JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH (POWER ELECTRONICS/ POWER AND INDUSTRIAL DRIVES/ POWER ELECTRONICS AND ELECTRIC DRIVES)

EFFECTIVE FROM ACADEMIC YEAR 2017- 18 ADMITTED BATCH

COURSE STRUCTURE AND SYLLABUS

I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-1	Machine Modeling and Analysis	25	75	4	0	0	4
PC-2	Modern Control Theory	25	75	4	0	0	4
PC-3	Power Electronic Devices and Converters	25	75	4	0	0	4
PE-1	1. Special Machines 2. High Frequency Magnetic Components 3. Programmable Logic Controllers and Applications	25	75	3	0	0	3
PE-2	1. Electric Traction systems 2. Advanced Digital Signal Processing 3. Digital Control Systems	25	75	3	0	0	3
OE-1	***Open Elective – I**	25	75	3	0	0	3
Laboratory I	Power Converters Simulation Lab	25	75	0	0	3	2
Seminar I	Seminar - I	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-4	Power Electronic Applications to Renewable Energy	25	75	4	0	1	4
PC-5	Embedded Systems for Power Electronic Applications	25	75	4	0	1	4
PC-6	Power Electronic Control of Drives	25	75	4	0	1	4
PE-3	1. HVDC & FACTS 2. Switched Mode Power Supplies (SMPS) 3. AI Techniques in Electrical Engineering	25	75	3	0	0	3
PE4	1. Dynamics of Electrical Machines 2. Hybrid Electric Vehicles 3. Smart Grid Technologies	25	75	3	0	0	3
OE-2	***Open Elective – II**	25	75	3	0	0	3
Laboratory II	Power Converters and Drives Lab	25	75	0	0	3	2
Seminar II	Seminar -II	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

III Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review I	100	0	0	0	22	8
Total	**200**	**100**	0	**3**	**22**	**14**

IV Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review II	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	200	0	0	0	16
Total	**100**	**200**	**0**	**0**	**24**	**24**

***Open Elective subjects must be chosen from the list of open electives offered by various departments.**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

MACHINE MODELLING AND ANALYSIS
(Professional core - I)

Prerequisites: Electrical Machines (DC and AC), control theory
Course Objectives:
- To comprehend the basic two-pole machine.
- To identify the methods and assumptions in modeling of machines.
- To write voltage and torque equations for different machines.
- To recognize the different frames for modeling of different AC machines.
- To express the voltage and torque equations in State space form

Course Outcomes: Upon the completion of the course the student will be able to
- Write the voltage equation and torque equations for different machines like dc machine, induction motor and Synchronous machines.
- Model different machines using phase and Active transformations.
- Identify the different reference frames for modeling of machines.

Unit-I:
Basic Two-pole DC machine - primitive 2-axis machine – Voltage and Current relationship – Torque equation.

Unit-II:
Mathematical model of separately excited DC motor and DC Series motor in state variable form – Transfer function of the motor - Numerical problems.
Mathematical model of D.C. shunt motor D.C. Compound motor in state variable form – Transfer function of the motor - Numerical Problems

Unit-III:
Liner transformation – Phase transformation (a, b, c to α, β, o) – Active transformation (α .β, o to d, q). Circuit model of a 3 phase Induction motor – Linear transformation - Phase Transformation – Transformation to a Reference frame – Two axis models for induction motor. dq model based DOL starting of Induction Motors.

Unit-IV:
Voltage and current Equations in stator reference frame – equation in Rotor reference frame – equations in a synchronously rotating frame – Torque equation - Equations I state – space form.

Unit-V:
Circuits model of a 3ph Synchronous motor – Two axis representation of Syn. Motor.
Voltage and current Equations in state – space variable form – Torque equation.
dq model based short circuit fault analysis- emphasis on voltage, frequency and recovery time.

