Millia Institute of Technology
Rambagh, Purnea

Affiliated to BIhar Engineering University, Patna

NAAC Accredited & ISO 9001:2015

SYLLABUS

Department of Electrical Engineering

5th SEMESTER

B. Tech (Electrical Engineering)

SEMESTER –V

Sl No.	Course Code	Course Title	Hours Per Week			Total Credits
			Lecture	Tutorial	Practical	
1.	100502	Control Systems	3	0	0	3
2.	100504	Microprocessors	3	0	0	3
3.	100506	Power Electronics	3	0	0	3
4.	100507	Power Systems-I (Apparatus and Modelling)	3	0	0	3
5.		Program Elective-I	3	0	0	3
6.	100502P	Control Systems Lab	0	0	2	1
7.	100504P	Microprocessor Lab	0	0	2	1
8.	100506P	Power Electronics Lab	0	0	2	1
9.	100507P	Power Systems-I (Apparatus and Modelling) Lab	0	0	2	1
10.	100510P	Summer Entrepreneurship-II	-	-	-	6
11.	100511P	NPTEL Courses-2	0	0	4	2
TOTAL						27

SEMESTER –V

Course Code-100502 Control Systems 3 0 0 3

Unit- 1.0: Introduction to control problem **7 hrs**

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra. Signal flow graph.

Unit- 2.0: Time Response Analysis **7 hrs**

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Unit- 3.0:

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit- 4.0: Frequency-response analysis **7 hrs**

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit- 5.0: Introduction to Controller Design **7 hrs**

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Unit-6.0: State variable Analysis **7 hrs**

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete time systems.

Text/ Reference:-

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.

Course Code- 100504 Microprocessors 3 0 0 3

Unit-1.0: Fundamentals of Microprocessors **7 hrs**

Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontroller sin embedded Systems. Overview of the 8051family.

Unit-2.0: The 8051 Architecture **8 hrs**

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit-3.0: Instruction Set and Programming **8 hrs**

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Unit-4.0: Memory and I/O Interfacing **6 hrs**

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices.

Unit-5.0: External Communication Interface **6 hrs**

Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Unit-6.0: Applications **6 hrs**

LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

Text/ Reference:-

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education,2007.
2. K. J. Ayala, “8051 Microcontroller”, Delmar CengageLearning, 2004.
3. R. Kamal, “Embedded System”, McGraw HillEducation, 2009.
4. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing,1996
5. D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
6. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991.

Course Code-100506 Power Electronics 3 0 0 3

Unit- 1.0: Power switching devices **7hrs**

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Unit- 2.0 Thyristor rectifiers **7hrs**

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Unit- 3.0 DC-DC converter **7hrs**

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Unit- 4.0 Single-phase and 3-phase voltage source inverter **7hrs**

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation. Current Source Inverter.

Unit- 5.0 **7hrs**

Balancing of rotating masses: Balancing of rotating masses in the same plane by a single revolving mass. Balancing of several rotating masses in the same plane. Balancing of several rotating masses in different planes by two revolving masses in suitable planes.

Unit- 6.0 **7hrs**

Governors: Watt, Porter, Proel & Hartnell Governors, Effect of friction, controlling force, governor effort and power, sensitivity and isochronisms.

Text/ Reference:-

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science& Business Media, 2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

Course Code- 100507 Power Systems-I (Apparatus and Modelling) 3 0 0 3

Unit 1.0- Basic Concepts **6 hrs**

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage.

Unit 2.0- Transmission and Distribution Systems **7 hrs**

Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power. Skin effect and Ferranti effect.

Unit 3.0- Power System Components **8 hrs**

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Unit 4.0- Transformers: **8 hrs**

Three-phase connections and Phase-shifts. Three-winding transformers, auto transformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single phase equivalent of three-phase transformers. Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations

Unit 5.0 – Over-voltages and Insulation Requirements **5 hrs**

Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Unit 6.0- Introduction to DC Transmission & Renewable Energy Systems **8 hrs**

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

Text/ Reference:-

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

Program Elective-I

Course Code- 103502 Wind and Solar Energy Systems 3 0 0 3

Unit 1.0- Physics of Wind Power **7 hrs**

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit 2.0- Wind generator topologies **9 hrs**

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit 3.0- The Solar Resource **6 hrs**

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit 4.0- Solar photovoltaic **7 hrs**

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms.Converter Control.

