MAHAMAYA TECHNICAL UNIVERSITY
NOIDA

Syllabus

M.TECH. FIRST YEAR COURSES

Branch: Electrical Engineering

Specialization: Power Electronics and Derives / Power Electronics

[Effective from the Session : 2012-13]

SEMESTER – I

Power Electronics and Derives / Power Electronics

SN	Course Code	Subject	Period			Evaluation Scheme								Credit
			Theory			Sessional					ESE		TOTAL	
		Theory	L	T	P	CT	AT	TA	TOT	P	TH	P		
1	EE-910/ PE-910	Fundamentals of Electric Drives	3	1	0	40	15	15	70	-	130	-	200	4
2	EE-911/ PE-911	Advanced Control System	3	1	0	40	15	15	70	-	130	-	200	4
3	EE-912/ PE-912	Power Converter-I	3	0	2	30	10	10	50	20	100	30	200	4
4	EE-913/ PE-913	Advanced Microprocessors and Application	3	0	2	30	10	10	50	20	100	30	200	4
5	EE-914/ PE-914	Power Semiconductor Devices	3	1	2	30	10	10	50	20	100	30	200	4
		TOTAL	15	3	6				290	60	560	90	1000	20

NOTE:-

1. EE: for Power Electronics and Derives.
2. PE: for Power Electronics.
3. Wherever the question is of 130 marks, 15 short answer questions of 2 marks each shall be asked in the question paper.

SEMESTER – II

Power Electronics and Derives / Power Electronics

SN	Course Code	Subject	Period			Evaluation Scheme								Credit
			Theory			Sessional					ESE		TOTAL	
		Theory	L	T	P	CT	AT	TA	TOT	P	TH	P		
1	EE-920/ PE-920	Power Semiconductor Controlled Electric Drives	3	0	2	30	10	10	50	20	100	30	200	4
2	EE-921/ PE-921	Power Converters-II	3	1	0	40	15	15	70	-	130	-	200	4
3	EE-922/ PE-922	NCESEC(Seminar Teaching)	0	3	2	30	10	10	50	50	100	-	200	4
4	EE-92?/ PE-92?	Elective-I	3	1	0	40	15	15	70	-	130	-	200	4
5	EE-928/ PE-928	Minor Project(Hardware based)	0	0	5	-	-	-	200	-	-	-	200	4
		TOTAL	9	5	9				440	70	460	30	1000	20

LIST OF ELECTIVE-I

1. EE-923/PE-923: Digital Control System
2. EE-924/PE-924: Modeling And Simulation of Power Electronic Circuits
3. EE-925/PE-925: Facts
4. EE-926/PE-926: Digital Signal Processor
5. EE-927/PE-927: Computer Aided Power System Analysis

NOTE:-

1. EE: for Power Electronics and Derives.
2. PE: for Power Electronics.
3. Wherever the question is of 130 marks, 15 short answer questions of 2 marks each shall be asked in the question paper.

EE-910/PE-910: FUNDAMENTALS OF ELECTRIC DRIVE

L T P
3 1 0

Objective & Outcome of learning

To introduce basic concepts of electric drives like four quadrant operation, electrical braking, dynamics of electrical drive system including transient stability, traction drive, estimation of motor power rating and selection of drives for industrial applications. After this course students would be able to analyze the performance of industrial drives in terms of efficiency and stability of drive operation.

1. **Introduction:**
   Basic drive components , classification and operating modes of electric drive, nature and type of mechanical loads, review of speed torque , characteristics of electric motors and load , joint speed torque characteristics.

2. **Electric Braking:**
   Plugging , dynamic and regenerative braking of dc and ac motors

3. **Dynamics of Electric Drives System:**
   Equation of motion , equivalent system of motor load comnination, stability considerations, electro mechanical transients during starting and braking , calculation of time and energy losses, optimum frequency of starting.

4. **Traction Drive:**
   Electric traction services, duty cycle of traction drives calculations of drive rating and energy consumption , desirable characteristics of traction drive and suitability of electric motors , control of traction drives.

