Harcourt Butler Technological Institute, Kanpur (U.P.) -208002

Evaluation Scheme
M. Tech. (Part Time-EE, Power Electronics and Control)

Sl. No.	Course Code	Subject	Periods			Evaluation scheme					Subject total
			L	T	P	Sessional				Exam	
						CT	AT	TA	Total	ESE	
Semester-I											
1.	QEE 101	Advance Power Electronics	3	1	0	30	10	10	50	100	150
2.	QEE 102	Advanced Control System	3	1	0	30	10	10	50	100	150
3.	QEE 103	EHV AC & DC Transmission	3	1	0	30	10	10	50	100	150
		Total	9	3	0				150	300	450
Semester-II											
1.	QEE 201	Industrial Drives and Automation	3	1	0	30	10	10	50	100	150
2.	QEE 202	Intelligent Techniques and Applications	3	1	0	30	10	10	50	100	150
3.	QEE 203	Advanced Microprocessors and Microcontrollers	3	1	0	30	10	10	50	100	150
		Total	9	3	0				150	300	450
Semester III											
1.	QEE 301	Modeling & Simulation	3	1	0	30	10	10	50	100	150
2.	QEE 302-306	Elective -I	3	1	0	30	10	10	50	100	150
3.	QEE 307	Seminar and Minor Project			2				100		100
		Total	6	2	2				200		400
Semester IV											
1.	QEE401-405	Elective-II	3	1	0	30	10	10	50	100	150
2.	QEE 406	Dissertation			12				50		50
		Total	3	1	12				100	100	200
Semester V											
1.	QEE501-505	Elective-III	3	1	0	30	10	10	50	100	150
2.	QEE 506	Dissertation			12				100		100
		Total	3	1	12				150	100	250
Semester VI											
1.	QEE 601	Dissertation			12				100	150	250
		Total			12				100	150	250
		Grand total									2000

Elective-I

1. QEE 302: Special Electrical Machines
2. QEE 303: Computer Methods in Power System
3. QEE 304: Virtual Instrumentation
4. QEE 305: Advanced Digital Signal Processing
5. QEE 306: Real Time Instrumentation

Elective-II

1. QEE 401: Power Quality and FACTS Devices
2. QEE 402: Embedded Systems
3. QEE 403: Biomedical Instrumentation

4. QEE 404: Digital Control Systems
5. QEE 405: Modeling and Dynamics of Electrical Machines

Elective-III

1. QEE 501: Non-conventional Energy Sources and Energy Converters
2. QEE 502: SCADA and Distributed Control Systems
3. QEE 503: Load and Energy Management
4. QEE 504: Robotics
5. QEE 505: Power System Security and Analysis

QEE-101: Advance Power Electronics

L	T	P
3	1	0

Unit-I

Review of semiconductor Devices: Conduction Process in semiconductors, p-n Junction, Charge control description, Avalanche breakdown, Power diodes, Thyristors, GTO, VI characteristics, Dynamic characteristics, ratings, protection, heat transfer by conduction, radiation and convection, heat sink design, driving circuits.

Unit-II

Power MOSFET and IGBT: Basic structure, I-V Characteristic, Physics of device operation, switching characteristics, operating limitation and safe operating area.

Emerging Devices and circuits: power junction FET, IGCT, Field Control Thyristor, MOS Control Thyristor etc. Power ICs, New semiconductor materials.

Unit-III

Snubber Circuits: Types of Snubber circuits, needs of Snubber circuit with diode, thyristor and transistors, Turn-off Snubber, over voltage snubber, turn on snubber, Snubber for bridge circuit configurations, GTO Snubber circuit.

Unit-IV

Gate and basic drive circuits: Design Consideration, De-coupled drive circuits, Electrically isolated drive circuits, cascade connected drive circuits, Power device protection in drive circuits, circuit layout considerations.

Unit-V

Design of magnetic components: Magnetic materials and cores, Copper windings, Thermal considerations, special inductor design and procedure, power and converter transformer design procedure and K-factor.

Reference Books:

1. Mohan, Undeland and Robbins, Power electronics: converters, Applications and Design, John Wiley & Sons
2. Rashid M.H., Power Electronics Handbook, Elsevier Press (Academic Press Series)
3. Finney D., The Power Thyristor and its Applications, McGraw Hill, New York
4. Lander C. W. Power Electronics, McGraw Hill Book Co., U.K.
5. Rashid M.H., Power Electronics - Circuits, Devices and Applications, PHI, India.\

QEE - 102: ADVANCED CONTROL SYSTEM

L	T	P
3	1	2

Unit-I

State Space Analysis of Continuous System:

Review of state variable representation of continuous system, conversion of state variable models to transfer function and vice-versa, solution of state equations and state transition matrix, controllability and observability, design of state observer and controller

Unit-II

Analysis of Discrete System:

Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modeling of sample-

hold circuit, solution of state difference equations, steady state accuracy, stability on the z-plane and Jury stability criterion, bilinear transformation, Routh-Hurwitz criterion on rth planes

Unit-III

Stability:

Lyapunov's stability theorems for continuous and discrete systems, methods for generating Lyapunov function for continuous and discrete system, Popov's criterion.

