

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

Course Code- 100504 Microprocessors**3 0 0 3****Unit-1.0: Fundamentals of Microprocessors****7 hrs**

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

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, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2007.
2. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.
3. R. Kamal, "Embedded System", McGraw Hill Education, 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- Basics of information theory, entropy for discrete ensembles.	7 hrs
Unit 2.0- Shannon's noiseless coding theorem; Encoding of discrete sources.	7 hrs
Unit 3.0 – Markov sources; Shannon's noisy coding theorem and converse for discrete channels.	7 hrs
Unit 4.0- Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.	7 hrs
Unit 5.0 – Techniques of coding and decoding; Huffman codes and uniquely detectable codes.	7 hrs
Unit 6.0- Cyclic codes, convolutional arithmetic codes	7 hrs

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- 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:**

Brief introduction to human physiology.

6 hrs**Unit- 2.0**

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

8 hrs**Unit- 3.0**

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

7hrs**Unit- 4.0**

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

8hrs**Unit- 5.0**

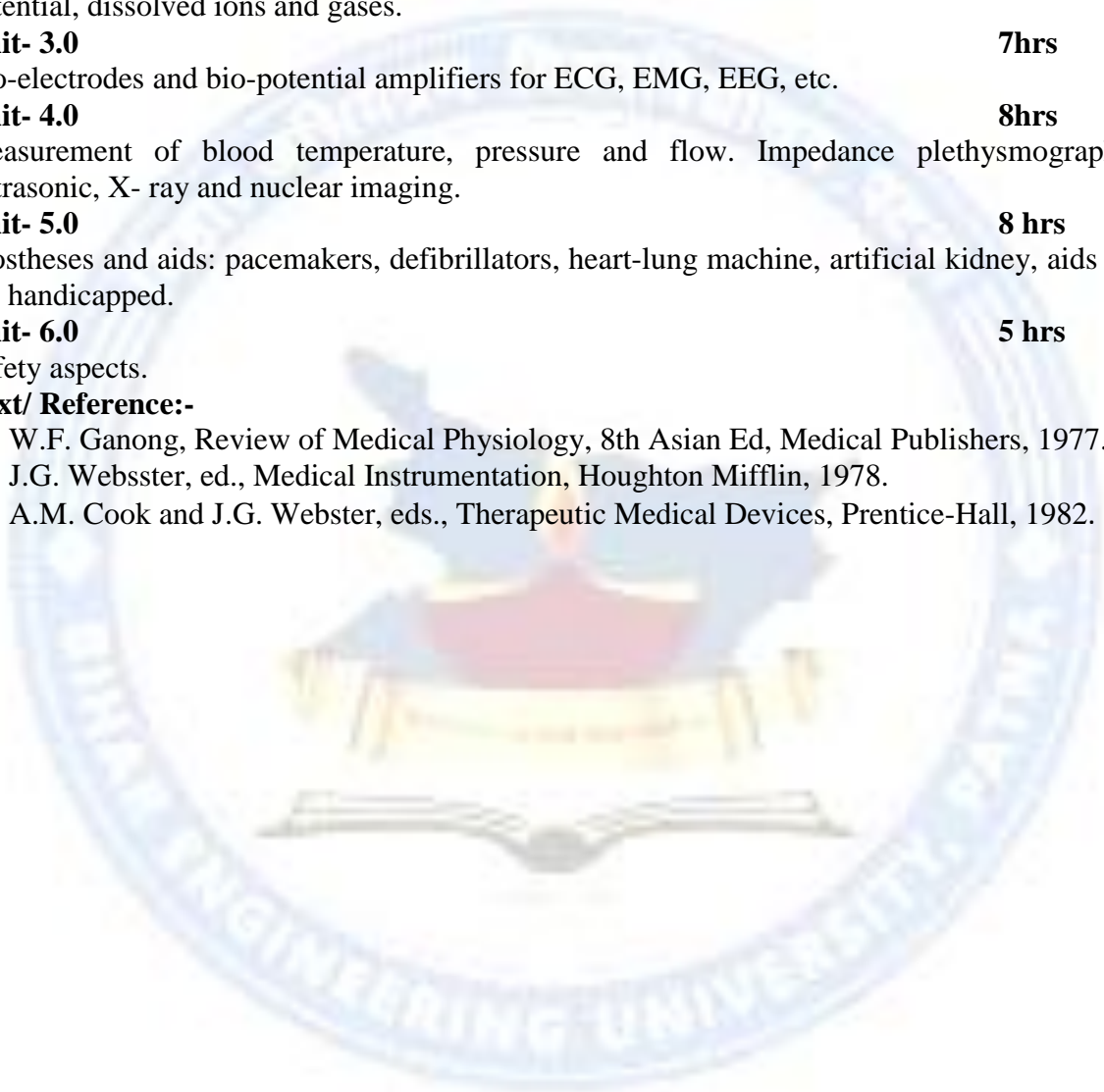
Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped.

8 hrs**Unit- 6.0**

Safety aspects.

5 hrs**Text/ Reference:-**

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Webster, 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: Review of MOS transistor models, Non-ideal behavior of the MOS Transistor. Sequential.	7hrs
Unit- 2.0 Transistor as a switch. Inverter characteristics, Integrated Circuit Layout: Design Rules, Parasitics.	7hrs
Unit- 3.0 Delay: RC Delay model, linear delay model, logical path efforts.	7hrs
Unit- 4.0 Power, interconnect and Robustness in CMOS circuit layout.	7hrs
Unit- 5.0 Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic.	7hrs
Unit- 6.0 Circuit Design: Static circuits. Design of latches and Flip-flops.	7hrs

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 Material and 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, Runge-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 reduction 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 systems.

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.