5. **Energy Conservation in Electric Drive:**
   Losses in electric drive system and their minimization energy, efficient operation of drives, load equalization.

6. **Estimation of Motor Power Rating:**
   Heating and cooling of electric motors, load diagrams, classes of duty , reference to India standards, estimation of rating of electric motors for continuous , short time and intermittent ratings.

7. **Special Electric drive:**
   Servo motor drive , step motor drive, linear induction motor drive, permanent magnet motor drive.

8. **Selection of electric drive:**
   Selection criteria of electric drive for industrial applications, case studies related to steel mills, paper mills , textile mills and machine tool etc.

Reference:

1. G.K. Dubey, “Fundamentals of Electric Drive”, Narosa Publishing House 1995
2. M.Chilkin, “Electric Drive”, Mir Publications
3. S.K Pillai, “A first course on Electric Drive”, New age international publishers 1981
4. N.K. De and P.K Sen, “Electric Drives”, Prentice Hall of India 1999
5. Vedam Subhramanyam “Electric Drive : Concepts and applications”, Tata Mc Graw Hill 1994

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Industrial applications
(ii) IEEE Transactions on Power Electronics
(iii) IEEE Transactions on Power Delivery
(iv) IEEE Transaction on Industrial Electronics
(v) IET Research Journal on Electrical Power Application
(vi) NPTEL Courses on Electrical Engineering

EE-911/PE-911: ADVANCED CONTROL SYSTEM

L	T	P
3	1	0

Objective & Outcome of learning

This course will help students to learn about the state space analysis applied to control system using matrices and different methods of analyzing nonlinear as well as discrete control systems. The course also introduces to the students the basic concepts of optimal, adaptive and robust control systems. At the end of the course the students shall be able to handle different control system problems in nonlinear as well as discrete domain.

1. **States Space Analysis:**
   Review of the state space representation of continuous linear time invariant system, conversion of state variable models to transfer functions and vie-versa, transformation of state variable, solution of state equations, state and output controllability and observability.

2. **Analysis of Nonlinear Systems:**
   Common physical nonlinearites , singular points, phase plane analysis, limit cycle, describing function method and stability analysis, jump resonance, linearization of nonlinear system. Lyapunov stability , methods for generating lyapunov function , statement of lure problem , circle criterion, popov criterion.

3. **Analysis of Discrete System:**
   Discrete time signals and systems, z-transformation, modeling of sample hold circuit, pulse transfer function, solution of difference equation by z-transform method , stability analysis in z-plane.

4. Basic concepts of optimal control, adaptive control and robust control system.

References:

1. K.Ogata, “Modern Control Engineering”, Prentice Hall of India , 1999
2. Norman S.Nise, “Control System Engineering”, John Wiley & Sons, 2001
3. Kuo B.C., “Digital Control System”, Saunders College publishing, 1992
4. M.Gopal , “Digital Control and state variable methods”, Tata Mcgraw Hill, 1997
5. M.Gopal , “Modern Control System Theory”, Wiley Eastern, 1993
6. K.Ogata, “ Discrete Time Control System”, Prentice Hall International, 1987.

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Control System Technology
(ii) IET Research Journal on Control Theory & Applications
(iii) NPTEL Courses on Electrical Engineering

EE-912/PE-912: POWER CONVERTERS -I

L T P
3 0 2

Objective & Outcome of learning

This course will impart knowledge about power electronic devices such as thyristors, triac and gate turn off thyristors and also the working of converters, cyclo-converters and voltage regulators using these devices. At the end of the course students will be able to use these devices for power electronic applications.

Details of experiments:

Experiments based on characteristics of various power electronic devices and the performance of various converters using these devices to be evaluated.

1. **Power Semiconductor Devices:**
   Structure, characteristics , ratings and protection of SCR, Triac and gate turn off thyristor

2. **Line Commutated Converters:**
   Single and three phase fully controlled and half controlled converters, performance characteristics, effect of source inductance, discontinuous current operation, inverter operation, power factor improvement techniques , sequence control, 12 pulse converters, dual converter, triggering circuits.

