SEMESTER VII

Sl. No	Code	Title	L	T	P	C	Category
1	MS4003	Economics	3	-	-	3	HL
2	EE4001	Control Systems - II	3	-	-	3	PT
3	EE4090	Electrical Engineering Drawing	1	-	3	3	PT
4		Elective - 5	3	-	-	3	PT
5		Elective - 6	3	-	-	3	FE
6	EE4091	Power Engineering Lab	-	-	3	2	PT
7	EE4092	Project	-	-	3	2	PT
			13	**-**	**9**	**19**	**9**

LIST OF ELECTIVES – VIITH SEMESTER

Sl. No	Code	Title	Credits
1	EE4021	Artificial Neural Networks and Genetic Algorithms	3
2	EE4022	AC Drives	3
3	EE4023	Computer Control of Industrial Processes	3
4	EE4024	Power System Operation and Control	3
5	EE4025	Analog MOS Circuits	3
6	EE4026	Switched-mode Power Supplies	3
7	EE4027	Bio-Signal Processing	3
8	EE4028	Power System Reliability and Deregulation	3
9	EE4029	Control & Guidance Engineering	3
10	EE4030	Switchgear and Protection	3

BRIEF SYLLABI

EE4001 CONTROL SYSTEMS - II

Pre-requisites : None

L	T	P	C
3	0	0	3

Non-linear Systems - Characteristics- types of nonlinearities Phase plane analysis Lyapunov's First method- Isocline and Delta method- limit cycles of phase plane- Concepts of Inverse Control-Feedback linearization- Principles of model predictive control. Describing functions- single valued and double valued non-linear elements - Limit cycles amplitude and frequency -Stability of non-linear systems . Lyapunov.s method for non-linear systems . Popov.s criterion- Circle criterion .Controllability Observability -State variable design, design of full order and reduced order observers. : Optimal control problem –State feedback regulator problem- Computer Control of Industrial Processes--Microprocessor/microcontroller/DSP based control-Programmable Logic controllers- PLC Programming-PC based control-Distributed Control Systems-

Total Hours: 42 Hours

EE4021: ARTIFICIAL NEURAL NETWORKS & GENETIC ALGORITHM METHODS

Prerequisite: NIL

L	T	P	C
3	0	0	3

Introduction to Artificial Neural Networks - Introduction to network architectures - knowledge representation - Learning process .Learning algorithms- Neural Network Architectures-MLFFN-Recurrent NN- RBF Network structure - separability of patterns - RBF learning strategies - comparison of RBF, RNN and MLP networks- Hopfield networks- Genetic Algorithm- Application to Engineering problems -Concept of neuro-fuzzy and neuro-genetic systems- GA as an optimization tool for ANN-Application of ANN in forecasting-Signal characterization-Fault diagnosis-Neuro-Fuzzy-Genetic Systems- Case Studies in solving Engineering problems of control, signal/image processing etc.

Total Hours: 42 Hours

EE4022 AC DRIVES

Prerequisite: EE3007 Power Electronics

L	T	P	C
3	0	0	3

AC machines for Drives - Principle of operation, Equivalent circuit, Modeling and characteristics of machines for drives. Phase controlled Induction motor Drives - Phase Controlled Cycloconverters – Stator Voltage control – Slip energy recovery scheme - Frequency controlled Induction motor Drives - Voltage Source Inverter (VSI) – VSI fed Induction motor - constant V/F control – Constant Flux control – Constant Slip-speed control – Flux weakening operation - Current Source Inverter (CSI) fed Induction motor Drives - Vector controlled Induction motor Drives – Permanent Magnet Motor drives.

Total Hours : 42 Hours

EE4023 COMPUTER CONTROL OF INDUSTRIAL PROCESSES

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Multivariable Control - H^2 / H Theory- Solution for design using H^2 / H - Case studies - Programmable Logic Controllers - Large Scale Control System – SCADA - Real Time Systems

Total Hrs: 42 Hrs

EE4024 POWER SYSTEM OPERATION AND CONTROL

Pre-requisites : None

L	T	P	C
3	0	0	3

Economic dispatch of thermal units and methods of solution- Unit commitment- Scheduling problems- AGC-Single and multi area system- AVR- Interchange of power and energy- Economy interchange between interconnected utilities- Power system security.

Total Hours: 42 Hours

EE4025 ANALOG MOS CIRCUITS

Pre-requisites: EE 2004 Basic Electronic Circuits
EE 2008 Analog Electronic Circuits

L	T	P	C
3	0	0	3

Basic MOS Device Physics and models -Single-Stage Amplifiers- Current sources and sinks –Passive and Active current mirrors - Differential amplifiers – CMOS Operational amplifiers – Mixed signal circuits – CMOS comparator design – analog multiplier – dynamic analog circuits – Introduction to switched capacitor circuits-MOSFET as switch – sample and hold circuits– switched capacitor filters -Ring Oscillator, LC oscillator, VCO - PLL, Charge pump PLL, delay locked loops and applications.