Unit 5.0 – Network Integration Issues **8 hrs**

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Unit 6.0- Solar thermal power generation **5 hrs**

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text/ Reference:-

1. T. Ackermann Wind Power in Power Systems John Wiley and Sons Ltd., 2005.
2. G.M. Masters, Temewable and Efficient Electric Power Systems John Wiley and Sons, 2004.
3. S.P. Sukhatme, Solar Energy : Principles of Thermal Collection and Storage, McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, grid intergration of wind energy conversion systems John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M.k. Ghosal Renewable Energy Applications Narosa Publication, 2004.
6. H.A. Duffie and W.A. Beckman, Solar Engineering of Thermal Processes, John Wiley and Sons,1991.

Course Code- 100903 Information Theory and Coding 3 0 0 3

Unit 1.0- **7 hrs**
Basics of information theory, entropy for discrete ensembles.
Unit 2.0- **7 hrs**
Shannon's noiseless coding theorem; Encoding of discrete sources.
Unit 3.0 – **7 hrs**
Markov sources; Shannon's noisy coding theorem and converse for discrete channels.
Unit 4.0- **7 hrs**
Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.
Unit 5.0 – **7 hrs**
Techniques of coding and decoding; Huffman codes and uniquely detectable codes.
Unit 6.0- **7 hrs**
Cyclic codes, convolutional arithmetic codes

Text/ Reference:-

6. N. Abramson, Information and Coding, McGraw Hill, 1963.
7. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
8. R.B. Ash, Information Theory, Prentice Hall, 1970.
9. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

Course Code- 100904 Speech and Audio Processing 3 0 0 3

Unit- 1.0: **7 hrs**

Introduction- Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Unit- 2.0: **5 hrs**

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation;

Unit- 3.0: **6 hrs**

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non- stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Unit- 4.0: **8 hrs**

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Unit- 5.0: **9 hrs**

Scalar Quantization of LPC- Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF, Linear Prediction Coding- LPC model of speech production; Structures of LP Cencoders and decoders; Voicing detection; Limitations of the LPC model

Unit- 6.0: **8 hrs**

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Text/ Reference:-

5. “Digital Speech” by A.M.Kondoz, Second Edition (Wiley Students“ Edition), 2004.
6. “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, W.C. Chu, Wiley Inter science, 2003.

Course Code- 100905 Introduction to MEMS 3 0 0 3

Unit-1.0: **4 hrs**

Introduction and Historical Background, Scaling Effects.

Unit-2.0: **7 hrs**

Micro/Nano Sensors, Actuators and Systems overview: Case studies.

Unit-3.0: **8 hrs**

Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

Unit-4.0: **8 hrs**

Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining:Surface Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding.

Unit-5.0: **8 hrs**

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending.

Unit-6.0: **7 hrs**

Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Text/ Reference:-

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E. Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano- and Micro engineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Micro fabrication, CRC Press, 1997.
5. G. Kovacs, Micro machined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Course Code- 100908 Bio-Medical Electronics 3 0 0 3

Unit- 1.0: **6 hrs**

Brief introduction to human physiology.

Unit- 2.0 **8 hrs**

Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases.

Unit- 3.0 **7hrs**

Bio-electrodes and bio-potential amplifiers for ECG, EMG, EEG, etc.

Unit- 4.0 **8hrs**

Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic, X- ray and nuclear imaging.

Unit- 5.0 **8 hrs**

Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped.

Unit- 6.0 **5 hrs**

Safety aspects.

