G. PULLA REDDY ENGINEERING COLLEGE (Autonomous): KURNOOL
Accredited by NBA of AICTE and NAAC of UGC
Affiliated to JNTUA, Anantapur

Scheme – 2017

M.Tech Syllabus (Power Electronics)

Department of Electrical and Electronics Engineering
G. Pulla Reddy Engineering College (Autonomous): Kurnool
Accredited by NBA of AICTE and NAAC of UGC
Affiliated to JNTUA,
Anantapuramu

Annexure – II

TWO YEAR M.TECH COURSE (SCHEME – 17)

Scheme of instruction and Examination

(Effective from 2017-18)

M.Tech I Semester **Power Electronics**

S.No	Subject	Code	Credits	Scheme of Instruction periods/week			Duration of end Exam (Hours)	Scheme of Examination Max. Marks		
				L	D/ T	P		End Exam	Internal Assessment	Total
I	**Theory**									
1.	Electrical Machine Modelling (EMM)	EE801	3	3	-	-	3Hrs	60	40	100
2.	Analysis of Power Converters (APC)	EE802	3	3	-	-	3Hrs	60	40	100
3.	Solid State Power Converters (SSPC)	EE803	3	3	-	-	3Hrs	60	40	100
4.	Digital Signal Processing (DSP)	EE804	3	3	-	-	3Hrs	60	40	100
5.	Elective –I		3	3	-	-	3Hrs	60	40	100
6.	Elective –II		3	3	-	-	3Hrs	60	40	100
7.	Technical English	AU101	-	-	-	-	-	-	-	-
II	**Practical**									
8.	Basic Simulation of Power Electronic Systems Lab (BSPESL)	EE805	2	-	-	3	3Hrs	50	50	100
			20	**18**	**-**	**3**		**410**	**290**	**700**

ELECTRICAL MACHINE MODELING (EMM)

I Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE801	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the various electrical parameters in mathematical form.

CO2: Understand the different types of reference frame theories and transformation relationships.

CO3: Find the electrical machine equivalent circuit parameters and modeling of electrical machines.

Basic concepts of modeling

Basic Elements of generalized theory of machines, circuit models of synchronous, induction and dc machines – general expressions for voltage and torque, Kron's primitive machine – voltage, power and torque equations-Restrictions of generalized theory of machines

DC Machines

Mathematical Models of separately excited DC motor, DC series motor – compound machines- steady state, transient and dynamic performance.

Linear Transformations

Necessity in electrical machines – phase transformations, concepts of power invariance, Transformation from rotating axes to stationary axes- Physical Concept of Parks transformations-Transformed Impedance Matrix- MMF distributions in the air gap in the development of phase transformations – symmetrical component transformations – space vector theory

Reference Frame Theory

Concept of reference frame – stationary reference frame – rotating reference frame - synchronously rotating reference frame – commutator transformation – in phase variables – two axis variables – transformation matrices – transformations to a rotating reference frame.

Induction Machines

Matrix models in various reference frames – steady state and transient analysis – derivation of steady state equivalent circuit – torque equation – speed torque characteristics.

Synchronous Machines

Matrix module of synchronous motor in rotating reference frame – performance of synchronous motor – steady state and dynamic performance of synchronous motor.

Text Books :

1. P.C. Krause, O. Wasynczuk, S.D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", IEEE Wiley-IEEE Press, ISBN 0-471-14326-0, 2nd Edition, 1995
2. P.S. Bimbhra, "Generalized Theory of Electrical Machines", Khanna, 4th edition, 2011
3. K. Mukhopadhyay, "Matrix Analysis Of Electrical Machines", New Age Publishers, 2005
4. Vedam Subramanyam, "Thyristor Control of Electric Drives" Tata McGraw-Hill publishers-Eighteenth edition, 2008.

Reference Books :

1. Bernard Adkins, Ronald G. Harley, "The general theory of alternating current machines: Application to practical problems", Chapman and Hall, 1978

Web References:

http://nptel.ac.in/courses/108106023/

www.iea.lth.se/publications/Theses/LTH-IEA-1043.pdf

http://www.darshan.ac.in/DIET/EE/396/electrical-machine-modeling-and-analysis/SubjectDetail

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and the student has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

ANALYSIS OF POWER CONVERTERS (APC)

I Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE802	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the, structure, static and dynamic characteristics of power semi conductor devices like diodes, BJT, SCR, MOSFET, IGBT, GTO, MCT, and IGCT.

