EN010501A ENGINEERING MATHEMATICS IV

(Common to all branches except CS & IT)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives: *Use basic numerical techniques to solve problems and provide scientific techniques to decision making problems.*

MODULE 1 Function of Complex variable (12 hours)

Analytic functions – Derivation of C.R. equations in cartision co-ordinates – harmonic and orthogonal properties – construction of analytic function given real or imaginary parts – complex potential – conformal mapping of z^2 , $\frac{1}{z}$ - Bilinear transformation – cross ratio – invariant property (no proof) – simple problems

MODULE 2 Complex integration (12 hours)

Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's series- Laurent's series – Zeros and singularities – types of singularities – Residues – Residue theorem – evaluation of real integrals in unit circle – contour integral in semi circle when poles lie on imaginary axis.

MODULE 3 Numerical solution of algebraic and transcendental equations (10 hours)

Successive bisection method – Regula –falsi method – Newton –Raphson method - Secant method – solution of system of linear equation by Gauss – Seidel method

MODULE 4 Numerical solution of Ordinary differential equations (10 hours)

Taylor's series method – Euler's method – modified Euler's method – Runge – Kutta method (IV order) - Milnes predictor – corrector method

MODULE 5 Linear programming problem (16 hours)

Definition of L.P.P., solution, optimal solution, degenerate solution – graphical solution –solution using simplex method (non degenerate case only) Big -M method – Duality in L.P.P. – Transportation problem –Balanced T.P. – initial solution using Vogel's approximation method - modi method (non degenerate case only)

References

1. B.V. Ramana – Higher Engg. Mathematics – Mc Graw Hill
2. M.R.Spicgel , S.Lipschutz , John J. Schiller, D.Spellman – Complex variables, schanm's outline series - Mc Graw Hill
3. S.Bathul – text book of Engg.Mathematics – Special functions and complex variables –PHI
4. B.S. Grewal – Numerical methods in Engg. and science - Khanna Publishers
5. Dr.M.K Venkataraman- Numerical methods in science and Engg -National publishing co

6. S.S Sastry - Introductory methods of Numerical Analysis -PHI
7. P.K.Gupta and D.S. Hira – Operations Research – S.Chand
8. Panneer Selvam– Operations Research – PHI
9. H.C.Taneja – Advanced Engg. Mathematics Vol II – I.K.International

EC010 502 CONTROL SYSTEMS

Teaching Scheme

2 hours lecture and 2 hours tutorial per week. Credit :4

Objectives

- *To develop the basic understanding of control system theory and its role in engineering design.*
- *To familiarize the inputs, outputs, and building blocks of a control system; to differentiate between open-loop and closed-loop control systems.*
- *To understand the utility of Laplace transforms and transfer functions for modeling complex interconnected systems.*
- *To understand the concept of poles and zeros of a transfer function and how they affect the physical behavior of a system.*
- *To understand the concept of Time Domain and Frequency Domain analysis and to determine the physical behavior of systems using these analysis.*
- *To understand state variable analysis of systems and the relationship with state variable representation and transfer functions.*

Module 1 (14 hours)

Introduction to Control Systems – Basic building blocks of a Control System – Open-Loop and Closed-Loop Control Systems – Feedback and effects of feedback – Types of feedback Control Systems – LTI Systems.

Impulse Response and Transfer Functions of LTI Systems – Properties of Transfer Functions – SISO and MIMO Systems – Mathematical modeling of electrical and mechanical systems (simple systems only) – Analogy between mechanical and electrical systems.

Block Diagrams – Reduction of Block Diagrams – Signal Flow Graph – Mason's Gain Formula – Conversion of Block Diagrams to Signal Flow Graphs.

Module 2 (14 hours)

Stability of Linear Control Systems – BIBO Stability and Asymptotic Stability – Relationship between characteristic equation roots and stability – Method of determining stability – Routh-Hurwitz Criterion.

Time-Domain Analysis of Control Systems – Transient Response and Steady-State Response – Typical test signals – Unit-Step response and Time-Domain specifications of first-order and prototype second-order systems – Steady-State Error – Static and Dynamic Error Constants.

Effects of adding poles and zeros to the Transfer Function – Dominant Poles and Insignificant Poles of Transfer Functions.