3. **AC voltage controllers:**
   Single phase ac voltage controllers feeding resistive and resistive inductive loads, sequence control, three phase ac voltage controllers.

4. **Cyclo Converter:**
   Single phase and three phase cyclo-converters, circulating and non circulating current operations, performance characteristics , control of harmonics , voltage and frequency control, control circuit.

References:

1. M.H. Rashid, “Power Electronics: circuits, Devices and Applications”, Prentice Hall India, 1996.
2. N.Mohan, T.M. Undeland and W.P. Robbins, “Power Converters, Applications and Design”, John Wily & Sons, 1995.
3. G.K. Dubey et al, “Thyristorized Power Controllers”, Wiley Eastern, 1987.
4. B.R. Pelly, “Thyristor Phase Controlled Converters and Cyclo-Converters”, Wiley interscience, 1971.
5. M.D. Singh and K.B. Khanchandani, “Power Electronics”, Tata Mcgraw Hill,2001.
6. V.Subrahmanyam, “Power Electronics”, New Age International Publishers, 1997.

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Industrial applications
(ii) IEEE Transactions on Power Electronics
(iii) IEEE Transactions on Industrial Electronics
(iv) IET Research Journal on Power Electronics
(v) NPTEL Courses on Electrical Engineering

EE-912P/PE-912P: POWER CONVERTERS –I LAB

As per syllabus.

EE-913/PE-913: ADVANCED MICROPROCESSORS AND APPLICATIONS

L	T	P
3	0	2

Objective & Outcome of learning

This course will introduce to the students regarding 16 bit, 32 bit and 64 bit microprocessors. It will make students fully conversant with 16 bit microprocessor architecture, programming and interfacing with various peripheral devices. Apart from microprocessors the course also imparts knowledge about 7051, 89C51 and 89C2051 microcontrollers. At the end of the course the students shall be able to design embedded systems using these microprocessors and microcontrollers.

Details of experiments:

Experiments in the programming of 16 bit microprocessor and the peripherals are to be carried out.

1. **Introduction:**
   Review of basic microprocessor, architecture and instruction set of a typical 8 bit microprocessor.

2. **Advanced Microprocessors:**
   Overview of 16 bit and 32 bit microprocessor , arithmetic and I/O coprocessors, architecture , register details, operation , addressing modes and instruction set of 16 bit 7086 , microprocessor ,assembly language programming, introduction to multiprocessing, multiuser, multitasking operating system concepts, Pentium I, II, II and IV processors, Motorola 67000 processor.

3. **Input Output Interfacing:**
   Parallel and series I/O, programmed I/O, Interrupt driven I/O, single and multi interrupt levels use of software polling and interrupt controlling for multiplying interrupt controller, DMA controller, programmable timer / counter, programmable communication and peripheral interface, synchronous and asynchronous data transfers, standard serial interfaces like Rs 232.

4. **Programmable Support Chips:**
   Functional schematic, operating modes, programming and interfacing of 8255, 8251, 8259 and 8253 with microprocessor.

5. **Memory Interfacing:**
   Types of memory, RAM and ROM, interfacing with timing considerations, DRAM interfacing.

6. **Analog Input & Output:**
   Microprocessor compatible ADC and DAC chips interfacing of ADC and DAC with microprocessor, use of sample and hold circuit and multiplexer with ADC.

7. **Microcontroller and micro Computer:**
   Concepts of micro controller and micro computer, micro controllers (7051/8751) based design, applications of micro computer in on line real time control

8. **Microprocessor development system:**
   Single user, time shared and networked MOS, hardware, facilities and software support in MDS, development of hardware and application software and hardware software integration in MDS.

9. **Microprocessor applications:**
   Design methodology, examples of microprocessor applications.

Reference:

1. RS Gaonkar, “Microprocessor Architecture programming and applications”, Wiley Eastern limited.
2. B. Ram, “Fundaments of Microprocessor and Micro Computers”, Dhanpat Rai and Sons.
3. Liu & Gibson, “Micro Computer Systems the 7086 / 7088 Family Architecture”, Prentice Hall of India.
4. D.V. Hall, “Micro Processor and Interfacing Programming and Software”, Mcgraw Hill.