CO2: Understand about protection and driver circuits for power semi conductor devices.

CO3: Understand the performance of single and multi quadrant, 1-Φ and 3-Φ bridge rectifiers for R and RL loads.

CO4: Understand the operation of single stage AC-AC converters (with fixed and variable output AC frequencies).

Power Semiconductor Devices

Power diodes, BJT, SCR, MOSFET, IGBT, GTO, MCT, IGCT – Structure– Their static and dynamic characteristics. Protection circuits – design features of driver circuit.

Single Phase Converters

Single phase converters – Half controlled and fully controlled converters with continuous and Discontinuous mode of operation – their performance parameters. Power factor improvement techniques of single phase Rectifiers. PWM techniques for rectifiers – Rectifiers with RLE load.

Three Phase Converters

Three phase converters – Half controlled and Fully controlled converters with continuous and Discontinuous mode of operation – their performance parameters. Twelve pulse converters.

Dual Converters

Single phase and three phase dual converters with circulating mode of operation and non-circulating mode of operation.

AC-AC converters

1-ϕ half and full wave AC voltage controllers with R and RL loads – 3-ϕ AC voltage controllers. PWM control– sequence control of AC voltage controller – Principle of 3-phase Matrix converter. 1-ϕ to 1-ϕ and 3-ϕ cycloconverters – advantages and disadvantages.

Text Books :

1. Muhammad H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education, 3rd Edition, 2003.
2. Dr. B.S.Bimbra, “Power Electronics”, Khanna Publishers, 3rd edition, 2003
3. Vedam Subrahmanyam, “Power Electronics”, New Age International, 1996
4. M.D. Singh, K.B. Khanchandani, “Power Electronics”, Tata McGraw-Hill, 2008

Reference Books :

1. G.K. Dubey, et.al, “Thristorized Power Controllers”, Wiley Eastern Ltd, 2001

Web References:
1. http://www.sciencedirect.com/science/book/9780120887958
2. http://www.freebookcentre.net/Electronics/Power-Electronics-Books.html
3. http://nptel.ac.in/downloads/108105066/
4. http://uni-site.ir/khuelec/wp-content/uploads/Mohan-Power-Electronics.pdf
5. http://www.e-booksdirectory.com/details.php?ebook=11306
Question Paper Pattern:
Internal Assessment: The question paper for internal examination shall consist of **Six** questions and the student has to answer any **Four** questions. **End Exam:** The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

SOLID STATE POWER CONVERTERS (SSPC)

I Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE803	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the basic differences between VSI and CSI, working/operation of line commutated, load commutated and forced commutated inverters.

CO2: Determine the performance of 1-Φ voltage source inverter with Single, Multiple, Sine PWM techniques.

CO3: Understand the operation of multilevel inverters to reduce harmonics.

CO4: Understand operation single and multi-quadrant DC-DC converters.

CO5: Understand the operation and design of single stage (Buck, Boost and Buck-Boost), two stage (fly back, push pull, half bridge and full bridge) DC-DC converters.

Introduction to Inverters

Single phase and three phase inverters - Voltage source and Current source inverters -Auto sequential current source inverter (ASCI) - Comparison of current source inverter and voltage source inverters - Voltage Control and harmonic minimization in inverters.

Pulse width modulated (PWM) Inverters

Sinusoidal PWM -Space Vector based PWM, Bus clamping PWM - Advanced PWM techniques - Selective harmonic elimination method - third harmonic injection method –Performance comparison.

Multi level inverters

Concept of Multi level Inverters - Classification of Multi level inverters, principle of operation and features of diode clamped multi-level inverters -Flying capacitor multi-level inverters and H-Bridge Inverter Topology - Comparison of multilevel inverter topologies -Introduction to advanced Multi level inverter topologies.

DC - DC Converters

Analysis of step-down and step-up DC to DC converters with R and RL Loads – Multi quadrant converters- Switched mode regulators – Analysis of buck regulators - Boost regulators – Buck and boost regulators – Cuk regulators.