Total Hours: 42 Hours

EE4026 SWITCHED MODE POWER SUPPLIES

Prerequisite: EE3007 Power Electronics

L	T	P	C
3	0	0	3

Introduction - Topologies of SMPS – EMI issues - Magnetic Circuits and design – Transformer design - - Inductor design - Power semiconductor selection and its drive circuit design – snubber circuits. Closing the feedback loop – Voltage Mode Control of SMPS - Current Mode Control and its advantages - Current Mode Vs Voltage Mode - Applications of SMPS - Resonant converters

Total Hours: 42 Hours

EE4027 BIO SIGNAL PROCESSING

Pre-requisites : None

L	T	P	C
3	0	0	3

Discrete time signals and systems –classification and representation of discrete –time signals - Classifications of sequences –basic operation of sequences – discrete time systems – Discrete Time Fourier Transform - Discrete Fourier Transform- Z- transform - The brain and it's potentials – electrophysiological origin of brain waves – EEG signal and it's characteristics – EEG analysis – linear prediction theory – recursive estimation of AR parameters –ECG signal processing –ECG data compression techniques- clinical applications-

Total Hours: 42 Hours

EE4028 POWER SYSTEM RELIABILITY AND DEREGULATION

Pre-requisites : None

L	T	P	C
3	0	0	3

Generator System Models, Reliability Indices, Interconnected Systems, Operating Reserve, Economics & Reliability, Distribution System - Parallel And Mesh Networks, Industrial Systems. Deregulated Systems- Introduction of Market structure-Market Architecture, Marginal cost of generation, Least-cost operation, Incremental cost of generation. Reconfiguring Power systems, Transmission network and market power, Power wheeling transactions and marginal costing, Transmission costing.

Total Hours : 42 Hours

EE4029 CONTROL & GUIDANCE ENGINEERING

Pre-requisites : EE3002 Control Systems I

L	T	P	C
3	0	0	3

Navigation Systems - Basics of satellite based navigation systems: Global Positioning Systems (GPS) and Global Navigation of Satellite Systems (GNSS) - Guidance Systems: Gyros: Principle of operation- Accelerometers- Navigation equations-Schuler principle and mechanization - Space vehicle dynamics and control - Missile guidance and Control –

Total Hours: 42 Hours

EE4030 SWITCHGEAR AND PROTECTION

Pre-requisites : None

L	T	P	C
3	0	0	3

Circuit breakers – principle of operation – classification –surges and traveling waves – protection against lightning – neutral earthing- basic concepts of insulation levels and their selection – protective relays – characteristics and types – protection schemes for equipments – standards and specifications related to switch gear and protection.

Total Hours: 42 Hours

EE4090 ELECTRICAL ENGINEERING DRAWING

Pre-requisites: EE2007 Electrical Machines I & EE3003 Electrical Machines II

L	T	P	C
1	0	3	3

Dc simplex lap/ wave armature windings - ac single layer/ double layer armature windings - sectional views of transformer limb with windings, core assembly of a power transformer and transformer tank with its accessories/ bushings - sectional views of dc machine armature with commutator and assembled dc machine - sectional views of salient pole and turbo alternators - sectional views of slip ring and squirrel cage induction motors - layouts and single line diagrams of substations.

Total Hours: 56 Hours

EE4091 POWER ENGINEERING LAB

Pre-requisite: EE3004 Power Systems I & EE3007 Power Electronics

L	T	P	C
0	0	3	2

14 Experiments on various power system relays, characteristics of power semiconductor devices, characteristics of Solar PV Modules, Converters and Inverters

Total Hours : 42 Hours

DETAILED SYLLABI

EE4001 CONTROL SYSTEMS - II

Pre-requisites : None

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: **(11 Hrs)**

Non-linear Systems - Characteristics- different types of nonlinearities and their occurrences Phase plane analysis . linearization and equilibrium points - stability of equilibrium points-Lyapunov's First method- Isocline and Delta method- limit cycles of phase plane- stability of limit cycles . Bendixson's criteria-Computer based analysis and simulation. Concepts of Inverse Control-Feedback linearization-Principles of model predictive control

Module 2: **(10 Hrs)**

Describing functions- Filter hypothesis- describing function for single valued and double valued non-linear elements - Limit cycles amplitude and frequency -Stability of non-linear systems . Lyapunov.s method for non-linear systems . Popov.s criterion- Circle criterion

Module 3: **(11 Hrs)**

Controllability Observability -state variable design, state feedback, pole placement - Ackerman's formula – design of full order and reduced order observers. : Optimal control problem – different performance measures and constraints - Optimal control using quadratic performance measures -State feedback regulator problem-

Module 4: **(10 Hrs)**

Compute Computer Control of Industrial Processes-Control hierarchies for plant level automation-Microprocessor/microcontroller/DSP based control-Programmable Logic controllers- Introduction to PLC Programming-PC based control-Distributed Control Systems-Control Networks-Protocols-Ethernet-Field Bus-Man-Machine Interface.