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on embedded systems
(ii) NPTEL Courses on Electrical Engineering

EE-913P/PE-913P: ADVANCED MICROPROCESSORS AND APPLICATIONS LAB:

As per syllabus.

EE-914/PE-914: POWER SEMICONDUCTOR DEVICES

L	T	P
3	1	2

Objective & Outcome of learning

This course imparts a thorough knowledge to students regarding structure, characteristics, protection and drive circuits of power diodes, power transistors, MOSFET, thyristor, GTO, IGBT, triacs etc. At the end of the course the students shall be able to work with these devices.

Details of experiments:

Experiments based on characteristics of various power electronic devices and performance of various converters using these devices.

1. **Introduction:**
   General overview of power semiconductor devices and their desirable characteristics. Comparison of power semiconductor devices.

2. **Power Diodes:**
   General purpose diode, fast recovery diode schottky diode, diode snubbers.

3. **Power Bipolar Juction Transistors:**
   Physical structure and device operation , static V-I and switching characteristics, secondary breakdown and safe operating area, snubber circuits , base drive control.

4. **Power MOSFETS:**
   Physical structure and device operation, static V-I and switching characteristics, operating limitations and safe operating area, gate series and snubber circuits.

5. **Thyristors:**
   Physical structure and device operation, two transistor analogy, static V-I and switching characteristics , age characteristics , firing circuits, snubber circuits series and parallel operation

6. **GTO (Gate Turn Off) Thyristors:**
   Physical structure and device operation, static V-I and switching characteristics, drive and snubber circuits

7. **Insulated Gate Bipolar Transistors:**
   Physical structure and device operation, static V-I and switching characteristics, safe operating area , drive and snubber , circuit.

8. **Special Power Devices:**
   Physical structure, device operation and staic V-I characteristics of reverse conducting thyristor , field controlled thyristor , MOS controlled thyristor
9. **Triacs:**
   Physical structure and device operation

Reference:

1. B. Jayant Baliga, "Modern Power Drives", John Willey & Sons 1987
2. N. Mohari, T.M. Undeland and W.P. Robbins, "Power Electronics Converters Applications and Design", John Willey & Sons 1995
3. M.H. Rashid, "Power Electronics Circuit Devices and Applications", Prentice Hall of India 1996
4. Dubey G.K. et al, "Thyristorised Power Controllers", Willey Eastern Limited 1987
5. M.D. Singh and K.B. Khanchandani, "Power Electronics", Tata McGraw Hill 2001
6. John G. Kassakian, Martin F. Schleht and G.C. Varghese, "Principles of Power Electronics", Addison Wesley publishing co 1991.

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Industrial applications
(ii) IEEE Transactions on Power Electronics
(iii) IEEE Transactions on Electron Devices
(iv) IET Research Journal on Power Electronics
(v) NPTEL Courses on Electrical Engineering

EE-914P/PE-914P: POWER SEMICONDUCTOR DEVICES LAB:

As per syllabus

SEMESTER-II

EE-920/PE-920: POWER SEMICONDUCTOR CONTROLLED ELECTRIC DRIVES

L	T	P
3	0	2

Objective & Outcome of learning

This course will impart knowledge to the students regarding the different control schemes used for the controlling of DC and AC drives and the implementation of these schemes of DC and AC drives using microprocessor. At the end of the course the students will be able to work with these drives in industries.

Details of experiments:

Experiments based on the performance evaluation of various AC & DC drives to be carried out.

1. **Introduction :**
   Solid state controlled electric drive – concept, elements and salient features; power converter motor system, closed loop control of electric drives, sensing of speed and current, performance parameters.

2. **Control of D.C. Drives :**
   Control of d.c. separately and series excited motor drives using controlled converters (single phase and three phase)Choppers Static ward Leonard control scheme Solid state electric braking schemes Closed loop control of solid state dc drives.

3. **Control of A.C. motor drives :**
   Operation of induction and synchronous motor drives from voltage source and current source inverters, slip power recovery, pump drives using ac line controllers, self controlled synchronous motor drive, vector control of induction and synchronous motor drives, closed loop schemes, brushless dc motor drive, switched reluctance motor drive.