Non linear System:

Types of non linearities, phenomena related to non - linear systems.

Analysis of non linear systems-Linearization method, second order non-linear system on the phase plane, types of phase portraits, singular points, system analysis by phase-plane method, describing function and its application to system analysis.

Unit-IV

Optimal Control:

Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization. Pontryagin's Minimum Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation, Riccati equation and its solution.

QEE- 103 : EHV AC & DC TRANSMISSION

L	T	P
3	1	2

UNIT-I

Introduction :

Need of EHV transmission, standard transmission voltage, comparison of EHV ac & dc transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission

UNIT-II

EHV AC Transmission :

Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferroresonance, reduction of switching surges on EHV system, principle of half wave transmission.

UNIT-III

Extra High Voltage Testing:

Characteristics and generation of impulse voltage, generation of high Ac and Dc voltages, measurement of high voltage by spheregaps and potential dividers.

Consideration for Design of EHV Lines:

Design factors under steady state limits, EHV line insulation design based upon transient over voltages.

Effects of pollution on performance of EHV lines.

UNIT-IV

EHV DC Transmission – I:

Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters.

Principle of dc link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of dc link.

UNIT-V

EHV DC Transmission – II:

Converter faults, protection against over currents and over voltages, smoothing reactors, generation of harmonics, ac and dc filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications.

QEE-201: Industrial Drives & Automation

L	T	P
3	1	0

Unit-I

Introduction: Definition, Types of loads, steady state & transient stability of drives, state of art of power electronics and drives, selection of motor rating, open-loop control and closed-loop control, transfer function and state space modeling, PSIM/ MATLAB.

Unit-II

D.C. Drives: Review of braking and speed control of D.C. motors, multi-quadrant operation, loss minimization in adjustable speed drives. Mathematical modeling of dc drives, stability analysis, modern control techniques: variable structure, adaptive control, Simulation of open loop and closed loop control of DC motor.

Unit-III

Induction motor drives: Review of braking and speed control of induction motors. Constant V/F, constant air gap flux, controlled voltage, controlled current and controlled slip operation. Mathematical modeling of induction motor drives, transient response and stability analysis Introduction to cyclo-converter fed induction motor drive, Simulation of open loop and closed loop control of induction motor.

Unit-IV

Synchronous motor drives: Adjustable frequency operation, voltage fed drive, current fed self-controlled drive, Simulation of open loop and closed loop control of synchronous motor.

Unit-V

Automation using drives: Introduction, various components of automation, different sensors used in automation, PLC introduction and ladder programming, industrial application of automation, sensor less vector control and DTC drive, recent trends in automation and case studies.

Reference Books:

1. Dubey G.K., Power Semiconductor Controlled Drive, Prentice Hall, New Jersey
2. Sen P.C., Thyristor Controlled DC Drives, Wiley, New York.
3. Murphy J.M.D. and Turnbull F.G., Power Electronics Control of AC Motors, Franklin Book Co.
4. Bose B.K., Power Electronics and AC Drives, Prentice Hall, New Jersey.
5. Bose B. K., Power Electronics and Variable Frequency Drives-technology and applications, IEEE Press.

QEE-202: Intelligent Techniques & Applications

L	T	P
3	1	0

Unit-I

Artificial intelligence: Definition, problem solving methods, searching techniques, knowledge representation, reasoning methods, predicate logic, predicate calculus, multivalue logic.

Unit-II

Fuzzy logic: Concepts, fuzzy relations, membership functions, matrix representation, de-fuzzification methods, Use of MATLAB Fuzzy Tool box, industrial applications and recent trends.

Unit-III

Artificial neural network: Introduction, multi-layer feed forward networks, back propagation algorithms, radial basis function and recurrent networks, Use of MATLAB NN Tool box, industrial applications and recent trends.

Unit-IV

Evolutionary techniques: Introduction and concepts of genetic algorithms and evolutionary programming, Use of MATLAB GA Tool box, industrial applications and recent trends.

Unit-V

Hybrid systems: Introduction and Algorithms for Neuro-Fuzzy, Neuro-Genetic, Genetic-Fuzzy systems, industrial applications and recent trends.