Module 3 (10 hours)

Root-Locus Technique – Basic properties of the Root Loci – Angle and Magnitude conditions – Rules for the construction of approximate Root Loci.

Control System Design by the Root-Locus Method – Preliminary design considerations – Lead Compensation – Lag Compensation – Lead-Lag Compensation – Parallel Compensation.

Module 4 (12 hours)

Frequency-Domain Analysis of Control Systems – Frequency-Domain specifications of prototype second order system – Effects of adding zeros and poles to the Forward-Path Transfer Function.

Nyquist Stability Criterion: Fundamentals – Relationship between the Root Loci and the Nyquist Plot.

Relative Stability – Gain Margin and Phase Margin – Stability analysis with Bode Plot and Polar Plot – Introduction to Nichols Plot, Constant-M & Constant-N circles and Nichols Chart (no analysis required).

Module 5 (10 hours)

State-Variable Analysis of Control Systems – Vector-Matrix representation of State Equations – State-Transition Matrix – State-Transition Equation – Relationship between State Equations and Higher-Order differential equations – Relationship between State Equations and Transfer Functions - Characteristic Equation, Eigen values and Eigen vectors.

References

1. B. C. Kuo, *Automatic Control Systems,* 7th ed., PHI Learning Pvt. Ltd., New Delhi, 2009.
2. K. Ogata, *Modern Control Engineering*, 5th ed., PHI Learning Pvt. Ltd., New Delhi, 2010.
3. R. C. Dorf, R. H. Bishop, *Modern Control Systems*, 11th ed., Pearson Education, New Delhi, 2008.
4. N. S. Nise, *Control Systems Engineering,* 5th ed., Wiley India Pvt. Ltd., New Delhi, 2009.
5. M. Gopal, *Control Systems: Principles and Design,* 3rd ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2008.

EC010 503 DIGITAL SYSTEM DESIGN

Teaching scheme **Credits: 4**
3 hours lecture and 1 hour tutorial per week.

Objectives

- *To design and implement combinational circuits using basic programmable blocks*
- *To design and implement synchronous sequential circuits*
- *To study the fundamentals of Verilog HDL*
- *Ability to simulate and debug a digital system described in Verilog HDL*

Module I (12hours)
Introduction to Verilog HDL: Design units, Data objects, Signal drivers, Delays , Data types, language elements, operators, user defined primitives, modeling-data flow, behavioral, structural, Verilog implementation of simple combinational circuits: adder, code converter, decoder, encoder, multiplexer, demultiplexer.

Module II (12 hours)
Combinational circuit implementation using Quine–McCluskey algorithm, Decoders, Multiplexers, ROM and PLA, Implementation of multi output gate implementations

Module III (12 hours)
Finite State Machines: State diagram, State table, State assignments, State graphs, Capabilities and limitations of FSM, Meta stability, Clock skew, Mealy and Moore machines, Modelling of clocked synchronous circuits as mealy and Moore machines: serial binary adder, Sequence detector, design examples.

Module IV (12 hours)
Digital System Design Hierarchy: State assignments, Reduction of state tables, Equivalent states, Determination of state equivalence using implication table, Algorithmic State Machine, ASM charts, Design example.

Module V (12 hours)
Verilog HDL implementation of binary multiplier, divider, barrel shifter, FSM, Linear feedback shift register, Simple test bench for combinational circuits.

Reference

1. Michael D.Ciletti, *Advanced Digital design with Verilog HDL*, Pearson Education, 2005.
2. S. Brown & Z. Vranestic, *Fundamentals of Digital Logic with Verilog HDL*, Tata McGraw Hill, 2002.
3. Samir Palitkar, *Verilog HDL A Guide to Digital Design and Synthesis*, Pearson, 2nd edition, 2003.
4. Peter J Ashenden ,*Digital Design, an embedded system approach using Verilog*, Elsevier, 2008
5. Frank Vahid, *Digital Design*, Wiley Publishers.
6. T R Padmanabhan, *Design through Verilog HDL*, IEEE press, Wiley Inter science, 2002.
7. Donald D Givone, *Digital Principles and Design*, Tata McGraw Hill, 2003.
8. Wakerly J F, *Digital Design Principles and Practices*, Prentice hall of India, 2008.
9. Nazeih M Botros, *HDL programming VHDL and Verilog*, Dreamtech press, 2009
10. David J. Comer, *Digital Logic and State Machine Design,* Oxford university press, 3rd edition, 1995.