Text/Reference Books:

1. Benjamin C Kuo, *Digital Control Systems*, Oxford University Press, 1992
2. Hassan K Khalil, *Nonlinear Systems*., Prentice Hall International (UK),1996
3. Mohandas K P : Modern Control Engineering,(Revised edition) Sanguine Pearson 2010
4. Alberto Isidori, .*Nonlinear Control Systems*., Springer Verlag, 1995.
5. S. Wiggins, .*Introduction to Applied Nonlinear Dynamical Systems and Chaos*, Springer Verlag, 1990
6. M. Gopal, *Digital Control & State Variable Methods*, Tata McGrawHill, 1992.

EE4021: ARTIFICIAL NEURAL NETWORKS & GENETIC ALGORITHM METHODS

Prerequisite: NIL

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: **(11 Hrs)**

Introduction to Artificial Neural Networks - Biological neurons .Computational models of neuron- McCulloch - Pitts model - types of activation function .Introduction to network architectures - knowledge representation - Learning process .Learning algorithms- - error-correction learning .Boltzmann learning-Hebbian learning, competitive learning- Learning paradigms- supervised learning - unsupervised learning - method of steepest descent - least mean square algorithms - Adaline/medaline units . perceptrons- derivation of the back-propagation algorithm-Adavnces in Learning strategies-Computer based simulation of simple Network Structures.

Module 2: **(11 Hrs)**

Neural Network Architectures-MLFFN-Recurrent NN- RBF Network structure - separability of patterns - RBF learning strategies - comparison of RBF, RNN and MLP networks- Hopfield networks- associative memory-energy function - spurious states - error performance - simulated annealing - applications of neural networks . Forecasting-the XOR problem - traveling salesman problem - image compression using MLPs - character retrieval using Hopfield networks-Advances in ANN Theory- Computer based simulation.

Module 3: **(11 Hrs)**

Genetic Algorithm-Introduction to Genetic Algorithms . The GA computation process-natural evolution-parent selection-crossover-mutation-properties - classification – Advances in the theory GA- Application to Engineering problems

Module 4: **(9 Hrs)**

Hybrid systems and Soft Computing- Limitations of ANN and GA- Concept of neuro-fuzzy and neuro-genetic systems- GA as an optimization tool for ANN-Application of ANN in forecasting-Signal characterization-Fault diagnosis-Neuro-Fuzzy-Genetic Systems- Case Studies in solving Engineering problems of control, signal/image processing etc.

Text/Reference Books:

1. Simon Haykin, *Neural Network – A Comprehensive Foundation*, 2nd Ed, Pearson Education, 2002.
2. Zurada J.M., *Introduction to Artificial Neural Systems*, Jaico Publishers,2003.
3. Bart Kosko, *Neural Network and Fuzzy Systems*, Prentice Hall of India, 2002
4. Goldberg D.E., *.Genetic Algorithms in Search Optimization and Machine Learning*, Addison Wesley,1989
5. Suran Goonatilake & Sukhdev Khebbal (Eds.), *Intelligent Hybrid Systems*., John Wiley,1995.
6. Hassoun Mohammed H, *Fundamentals of Artificial Neural Networks*, Prentice Hall of India, 2002.

EE4022 AC DRIVES

Prerequisite: EE3007 Power Electronics

L	T	P	C
3	0	0	3

Total Hours : 42 Hours

Module 1: AC Machines for Drives (8 Hrs)

Induction machine – Synchronous machine – Permanent Magnet machines – Synchronous reluctance and variable reluctance machine – Principle of operation, Equivalent circuit, Modeling and characteristics of all these machines.

Module 2: Phase Controlled Induction Motor Drives (13 Hrs)

Cycloconverters - Phase Controlled Cycloconverters – Circuits and operation principle – Circulating and non-circulating current mode – load and line harmonics – Line Displacement power factor. Stator Voltage control – Slip energy recovery scheme.

Module 3: Frequency Controlled Induction Motor Drives (10 Hrs)

Voltage Source Inverter (VSI) – VSI fed Induction motor - constant V/F control – Constant Flux control – Constant Slip-speed control – Torque pulsation – effect of Harmonics and its control - PWM control – Flux weakening operation.

Module 4: Current Source Inverter fed Induction Motor Drives (11 Hrs)

Current Source Inverter (CSI) fed Induction motor Drives - CSI – Operation – Modeling - Steady state performance of CSI motor drive. Vector controlled Induction motor Drives – principle and operation. Permanent Magnet Motor drives.