TEXT BOOKS:
1. Analysis of electric machinery and Drive systems- Paul C. Krause , Oleg Wasynezuk, Scott D. Sudhoff, third edition, IEEE press
2. Generalized Machine theory P.S. Bimbhra, Khanna Publishers, 2002

REFERENCES:

1. Thyristor control of Electric Drives - Vedam Subramanyam, Tata McGraw-Hill Education, 1988
2. Power System Stability and Control – Prabha Kundur, EPRI.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

MODERN CONTROL THEORY
(Professional core - II)

Prerequisites: Linear control systems

Course Objectives:

- To explain the concepts of basic and modern control system for the real time analysis and design of control systems.
- To explain and apply concepts of state variables analysis.
- To study and analyze non linear systems.
- To analyze the concept of stability of nonlinear systems and categorization.
- To apply the comprehensive knowledge of optimal theory for Control Systems.

Course Outcomes: Upon the completion of the course the student will be able to

- Understand the concepts of state variable analysis
- Apply the knowledge of basic and modern control system for the real time analysis and design of control systems.
- Analyze the concept of stability of nonlinear systems and optimal control

UNIT–I:
Mathematical Preliminaries: Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non-uniqueness of state model – State diagrams for Continuous-Time State models.

UNIT-II:
State Variable Analysis: Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and its properties. General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability Canonical forms of State model.

UNIT-III:
Non Linear Systems: Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

UNIT-IV:
Stability Analysis: Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

State feedback controller design through Pole Assignment – State observers: Full order and Reduced order.

UNIT-V:

Optimal Control: Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.

TEXT BOOKS:

1. Modern Control System Theory by M.Gopal – New Age International -1984
2. Control System Engineering, Nagrath and Gopal - New Age International – Fourth Edition

REFERENCES:

1. Optimal control by Kirck , Dover Publications
2. Advanced Control Theory A. Nagoor Kani, RBA Publications, 1999
3. Modern Control Engineering by Ogata. K – Prentice Hall - 1997

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

POWER ELECTRONIC DEVICES AND CONVERTERS
(Professional core - III)

Course Objectives:

- To understand the characteristics and principle of operation of modern power semi conductor devices.
- To analyze and design switched mode regulator for various industrial applications.
- To analyze different power converters and know their applications

Course Outcomes: Upon the completion of the course the student will be able

- To choose appropriate device for a particular converter topology.
- To analyze and design various power converters and controllers

UNIT-I:
Modern Power Semiconductor Devices: Modern power semiconductor devices – MOS turn Off Thyristor (MTO) – Emitter Turn off Thyristor (ETO) – Integrated Gate-Commutated thyristor (IGCTs) – MOS-controlled Thyristors (MCTs) – Insulated Gate Bipolar Transistor (IGBT) – MOSFET – comparison of their features.

Unit-II:
D.C. to D.C. Converters: Analysis of step – down and step-up dc to dc converters with resistive and Resistive –inductive loads – Switched mode regulators – Analysis of Buck Regulators – Boost regulators – buck and boost regulators – Cuk regulators – Condition for Continuous inductor current and capacitor voltage – comparison of regulators – Multi-output boost converters – Advantages - Applications.

Unit-III:
PWM Techniques: single PWM – Multiple PWM – sinusoidal PWM – modified PWM – phase displacement Control – Advanced modulation techniques for improved performance – Trapezoidal, staircase, stepped, harmonic injection and delta modulations – Advantage – application.
Third Harmonic PWM – 60 degree PWM – space vector modulation – Comparison of PWM techniques – harmonic reductions.

UNIT-IV:
Multilevel Inverters: Two level voltage source inverter - Multilevel concept – Classification of multilevel inverters – Diode clamped multilevel inverter – principle of operation – main features – improved diode Clamped inverter – principle of operation – Flying capacitors multilevel inverter – principle of operation – main features. Cascaded multilevel inverter – principle of operation – main features – Multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives – Switching device currents – de link capacitor voltage balancing – features of Multilevel inverters – comparisons of multilevel converters.

UNIT-V:
Resonant Pulse Inverters: Resonant pulse inverters – series resonant inverters – series resonant inverters with unidirectional switches – series resonant inverters with bidirectional Switches – analysis of half bridge resonant inverter - evaluation of currents and Voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverters – for series loaded inverter – for parallel loaded inverter – For

series and parallel loaded inverters – parallel resonant inverters – Voltage control of resonant inverters.

Resonant converters: Resonant converters – Zero current switching resonant converters – L type ZCS resonant converter – M type ZCS resonant converter – zero voltage switching resonant converters – comparison between ZCS and ZVS resonant Converters – Two quadrant ZVS resonant converters – resonant de-link Inverters – evaluation of L and C for a zero current switching inverter.