Text/ Reference:-

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

Course Code- 100913 CMOS Design 3 0 0 3

Unit- 1.0: **7hrs**
Review of MOS transistor models, Non-ideal behavior of the MOS Transistor. Sequential.
Unit- 2.0 **7hrs**
Transistor as a switch. Inverter characteristics, Integrated Circuit Layout: Design Rules, Parasitics.
Unit- 3.0 **7hrs**
Delay: RC Delay model, linear delay model, logical path efforts.
Unit- 4.0 **7hrs**
Power, interconnect and Robustness in CMOS circuit layout.
Unit- 5.0 **7hrs**
Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic.
Unit- 6.0 **7hrs**
Circuit Design: Static circuits. Design of latches and Flip-flops.
Text/ Reference:-

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4thEdition, Pearson Education India, 2011.
2. C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985

Course Code- Power Electronics 3 0 0 3

Unit- 1.0: **7hrs**

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Unit- 2.0 **7hrs**

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Unit- 3.0 **7hrs**

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.

Unit- 4.0 **7hrs**

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

Unit- 5.0 **7hrs**

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter – series loaded half bridge DC-DC converter.

Unit- 6.0 **7hrs**

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Text/ Reference:-

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand& Co.
4. V.R.Moorthi, “Power Electronics”, Oxford University Press.
5. Cyril W., Lander,” Power Electronics”, edition III, McGraw Hill.
6. G K Dubey, S R Doradla,: Thyristorised Power Controllers”, New Age International Publishers. SCR manual from GE, USA.

Course Code- 100919 Nano electronics 3 0 0 3

Unit- 1.0: **7hrs**

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States.

Unit- 2.0 **7hrs**

Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig- Penny Model. Brillouin Zones.

Unit- 3.0 **7hrs**

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs

Unit- 4.0 **7hrs**

Limits to scaling, system integration limits (interconnect issues etc.).

Unit- 5.0 **7hrs**

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics.

Unit- 6.0 **7hrs**

Bandstructure and transport, devices, applications,2D semiconductors and electronic devices, Graphene, atomistic simulation.

Text/ Reference:-

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.

Course Code-100921 Scientific computing 3 0 0 3

Unit- 1.0: **7hrs**

Introduction: Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis..

Unit- 2.0 **7hrs**

Stability and Accuracy Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating- Point Arithmetic.

Unit- 3.0 **7hrs**

Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting.

Unit- 4.0 **7hrs**

Cancellation System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems.

Unit- 5.0 **7hrs**

Eigenvalues and singular values: Eigenvalues and Eigenvectors, Methods for Computing All Eigenvalues, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD.

Unit- 6.0 **7hrs**

Nonlinear equations: Fixed Point Iteration, Newton's Method, Inverse Interpolation Method

Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation Numerical Integration And Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation, Initial Value Problems for ODES, Euler's Method, Taylor Series Method, Runga-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigenvalue Problems Partial Differential Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences.

Text/ Reference:-

1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw-Hill, 2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007
3. Xin-she Yang (Ed.)., "Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008
4. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1st Ed., 2006
5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010.

Course Code- 104503 Linear Control System 3 0 0 3

Unit 1.0- **8 hrs**

Control Systems: Basics & Components, Introduction to basic terms, Classifications and types of Control Systems, Block diagrams & Signal flow graphs. Transfer function, Determination of transfer function using Block diagram re-duction techniques and Mason's Gain formula. Control system components: Electrical, Mechanical, Electronic, AC/DC Servo Motors, Stepper Motors, Tacho Generators, Synchros, Magnetic Amplifiers, Servo Amplifiers 8 Hrs.

Unit 2.0- **6 hrs**

Time-Domain Analysis : Time domain performance specifications, Transient response of first and second order systems, Steady state errors and Static error constants in unity feedback control systems, response with P, PI and PID controllers, Limitations of time domain analysis. 8 Hrs.

Unit 3.0 – **9 hrs**

Frequency Domain Analysis : Polar and inverse polar plots, Frequency domain specifications and Performance of LTI systems, Logarithmic plots (Bode plots), Gain and Phase Margins, Relative stability. Correlation with time domain performance, Closed loop frequency responses from Open loop response. Limitations of frequency domain analysis, Minimum/Non-minimum phase sys- tems.