Isolated DC-DC Converters

Requirement for isolation in the switch-mode converters -Transformer connection – Forward and flyback converters - Power circuit and steady-state analysis - Push-Pull Converters – Power circuit and steady-state analysis - Utilization of magnetic circuits in single switch and push-pull topologies, Half bridge and full-bridge converters.

Text Books :

1. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, 3rd Edition, 2003.
2. B. K. Bose, "Modern Power Electronics & AC Drives", Prentice Hall, 2002
3. Dr. B.S.Bimbra, "Power Electronics", Khanna Publishers, 3rd edition, 2003
4. Vedam Subrahmanyam, "Power Electronics", New Age International, 1996
5. M.D. Singh, K.B. Khanchandani, "Power Electronics", Tata McGraw-Hill, 2008

Reference Books :

1. G.K. Dubey, et.al, "Thristorized Power Controllers", Wiley Eastern Ltd, 2001
2. D. Grahame Holmes, Thomas A. Lipo, "Pulse Width Modulation for Power Conversion", John Wiley & Sons, 2003

Web References:

1. http://www.sciencedirect.com/science/book/9780120887958
2. http://www.freebookcentre.net/Electronics/Power-Electronics-Books.html
3. http://nptel.ac.in/downloads/108105066/
4. http://uni-site.ir/khuelec/wp-content/uploads/Mohan-Power-Electronics.pdf
5. http://www.e-booksdirectory.com/details.php?ebook=11306

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and the student has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

DIGITAL SIGNAL PROCESSING (DSP)

I Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE804	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the basic concepts of digital signal processing.

CO2: Characterize LTI discrete-time signals and systems.

CO3: Understand the different parametric & nonparametric spectrum estimation methods.

CO4: Understand and apply various Z transform theorems & properties on discrete systems.

CO5: Understand and apply DFT and FFTs to a digital signal.

CO6: Design analog filters using various techniques.

CO7: Design digital filters using various techniques.

Discrete Time Signals and Systems

Discrete time signals and sequences, linear shift, invariant systems, stability and causality, linear constant, coefficient of difference equations, frequency domain representation of discrete time systems and signals, properties of Fourier transform of discrete sequence, sampling of continuous time signals.

Z-Transforms

Z-transform and inverse Z-transforms, theorems and properties, systems function, sampling the Z-transform.

Discrete Fourier Transform (DFT)

Fourier representation of frequency domain sequences, discrete fourier transform (DFT), properties of DFT, Inverse DFT (IDFT).

Fast Fourier Transform

Introduction, Radix-2 FFT algorithms, applications of FFT algorithms.

Design of Filters

Design of FIR filters - Design of IIR filters.

Implementation of Discrete-Time Systems

Structures of FIR systems - Structures of IIR systems.

Text Books :

1. John G. Proakis et.al. “Digital Signal Processing, Principles, Algorithms and Applications”, Prentice Hall, 4th edition, 2007
2. Johnny R Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1989

Reference Books :

1. Alan V. Oppenheim, Ronald W. Schafer, “Digital Signal Processing”, Prentice-Hall, 1975
2. William D. Stanley, Gary R. Dougherty, “Digital Signal Processing”, Reston Pub. Co., 2nd edition, 1984
3. Andreas Antoniou, “Digital filters”, McGraw-Hill, 2nd edition, 2000.

Web References:

1. http://nptel.ac.in/courses/117102060/
2. https://lecturenotes.in/note/50/digital-signal-processing
3. https://onlinecourses.nptel.ac.in/noc16_ec13
4. https://www.scribd.com/document/317199607/PDF-of-Digital-Signal-Processing-Ramesh-Babu-2

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and the student has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

SIMULATION OF POWER ELECTRONIC SYSTEMS LAB (SPESL)

I Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE805	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	-	**-**	**3**	**3**	**50**	**50**	**100**

End Exam Duration: 3 Hrs

Course Outcomes : At the end of the course the student will be able to

CO1: Acquire knowledge about Simulink and MATLAB programming.

CO2: Understand and develop pulse width modulated two and three level inverter using MATLAB.

CO3: Develop the mathematical model of induction motor using MATLAB.