Text/Reference Books:

1. Electrical Motor Drives : modeling, Analysis and control : R Krishnan - 1st edition – 2007 : Pearson Eduction.
2. Electric Drives Concepts and applications – Vedam Subrahmanyam – 1st Edition 1994 : Tata McGrawHill Education Pve Ltd.
3. André Veltman, Duco W.J. Pulle and Rik W. De Doncker : Fundamentals of Electrical Drives – 1st edition 2007 Springer
4. G.K.Dubey & C.R.Kasaravada ,"Power Electronics & Drives", Tata McGraw Hill,1993.
5. Dubey ,Power Electronics Drives ,Wiley Eastern,1993
6. Chilikin ,M ,Electric drives , Mir publications, 2nd edition,1976
7. Ned Mohan ,"Power Electronics", et. al ,Wiley 2006

EE4023 COMPUTER CONTROL OF INDUSTRIAL PROCESSES

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hrs: 42 Hrs

Module 1: Multivariable Control **(12 Hrs)**

Multivariable control- Basic expressions for MIMO systems- Singular values- Stability norms- Calculation of system norms- Robustness- Robust stability- H^2 / H Theory- Solution for design using H^2 / H - Case studies. Interaction and decoupling- Relative gain analysis- Effects of interaction- Response to disturbances- Decoupling- Introduction to batch process control.

Module 2: Programmable Logic Controllers **(10 Hrs)**

Programmable logic controllers- Organisation- Hardware details- I/O- Power supply- CPU- Standards- Programming aspects- Ladder programming- Sequential function charts- Man- machine interface- Detailed study of one model- Case studies.

Module 3: Large Scale Control System **(12 Hrs)**

SCADA: Introduction, SCADA Architecture, Different Commnication Protocols, Common System Components, Supervision and Control, HMI, RTU and Supervisory Stations, Trends in SCADA, Security Issues

DCS: Introduction, DCS Architecture, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, configuration of DCS, displays, redundancy concept - case studies in DCS.

Module 4: Real Time Systems **(8 Hrs)**

Real time systems- Real time specifications and design techniques- Real time kernels- Inter task communication and synchronization- Real time memory management- Supervisory control- direct digital control- Distributed control- PC based automation.

Text/Reference Books:

1. Shinskey F.G., Process control systems: application , Design and Tuning, McGraw Hill International Edition , Singapore,1988.

2. Be.langer P.R. , Control Engineering: A Modern Approach, Saunders College Publishing , USA, 1995.

3. Dorf, R.C. and Bishop R. T. , Modern Control Systems , Addison Wesley Longman Inc., 1999

4. Laplante P.A., Real Time Systems: An Engineer.s Handbook, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.

5. Constantin H. Houpis and Gary B. Lamont, Digital Control systems, McGraw Hill Book Company, Singapore, 1985.

6. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,1999

7. Gordon Clarke, Deon Reynders:Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004

8. Efim Rosenwasser, Bernhard P. Lampe, Multivariable computer-controlled systems: a transfer function approach, Springer, 2006

EE4024 POWER SYSTEM OPERATION AND CONTROL

Pre-requisites : None

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: **(11 Hrs)**

Economic dispatch of thermal units and methods of solution- Formulation of AC power flow- Transmission losses- B matrix loss formula- Take-or-pay fuel supply contract- Composite generation production cost function- solution by gradient search techniques.

Module 2: **(11 Hrs)**

Unit commitment- Solution methods- Hydrothermal coordination- Scheduling problems- Short term hydrothermal scheduling problem - Short term hydro scheduling-load model - prime mover model - governor model - tie-line model - generation control.

Module 3: **(10 Hrs)**

AGC-Single and multi area system-Speed governing -TG response-ALFC loop-tie line bias control - AVR-Exciter types-Modeling - AVR loop

Module 4: **(10 Hrs)**

Interchange of power and energy- Economy interchange between interconnected utilities- inter - utility economy energy evaluation- capacity interchange - diversity interchange - energy banking- emergency power interchange - power pools.

Power system security -factors affecting power system security - contingency analysis- linear sensitivity factors - optional power flow - linear sensitivity analysis -state estimation

Text/Reference Books:

1. A.J. Wood and B.F. Wollenberg, “Power Generation Operation and Control”, John Wiley & Sons, ICN., 2nd Edition.
2. A.K.Mahalanabis, “Computer Aided Power system analysis and control”, Tata McGraw Hill 1991
3. O.I. Elgerd: “Electric Energy Systems Theory”, McGraw Hill, 2nd Edition, 1982,Dec.
4. Antonio Gomez-Exposito, Antonio j.conejo & Claudio canizares, “Electric Energy systems analysis and operation”, CRP press, 2009.

EE4025 ANALOG MOS CIRCUITS

Pre-requisites: EE 2004 Basic Electronic Circuits
EE 2008 Analog Electronic Circuits

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: **(10 Hrs)**

Basic MOS Device:

Analog MOS models – Device construction, Principle of operation, static characteristics, Body effect on static characteristics and DC biasing, VVR explanation and use, channel length modulation – Early Voltage, low frequency model – MOS in saturation –high frequency model – MOS resistors and resistor circuits

Module 2: **(9 Hrs)**

Single-Stage Amplifiers-– common source –common gate – common drain amplifiers, cascode and folded cascode structures

Current sources and sinks – regulated cascode current source/sink, Wilder current source

Passive and Active current mirrors – Basic Current mirrors-cascode current mirror – Wilson current mirror – Active Current mirror

Module 3: **(11 Hrs)**

Differential amplifiers – Basic differential pair, common mode response.