Reference Books:

1. Rajasekaran S. and Pai G.A.V., "Neural Networks, Fuzzy Logic And Genetic Algorithm Synthesis and applications, PHI New Delhi.
2. Lin C. and Lee G., "Neural Fuzzy Systems", Prentice Hall International Inc.
3. Goldberg D.E. Genetic Algorithms in Search Optimization & Machine Learning, Addition Wesley Co., New York.
4. Kosko B., "Neural Networks & Fuzzy Systems A dynamical systems approach to machine Intelligence, Prentice Hall of India.
5. Taylor C.W., "Power System stability" Mc-Graw Hill, New York.

QEE-203: Advanced Microprocessors and Micro-controllers

L	T	P
3	1	0

Unit-I

Introduction: An Overview of 8085 & 8086 microprocessors

16 BIT Microprocessors: 80186/80286, Architecture, Instruction Set, Programming Concepts, Real Mode and Protection Mode Operation

Unit-II

Advanced Processors: 32 bit microprocessor architecture, Addressing, Instruction Set, Programming concepts.

Input-Output Techniques: Serial & Parallel, and other I/O standards, Interrupt Structures, Standard bus structures

Unit-III

Programmable Peripheral Chips and Their Use: Timer/Counter, Serial & Parallel Data Transfer Controller, Interrupt Controller, Co-Processor, RISC Processor, Pentium Super Scalar Architecture

Unit-IV

Microcontroller: 8 bit Microcontroller, architecture, Addressing Modes, Timers, Counters, Interrupts, Serial Communication, Programming Concepts and applications to Electric Drive Systems

Unit-V

Introduction to Various Microcontrollers: 16 bit and 32 bit Microcontrollers.

Reference Books:

1. B.B. Brey, The Intel Microprocessor-8086/8088, 80186,80286,80386,80486, Pentium, Architecture,

Programming, PHI
2. Douglas V. Hall, Microprocessors & Interfacing-Programming & hardware, TMH
3. Mazidi M. The 8051 Micro-controller & Embedded Systems, PHI
4. Kenneth Hintz & Daniel Tabak: Micro-controller, Architecture, Implementation & Programming, McGraw Hill Int.
5. J. Aayla : 8051 Micro-controller, PHI.

QEE-301: Modeling & Simulation

L	T	P
3	1	0

Unit-I
Introduction: Objectives of Modeling, System Theory and State Variables.

Type of Models: Analytic, Simulation, Measurement, Analytic Modeling, Probability Theory, Random Variables, Poisson Process, Markov Chains.

Unit-II
Queuing Theory: Littles Law, M/M/1, M/M/1/k, M/M/C Queuing Models, M/G/1 [Impact Variation in Service Times].

Unit-III
Petrinets: Stochastic Petrinets [SPN], GSPN.

Unit-IV
Simulation: Continuous & discrete Event Simulation, Monte Carlo Simulation, Pseudo Random Number Generation, Non-Uniform Random Variable Generation, Simulation Language Features : Simpack, GPSS, GASP IV, CSIM, Estimation of Simulation Outputs/Output Matrix, Confidence Intervals, Regenerative Simulation, Method of Batch Means.

Unit-V
Case Studies: Analytic versus Simulation Models, Application to Operating Systems, Data Bases, Networks Architecture.

Reference Books:
1. Modeling and Simulation in Engineering by Catalin Alexandru, In Tech.
2. Principles of Modeling and Simulation by Sokolowski and Banks, Wiley
3. Modeling and Simulation in Science, Engineering and Technology by Bellomo & Nicolo, Springer

QEE-302: Special Electric Machines

L	T	P
3	1	0

Unit-I
Special AC Machines: Constructional aspects, design and analysis of reluctance, shaded pole, hysteresis, printed circuit, claw motors, Servomotors and A.C. tacho-generators.

Unit-II
Devices: Introduction of permanent magnet materials, angled field and axial field devices, cross-field machines, special forms of rotating amplifiers, electromagnetic clutches, coupling and brakes, eddy current devices.

Unit-III
Linear Machines: Linear devices and actuators Linear electric machines: Classification, application, constructional aspects, design and method of analysis of various types, Goodness factor.

Unit-IV
Linear Electric Motors: Transverse-edge, entry-end, exit end, short primary, short secondary effects in linear electric motors, Force, energy and power LEMs for low speed medium speed and high speed applications. Electromagnetic levitation and guidance schemes-attraction, repulsion.

Unit-V
Advanced Motors and Drive Systems Principle, construction, operation and drive application of Square wave Permanent Magnet (PM) brushless motor drives, sine wave PM brushless motor drives, PM and synchronous reluctance based motors, switched reluctance motors, Energy efficient motors.