CO4: Design various converters with R and RL Load using PSIM

LIST OF EXPERIMENTS

1. Develop a simulink model for a three-phase induction motor using synchronously rotating reference frame.
2. Develop a simulink model for a three-phase induction motor using stationary reference frame.
3. Develop a simulink model for sinusoidal pulse width modulation algorithm for three-phase voltage source inverter. Study the same at various switching frequencies and at various modulation indices.
4. Develop a simulink model for space vector pulse width modulation (SVPWM) algorithm for three-phase voltage source inverter. Study the same at various switching frequencies and at various modulation indices.
5. Develop a simulation model for pulse width modulated diode clamped three-level inverter and compare the same with two-level inverter. (Carrier comparison approach only).
6. PSIM simulation of single phase dual converter with R and R-L loads.
7. PSIM simulation of three-phase AC voltage controller with R and R-L loads.
8. PSIM simulation of single phase full controlled rectifier with R and R-L loads
9. PSIM simulation of three-phase full controlled rectifier with R and R-L loads
10. PSIM simulation of four quadrant chopper with R and R-L loads.

Reference Books :

1. cdn.intechopen.com/pdfs/39326.pdf
2. www.hamzaproducts.com/matlab-manual-for-power-electronics.pdf

M.Tech II Semester **Power Electronics**

S.No	Subject	Code	Credits	Scheme of Instruction periods/week			Duration of end Exam (Hours)	Scheme of Examination Max. Marks		
				L	D/ T	P		End Exam	Internal Assessment	Total
I	**Theory**									
1.	Solid State DC Drives (SDCD)	EE806	3	3	-	-	3Hrs	60	40	100
2.	Solid State AC Drives (SACD)	EE807	3	3	-	-	3Hrs	60	40	100
3.	HVDC and FACTS (HVDC)	EE808	3	3	-	-	3Hrs	60	40	100
4.	Advanced Simulation of Power Electronic Systems (ASPES)	EE809	3	3	-	-	3Hrs	60	40	100
5.	Elective-III		3	3	-	-	3Hrs	60	40	100
6.	Elective-IV		3	3	-	-	3Hrs	60	40	100
7.	Research Methodology	AU102	-	-	-	-	-	-	-	-
II	**Practical**									
8.	Electrical Drives Lab (EDL)	EE810	2	-	-	3	3Hrs	50	50	100
			20	**18**	**-**	**3**		**410**	**290**	**700**

SOLID STATE DC DRIVES (SDCD)

II Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE806	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Select the suitable drive for the required load characteristics.

CO2: Understand the concept of Converter /Chopper control of Dc motor drive.

CO3: Gain adequate knowledge about DC motor drive and various speed control methods.

Review of Conventional DC Drives

Review of conventional DC Drives, Steady state speed torque relation of DC motor, methods of speed control, electrical braking for both series and separately excited DC motors, Multi quadrant operation of separately excited DC motor with regenerative braking, transfer function separately excited DC motor- field and armature control.

Rectifier Control of DC Drives

Introduction, types, 1-ϕ half controlled and fully controlled converters and 3-ϕ fully controlled converters connected to separately excited and series motor, continuous and discontinuous modes of operation, dual converter fed DC drives, reversible DC drives.

Chopper Controlled dc drives

Introduction, types, Type A and Type B chopper fed drives, chopper fed separately excited and series motor drives, motoring operation, regenerative operation and braking operation, multi-quadrant drives, closed loop control of dc drives-Single and four quadrant variable speed drives.

Closed loop operation of DC Drives

Speed controlled drive system, current control loop, pulse width modulated current controller, hysteresis current controller, modeling and design of current controller.

Simulation of DC motor drives

Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

Text Books :

1. S. B. Dewan, Gordon R. Slemon, A. Straughen, “Power Semiconductor Drives”, John Wiley and Sons, 1987
2. Vedam Subrahmanyam, “Thyristor Control of Electric Drives”, TMH, 2008
3. P. C. Sen, “Thyristor DC Drives”, Wiley, 1st edition, 1981

Reference Books :

1. G K Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989
2. R. Krishnan, “Electric Motor Drives: Concepts and Applications”, Prentice Hall; 1st edition, 2001

Web References:
1. www.emic-bg.org/files/Electric_Motors_Drives.pdf
2. http://www.freebookcentre.net/electronics-ebooks-download/DC-Motor-Drive-(PDF-36p).html
3. https://library.e.abb.com/public/8bf2f10f6872424396a5ccbf77f8435f/Technical%20e-book%20ACS580_b.pdf
Question Paper Pattern:
Internal Assessment: The question paper for internal examination shall consist of **Six** questions and the student has to answer any **Four** questions. **End Exam:** The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

SOLID STATE AC DRIVES (SACD)

II Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE807	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand conventional methods for the control of AC motors.