EC 010 504(EE) Electric Drives & Control

Teaching Schedule

2 hours Lecture and 2 hours tutorial /week Credits -4

Objectives:

- *To understand the characteristics and operational features of important power electronic devices*
- *Understanding the basic working principles of DC and AC machines*

Module 1(10 Hours)

D.C.Machines – DC Generator- Types, Open Circuit Characteristics and Load characteristics of d.c. shunt generator – Losses and efficiency. D C motor – starter – torque equation – speed torque characteristics of shunt, series and compound motors – Losses – efficiency – Brake test – Swinburne's test.

Module 2(12 Hours)

A.C Machines – Transformers: transformer on no-load and load operation – phasor diagram – equivalent circuit – regulation – losses and efficiency – o.c. and s.c. tests. Three phase induction motors: types –Principle of operation-slip- torque equation – torque-slip characteristics–starters – single phase induction motors – types – working. Alternator –types- principle- emf equation – regulation by emf and mmf methods. Synchronous motor – Principle of operation.

Module3(10 Hours)

Power semiconductor Devices – SCR-Constructional features- Characteristics- rating and specification- Triggering circuits-protection and cooling. Construction and characteristics of power diodes, TRIAC, BJT, MOSFET and IGBT. .

Module 4(14 Hours)

Phase controlled Rectifiers - Operation and analysis of Single phase and multi-phase-controlled rectifiers with R, RL and back EMF load- free wheeling effect. Chopper-classification- Step down- step up- two and four quadrant operations.

Inverters- Single phase and three phase bridge inverters- VSI and CSI- PWM Inverters. SMPS, UPS– principle of operation and block schematic only.

Module 5(14 Hours)

DC drives**:** Methods of Speed control of dc motors– single phase and three phase fully controlled bridge rectifier drives. Chopper fed drives: Single, Two and four quadrant chopper drives. Induction Motor drives: Stator voltage, stator frequency and V/f

Control, Static rotor resistance control. Synchronous motor drives: Open loop and self controlled modes.

Text Books:

1 J B Gupta, *Electrical Machines* , S K Kataria and Sons

2 Vedam Subramaniam ,*Power Semiconductor Drives* –, TMH
3 Rashid Muhammad, *Power Electronics*: Pearson Edn.

References

1. Electrical & Electronic Technology: Hughes, Pearson Education
2. Harish C Ray *Power Electronics*:, Galgotia Pub
3. P S Bimbhra ,*Power Electronics*: Khanna Publishers
4. M.D Singh and K.B Khanchandani, *Power Electronics* –, TMH, 1998
5. Wildi - Electrical Machines, Drives and Power systems 6/ePearson Education

EC010 505 APPLIED ELECTROMAGNETIC THEORY

Teaching Schemes **Credit: 4**
3 hours lecture and 1 hour tutorial per week.

OBJECTIVES

- *To analyze fields potentials due to static changes*
- *To evaluate static magnetic fields*
- *To understand how materials affect electric and magnetic fields*
- *To understand the relation between the fields under time varying situations*
- *To understand principles of propagation of uniform plane waves.*

Module I (14hours)

Review of vector analysis: Cartesian, Cylindrical and Spherical co-ordinates systems- Coordinate transformations. Vector fields: Divergence and curl- Divergence theorem- Stoke's theorem. Static electric field: Electrical scalar potential- different types of potential distribution- Potential gradient- Energy stored in Electric field - Derivation of capacitance of two wire transmission line and coaxial cable –Electrostatic boundary conditions– Steady magnetic field: Ampere's Law, Faraday's Law, Helmholtz's theorems, Energy stored in magnetic fields- Magnetic dipole- Magnetic boundary conditions- Vector magnetic potential A- Magnetic field intensity, Inductance of two wire transmission line and coaxial cable- Relation between E, V and A.- Equation of continuity, Poisson and Laplace equations.