Reference Books:
6. B.K. Bose, Power Electronics and variable frequency drives, Prentice Hall, New Jersey.
2. T.J.E. Miller, Brushless permanent magnet and reluctance motor drives, Oxford University Press, UK.
3. S.A. Nasar, Linear induction motor, John Wiley, New York.
4. J. C. Andreas, Energy Efficient Motors, Marcel Dekker.
5. J.M.P. Murphy, Power Electronics control of AC Drives, Pergamon Press.

QEE 303: Computer Methods in Power System

L	T	P
3	1	0

Unit-I
Overview: Review of modeling of power system components, formulation and modifications of the Impedance and Admittance matrices, storage techniques

Unit-II
Optimal power flow: Review of load flow with and without tap changing and phase shifting transformer, load flow for radial (distribution) systems, Optimal power flow (OPF) problem formulation and solution techniques, Simulation and Development of programs for Load Flow Studies and Optimal Power Flow.

Unit-III
Fault studies: Their representation, Transformation methods for balanced and unbalanced faults, Simulation and Development of programs for Fault Studies.

Unit-IV
Power system security: Factors affecting security, Contingency analysis, Network sensitivity using load flow, correcting the generation dispatch by using sensitivity method and linear programming.

Unit-V
State estimation in power systems: Method of least-squares, State estimation of AC network, Detection and identification of bad measurements, Network observability and pseudo measurements, Application of power system state estimation, Dispatch and State Estimation using MATLAB or any other application software, Use of Application Specific software like ETAPS, PSCAD etc.

Reference Books:

1. Power System Analysis by Grainger J.D. , McGraw-Hill, Inc, Singapore.
2. Power Generation, Operation and Control by Wood A.J. and Wollenberg B.F., John Wiley & Sons, New York, USA.

3. Power System Analysis & Design by Glover J.D. and Sarma , PWS Publishing Company, Boston, USA.
4. Computer Methods in Power System Analysis by Stagg G. W. and Elabiad A. H, McGraw Hill, New York
5. Computer Techniques in Power System Analysis by Pai M. A., Tata McGraw Hill Publishing Co. Ltd.
6. Computer Aided Power System Analysis by Kusic C.L., Tata McGraw Hill Publishing Co. Ltd.

QEE-304: Virtual Instrumentation

L	T	P
3	1	0

Unit-I
Review: Graphical programming in data flow VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O. Labview simulations around various elements of like charts, graphs, loops, arrays, clusters etc., and data-acquisition and signal processing tools.

Unit-II
Elements of Data acquisition: ADC, DAC, DIO, counters & timers, PC Hardware structure, timing, interrupts; DMA Software and hardware installation Current loop RS232C/ RS485, GPIB.

Unit-III
Signal processing: Sampling Signals, Sampling Considerations, Need of Anti-aliasing Filters, The Discrete Fourier Transform (DFT) and the Fast Fourier transform (FFT), The Power Spectrum, Auto-correlation, Cross-correlation, Convolution, convolution, Characteristics of Different Types of Window Functions, Realization of IIR and FIR filters.

Unit-IV
System buses, Interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., Networking basics for office & industrial applications, VISA and IVI, Motion Control.

Unit-V
Machine Vision : Digital images, definition, types, files, borders ad masks, image display, pallets, Region of Interest, Non- Destructive overlays, Convolution kernels, Spatial filters, Gray scale morphology, Thresholding, Particle measurement, Edge detection, Pattern matching.

Reference Books:
1. Virtual Instrumentation using LabVIEW by Gupta & John, Tata Mc Graw Hill
2. Virtual Instrumentation using LabVIEW by Jerome, PHI Learning Pvt Ltd
3. Virtual Instrumentation for Control Applications by Rizvi, Sunder, Haroon and Mirza, Spinger

QEE-305: ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P
3	1	2

Unit – I
Discrete-Time Signals and Systems
Discrete-Time Signals, Discrete-Time Systems, Analysis of Discrete-Time Linear Time-Invariant Systems, Discrete Time systems described by Difference Equation, Implementation of Discrete-Time Systems, Signal flow Graph representation of digital network, matrix representation..

The z-Transform: The Direct z-transform, Properties of the z-transform, Rational z-transforms, Inversion of the z transform, analysis of Linear Time-Invariant systems in the z- domain.

Unit – II

Discrete Fourier Transform:

Frequency Domain Sampling: The Discrete Fourier Transform Frequency- Domain Sampling and Reconstruction of Discrete-Time Signals. The Discrete Fourier Transform (DFT). The DFT as a linear Transformation. Relationship of the DFT to Other Transforms. Properties of the DFT. Periodicity, Linearity, and Symmetry Properties. Multiplication of two DFTs and Circular Convolution. Additional DFT Properties. Frequency
analysis of signals using the DFT.

Unit – III

Basic IIR Filter Structures: Direct forms (I & II), cascade and parallel realizations. Signal flow graph, Transposed structure, Basic FIR filter structures-. Direct form structure, frequency sampling structure, Lattice structure, Linear phase FIR structure.