CO2: Understand stator control methods for induction motor and synchronous motors using single stage and two stage AC-AC converters.

CO3: Apply slip power recovery schemes for the control of induction motor.

CO4: Apply closed loop decoupled control methods for the control of induction motor

CO5: Understand speed control method for reluctance motor and brushless DC motor.

Review of Conventional AC Drives

Review of conventional AC Drives, speed-torque and slip-torque relations of Induction Motor and Synchronous Motor.

Speed control of Induction Motor

Speed control of 3-phase Induction Motor using stator voltage control method using AC Voltage Controllers, Stator frequency control method using Cycloconverters, stator V/F control method using Voltage Source Inverters (VSI), stator current control method using current source inverters (CSI), PWM inverter drives, dynamic and regenerative braking of VSI and CSI fed Induction Motor Drives.
Speed control of 3-phase induction motor using Static rotor resistance control method, Slip power recovery schemes, Static Kramer method, and Static Scherbius method.
Speed control of 3-phase induction motor by vector control methods: Basic concepts of Direct and Indirect methods of vector control. Speed control of induction motor by Direct Torque Control (DTC).

Speed control of Synchronous motor

Self control and separately control of synchronous motors, VSI and CSI fed synchronous motors, margin angle control; Cycloconverter fed synchronous motor, speed control and performance of synchronous motor using a variable frequency supply with DC link inverter.

Variable Reluctance Motor drives

Torque production in the variable reluctance motor drives, drive characteristics and control principles, current control variable reluctance motor drives.

Brushless DC motor Drives

Three-phase full wave brushless dc motor, sinusoidal type of brushless dc motor, current controlled brushless DC motor drive.

Text Books :

1. S. B. Dewan, Gordon R. Slemon, A. Straughen, “Power Semiconductor Drives”, John Wiley and Sons, 1987.
2. B. K. Bose, “Modern Power Electronics & AC Drives”, Prentice Hall, 2002.
3. Vedam Subrahmanyam, “Thyristor Control of Electric Drives”, TMH, 2008.
4. G K Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.

Reference Books :

1. Murphy J.M.D, Turnbull, F.G, "Thyristor Control of AC Motor", Pergamon Press, 1973.
2. Peter Vas, "Sensorless Vector and Direct Torque Control", Oxford University Press, USA, 1998.

Web References:

1. http://www.faadooengineers.com/threads/3532-Basics-of-AC-Drives-Ebook-PDF-Download-Siemens-Step-Course
2. https://library.e.abb.com/public/8bf2f10f6872424396a5ccbf77f8435f/Technical%20e-book%20ACS580_b.pdf
3. http://lnodroundtable.com/groups/modern-power-electronics-and-ac-drives-textbook-pdf-epub/

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and the student has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

HVDC AND FACTS (HVDC)

II Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE808	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the basic concepts of power converters used in transmission grid.

CO2: Understand the importance and advantage of HVDC Links.

CO3: Understand the various firing angle control methods.

CO4: Analyze the protection of HVDC system, power flow in AC/DC system and Per Unit representation.

CO5: Understand the design of various types of FACTS controllers.

CO6: Compensate reactive power using series compensation and shunt compensation.

Basic concepts

Choice of converter configurations - Analysis of Graetz circuit – Characteristics of 6-pulse and 12-pulse converters – Principle of DC link control – Converter control characteristics – Firing angle control – Current and extinction angle control – Effect of source inductance on the systems.

Converter faults & protection

Converter faults – protection against over currents & over voltages in converter station – surge arresters – smoothing reactors – DC breakers – Effects of proximity of AC & DC transmission lines.

Power Flow Analysis in AC/DC Systems

Modeling of DC Links – solution of DC load flow – P.U system for DC quantities.