Module II (12 hours)

Maxwell's equations and travelling waves: Conduction current and displacement current, Maxwell's equations- Plane waves- Poynting theorem and Poynting vector- Power flow in a co-axial cable – Instantaneous Average and Complex Poynting Vector. Plane electromagnetic waves- Solution for free space condition- Uniform plane wave:-wave equation for conducting medium- wave propagation in conductors and dielectric, depth of penetration, reflection and refraction of plane waves by conductor and dielectric. Wave polarization - Polarization of electromagnetic wave and derivation of polarization angle.

Module III (14 hours)

Guided wave :-Guided waves between parallel planes- Transverse Electric and Transverse Magnetic waves and its characteristics- Waves in Rectangular Waveguides- Transverse Magnetic Waves in Rectangular Wave guides – Transverse Electric Waves in Rectangular Waveguides – characteristic of TE and TM Waves – Cut off wavelength and phase velocity – Impossibility of TEM waves in waveguides – Dominant mode in rectangular waveguide – Attenuation of TE and TM modes in rectangular waveguides – Wave impedances – characteristic impedance – Excitation of modes.

Moddule IV(10 hours)

Circular waveguides and resonators:- Bessel functions – Solution of field equations in cylindrical co-ordinates – TM and TE waves in circular guides – wave impedances and characteristic impedance – Dominant mode in circular waveguide – excitation of modes – Microwave cavities, Rectangular cavity resonators, circular cavity resonator, Q factor of a cavity resonator.

Module IV (10hours)

Transmission lines:- Uniform transmission line- Transmission line equations. Voltage and Current distribution, loading of transmission lines. Transmission line Parameters – Characteristic impedance - Definition of Propagation Constant. General Solution of the transmission line, Derivation of input impedance of transmission line. VSWR and reflection coefficient – wavelength and velocity of propagation. Waveform distortion – distortion less transmission line. The quarter wave line and impedance matching:-The Smith Chart – Application of the Smith Chart – Single stub matching and double stub matching.

REFERENCES

1. W H.Hayt & J A Buck : "*Engineering Electromagnetics*" Tata McGraw-Hill, 7th Edition 2007.
2. Mathew N.O. Sadiku: "*Elements of Electromagnetics*"–, Oxford Pub, 3rd Edition.
3. David K.Cheng: "*Field and Wave Electromagnetics* - Second Edition-Pearson Edition, 2004.
4. W H.Hayt & J A Buck ,*"Problems and Solutions in Electromagnetics"* - Tata McGraw-Hill,2010
5. E.C. Jordan & K.G. Balmain: "*Electromagnetic Waves and Radiating Systems*." PHI.
6. J. D. Kraus : "*Electromagnetics*", 5th Edition, Mc Graw Hill Publications.
7. Edminister : "*Electromagnetics*", Schaum series, 2 Edn.
8. D A Pozar, Microwave Engineering, Wiley
9. Umran S. Inan & Aziz S. Inan: *Engineering Electromagnetics*, Pearson Education, 1999.
10. Nannapaneni Narayana Rao: *Elements of Engineering Electromagnetics*, 5th Edition, Pearson Education.
11. Clayton R.Paul ,Keith W.Whites, Syed A Nasar "Introduction to Electromagnetic Fileds" TATA McGraw-Hill 3rd Edition

EC010 506 MICROPROCESSORS AND APPLICATIONS

Teaching scheme **Credits: 4**
3 hours lecture and 1 hour tutorial per week.

Objectives

- *To study the architecture of microprocessors 8085 and 8086.*
- *To understand the instruction set of 8085.*
- *To know the methods of interfacing them to the peripheral devices.*
- *To use all the above in the design of microprocessor based systems.*

Module I (12hours)
Introduction to microprocessors and microcomputers: Function of microprocessors- organisation of a microprocessor based system – microprocessor architecture and its operations – memory – I/O devices - pin configuration and functions of 8085 – tristate bus concept - control signals– de-multiplexing AD_0-AD_7 – flags - memory interfacing - I/O addressing - I/O mapped I/O - memory mapped I/O schemes - instruction execution - fetch/execute cycle - instruction timings and operation status.

Module II (12 hours)
Intel 8085 instruction set - instruction and data format – simple programs - programs in looping, counting and indexing – 16 bit arithmetic operations - stack and subroutines - basic concepts in serial I/O – 8085 serial I/O lines

Module III (12 hours)
Basic interfacing concepts – interfacing input devices – interfacing output devices – interfacing as memory mapped I/O - Interrupts – vectored interrupt – restart as software instruction – interfacing A/D and D/A converters.