Unit – IV

Symmetric and Anti-symmetric FIR Filters, Design of Linear-Phase FIR Filters Using Windows, Design of Linear-Phase FIR Filters by the Frequency Sampling Method, Design of FIR, Equiripple filter design Differentiators. Design of Hilbert Transformers.

Unit – V

Design of IIR Filters From Analog Filters: IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance. IIR
Filter Design by the Bilinear Transformation. The Matched-z Transformation, Characteristics of Commonly Used Analog Filters, Application of above technique to the design of Butterworth & Chebyshev

QEE-306: Real Time Instrumentation

L	T	P
3	1	0

Unit-I

Introduction: Static and Dynamic characteristics, Error analysis; transducers & sensors; their characteristics and parameters; role of instrumentation in monitoring, control and industrial automation.

Signal Conditioning: Amplifiers, multiplexers & dividers, timer multiplexers, Signal
Converters, ADC and DAC, Signal conditioning, digital signal conditioning.

Unit-II

Transmission of digital signals: Telemetry methods and errors, PLCC, AM, FM, PAM, PWM, PCM Techniques.

Data Acquisition System: role of dedicated computers, analog and digital control, computer systems for real time applications, distributed and supervisory control, SCADA and its organization and structure

Unit-III

Control Schemes: Centralized, hierarchical and decentralized control schemes, man machine interface, energy management system.

Unit-IV

Real Time Control Applications: Instrumentation and conditioning of drive signals, data acquisition of drive system, energy management system applications like AGC, VAR Control.

Unit-V

Estimation and Control: State estimation, security monitoring, economic dispatch, on line load management. Power system digital relaying, Power plant instrumentation.

Reference Books:

1. Torsten Cegrell Power System Control Technology, PHI, India
2. Kusic C. L., Computer Aided Power System Analysis, TMH, New Delhi
3. Wood A. J. and Wollenberg B. Power generation operation and control, John Wiley.
4. Cerni R.H and Foster L.E., Instrumentation for Engineering Management, John Wiley & Sons.

QEE-401: Power Quality and FACTS Devices

L	T	P
3	1	0

Unit-I

Overview: Sources of pollution and regulations, various power quality problems, transmission problems and needs, the emergence of FACTS, FACTS controller & consideration.

Unit-II

Harmonics: Effects-within the power system, Interference with communication Harmonic measurements, Harmonic elimination, Harmonic distortion due to various sources, Effects of harmonic distortion, THD calculation, Harmonic filter design, Active and Passive Filters.

Unit-III

Monitoring power quality: Monitoring essentials, reliability indices, Power quality measuring equipment, Current industry trends, Fourier series, Fourier transform and wavelet transform.

Unit-IV

Series and shunt compensation: Fundamental of series compensation, principle of operation, TCSC operation in power system, SSSC :principle of operation, Shunt SVC principles, configuration & control, STATCOM, Modeling and applications of series and shunt compensating devices.

Unit-V

Phase shifter: Principle of operation, steady state model of static phase shifter, operating characteristics of SPS , power current configuration of SPS applications.

Unified power flow controllers: Basic operating principles & characteristics, control UPFC installation applications, UPFC model for power flow studies.

Reference Books:

1. Song Y.H. and Johns A.T., "Flexible AC Transmission Systems", IEEE Press.
2. Hingorani N.G. and Gyragyi L., "Understanding FACTS (Concepts and Technology of Flexible AC Transmission System)", Standard Publishers & Distributors, Delhi.
3. Ghosh A. and Ledwich G., "Power Quality Enhancement using Custom Power Devices", Kluwer Academic Publishers.
4. Mathur R.M. and Verma R.K., "Thyristor based FACTS controllers for Electrical Transmission Systems",

IEEE Press.
5. M.H.J. Bollen, Understanding Power Quality and Voltage Sag, IEEE Press.

QEE-402: Embedded Systems

L	T	P
3	1	0

Unit-I

Introduction to embedded systems: Background and History of Embedded Systems, definition and Classification, Programming languages for embedded systems: desirable characteristics of programming languages for embedded systems, low-level versus high-Level languages, main language implementation issues: control, typing. Major programming languages for embedded systems. Embedded Systems on a Chip (SoC) and the use of VLSI Designed circuits.

Unit-II

Processor and Memory Organization: Structural units in processor, Processor selection for an embedded system, Memory devices, Memory selection, Allocation for memory to program segments and blocks and memory map of a system, DMA, Interfacing processor. I/O Devices - Device I/O Types and Examples Synchronous - Iso-synchronous and Asynchronous Communications from Serial Devices - Examples of Internal Serial-Communication Devices - UART and HDLC - Parallel Port Devices- Sophisticated interfacing features in Devices/Ports- Timer and Counting Device.