FACTS concept & General System Considerations

Transmission Interconnections- Flow of power in an AC system- Loading capability limits- Power flow and dynamic stability considerations of a transmission interconnection – Relative importance of controllable parameters- Basic types of FACTS controllers- Brief description and definitions of FACTS controllers.

Static Shunt and Series Compensation

Objectives of shunt compensation – Midpoint voltage Regulation for Line segmentation – End line voltage support to prevent voltage Instability – Improvement of Transient Stability – Power oscillation damping – Objectives of series compensation – Concept of series capacitive compensation – Voltage stability - Improvement of transient stability – Power oscillation damping – Sub synchronous oscillation damping

Text Books :

1. K. R. Padiyar, “HVDC Power Transmission Systems”, New Age International Pub., 2nd edition, 2012
2. E. W. Kimbark, “Direct Current Transmission”, Wiley-Interscience, 1971
3. N. G. Hingorani, Laszlo Gyugyi, Hingorani, “Understanding FACTS Devices”, IEEE Computer Society Press, 1999

Reference Books :

1. J. Arrillaga, "High Voltage Direct Current Transmission", IET / BSP Books, 2nd edition, 2013
2. G.K. Dubey, et.al, "Thyristorized Power Controllers", Wiley Eastern Ltd, 2001

Web References:

1. http://nptel.ac.in/courses/108104013/37
2. http://textofvideo.nptel.iitm.ac.in/108104013/lec1.pdf
3. http://www.siemens.co.in/pool/about_us/our_business_segments/hvdc_proven_technology.pdf
4. https://people.qatar.tamu.edu/shehab.ahmed/ecen_459/FACTS.pdf
5. http://www.faadooengineers.com/threads/42779-HVDC-KR-Padiyar
6. http://www.faadooengineers.com/threads/11735-Facts-k-r-padiyar
7. http://storageelectricity.blogspot.in/2014/09/understanding-facts-by-hingorani.html
8. http://research.iaun.ac.ir/pd/bahador.fani/pdfs/UploadFile_6422.pdf

Question Paper Pattern:

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End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

ADVANCED SIMULATION OF POWER ELECTRONIC SYSTEMS (ASPES)

II Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE809	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the modeling of various power electronic converter and electrical machines.

CO2: Understand various models in both PSpice and MATLAB environment.

CO3: Understand the graphical method of formulating the equations.

CO4: Understand system behavior and also its analysis methods like State space averaging circuit averaging and averaged switch modeling.

Modeling

Principles of Modeling Power Semiconductor Devices - Macro models versus Micro models - Thyristor model - Semiconductor Device modeled as Resistance, Resistance-Inductance and Inductance-Resistance Capacitance combination - Modeling of Electrical Machines – Modeling of control circuits for power electronic switches computer formulation of equations for power electronic systems.

Computer Formulation of Equations for Power Electronic Systems

Review of graph theory as applied to Electric networks- Systematic method of formulating state equations - Computer solution of state equations - Explicit Integration method - Implicit Integration method.

AC equivalent circuit modeling

Basic AC modeling approach-State space averaging circuit averaging and averaged switch modeling-Modeling the PWM.

Circuit Analysis using ORCAD- PSpice

Simulation Overview - Creating and preparing a circuit for simulation - Simulating a circuit with PSpice - Simple multi-run analyses -Statistical analyses – Simulation examples of power electronic systems- Creating symbols -Creating - Models – Analog behavioral modeling - Setting up and running analyses – Viewing results - Examples of power electronic systems.

Circuit Analysis using MATLAB

Dynamic modeling and simulation of DC-DC converters using MATLAB-Simulation of State Space Models - Modeling and simulation of inverters using MATLAB.

Text Books :

1. V. Rajagopalan, “Computer Aided Analysis of Power Electronic Systems”, Marcel Dekker, Inc., 1987.
2. Randall Alan Shaffer, “Fundamentals of Power Electronics with MATLAB”, Charles River Media, 2007.
3. J. P. Agrawal, “Power Electronic Systems: Theory and Design”, Pearson Education Inc., 3rd edition, 2009

Reference Books :

1. Robert W. Erickson, Dragan Maksimovic, "Fundamentals of Power Electronics", Springer International Edition, 2nd edition, 2001.
2. Ned Mohan, Tore M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley and Sons, 2nd edition, 2009
3. ORCAD PSpice Basics: Circuit Analysis Software, User's Guide, ORCAD Corporation.