4. **Microprocessor Control of Electric Drive :**
   Functions of microprocessor in electric drive control, salient features of microprocessor control, microprocessor based control schemes for d.c., induction and synchronous motor drives, applications.

Reference:

1. G.K. Dubey, “Fundamentals of Electric Drives”, 2nd edition, Narosa publishing House.
2. G.K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, New Jersey
3. S.B. Dewan, G.R. slemon, a. Sraughen, “Power Semiconductor Drives”, John Willey & sons
4. M.D.Singh, K.B.Khanchandani, “Power Electronics”, Tata Mcgraw-Hill, New Delhi
5. Bimal Kumar Bose, “Modern Power Electronics and AC Drives”, Pearson Education

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Industrial applications
(ii) IEEE Transactions on Power Electronics
(iii) IEEE Transactions on Power Delivery
(iv) IEEE Transactions on Power Electronics
(v) NPTEL Courses on Electrical Engineering
(vi) IET Research Journal on Power Electronics

EE-920P/PE-920P: POWER SEMICONDUCTOR CONTROLLED ELECTRIC DRIVES

As per syllabus

EE-921/PE-921: POWER CONVERTER -II

L	T	P
3	1	0

Objective & Outcome of learning

This course imparts knowledge to the students regarding hard switched power electronic devices such as power transistor, MOSFET, IGBT etc. The course also make students fully conversant with the dc-dc converters and inverters using these devices. At the end of the course the students shall be able to design dc-dc converters and inverters using hard switched devices.

1. Power Semiconductor Devices :

Structure, characteristics and ratings of Power Transistor, MOSFET, Insulated Gate Bipolar Transistor (IGBT) and MOS – Controlled Thyristor (MCT); drive and Snubber circuits.

2. DC – DC Converters:

Review of chopper fundamentals, step down chopper with resistive and resistive – inductive loads with conituous and discontinuous current operations, step up chopper, commutation techniques, impulse commutated and resonant pulse chopper, multiquadrant and multiphase choppers.

Swithcing mode regulators: Buck, Boost, Buck – Boost, Cuk and flyback regulators.

3. DC – AC Inverters :

Single phase and three phase voltage source and current source inverters, commutation methods, voltage and frequency control, harmonic reductions.

4. Resonant Inverters :

Classification, series and parallel resonant inverters, load resonant inverters, zero voltage switching and zero current switching resonant inverters, resonant dc link inverters.

Reference:

1. M.H. Rashid, “Power Electronics: circuits, Devices and Applications”, Prentice Hall India, 1996.
2. N.Mohan, T.M. Undeland and W.P. Robbins, “Power Converters, Applications and Design”, John Wily & Sons, 1995.
3. M.D. Singh and K.B. Khanchandani, “Power Electronics”, Tata Mcgraw Hill,2001.
4. D.W. Hart, “Introduction to Power Electronics”, Prentice Hall International, 1977.

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Industrial applications
(ii) IEEE Transactions on Power Electronics
(iii) NPTEL Courses on Electrical Engineering
(iv) IEEE Transactions on Electron Devices
(v) IET Research Journal on Power Electronics

EE-922/PE-922: NON – CONVENTIONAL ENERGY SOURCES AND ENERGY CONVERTERS

L	T	P
0	3	2

Objective & Outcome of learning

This course is designed for the development of self study and seminar delivery skills in the students. The course covers the major non-conventional energy sources such as solar energy, wind energy and fuel cell etc. The subparts of each topic of the course will be allotted to each student. The students will deliver the seminar on their allotted topics during the scheduled hours of the subject.

1. **Introduction:**
   Various non–conventional energy resources. Introduction, importance, classification, relative merits and demerits.