Unit-III

Microcontroller: Introduction to Microcontrollers, Evolution, Microprocessors vs. Microcontrollers, MCS-51 Family Overview, Important Features, Architecture. 8051 Pin Functions, Architecture, Addressing Modes, Instruction Set, Instruction Types.

Unit-IV

Programming: Assembly Programming. Timer Registers, Timer Modes, Overflow Flags, Clocking Sources, Timer Counter Interrupts, Baud Rate Generation. Serial Port Register, Modes of Operation, Initialization, Accessing, Multiprocessor Communications, Serial Port Baud Rate.

Unit-V

Interrupts: Interrupt Organization, Processing Interrupts, Serial Port Interrupts, External Interrupts, Interrupt, Service Routines. Microcontroller Specification, Microcontroller Design, Testing, Timing Subroutines, Look-up Tables, Serial Data Transmission.

Applications: Interfacing Keyboards, Interfacing Displays, Interfacing A/D and D/A Converters, Pulse Measurement, Loudspeaker Interface, Memory Interface.

Reference Books:

1. Embedded Systems by Raj Kamal, Tata Mc Graw Hill Education 2008
2. Embedded System Design by Peter, Spinger
3. Introduction to Embedded Systems by Shibhu, Tata, McGraw Hill Educatio

QEE-403: Bio-Medical Instrumentation

L	T	P
3	1	0

Unit-I

Characteristrics of Transducers and Electrodes for Biological Measurement: Introduction to human body; block diagram, classification, characteristics, Various physiological events and suitable transducer for their recording, Bioelectric potentials.

Cardiac System: Cardiac musculature, Electro cardiography, ECG recording, Phonocardiography, holter recoding ECG lead system, Heart rate meter, vector cardiography, Pacemakers, Defibrillators.

Unit-II

Blood Pressure and Blood Flow Measurement: Invasive and non-invasive methods of Blood pressure, Characteristics of blood flow and heart sound, Cardiac output measurement, Plethysmography.

Respiratatory System: Mechanics of breathing, Parameters of respiration, Respiratory system measurements, Respiratory therapy instruments.

Unit-III

Muscoskeletal systems: EMG, Clinical applications, Muscles stimulator.

Instrumentation for Measuring Nervous Function: EEG signal, frequency band classification, Lead systems, EEG recording, Clinical applications of EEG signal, X-ray CT scan, MRI, PET.

Unit-IV

Clinical Laboratory Instrumentation: Test on blood cell, Blood cell counter, Blood glucose monitors, auto analyzer, Pulse-oximeter.

Recent Trends in Biomedical Engineering: Patient care and monitoring, Non-invasive diagnostic instrumentation, Biotelementry, Telemedicine, Prosthetic devices, Lie detector test, Application of lasers and ultrasonic in biomedical field.

Unit-V

Troubleshooting & Electrical Safety of Biomedical Instruments: Physiological effect of current and safety measurement, Design of biomedical instruments, Simulations on various biomedical applications.

Reference Books:

7. Biomedical Engineering Fundamentals by Bronzino, CRC Press
8. A Textbook on Biomedical Engineering by R M Kenedi, Balckie
9. Introduction to Biomedical Engineering by Enderle & Bronzino, Academic Press

QEE – 404: Digital Control System

L	T	P
3	1	2

UNIT-I

Signal Processing in Digital Control:

Basic digital control system, advantages of digital control and implementation problems, basic discrete time signals, z-transform and inverse z-transform, modeling of sample-hold circuit., pulse transfer function, solution of difference equation by z-Transform method.

UNIT-II

Design of Digital Control Algorithms:

Steady state accuracy, transient response and frequency response specifications, digital compensator design using frequency response plots and root locus plots.

UNIT-III

State Space Analysis and Design:

State space representation of digital control system, conversion of state variable models to transfer functions and vice versa, solution of state difference equations, controllability and observability, design of digital control system with state feedback.

UNIT-IV

Stability of Discrete System:

Stability on the z-plane and Jury stability criterion, bilinear transformation, Routh stability criterion on rth plane. Lyapunou's Stability in the sense of Lyapunou, stability theorems for continuous and discrete systems, stability analysis using Lyapunor's method.

UNIT-V

Optimal digital control :

Discrete Euler Lagrange equation, max. min. principle, otpimality & Dynamic programming, Different types of problem and their solutions.

QEE-405: Modeling & Dynamics of Electrical Machines

L	T	P
3	1	0

Unit-I

Introduction: Challenges in computer simulations, Mechanics of simulation, solution techniques for time domain analysis, introduction of widely used circuit- oriented simulators like Pspice, MATLAB, PSIM, equation solvers, simulation of power electronics circuits and converters.