Web References:

1. https://ece.uwaterloo.ca/~pwr_elec/
2. https://www.scribd.com/document/317675553/circuit-sim-1-IITB-pdf
3. https://www.fer.unizg.hr/_download/repository/Modeling_and_Simulation_of_Power_Electronic_converters.pdf

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and the student has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

ELECTRICAL DRIVES LAB (EDL)

II Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE810	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	-	**-**	**3**	**3**	**50**	**50**	**100**

End Exam Duration: 3 Hrs

Course Outcomes : At the end of the course the student will be able to

CO1: Acquire knowledge about DSP and dSPACE controllers.

CO2: Understand speed control of DC motor using micro controller, DSP, rectifier and chopper.

CO3: Understand speed control of induction motor using ac voltage controller.

CO4: Understand v/f controlled induction motor drive using dSPACE and DSP controllers.

LIST OF EXPERIMENTS

1. Verification of SPWM and SVPWM methods using dSPACE kit.
2. Verification of SPWM and SVPWM methods using DSP kit.
3. Verification of V/f controlled induction motor drive using dSPACE kit.
4. DSP based speed control of BLDC motor drive
5. Microcontroller based speed control of separately excited DC motor.
6. Speed control of DC Motor using three-phase rectifier.
7. Four-quadrant and step down chopper fed DC motor drive.
8. Static Kramer drive
9. Static rotor resistance control of SRIM using chopper.
10. Speed control of induction motor using three-phase AC voltage controllers.

Reference Books :

1. B. K. Bose, “Modern Power Electronics & AC Drives”, Prentice Hall, 2002.
2. Vedam Subrahmanyam, “Thyristor Control of Electric Drives”, TMH, 2008

M.Tech III & IV Semester **Power Electronics**

S.No	Subject	Code	Credits	Scheme of Instruction periods/week			Duration of end Exam (Hours)	Scheme of Examination Max. Marks		
				L	D/ T	P		End Exam	Internal Assessment	Total
1.	Project Dissertation	EE901	12	-	-	-	-	50	50	100

List of Electives

Description	Subject title	Code
Audit Course – I	Technical English	AU101
Audit Course – II	Research Methodology	AU102
Elective I	1. Digital Control Systems (DCS)	EE811
	2. Nonlinear Control Systems (NLCS)	EE812
	3. Modern Control Theory (MCT)	EE813
Elective II	1. Neural Networks and Fuzzy Logic (NNFL)	EE814
	2. Soft Computing Techniques (SCT)	EE815
	3. Microcontrollers and Applications (MCA)	EE816
Elective III	1. Power Quality (PQ)	EE817
	2. EMI and EMC issues (EMI)	EE818
	3. Industrial Applications of Power Electronics (IAPE)	EE819
Elective IV	1. Renewable Energy Sources (RES)	EE820
	2. Power Electronics in Solar and Wind Energy Systems (PESWS)	EE821
	3. Programmable Logic Controllers (PLC)	EE822

TECHNICAL ENGLISH (TE)

I Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
AU101	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	-	**-**	**-**	**-**	**-**	**-**	**-**
Sessional Exam Duration :				**End Exam Duration:**			

Course Outcomes : At the end of the course the student will be able to

CO1: Write Technical Reports, Journal Papers and Project Reports.

CO2: Write Job Applications, Resumes and Statements of Purpose.

Course Content

1. Technical Reports –Formats and Styles
   a) Feasibility Report
   b) Factual Report
   c) Project Reports
2. Journal Papers- Formats
3. Paper Presentation Strategies
4. Statement of Purpose for Internships and Apprenticeships
5. Letter Writing- Job Applications, Resume Preparation
6. Common Errors in Research Papers

Reference Books :

1. Sangeeta Sharma & Binod Mishra, Communication Skills for Engineers and Scientists, PHI Learning Private Limited.
2. M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw-Hill Publishing Company Ltd., 2005.
3. Thomas S. Kane , The Oxford Essential Guide to Writing, OUP, 2010
4. Joan van Emden, A Guide to Technical Report Writing http://scisweb.ulster.ac.uk/~projects/guide-to-technical-writing-1.pdf

RESEARCH METHODOLOGY (RM)

II Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
AU102	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	-	-	-	-	-	-	-
Sessional Exam Duration :				**End Exam Duration:**			

Course Outcomes : At the end of the course the student will be able to

CO1: Understand overview of research process, state the research problem and conduct a literature review of the concepts comprising the research questions.