TEXT BOOKS:

1. Power Electronics – Mohammed H. Rashid – Pearson Education Third Edition – First Indian reprint 2004.
2. Power Electronics – Ned Mohan, Tore M. Undeland and William P. Robbins – John Wiley and Sons – Second Edition.

REFERENCE BOOKS:

1. Power Electronics – Daniel W. Hart, McGraw Hill Publications.
2. Power Electronics Devices, Circuits and Industrial applications, V. R. Moorthi, Oxford University Press
3. Power Electronics, Dr. P. S. Bimbhra, Khanna Pubishers.
4. Elements of Power Electronics, Philip T. Krein, Oxford University Press.
5. Power Electronics, M. S. Jamil Asghar, PHI Private Limited.
6. Principles of Power Electronics, John G. Kassakian, Martin F. Schlect, Geroge C. Verghese, Pearson Education.
7. Fundamentals of Power Electronics, Robert W. Erickson, Dragan and Maksimobic, Springer.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

SPECIAL MACHINES
(Professional Elective – I)

Course objectives:

- To understand the working and construction of special machines
- To know the use of special machines in different feed-back systems
- To understand the use of digital controllers for different machines

Course Outcomes: Upon the completion of this subject, the student will be able

- To understand the operation of different special machines
- To select different special machines as part of control system components
- To use special machines as transducers for converting physical signals into electrical signals
- To design digital controllers for different machines

UNIT–I:
Stepper Motors: Introduction-synchronous inductor (or hybrid stepper motor), Hybrid stepping motor, construction, principles of operation, energization with two phase at a time- essential conditions for the satisfactory operation of a 2-phase hybrid step motor - very slow - speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors-an open-loop controller for a 2-phase stepping motor.

UNIT-II:
Variable Reluctance Stepping Motors: Variable reluctance (VR) Stepping motors, single-stack VR step motors, Multiple stack VR motors-Open-loop control of 3-phase VR step motor-closed-Loop control of step motor, discriminator (or rotor position sensor) transilator, major loop-characteristics of step motor in open-loop drive – comparison between open-loop position control with step motor and a position control servo using a conventional (dc or ac) servo motor- Suitability and areas of application of stepping motors-5- phase hybrid stepping motor - single phase - stepping motor, the construction, operating principle torque developed in the motor.
Switched Reluctance Motor: Introduction – improvements in the design of conventional reluctance motors- Some distinctive differences between SR and conventional reluctance motors-principle of operation of SRM- Some design aspects of stator and rotor pole arcs, design of stator and rotor and pole arcs in SR motor-determination of L(θ)-θ profile - power converter for SR motor-A numerical example –Rotor sensing mechanism and logic control, drive and power circuits, position sensing of rotor with Hall problems-derivation of torque expression, general linear case.

UNIT–III:
Permanent Magnet Materials and PM DC Machines: Introduction, Hysteresis loops and recoil line-stator frames (pole and yoke - part) of conventional PM dc Motors, Equivalent circuit of PM Generator and Motor-Development of Electronically commutated dc motor from conventional dc motor.
Brushless DC Motor: Types of construction – principle of operation of BLDM- sensing and switching logic scheme, sensing logic controller, lockout pulses –drive and power circuits, Base drive circuits, power converter circuit-Theoretical analysis and performance prediction, modeling and magnet circuit d-q analysis of BLDM -transient analysis formulation in terms of flux linkages as state variables-Approximate solution for current and torque under steady state –Theory of BLDM as variable speed synchronous motor (assuming sinusoidal flux distribution)- Methods or reducing Torque Pulsations, 180 degrees pole arc and 120 degree current sheet.

UNIT-IV:

Linear Induction Motor: Development of a double sided LIM from rotary type IM- A schematic of LIM drive for electric traction development of one sided LIM with back iron-field analysis of a DSLIM fundamental assumptions.

UNIT-V:

Permanent Magnet Axial Flux (Pmaf) Machines: Construction, Armature windings – Toroidal Stator and Trapezoidal Stator Windings, Torque and EMF equations, Phasor diagram and output equation.