Unit-II

Dynamic Conditions: concept, constraints and considerations; modeling and performance simulation methods, concept of reference frame, generalized transformation, formulation of dynamic equations of a generalized machine in arbitrary reference frame.

Unit-III

D.C. Machine Dynamics: Ideal machine; dynamic equation; transfer function and block diagram; linear analysis of D.C. generators; effects of saturation; analysis and performance under disturbances. Switching and surge voltage transients in transformers.

Unit-IV

Induction Machines: transients and dynamics; basic electro mechanical equations;
linearized and non-linearized analysis; operation on harmonic supplies; unbalanced operation.

Unit-V

Synchronous Machine Transients: coupled circuit viewpoint; approximate physical picture, equivalent circuit under transient conditions and its applications; synchronous motor operation with variable/fixed load torque and excitation; equal-area criterion for the study of transient stability.

Reference Books:

1. Krause P.C., Electric Machinery, McGraw Hill
2. Kimbark E.W., Power System Stability Vol 3 Synchronous Machine, John Wiley & Sons
3. Concordia C., Synchronous machines, Theory and Performance, John Wiley & Sons.
4. Adkins B. and Harley R. G., The General theory of Alternating Current Machines, Chapman & Hall

QEE -501 : NON-CONVENTIONAL ENERGY RESOURCES AND ENERGY CONVERTERS

L	T	P
3	1	0

UNIT-I Introduction

Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells:

Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT-II Solar Thermal Energy:
Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT-III Geothermal Energy:
Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.
Magneto-hydrodynamics (MHD):
Principle of working of MHD Power plant, performance and limitations.
Fuel Cells:
Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IV Thermo-electrical and thermionic Conversions:
Principle of working, performance and limitations.
Wind Energy:
Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

UNIT-V Bio-mass:
Availability of bio-mass and its conversion theory.
Ocean Thermal Energy Conversion (OTEC):
Availability, theory and working principle, performance and limitations.
Wave and Tidal Wave:
Principle of working, performance and limitations. Waste Recycling Plants.

Reference Books:

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, " Energy Resources: Conventional & Non-Conventional " BSP Publications,2006.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.

QEE -502: SCADA AND DISTRIBUTED CONTROL SYSTEM

Unit I. SCADA:
Purpose and necessity, general structure, data acquisition, transmission & monitoring. General power system hierarchical Structure. Overview of the methods of data acquisition systems, commonly acquired data, transducers, RTUs, data concentrators, various communication channels- cables, telephone lines, power line carrier, microwaves, fiber optical channels and satellites.

Unit II. Supervisory and Control Functions:
Data acquisitions, status indications, majored values, energy values, monitoring alarm and event application processing. Control Function: ON/ OFF control of lines, transformers, capacitors and applications in process in industry - valve, opening, closing etc.
Regulatory functions: Set points and feed back loops, time tagged data, disturbance data collection and analysis. Calculation and report preparation.

Unit III. MAN- Machine Communication:
Operator consoles and VDUs, displays, operator dialogues, alarm and event loggers, mimic diagrams, report and printing facilities.

Unit IV. Data basis- SCADA, EMS and network data basis. SCADA system structure - local system, communication system and central system. Configuration- NON-redundant- single processor, redundant dual processor. multicontrol centers, system configuration.
Performance considerations: real time operation system requirements, modularization of software programming languages.

Unit V.
Introduction of distributed control system, concept, basic strictures, block diagram, applications.
References:
1. Torsten Cergrell, " Power System Control Technology", Prentice Hall International.
2. George L Kusic "Computer Aided Power System Analysis",, Prentice Hall of India,
3. A. J. Wood and B. Woolenberg, "Power Generation Operation and Control", John Wiley & Sons.
4. Sunil S Rao, "Switehgear Protection & Control System" Khanna Publishers 11th Edition.

QEE-503: Load and Energy Management

L	T	P
3	1	0

Unit-I
Load Forecasting: Classification and characterization of loads, Approaches to load forecasting, Forecasting methodology, Energy forecasting, Peak demand forecasting, Non-weather sensitive forecast and Weather sensitive forecast, Total forecast, Annual and monthly peak demand forecasts. Applications of state estimation to load forecasting.

Unit-II
Load Management: Introduction to Load management. Electric energy production and delivery system structure (EEPDS). Design alternatives for EEPD systems. Communication/control techniques for load management. Tariff structure and load management, principles of macro & microeconomics and energy pricing strategies, Assessing the impacts of load management.

Unit-III
Energy Demand Forecasting: Static and dynamic analysis of energy demand, elements of energy demand forecasting, methodologies and models for energy demand forecasting, techno-economic approach in energy demand forecasting.