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Module IV (12 hours)
Programmable interface devices – basic concepts – 8279 programmable keyboard / display interface – 8255A programmable peripheral interface – 8254 programmable interval timer – 8259A programmable interrupt controller - DMA and 8237 as DMA controller.

Module V (12 hours)
Intel 8086 Microprocessor - Internal architecture – Block diagram – Minimum and maximum mode operation – Interrupt and Interrupt applications – memory organization – even and odd memory banks – segment registers – logical and physical address – advantages and disadvantages of physical memory.

Reference

1. Ramesh S Goankar, *8085 Microprocessors Architecture Application and Programming,* Penram International, 5th edition, 1999.
2. Aditya P Mathur, *Introduction to Microprocessor*, Tata McGraw-Hill, 3rd edition, 2002.
3. Douglas V Hall, *Microprocessors and Interfacing*, Tata McGraw-Hill 2nd edition, 2008.
4. N Senthil Kumar, M Saravanan, *Microprocessors and Microcontrollers*, Oxford University press, 2010.
5. John Uffenbeck, *Microcomputer and Microprocessor, The 8080, 8085 And Z80 Programming, Interfacing and Trouble Shooting*, PHI, 3rd edition, 2006.
6. Michel Slater, *Microprocessor Based Design A Comprehensive Guide to Effective Hardware Design*, PHI, 2009.

7. P K Ghosh, P R Sridhar, *0000 to 8085 Introduction to Microprocessors for Engineers and Scientists*, Prentice Hall of India, 2nd edition, 2006.

EC010 507 DIGITAL ELECTRONICS LAB

Teaching scheme **Credits: 2**
3 hours practical per week.

Objectives

- *To provide experience on design, testing, and realization of few digital circuits used.*
- *To understand basic concepts of memories, decoders etc.*

LIST OF EXPERIMENTS:-

1. Study of Logic Gates: Truth-table verification of OR, AND, NOT, XOR, NAND and NOR gates.
2. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
3. Design and Realization of half, full adder or subtractor using basic gates and universal gates.
4. Flip Flops: Truth-table verification of JK Master Slave FF, T and D FF.
5. Asynchronous Counter: Realization of 4-bit up counter and Mod-N counters.
6. Synchronous Counter: Realization of 4-bit up/down counter and Mod-N counter.
7. Shift Register: Study of shift right, SIPO, SISO, PIPO, PISO and shift left operations
8. Ring counter and Johnson Counter.
9. Design examples using Multiplexer and De multiplexer.
10. LED Display: Use of BCD to 7 Segment decoder / driver chip to drive LED display
11. Static and Dynamic Characteristic of NAND gate (both TTL and MOS)

Mini Project based on above experiments.

EC 010 508(EE) Electric Drives and Control Lab

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To familiarise the students with the working and characteristics of various electrical machines.*
- *To provide experience on design and analysis of few power electronic circuits*

Experiments

1. OCC of self and separately excited D.C machines – critical resistances of various speeds. Voltage build-up with a given field circuit resistance. Critical speed for a given field circuit resistance.
2. Characteristics of D.C series motor
3. Load Test on D.C shunt motor and obtain the performance characteristics.
4. Swinburne's test on D.C machine
5. Polarity, transformation ratio tests of single phase transformers
6. O.C and S.C tests on single phase transformers – calculation of performance using equivalent circuit – efficiency, regulation at unity, lagging and leading power factors.
7. Load test on a single phase transformer .
8. Load test on induction motor.
9. Pre-determination of regulation of an alternator by emf and mmf methods.
10. VI characteristics of SCR .
11. VI characteristics of TRIAC.
12. R and RC-firing scheme for control of SCR.
13. UJT-firing scheme for SCR.
14. Design and Implementation of digital firing scheme for simple SCR circuits.

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References:

1. Dr. P S Bimbra, *Electrical Machinery*, Khanna Publishers
2. R K Rajput, *A text book of Electrical Machines*, Laxmi publishers
3. . Umanand, *Power Electronics- Essentials and Applications*, Wiley India 2009