2. **Solar Energy :**
   Solar photovoltaics: Introduction, solar radiation and its relation with photovoltaic effect. Solar cell material; silicon mono and poly crystalline, raw material other than silicon, different types of solar cell contruction and design, flat plate arrays:-optimal system sizing and protection, photovoltaic concentration,photovoltaic systems- standalone, PV-hybrid, grid interactive. Stationary and tracking panels, maximum power point tracking, energy storage, converter and inverter systems and their control. Application-water pumping and power plants, cost and economics, recent deveploments.

3. **Solar thermal**: Thermal characteristics of solar radiation, solar collectors:-material, types, focusing. Solar thermal power plant layout and arrangement, solar cooling, recent deveploment.

4. **Wind Energy :**
   Wind power and its sources; site selection criterion, wind characterstics, momentum theory, classification of wind machines. Wind mill- different design and their control. Wind generators- different types, wind farms and grid Wind generation in India. Issues of wind integration- intermittent supply, economics, government regulation and subsidies. Wind penetration and its effects, ecomic issues, recent deveploment, international scenario.

6. **Fuel Cells :**
   Basic construction and principle of operation of fuel cell, Gibbs-Helmholtz equation, thermodynamics free energy and conditions of equilibrium, classification of fuel cells, different types of fuel cells-low and medium temperature alkaline type, low temperature ion exchange membrance, direct high temperature fuel cells, Redox fuel cell, operation characterstics. Fuel cell power plants and its intergration with wind anf solar photovoltaic systems, Applications, recent deveploments

References :

1. F. C. Treble, “Generating electricity from sun”, pergamon press, UK
2. Tapan Bhattacharya, “Terrestrial solar photovoltaics”, Narosa publishing house, New Delhi, 1998.
3. G. D. Rai, “Non-conventional energy resources”, khanna publishers, New Delhi, 2003.
4. S. P. Sukhatme, “Solar energy principles of thermal collection and storage”, Mc-Graw Hill publishing company Ltd., New Delhi, 1984.
5. C. J. Winter, L. C. Sizmann and Van-Hull, “ Solar power plants”, Spriger-Verlog publishers, 1991.
6. N. G. Clavert, “ Wind power principle, their application on small scale”, Calvert technical press edition, 2004.
7. Fuel cell handbook(5^{th} edition) by EG&G services, Parsoncs Inc.
8. I Earnest and T. Wizelius, “ Wind power palnts and projects development”, PHI, 2010.

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Energy Conversion
(ii) IEEE Transactions on Power System
(iii) IEEE Transactions on Power Delivery
(iv) IET Research Journal on Renewable Power Generation
(v) NPTEL Courses on Electrical Engineering

EE-922P/PE-922P: NON – CONVENTIONAL ENERGY SOURCES AND ENERGY CONVERTERS

As per syllabus.

ELECTIVE-I

EE-923/PE-923: DIGITAL CONTROL SYSTEM

L T P
3 1 0

Objective & Outcome of learning

This course imparts knowledge to students about application of digital signal processing and state space analysis in designing of digital control systems and analyzing the stability of digital control systems using various techniques. At the end of the course the students will be able to design and analyze the stability of digital control systems.

1. **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, stability on the z-plane and jury stability criterion, bilinear transformation, Routh Stability Criterion on plane.

2. **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.

3. **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 absorbability, design control system with state feedback, stability analysis using Lyapunov stability theorem, optimal digital control system.

Reference:

1. B.C. Kuo, “Digital Control System”, Saunders college publishing 1992
2. K.Ogata, “Discrete Time Control System”, Prentice Hall 1987
3. C.L. Philips and T. Nagle, “Digital Control System Analysis and Design”, Prentice Hall 1990
4. M.Gopal, “Digital Control and State Variable Methods”, TMH 1997
5. J.R leigh, “Applied Digital Control”, Prentice Hall 1985
6. C.H. Houpis and G.B. Lamont, “Digital Control System Theory Hardware & Software”, Mcgraw Hill 1992

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Control System Technology
(ii) IEEE Transactions on Automatic Control
(iii) IEEE Transactions on Embedded System
(iv) IET Journal on Control Theory & Applications
(v) NPTEL Courses on Electrical Engineering

ELECTIVE –I

EE-924/PE-924: MODELING AND SIMULATION OF POWER ELECTRONIC CIRCUITS

L	T	P
3	1	0

Objective & Outcome of learning

This course will make students conversant with the modeling and simulations of various power electronic devices and converters using simulation softwares like PSICE and MATLAB simulink. At the end of the course the students will be able to simulate power electronic converters and analyze their performance on computer, which will help in selecting the specifications of various components for fabricating the actual systems.