Frequency response of amplifiers- General considerations of Miller effect, common source, common gate, common drain amplifiers, cascade and differential pair.

CMOS Operational amplifiers – Basic one and two stage CMOS OAs, folded cascade type.

Module 4: **(12 Hrs)**

Mixed signal circuits – CMOS comparator design – analog multiplier – dynamic analog circuits – charge injection and capacitive feed through in

Introduction to switched capacitor circuits- MOSFET as switch – sample and hold circuits– switched capacitor filters

Ring Oscillator, LC oscillator, VCO - PLL, Charge pump PLL, delay locked loops and applications.

Text/Reference Books:

1. Adel S. Sedra and K. C. Smith, 'Microelectronic circuits' 4th edition, Oxford University Press, 2003
2. Jacob Baker R., Li H.W.& Boyce D.E., `CMOS - Circuit Design, Layout & Simulation', PHI,2005.
3. Behzad Razavi, 'Design of Analog CMOS Integrated Circuit' Tata-Mc GrawHill, 2002.
4. Roubik Gregorian & Gabor C Temes, Analog MOS Integrated Circuits for Signal Processing, John Wiley, 1986.

EE4026 SWITCHED MODE POWER SUPPLIES

Prerequisite: EE3007 Power Electronics

Total Hours: 42 Hours

L	T	P	C
3	0	0	3

Module 1: Introduction **(8 Hrs)**

Linear regulator Vs. Switching regulator – Topologies of SMPS – isolated and non isolated topologies – Buck – Boost – Buck boost – Cuk – Polarity inverting topologies – Push pull and forward converters half bridge and full bridge – Fly back converters Voltage fed and current fed topologies. EMI issues.

Module 2: Design Concepts **(10 Hrs)**

Magnetic Circuits and design – Transformer design - core selection – winding wire selection – temperature rise calculations - Inductor design. Core loss – copper loss – skin effect - proximity effect. Power semiconductor selection and its drive circuit design – snubber circuits. Closing the feedback loop – Control design – stability considerations

Module 3: Control Modes **(12 Hrs)**

Voltage Mode Control of SMPS.. Transfer Function and Frequency response of Error Amp. Transconductance Error Amps . PWM Control ICs (SG 3525,TL 494,MC34060 etc.)

Current Mode Control and its advantages. Current Mode Vs Voltage Mode. Current Mode PWM Control IC(eg. UC3842).

Module 4: **(12 Hrs)**

Applications of SMPS - Active front end – power factor correction – High frequency power source for fluorescent lamps - power supplies for portable electronic gadgets.

Resonant converters

Principle of operation – modes of operation – quasi resonant operation- advantages.

Text/Reference Books:

1. Abraham I Pressman - Switching power supply design – 2nd edition 1998 Mc-Graw hill Publishing Company.
2. Keith H Billings - Switch mode power supply handbook – 1st edition 1989 Mc-Graw hill Publishing Company.
3. Sanjaya Maniktala - Switching power supplies A to Z. – 1st edition 2006, Elsevier Inc.
4. Daniel M Mitchell : DC-DC Switching Regulator Analysis. McGraw Hill Publishing Company
5. Ned Mohan et.al : Power Electronics. John Wiley and Sons.
6. Otmar Kilgenstein : Switched Mode Power Supplies in Practice. John Wiley and Sons.
7. Mark J Nave : Power Line Filter Design for Switched-Mode Power Supplies. Van Nostrand Reinhold, New York.

EE4027 BIO SIGNAL PROCESSING

Pre-requisites : None

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: **(12 Hrs)**

Discrete time signals and systems –classification and representation of discrete –time signals
Classifications of sequences –basic operation of sequences – discrete time systems – Discrete Time Fourier Transform - Discrete Fourier Transform – computation of DFT –Mathematical derivation of unilateral z-Transform – properties of z- Transform –the inverse z – Transform – bilateral z –Transform -power series – region of convergence

Module 2: **(12 Hrs)**

The brain and it's potentials – electrophysiological origin of brain waves –EEG signal and it's characteristics – EEG analysis – linear prediction theory – recursive estimation of AR parameters
Spectral error measure – transient detection and elimination (the case of epileptic patents)-review of Wiener Filtering Problem – principle of adaptive filter –the Steepest -Descent Algorithm -50Hz interference and it's cancellation –cancellation of ECG signal from the electrical activity of the chest muscles -

Module 3: **(10 Hrs)**

Basic electrocardiography- ECG data a acquisition-ECG lead systems – steps in ECG analysis -ECG parameters and their estimation – QRS detection algorithm -arrhythmia analysis and monitoring - long term ECG recording

Module 4: **(8 Hrs)**

Direct ECG data compression techniques – Transformation compression Techniques –other data compression techniques – Prony's method – clinical applications