TEXT BOOKS:

1. Special electrical machines, K. Venkataratnam, - University press.
2. Special electrical machines, E. G. Janardanan, - PHI.
3. R. K. Rajput, “Electrical machines”-5th edition.
4. V. V. Athani, “Stepper motor: Fundamentals, Applications and Design”- New age International pub.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

HIGH FREQUENCY MAGNETIC COMPONENTS
(Professional Elective – I)

Course objectives:

- To understand the fundamentals of magnetic devices
- To know the skin and proximity effects in windings
- To design high frequency transformers
- To analyze and design the various components of converters

Course Outcomes: Upon the completion of this subject, the student will be able

- To understand the operation of magnetic devices
- To appreciate the skin and proximity effects in various windings
- To analyze and design the components in power electronic converters
- To design transformers of High frequency used in converters

Unit-I:

Fundamentals of Magnetic Devices: Introduction, Magnetic Relationships, Magnetic Circuits, Magnetic Laws, Eddy Currents, Core Saturation, Volt-Second Balance, Inductance, Inductance Factor, Magnetic Energy, Self-Resonant Frequency, Classification of Power Losses in Magnetic Components, Non-inductive Coils.

Magnetic Cores: Introduction, Properties of Core Materials, Magnetic Dipoles, Magnetic Domains, Curie Temperature, Magnetization, Magnetic Materials, Hysteresis, Core Permeability, Core Geometries, Iron Alloy Cores, Amorphous Alloy Cores, Nickel–Iron and Cobalt–Iron Cores, Ferrite Cores, Powder Cores, Nano-crystalline Cores, Superconductors, Hysteresis Core Loss, Eddy-Current Core Loss, Total Core Loss, Complex Permeability.

Unit-II:

Skin Effect & Proximity Effect: Introduction, Magnet Wire, Wire Insulation, Skin Depth, Ratio of AC-to-DC Winding Resistance, Skin Effect in Long Single Round Conductor, Current Density in Single Round Conductor, Impedance of Round Conductor, Magnetic Field Intensity for Round Wire, Other Methods of Determining the Round Wire Inductance, Power Density in Round Conductor, Skin Effect on Single Rectangular Plate. Proximity and Skin Effects in Two Parallel Plates, Anti-proximity and Skin Effects in Two Parallel Plates, Proximity Effect in Multiple-Layer Inductor, Appendix: Derivation of Proximity Power Loss.

Winding Resistance at High Frequencies: Introduction, Winding Resistance, Square and Round Conductors, Winding Resistance of Rectangular Conductor, Winding Resistance of Square Wire, Winding Resistance of Round Wire, Leakage Inductance, Solution for Round Conductor Winding in Cylindrical Coordinates, Litz Wire, Winding Power Loss for Inductor Current with Harmonics, Effective Winding Resistance for Non-sinusoidal Inductor Current, Thermal Model of Inductors.

Unit-III:

Transformers: Introduction, Neumann's Formula for Mutual Inductance, Mutual Inductance, Energy Stored in Coupled Inductors, Magnetizing Inductance, Leakage Inductance, Measurement of Transformer Inductances, Stray Capacitance, High-Frequency Transformer Model, Non-interleaved Windings, Interleaved Windings, AC Current Transformers, Winding Power Losses with Harmonics, Thermal Model of Transformers.

Design of Transformers: Introduction, Area Product Method, Optimum Flux Density, Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM, Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM.

Unit-IV:

Integrated Inductors: Introduction, Resistance of Rectangular Trace, Inductance of Straight Rectangular Trace, Construction of Integrated Inductors, Meander Inductors, Inductance of Straight Round Conductor, Inductance of Circular Round Wire Loop, Inductance of Two-Parallel Wire Loop, Inductance of Rectangle of Round Wire, Inductance of Polygon Round Wire Loop, Bond-wire Inductors, Single-Turn Planar Inductor, Inductance of Planar Square Loop, Planar Spiral Inductors, Multi-metal Spiral Inductors, Planar Transformers, MEMS Inductors, Inductance of Coaxial Cable, Inductance of Two-Wire Transmission Line, Eddy Currents in Integrated Inductors, Model of RF Integrated Inductors, PCB Inductors.