1. **Simulation tools:**
   General overview and understanding of SPICE/PSPICE and MATLAB SIMULINK softwares.

2. **Modeling of power electronics devices:**
   Criteria for switch selection , modeling of Diode , SCR , Power transistor MOSFET AND IGBT for ac and dc circuit using SPICE /PSPICE and MATLAB SIMULINK software, simulation of driver and snubber circuits.

3. **Simulation of power electronics circuits:**
   Simulation and design of converters, Choppers, A.C. Voltage Controllers, Inverters and Cyclo-converters

Reference:

1. M.H. Rashid " Power Electronics Circuit Devices and Applications", Prentice Hall of India 1996
2. D.W. Hart, "An Introduction to Power Electronics", Prentice Hall International , 1997
3. L.P. Huelsman, "Basic Circuit Theory", Prentice Hall of India 1995
4. The Mathworks Inc., "MAT LAB the Language of Technical Computing", version 6
5. The Mathworks Inc., "SIMULINK Dynamic System Simulation"

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Industrial applications
(ii) IEEE Transactions on Power Electronics
(iii) IEEE Transactions on Power Delivery
(iv) MATLAB Tools on Control and power system
(v) NPTEL Courses on Electrical Engineering
(vi) IET Research Journal on Power Electronics

ELECTRIVE -I

EE-925/PE-925: FACTS

L T P
3 1 0

Objective & Outcome of learning

To impart advanced knowledge about the FACTS – systems involving their applications in long Bulk power Transmission line, in distribution systems, in custom Power and improving stability & voltage profile in power system. This is a new technology which has found acceptance in Power Industry. At the end of the course the student should be able to design power and distribution system using various FACT devices.

1. **Basic Issues Involved in Bulk Power Transmission:**
   Angle stability, voltage stability, power flow control and sub-synchronous resonance (SSR).

2. **Basic Issues Involved in Power distribution Systems:**
   Harmonics, load unbalance, poor power factor and voltage interruptions.

3. **Introduction of Basic FACTS devices:**
   SVC, STATCOM, TCSC, SSSC and UPFC. Introduction to concepts of Custom Power (CP) devices

4. **Introduction to CP devices:**
   DSTATCOM, DVR, UPQC. Modeling of SVC, STATCOM, TCSC, SSSC and UPFC.

5. **Case Study**
   DSTATCOM in Current Control Mode:
   Reference current generation techniques.
   DSTATCOM in voltage control Mode:
   Reference voltage generation, DVR reference voltage generation.

References:

5. N.G. Hingirani and L.Gyugi, Understanding FACTS, IEEE Press, 1999.
6. Y.H. Song and A.T. Johns, "Flexible AC Transmission Systems (FACTS), IEEE, 1999.
7. M.H.J. Bollen, " Understanding Power Quality Problems:, IEEE Press, 2000.
8. R.c. dugan, M.F. Mc Granaghan and H.W. Beaty, "Electric Power Systems Quality", Mc Graw Hill, 1996.
9. K.R. Padiyar, "FACTS controllers in Power Transmission and Distribution", New Age, New Delhi, 2007.

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Industrial applications
(ii) IEEE Transactions on Power Electronics
(iii) IEEE Transactions on Power Delivery
(iv) MATLAB Tools on Control and power system
(v) NPTEL Courses on Electrical Engineering
(vi) IET Research Journal on Power Electronics
(vii) IET Research Journal on Generation, Transmission and Distribution.

ELECTRIVE -I
EE-926/PE-926: DIGITAL SIGNAL PROCESSOR

L	T	P
3	1	0

Objective & Outcome of learning

This course will make students conversant with the designing of analog and digital FIR filters using various digital signal processing techniques. At the end of the course the students will be able to design and analyze digital filters.