Text/Reference Books:

1. Biomedical signal processing by DC Reddy , TMH 2005 edition
2. A Biomedical signal processing by Willis J Tompkins, PHI, 2009
3. Biomedical signal analysis by Rangaraj M. Rangayyan ,IEEE Press, 2002
4. Bioelectrical signal processing in cardiac and neurological applications : Leif Sornmo and Pablo
5. Laguna , Elsevier Academic Press, 2005
6. Advances in Cardiac Signal Processing , U.R. Acharya J.S. Suri JAE Spaan, S.M.Krishnan(Editotrs)

EE4028 POWER SYSTEM RELIABILITY AND DEREGULATION

Pre-requisites : None

L	T	P	C
3	0	0	3

Total Hours : 42 Hours

Module 1: **(10 Hrs)**

Generator System Models- State Load Model- Probability Methods- Unit Unavailability- Outage Probability- Generating Capacity Limits- Recursive Techniques- Capacity Expansion Analysis - Scheduled Outages - Reliability Indices- Frequency Duration Method. Power quality issues.

Module 2: **(11 Hrs)**

Interconnected Systems - Two Systems with Tie- Probability Array Methods- Reliability Indices- Variable Reserve And Maximum Peak Load Reserve- Multi Connected Systems.

Distribution System- Interruption Indices- System Performance- risk prediction- Radial Systems- Effect Of Load Transfer- Line Failures- Parallel And Mesh Networks- Industrial Systems.

Module 3: **(10 Hrs)**

Deregulated Systems: Need and conditions for deregulation-Introduction of Market structure-Market Architecture-Spot market-forward markets and settlements. Review of Concepts- marginal cost of generation-least-cost operation-incremental cost of generation.

Module 4: **(11 Hrs)**

Reconfiguring Power systems- Unbundling of Electric Utilities- Competition and Direct access. Transmission network and market power - Power wheeling transactions and marginal costing - transmission costing. Framework and methods for the analysis of Bilateral and pool markets.

Text/Reference Books:

1. Dong, Z., Zhang, P. Ma, J., Zhao, J., Ali, Meng, K., Yin, "Emerging Techniques in Power System Analysis" Springer, 1st edition 2010.
2. S.C. Savulescu, "Real-Time Stability assessment in modern power system control centres", John Wiley & Sons, January 2009
3. Eric Monmasson, "Static Converters", John Wiley & Sons, September 2009.
4. Bo Bergman, Jacques de Mare, Thomas Svensson, Sara Loren, "Robust Design methodology for reliability", John Wiley & Sons, October 2009
5. Ali A. Chowdhury, Don O. Koval, "Power distribution system reliability-Practical methods and applications" John Wiley & sons Inc., *IEEE Press* 2009
6. Richard E.Brown, "Elactric power distribution reliability" Taylor & Francis Group,LLC,2009.
7. Elmakias, David (Ed.) "New Computational Methods in Power System Reliability" Studies in Computational Intelligence, Springer 2008
8. Leveque, Francois , "Transport Pricing of Electricity Networks" Springer 2003
9. Steven Stoft , " Power System Economics-Designing markets for electricity" *IEEE Pres*,2002
10. M. Shahidehpour, H. Yamin and Zuyi Li, "Market operations in electric power systems-Forecasting, scheduling and risk management" John Wiley & sons Inc., 2002
11. Kankar Bhattacharya, Math H.J. Bollen, and Jaap E. Daalder, "Operation of restructured power systems", Kluwer international series,2001
12. Loe lei lai, "Power system restructuring and deregulation- trading, performance and information technology", John Wiley and sons,ltd,2001
13. Wilson K. Kazibwe and Musoke H Semdaula. "Electric Power Quality Control Techniques". Van Nostarand Reinhold New York.2001
14. Yong-Hua Song "Modern Optimisation Techniques in Power Systems" Intelligent Systems, Control and Automation: Science and Engineering, Vol. 20, Springer 1999
15. Roy Billinton, Ronald N. Allan, "Reliability Assessment of Large Electric Power Systems", *IEEE Press* 1995
16. R.Ramakumar, "Reliability Engineering: Fundamentals and Applications", Prentice Hall, 1993
17. Roy Billinton, "Power System Reliability Evaluation", Plenum Press, New York,1991
18. 7.J. Endrenyi, "Reliability Modeling in Electrical Power Systems", *Wiley* New York, 1978

EE4029 CONTROL & GUIDANCE ENGINEERING

Pre-requisites : EE3002 Control Systems I

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: **(12 Hrs)**

Navigation Systems:

General principles of early conventional navigation systems-Geometric Concepts of navigation-Reference frames-Direction cosine matrix-Euler angles-Transformation of angular velocities-Quaternion representation in co-ordinate transformations-Comparison of transformation methods. Inertial platforms-Stabilized platforms-Gimbaled and Strap down INS and their mechanization-Gyrpcompassing for initial alignment, Externally aided inertial navigation systems, TACAN, TERCOM, LORAN, OMEGA, DECCA, VOR, DME, JTIDS, FLIR-Basics of satellite based navigation systems: Global Positioning Systems (GPS) and Global Navigation of Satellite Systems (GNSS)