Design of Inductors: Introduction, Restrictions on Inductors, Window Utilization Factor, Temperature Rise of Inductors, Mean Turn Length of Inductors, Area Product Method, AC Inductor Design, Inductor Design for Buck Converter in CCM, Inductor Design for Buck Converter in DCM method.

Unit-V:

Self-Capacitance: Introduction, High-Frequency Inductor Model, Self-Capacitance Components, Capacitance of Parallel-Plate Capacitor, Self-Capacitance of Foil Winding Inductors, Capacitance of Two Parallel Round Conductors, Capacitance of Round Conductor and Conducting Plane, Self-Capacitance of Single-Layer Inductors, Self-Capacitance of Multi-layer Inductors, Capacitance of Coaxial Cable.

TEXT BOOK:

1. Design of Magnetic Components for Switched Mode Power Converters, Umanand L., Bhat, S.R., ISBN: 978-81-224-0339-8, Wiley Eastern Publication, 1992.

REFERENCES:

1. High-Frequency Magnetic Components, Marian K. Kazimierczuk, ISBN: 978-0-470-71453-9 John Wiley & Sons, Inc.
2. G. C. Chryssis, High frequency switching power supplies, McGraw Hill, 1989 (2nd Ed.)
3. Eric Lowdon, Practical Transformer Design Handbook, Howard W. Sams & Co., Inc., 1980
4. “Thompson --- Electrodynamic Magnetic Suspension.pdf”
5. Witulski --- “Introduction to modeling of transformers and coupled inductors” Beattie --- “Inductance 101.pdf”
6. P. L. Dowell, "Effects of eddy currents in transformer windings.pdf"
7. Dixon--- “Eddy current losses in transformer windings.pdf”
8. J J Ding, J S Buckkeridge, “Design Considerations For A Sustainable Hybrid Energy System” IPENZ Transactions, 2000, Vol. 27, No. 1/EMCh.
9. Texas Instruments --- “Windings.pdf”
10. Texas Instruments --- “Magnetic core characteristics.pdf”
11. Ferroxcube --- “3f3 ferrite datasheet.pdf”
12. Ferroxcube --- “Ferrite selection guide.pdf”
13. Magnetics, Inc., Ferrite Cores (www.mag-inc.com).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

PROGRAMMABLE LOGIC CONTROLLERS AND APPLICATIONS
(Professional Elective – I)

Course Objectives:

- To understand the generic architecture and constituent components of a Programmable Logic Controller.
- To develop a software program using modern engineering tools and technique for PLC.
- To apply knowledge gained about PLCs to identify few real life industrial applications

Course Outcomes: Upon the completion of the course the student will be able to

- Develop and explain the working of PLC with the help of a block diagram.
- Execute, debug and test the programs developed for digital and analog operations.
- Reproduce block diagram representation on industrial applications using PLC.

Unit-I:
PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

Unit-II:
PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation.
Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction, and flow chart for spray process system.

Unit-III:
PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

Unit-IV:
Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

Unit-V:
Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

REFERENCE BOOKS:

1. Programmable Logic Controllers – Principle and Applications by John W Webb and Ronald A Reiss Fifth edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR Hackworth and F.D Hackworth – Jr- Pearson, 2004.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

ELECTRIC TRACTION SYSTEMS
(Professional Elective - II)

Course Objectives:
- To understand various systems of track electrification, power supply system and mechanics of electric train.
- To identify a suitable drive for electric traction.

Course Outcomes: Upon the completion of the course the student will be able to
- Understand Traction systems and its mechanics
- Identify the power supply equipment for traction systems
- Analyze various types of motors used in traction and differentiate AC and DC traction drives

UNIT – I
Traction Systems : Electric drives - Advantages & disadvantages - System of track electrification - d.c., 1-Phase low frequency, 3-Phase low frequency and composite systems, Problems of 1-phase traction system - Current unbalance, Voltage unbalance, Production of harmonics, Induction effects, Booster transformer - Rail connected booster transformer. Comparison between ac. and d.c. systems.

UNIT – II
Traction mechanics: Types of services, Speed - time curves - Construction of quadrilateral and trapezoidal speed time curves, Average & schedule speeds. Tractive effort - Speed characteristic, Power of traction motor, specific energy consumption - Factors affecting specific energy consumption, Coefficient of adhesion, slip - Factors affecting slip, magnetically suspended trains.