Unit-IV
Research Trends: Energy management strategy, symbiotic relation between information, energy models and decision making.

Unit-V
Case Studies: Industrial energy forecasting, transportation energy forecasting, residential, commercial and agricultural energy forecasting

Reference Books:
1. Martino J., technological Forecasting for Decision Making, Elsevier Press, New York.
2. Gellings C.W. and Penn Well P.E. Demand Forecasting in the Electric Utility Industry, Fairmount Press
3. Makridakis S., Forecasting Methods and Applications, Wiley.

QEE-504: Robotics

L	T	P
3	1	0

Unit-I

Basic Concepts in Robotics: Automation and robotics, robot anatomy, basic structure of robots, resolution, accuracy and repeatability.

Classification and Structure of Robotic System: Point to point and continuous path Systems. Control loops of robotic systems, the manipulators, the wrist motion and grippers.

Unit-II

Drives and Control Systems: Hydraulic systems, Dc servo motors, basic control systems concepts and models, control system analysis, robot activation and feed back components. Positional and velocity sensors, actuators. Power transmission systems, robot joint control design.

Robot arm Kinematics and Dynamics: The direct kinematics problem, the inverse kinematics solution , Lagrange-Euler formation ,generalized D'Alembert equations of motion, Denavit Hartenberg convention and its applications.

Unit-III

Sensors in robotics: Tactile sensors, proximity and range sensors, force and torque sensors, uses of sensors in robotics.

Vision Systems: Vision equipment, image processing, concept of low level and high level vision.

Unit-IV

Robot Programming: Method of robots programming, lead through programming methods, a robot programs as a path in space ,motion interpolation, WAIT, SIGNAL and DELAY commands, branching capabilities and limitation of lead through methods.

Unit-V

Robot Language: The textual robot languages , generations of robot programming languages, robot language structure, constants, variables and other data objects.
Motion commands, end effectors and sensor commands computations, programme control and subroutines, communication and data processing ,monitor mode commands. Introduction to artificial intelligence.

Reference Books:

1. Robotics: Modelling, Planning and Control by Sciavicco, Springer 2009
2. A text book on Industrial Robotics by Ganesh S Hedge Laxmi Publications, 2006
3. Robotics and Control by R K Mittal and I J Nagrath Tat McGrawHill Education 2003

QEE-505: Power System Security and Analysis

L	T	P
3	1	0

Unit-I

Power transmission in uncompensated AC transmission lines: Electrical parameters of transmission lines and representation by line equation, concept of power in AC transmission systems, Power flow in a two terminal power transmission network, Power circle diagram, Surge impedance loading, Operation of transmission lines under no-load conditions, heavy loading conditions, voltage regulation and its relation with reactive power, Maximum power transfer in an uncompensated line loadability

Unit-II

Reactive power flow and voltage control problems: Reactive power voltage, Coupling concept, Governing effects on reactive power flow, Real and reactive power, Static and transient stability, concept of

dynamic stability, Relation between V-Q at a node, Reactive power requirement, Operation aspects, Basic principle system voltage control, reactive power flow constants, Effect of transformer tap changing and generator excitation adjustment in the post disturbance period, The practical aspects of reactive power flow problems leading to voltage collapse in EHV lines

Unit-III

Voltage stability: Reactive power and voltage collapse and changes in the power system contributing to voltage collapse, Concept of stability of transmission system, Relation between voltage stability and rotor angle stability. Stability margin, Definition and classification of voltage stability, Mechanism of voltage collapse, Analysis of power system voltage stability, Voltage collapse and its modeling, Voltage security and transient voltage analysis, Power transfer and voltage limits, Voltage stability indictors

Unit-IV

Power system security: Introduction, Power system security analysis, planning, operation & control and its assessment, Computation of voltage stability limits, Transfer capacity, Stability margin, Computation of voltage collapse time, Minimum singular value, Various methods of collapse point, Contingency analysis

Unit-V

Voltage control and improvement of voltage stability in power transmission system: Introduction**,** Role of transformer in voltage control of a power system its modeling under various cases, Quantitative methods to determine the tap setting for voltage control using OLTC at a load bus and its effect on voltage stability, Practical aspects of voltage instability due to OLTC operation, Voltage stability improvement methods, Series, shunt and series-shunt compensation, Use of various FACTS devices for these compensation

Reference Books:

1. Power System Analysis Operation and Control by Abhijit Chakrabarti and Sunita Halder, PHI Learning
2. Reactive Power Control and Voltage Stability in Power Transmission Systems by Abhijit Chakrabarti, D P Kothari, AK Mokhopadhyay and Abhinandan De, PHI Learning
3. Power System Stability and Control by Prabha Kundur, Tata McGraw Hill
4. Power System Stability by E W Kimbark, Wiley