Module 2: **(10 Hrs)**

Guidance Systems:

Guidance information requirements-Energy Conservation Methods-Time Conservation Methods-Collision Warning and Avoidance-Rendezvous - Satellite Orbit maintenance-Inertial navigation-block diagram representation of essential components-Inertial sensors, Gyros: Principle of operation-TDF and SDF gyros-precession-Nutation-gimbal lock-gimbal flip-gyro transfer function-rate gyro-integrating gyro-Constructional details and operation of floated rate integrating gyro-Dynamically tuned gyro-Ring laser gyro-Fiber optic gyro-gyro performance parameters-Accelerometers-transfer function-Pendulous gyro integrating accelerometer-Vibrating String accelerometer-Accelerometer performance parameters- Navigation equations-Schuler principle and mechanization

Module 3: **(10 Hrs)**

Space vehicle dynamics and control:

Powered flight-unpowered flight-Orbital mechanics, Orbital parameters, circular, elliptical, parabolic, hyperbolic and rectilinear orbits, energy of the orbit, orbital transfer and rendezvous, LEO, SSPO,GSO,GTO orbits, impulse transfer between circular orbits, Hoffmann transfer, other co-planar and non-coplanar transfers, N-body problem, two-body problem- Re-entry of space vehicle, re-entry dynamics, ballistic re-entry, skip re-entry, double-dip re-entry, aerobraking, lifting body re-entry, entry corridor, equilibrium glide, thermal and structural constraints, commanded drag guidance.

Module 4: **(10 Hrs)**

Missile guidance and Control:

Guided missile - surface to surface, surface to air, air to surface and air to air missiles. Tactical and strategic missile, Subsystems of a missile – airframe, flight control and guidance, warhead, data link, fuze, propulsion, telemetry. Control – Canad, wing and tail control. Steering policy – skid to turn (STT), preferred orientation control (POC), bank to turn (BTT) and hybrid. Aerodynamic and Ballistic missiles. Auto pilots. Types of fuze, warhead and propulsion systems. Guidance sequence, different schemes of guidance during launch, midcourse and terminal phases. Collision avoidance

Text/Reference Books:

1. Marshall H Kaplan, Modern Spacecrafts dynamics and control' John Wiley & Sons, 1976.
2. Hanspeter Schaub, John L. Junkins, Analytical Mechanics of Space Systems, AIAA, USA, 2003.
3. Edward V B Stearns, Navigation and Guidance in Space, Prentice Hall, 1983.
4. Manuel Fernadez, George R Macomber, Inertial Guidance Engineering, Prentice Hall, 1962.
5. Ching-Fang –Lin, Modern Navigation, Guidance, and Control Processing, Prentice-Hall, 1991.
6. M.J. Zucrow, Aircraft & Missile Propulsion**,** John Wiley & Sons, 1958.
7. David B. Newman, Space Vehicle Electronics, D. Van Nostrand Co, 1964.
8. A C Kermode, Mechanics of flight, Pearson Education, 2004
9. Paul Zarchan, Tactical and Strategic Missile Guidance, AIAA, 2007.

EE4030 SWITCHGEAR AND PROTECTION

Pre-requisites : None

Total Hours: 42 Hours

L	T	P	C
3	0	0	3

Module 1: **(10 Hrs)**

Circuit breakers-principles of operation–RRRV-Current chopping. Constructional features and Selection of LT breakers (MCB/MCCB/ELCB) and HT Breakers (ABCB - OCB – SF_6CB– VCB); Circuit breaker ratings-Testing of circuit breakers.

Module 2: **(10 Hrs)**

Overvoltages – Surges and travelling waves – Wave propagation on transmission lines - reflection and attenuation- Lightning strokes- protection against lightning - earth wires- lightning diverters - surge absorbers - arcing ground - neutral earthing - basic concepts of insulation levels and their selection - BIL – Co-ordination of insulation.

Module 3: **(12hours)**

Protective relays - protective zones - requirement of protective relaying- definitions-Codes-Standards - Types – Over current Relays - Earth fault relays- Directional relays- Differential relays- Distance relays- Under voltage/ Frequency relays. Static, digital and numerical relays-PC based relays-Construction-Characteristic Functions-Converter Elements-Comparators-Relay Schematics, Analysis.

Module 4: **(10 Hrs)**

Protection Scheme for Generators-Power Station & DG sets, Power & Distribution Transformers, Transmission lines and Busbars, Motors.

NEC and importance of relevant IS/IEC specifications related to switchgear and protection.