UNIT – III
Power supply arrangements : High voltage supply, Constituents of supply system - Substations, Feeding post, Feeding & sectioning arrangements, Remote control center, Design considerations of substations, Over head equipment - principle of design of OHE, Polygonal OHE - Different types of constructions, Basic sag & tension calculations, Dropper design, Current collection gear for OHE.

UN IT – IV
Traction motors : Desirable characteristics, D.C. series motors, A.C. series motors, 3-Phase induction motors, linear induction motors, D.C. motor series & parallel control - Shunt bridge transition – Drum controller, Contact type bridge transition control, Energy saving, Types of braking in a.c. and d.c. drives, Conditions for regenerative braking, Stability of motors under regenerative braking.

UNIT – V
Semi conductor converter controlled drives: Advantages of A.C. Traction - Control of d.c. motors - single and two stage converters, Control of ac. motors - CSI fed squirrel cage induction motor, PWM VSI induction motor drive, D.C. traction — Chopper controlled d.c. motors, composite braking, Diesel electric traction — D.C. generator fed d.c. series motor, Alternator fed d.c. series motor, Alternator fed squirrel cage induction motor, Locomotive and axle codes.

TEXT BOOKS:

1. Partab.H - Modern Electric Traction, Dhanpat Rai & Sons – 1998.
2. Dubey. G.K. - Fundamentals of Electrical Drives, Narosa Publishing House - 2001.

3. C. L. Wadhwa — Generation, Distribution and Utilization of Electrical Energy, New Age International - 2006.
4. J.B. Gupta - Utilization of Electrical Power and Electric Traction, S. K. Kataria & Sons publications, 9^{th} edition 2004.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

ADVANCED DIGITAL SIGNAL PROCESSING
(Professional Elective - II)

Prerequisite: Digital Signal Processing
Course Objectives:
- To have an overview of signals and systems and DFT & FFT Transforms.
- To study the design of IIR & FIR filters.
- To study the applications of DSP techniques in processors.

Course Outcomes: Upon the completion of the course the student will be able to
- Understand types of digital signals and Transforms and its application to signals and systems.
- Design IIR & FIR filters.
- Estimate power spectrum using various methods

UNIT–I:
Digital Filter Structures: Block diagram representation – Equivalent Structures – FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Sine-cosine generator- Computational complexity of digital filter structures.

UNIT–II:
Digital Filter Design: Preliminary considerations- Bilinear transformation method of IIR filter design – design of Low pass high-pass – Band-pass, and Band stop- IIR digital filters – Spectral transformations of IIR filters – FIR filter design –based on Windowed Fourier series – design of FIR digital filters with least – mean square-error – constrained Least –square design of FIR digital filters.

UNIT-III:
DSP Algorithme Implémentation: Computation of the discrete Fourier transform- Number representation – Arithmetic operations – handling of overflow – Tunable digital filters – function approximation.

UNIT-IV:
Analysis Of Finite Word Length Effects: The Quantization process and errors-Quantization of fixed –point and floating –point Numbers – Analysis of coefficient Quantization effects – Analysis of Arithmetic Round-off errors- Dynamic range scaling – signal –to- noise in Low –order IIR filters- Low –Sensitivity Digital filter – Reduction of Product round-off errors feedback – Limit cycles in IIR digital filter – Round – off errors in FFT Algorithms.

UNIT-V:
Power Spectrum Estimation: Estimation of spectra from Finite Duration Observations signals- Non-parametric methods for power spectrum Estimation- parametric method for power spectrum Estimation- Estimation of spectral form-Finite duration observation of signals- Non-parametric methods for power spectrum estimation – Walsh methods – Blackman and torchy method.

TEXT BOOKS:
1. Digital Signal Processing principles –algorithms and Applications- john G. Proakis –PHI – 3rd edition 2002.
2. Digital Time Signal Processing: Alan V. Oppenheim, Ronald W ,Shafer – PHI 1996 1st Edition reprint

3. Advanced Digital Signal Processing – Theory and Applications – Glenn Zelniker, Fred J. Taylor.

REFERENCE BOOK:

1. Digital Signal Processing – S. Salivahanan . A Vallavaraj C. Gnanapriya –TMH – 2^{nd} reprint 2001.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

DIGITAL CONTROL SYSTEMS
(Professional Elective - II)

Prerequisites: Linear control systems, Z-Transforms

Course Objectives:

- To explain basic and digital control system for the real time analysis and design of control systems.
- To apply the knowledge state variable analysis in the design of discrete systems.
- To explain the concept of stability analysis and design of discrete time systems.