Unit 4.0- **5 hrs**

Stability and Compensation Techniques : Concepts, absolute, Asymptotic, Conditional and Marginal stability, Routh–Hurwitz and Nyquist stability criterion.

Unit 5.0 – **5 hrs**

Root locus technique and its application. Concepts of compensation, series/parallel/series-parallel/feedback compensation, Lag/Lead/Lag- Lead networks for compensation, Compensation using P, PI, PID controllers.

Unit 6.0- **9 hrs**

Control System Analysis using State Variable Methods Control Systems Engineering Syllabus State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback. 8 Hrs.

Text/ Reference:-

10. "Automatic Control System", B. C. Kuo, Prentice Hall of India, 7th edition, 2001
11. "Control Systems Engineering -Principles and Design", Nagraath and Gopal New Age Publishers
12. "Control systems engineering", Norman S. Nise, John Wiley and Sons (Asia) Singapore
13. "Design of Feedback Control System", Raymond T. Stefani, Oxford University Press
14. "Modern control engineering", K. Ogata, Pearson, 2002.

Course Code-104504 Linear Integrated Circuits and Applications 3 0 0 3

Unit- 1.0: **7 hrs**

IC Fabrication: IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance and FETs.

Unit- 2.0: **7 hrs**

Characteristics of OPAMP: Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP- AMP;

Unit- 3.0: **7 hrs**

Basic applications of Op-Amp – Inverting and Non-inverting Amplifiers, V/I and I/V converters, Summer, Differentiator and Integrator.

Unit- 4.0: **7 hrs**

Applications of OPAMP : Instrumentation amplifier, Log and Antilog Amplifiers, first and second order active filters, comparators, multivibrators, wave- form generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using Op-Amps.

Unit- 5.0: **7 hrs**

Special ICs: Functional block, characteristics and application circuits with 555 Timer IC-566 voltage controlled oscillator IC; 565-phase lock loop IC, Ana- log multiplier ICs.

Unit-6.0: **7 hrs**

Application ICs : IC voltage regulators –LM78XX, 79XX Fixed voltage regulators- LM317, 723 Variable voltage regulators, switching regulator- SMPS- LM 380 power amplifier-ICL 8038 function generator IC.

Text/ Reference:-

7. “Op-amp and Linear ICs”, David A. Bell, Oxford, 2013
8. “Linear Integrated Circuits”, D. Roy Choudhary, Sheil B. Jani, II edition, New Age, 2003
9. “Op-amps and Linear Integrated Circuits”, Ramakant A. Gayakward, IV edition, Pearson Education, PHI, 2000
10. “Opamps and Linear Integrated Circuits Concepts and Applications”, Fiore, Cengage, 2010
11. “Fundamentals of Analog Circuits”, Floyd and Buchla, Pearson, 2013
12. “Integrated Electronics - Analog and Digital circuits system”, Jacob Millman, Christos C. Halkias, Tata McGraw Hill, 2003
13. “Op-amp and Linear ICs”, Robert F. Coughlin, Fredrick F. Driscoll, PHI Learning, 6th edition, 2012.

Course Code-100502P Control Systems Lab 0 0 2 1

Hands-on/Computer experiments related to the course contents of Control Systems theory.

Course Code- 100504P Microprocessor Lab 0 0 2 1

Hands-on experiments related to the course contents of Microprocessor theory.

Course Code- 100506P Power Electronics Lab 0 0 2 1

Hands-on experiments related to the course contents of Power Electronics theory.

Course Code- 100506P Power Systems-I (Apparatus and Modelling) Lab 0 0 2 1

Hands-on experiments related to the course contents of Power Systems-I (Apparatus and Modelling) theory. Visits to power system installations (generation stations, EHV substations etc.) are suggested. Exposure to fault analysis and Electro- magnetic transient program (EMTP) and Numerical Relays are suggested.