Text/Reference Books:

1. Sunil S Rao, “Switch Gear Protections”, Khanna Publications, Delhi 1999
2. Allen Greenwood, “ Electrical Transients in Power Systems”, 1991.
3. Van. C. Warrington A.R., “Protective Relays” Vol. 1 & 2, Chapman & Hall, 1998.
4. T S Madhav Rao, “Power system protection static relays with microprocessor Applications”, Tata McGraw hill Publication,1998.
5. Badri Ram, D N Vishwakarma, “ Power System Protection and Switchgear’, Tata Mc Graw Hill, 2005.
6. Anderson P M, “ Power System Protection”, IEEE publication, 1999.
7. Walter -Marcel Dekker, “Protective relaying theory and applications”, 2ed, Elmore, 2004.

EE4090 ELECTRICAL ENGINEERING DRAWING

Pre-requisites: EE2007 Electrical Machines I & EE3003 Electrical Machines II

L	T	P	C
1	0	3	3

Total Hours: 56 Hours

Module 1: Armature Windings **(16 Hrs)**

1. Simplex lap/ wave dc armature windings with equalizer rings/ dummy coils.
2. Simplex lap/ wave, integral/ fractional slot, double layer three phase ac armature windings with full pitched/ short chorded coils.
3. Mush type/ concentric, 2-tier/ 3-tier, bifurcated/ unbifurcated single layer three phase ac armature windings.

Module 2: Transformers **(12 Hrs)**

1. Sectional plan and elevation of a transformer limb with windings.
2. Sectional plan and elevation of the core assembly of a power transformer.
3. Sectional plan and elevation of a distribution transformer tank with its accessories.
4. Sketches of capacitor and oil filled type transformer bushings.

Module 3: Rotating Machines **(24 Hrs)**

DC Machines

1. Sectional front and side elevation of armature with commutator.
2. Sectional front and side elevation of yoke and pole assembly with field winding.
3. Sectional front and side elevation of assembled Machine.

Alternators

1. Sketches of the methods of pole fixing and slot details of turbo & water wheel alternators.
2. Sectional front and side elevation of water wheel rotor assembly with winding.
3. Sectional front and side elevation of salient pole alternator.
4. Sectional front and side elevation of turbo alternator.

Induction Motors

1. Sectional front and side elevation of slip ring induction motor.
2. Sectional front and side elevation of squirrel cage induction motor.

Module 4: Substations **(4 Hrs)**

1. Layouts and single line diagrams of outdoor and indoor substations.
2. Layout of a 220KV substation.
3. Layout of a captive power substation.
4. Single line diagram of a distribution center.

Text/Reference Books:

1. Clayton & Hancock, Performance and Design of DC Machines, ELBS, 1992.
2. Say M.G, Performance and Design of AC machines, Pitman, ELBS, 1991.
3. A.K. Sawhney, Electrical Machine Design, Dhanpath Rai, New Delhi, 1991.
4. Narang K.L., A Text Book of Electrical Engineering Drawing, Tech India Publications.
5. Bhattacharya S.K, Electrical Engineering Drawing, Wiley Eastern, Edition 2.

EE4091 POWER ENGINEERING LAB

Pre-requisite: EE3004 Power Systems I & EE3007 Power Electronics

L	T	P	C
0	0	3	2

Total Hours : 42 Hours

List of Experiments

1. IDMT Over current relay: plot the IDMT characteristics of the inverse over current relay, identify PSM and settings required for a 3 phase 5 hp induction motor with 120% overload limit, Determine the tripping time for 50*I.
2. Under voltage and Over voltage relay: Plot the inverse characteristics of the relay in under and over voltage operation zone. Determine the tripping time for 150*V and 50*V.
3. Design and setup a single-phase full-converter and study its performance for R and RL loads.
4. Solar PV Module: Plot I-V characteristics of a P-V Module. Determine the maximum power point and power transferred for a lamp load.
5. Design and setup a single-phase semi-converter and study its performance for R and RL loads.
6. Design and set up a Single Phase half wave rectifier and study its performance for R and RL loads.
7. Design and set up a Single Phase AC voltage controller using Triac.
8. Design and set up a Single Phase square wave inverter and study the effect of variation is DC Bus voltage and duty cycle.
9. Study of V-I characteristics of Thyristor.
10. Study of V-I characteristics of IGBT.
11. Study of V-I characteristics MOSFET.
12. Study of switching characteristics of IGBT.
13. Study of switching characteristics of MOSFET.
14. Cable Testing: Determine the IR value, conductor resistance and calculate the leakage current. Conduct HV test on 415V grade cable.

Text/Reference Books:

1. Ned Mohan et.al ,"Power Electronics",John Wiley and Sons,2006
2. Rashid, Power Electronics, Circuits Devices and Applications, Pearson Education, 3rd edition, 2004.
3. G.K.Dubey, Thyristorised Power Controllers, Wiley Eastern Ltd, 1993.
4. Dewan & Straughen, Power Semiconductor Circuits, John Wiley & Sons, 1975.
5. Cyril W Lander, Power Electronics, Mc Graw Hill, 3rd edition, 1993.