Course Outcomes: Upon the completion of the course the student will be able to

- Understand the concepts of Digital control systems.
- Analyze and design discrete systems in state variable analysis.
- Relate the concepts of stability analysis and design discrete time systems.

UNIT – I:
Introduction: Block Diagram of typical control system- advantages of sampling in control systems – examples of discrete data and digital systems – data conversion and quantization – sample and hold devices – D/A and A/D conversion – sampling theorem – reconstruction of sampled signals –ZOH.
Z-transform: Definition and evaluation of Z-transforms – mapping between s-plane and z-plane – inverse z-plane transform – theorems of the Z-transforms –limitations of z-transforms –pulse transfer function –pulse transfer function of ZOH –relation between G(s) and G(z) – signal flow graph method applied to digital systems.

UNIT- II:
State Space Analysis: State space modeling of digital systems with sample and hold – state transition equation of digital time in variant systems – solution of time in variant discrete state equations by the Z-Transformation – transfer function from the state model – Eigen values – Eigen vector and diagonalisation of the A-matrix – Jordan canonical form. Computation of state transition matrix-Transformation to phase to variable canonical form-The state diagram – decomposition of digital system – Response of sample data system between sampling instants using state approach.
Stability: Definition of stability – stability tests – The second method of Liapunov.

UNIT- III:
Time Domain Analysis: Comparison of time response of continuous data and digital control systems-correlation between time response and root locus j the s-plane and z-plane – effect of pole-zero configuration in the z-plane upon the maximum overshoot and peak time of transient response – Root loci for digital control systems – steady state error analysis of digital control systems – Nyquits plot – Bode plot-G.M and P.M.

UNIT- IV:
Design: The digital control design with digital controller with bilinear transformation – Digital PID controller-Design with deadbeat response-Pole placement through state feedback-Design of full order state observer-Discrete Euler Lagrance Equation – Discrete maximum principle.

UNIT-V:

Digital State Observer: Design of - Full order and reduced order observers. Design by max. Principle: Discrete Euler language equation-discrete maximum principle.

TEXT BOOKS:

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition.
2. Digital Control and State Variable Methods by M. Gopal, TMH.

REFERENCE BOOKS:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control Engineering, M. Gopal

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – I Sem. (PE/PEED/PID)

POWER CONVERTERS SIMULATION LAB

Course Objectives:

- Students must be able to write the programs for the given problem / system using suitable software
- Students must be able to model the given problem / system using suitable software

Course Outcomes: Upon the completion of this course, the student will be able to

- Acquire knowledge about potential softwares used in electrical engineering.
- Choose and simulate any problem related to Power Electronics and allied fields using appropriate soft wares
- Validate the obtained results and maintain the record

List of Experiments:

1. Modelling and simulation of separately excited DC motor and to study the dynamic behaviour of the machine for change in load torque
2. Modelling and simulation of separately excited Induction machine and to study the dynamic behaviour of the machine for change in load torque
3. Modelling and simulation of three phase synchronous machine and to study the dynamic behaviour of the machine for change in load torque
4. Simulation & analysis of Boost converters with RL load.
5. Simulation & analysis of Boost converters with RL load.
6. Simulation & analysis of Buck-Boost converters with RL load
7. Single-Phase Inverter using PWM Controller with RL Load.
8. Simulation & analysis of three phase PWM inverter fed Induction Motor.
9. Simulation & analysis of Multi Level inverter fed Induction Motor.
10. Mathematical Modeling of discrete time Systems
11. State Space Model For Classical Transfer Function Using MATLAB Verification
12. Obtain PID controller parameters for DC Motor Speed Control.
13. Dynamic behavior of a Induction motor using transfer function approach.
14. Dynamic behavior of a Induction motor using State Space Model approach.

Note: Any ten experiments can be conducted.
Note: Use the suitable software for simulation.