6. **Introduction:**
   Motivation, advantages and applications of digital signal processing, review of A/D and D/A conversion, quantization noise.

7. **Discrete Time Signals and Systems:**
   Representation of discrete signals, linear time invariant system, FIR and HR system, stability and causality of the systems, systems described by difference equations, solution of difference equations

8. **Realization of Digital Systems:**
   Block diagram and signal flow representations, matrix representation, direct, cascade, parallel, lattice and ladder realization of HR systems, direct, cascade and lattice realization of FIR systems.

9. **Fast Fourier Transform:**
   Introduction to discrete Fourier transform and fast fourier transform, circular and linear convolutions , FFT algorithms, Radix-2 , Radix-4 and split radix algorithms, applications of FFT algorithms.

10. **FIR Digital Filter Design:**
    Properties of linear phase FIR filter, frequency sampling design techniques, window design techniques (Uniform window, Hamming window, kaisc window), optimal FIR filter design.

11. **FIR Filter Design**
    Characteristics of proto type analog filter, comparison of HR and FIR filters, impulse invariant transformation and bilinear transformation, design of digital, butterworth, chebyshev and elliptic filters, introduction to digital signal processor

Reference:

1. A.V. Openheim and R.W. Schafev, “Discrete Time Signal Processing”, Prentice Hall Englewood Cliffs, N.J. 1975
2. J.G. Proakis and D.G. Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Prentice Hall of India
3. L.R. Rabiner and B. Gold, “Theory and Applications of Digital Signal Processing”, Prentice Hall Englewood cliffs, nj 1975
4. Vinay K. Ingle & John G. Proakis, “Digital Signal Processing Using Matlab”, Thomson Asia Pvt. Ltd.
5. Sanjit K. Mitra, “Digital Signal Processing”, Tata Mcgraw Hill 2001

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on digital signal processing
(ii) IEEE Transactions on Power Electronics
(iii) IEEE Transactions on Automatic control
(iv) NPTEL Courses on Electrical Engineering

ELECTRIVE -I
EE-927/PE-927: COMPUTER AIDED POWER SYSTEM ANALYSIS

Objective & Outcome of learning

To emphasize the fundamentals of power system analysis while employing a computer for computational purpose for modeling and simulation of a system. This course will handle three basis problems of short circuit analysis, load flow studies and the transient stability. At the end the student will be in a position to develop his own program for such pourposes and feel more confident while using commercial software in the field.

1. NETWORK MATRICES:

Evaluation of Bus Admittandce matrix (YBUS), Bus Impedance matrix (ZBUS), Branch Impedance matrix (ZBT) and Loop Admittance matrix (ZLOOP) by singular and nonsinugular transformation.

2. SHORT CIRCUIT STUDIES:

Formulation of ZBUS for single phase and three phase networks, transformation of network matrices using symmetrical components; short circuit studies using computer.

3. LOAD FLOW STUDIES:

Representation of off load and on load tap changing and phase shifting transformer and dc link, decoupled and fast decoupled methods, sparsity technique, introduction to load flow of integrated ac/dc/ system.

4. STSBILITY STUDIES:

Network formulation for stability studies for different types of loads (constant impedance, constant current and constant power loads), digital computer solution of swing equation for single and multimachine cases using Runge-Kutta and predictor corrector method, effect of exciter and governor on transient stability.

REFERENCES:

1. G.W. Stagg and A. H. El-Abiad, “Computer methods in power system analysis”, McGraw Hill, 1971.
2. G. L. Kusic, “Computer aided power system analysis”, PHI, 1986.
3. L.P.Singh, “ Advanced power system analysis and dynamics”, Wiley Eastern
4. J. Arillage and C.P. Arnold, “Computer analyzing power system”, John Wiley, 1990.
5. A. R. Bergen and V. Vittal, “Power system analysis”, Prentice Hall, 2000.

Related Journals and Books for applications and advanced works.

(i) IEEE Transactions on Power System
(ii) IET Journal on Generation, Transmission and Distribution
(iii) NPTEL Courses on Electrical Engineering