phase change; Radiation: Stefan Boltzmann law, Planck's law, emissivity and absorptivity, radiant exchange between black surfaces; Heat exchangers: LMTD and □-NTU methods, heat transfer enhancement techniques, special heat transfer processes like transpiration and film cooling, ablative cooling; Mass transfer: molecular diffusion, Fick's law, equimolar counter diffusion, molecular diffusion in a stationary gas, analogy between heat and mass transfer, evaluation of mass transfer coefficients by dimensional analysis. Mass transfer in boundary layer, flow over a flat plate.

Texts and References

1. F.P. Incropera and D.P. Dewitt, *Fundamentals of Heat and Mass Transfer*, 4e, John Wiley and Sons. 1996.

2. J.P. Holman, *Heat Transfer*, 8e, McGraw Hill, 1997.

3. M.N. Ozisik, *Heat Transfer – A basic approach*, McGraw Hill, 1985.

4. A. Bejan, *Convection Heat Transfer*, 2e, Interscience, 1994.

ME-310 Mechanical Engineering Laboratory – II (0 0 4 4)

Metallography: microscopic techniques, determination of volume fraction of different phases in material including metals, estimation of grain sizes, study of heat affected regions in welded steel specimen; Machining processes: Measurement of tool angles and radius for single point cutting tool, determination of cutting forces, shear plane,

chip thickness ratio, profile estimation using coordinate measuring machine; Demonstration of various mechanisms and gear systems; Experiments in conduction, free and forced convection, heat exchangers, petrol and diesel engines.

ME-321 Applied Thermodynamics – I (2 1 0 6)

Pre-requisites: Nil

Vapour Power Cycles: Carnot cycle, Rankine cycle, reheat cycle, regenerative cycle, steam cycles for nuclear power plant, back-pressure and extraction turbines and cogeneration, low-temperature power cycles, ideal working fluid and binary/multi-fluid cycles; *Steam Generator*: subcritical and supercritical boilers, fluidized bed boilers, fire-tube and water-tube boilers, mountings and accessories; *Condenser*; *Cooling Tower:* hygrometry and psychrometric chart; *Steam Turbine*: impulse and reaction stage, degree of reaction, velocity triangle, velocity and pressure compounding, efficiencies, reheat factor, governing, nozzles; *Heat Pump and Refrigeration Cycles*: reversed Carnot cycle and performance criteria, vapour compression and vapour absorption refrigerators, gas cycles, refrigerants and environmental issues; *Air-conditioning*; *Reciprocating Air Compressors*: work transfer, volumetric efficiency, isothermal efficiency, multistage compression with intercooling.

Texts:

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