CO2: Study the data collection methods and process the data statistically.

CO3: Understand the basic properties of estimators, analyze the estimated data and interpret the data in a research paper.

Meaning, Objective and Motivation in Research

Types of Research, Research Approaches, Research Process, Validity and Reliability in Research. Features of Good Design, Types of Research Design, Basic Principles of Experimental Design, Steps in Sampling Design, Characteristics of a Good Sample Design, Random Samples and Random Sampling Design.

Measurement and Scaling Techniques

Errors in Measurement, Tests of Sound Measurement, Scaling and Scale Construction Techniques, Forecasting Techniques, Time Series Analysis, Interpolation and Extrapolation.

Methods of Data Collection

Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules.

Statistical Processing

Correlation and Regression Analysis, Method of Least Squares, Regression Vs. Correlation, Correlation Vs. Determination, Types of Correlation and Their Specific Applications.

Hypothesis Testing

Tests of Hypothesis, Parametric Vs. Non-Parametric Tests, Procedure for Testing Hypothesis, Use of Statistical Techniques for Testing Hypothesis, Sampling Distribution, Sampling Theory Chi-Square Test, Analysis of Variance and Covariance, Multivariable Analysis

Text Books :

1. C.R. Kothari, *Research Methodology (Methods & Techniques)*, New Age International Publishers.
2. R.Cauvery, V.K.Sudha Nayak, M.Girija, Research Methodology, S.Chand Publishers.

Reference Books :

1. Dr.Chandrakant Kokare, Dr.Shrikant Kokare," Research Methodology", Repro Knowledgcast Limited, 2015

Web References:

1. http://www.sociology.kpi.ua/wp-content/uploads/2014/06/Ranjit_Kumar-Research_Methodology_A_Step-by-Step_G.pdf

2. http://www.socscidiss.bham.ac.uk/methodologies.html
3. https://www.bcps.org/offices/lis/researchcourse/develop_writing_method_quantitative.html
4. https://groups.google.com/forum/#!msg/klubs_mba/e24oSszYJPI/APKTFNtmg8EJ
5. https://www.researchgate.net/publication/270956555_CHAPTER_3_-_RESEARCH_METHODOLOGY_Data_collection_method_and_Research_tools
6. https://www.slideshare.net/collinsbrobbey/sample-study
7. http://libguides.usc.edu/writingguide/methodology

DIGITAL CONTROL SYSTEMS (DCS)

I Semester : POWER ELECTRONICS				Scheme : 2017			
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE811	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs				**End Exam Duration: 3 Hrs**			

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the basic A/D and D/A conversion

CO2: Understand the Z- Transform

CO3: Understand the state space analysis methods

CO4: Understand the stability analysis and time domain analysis

CO5: Understand digital process control and design.

Introduction

Block diagram of typical digital control system - advantages of sampling in control systems - examples of discrete data and digital control systems - reconstruction of sampled signals, ZOH.

Z-Transform

Definition and evaluation of Z-transforms, mapping between s-plane and z-plane - inverse Z-transform, theorems of Z-transforms - limitation of Z-transform - pulse transfer function - pulse transfer function of ZOH - relation between G(s) and G(z) - signal flow graph method applied to digital systems.

State Space Analysis

State space modeling of digital systems with sample and hold - state transition equation of digital time in variant systems - solution of time in variant discrete state equation by the Z-transformation - transfer function from the state model, Eigen values, Eigen vectors and diagonalisation of the A-matrix, Jordan canonical form, computation of state transition matrix.

Stability

Definition of stability, stability tests, the second method of Lyapunov.

Time Domain Analysis

Comparison of time responses of continuous data and digital control systems - correlation between time response and root locus in the s-plane and z-plane - root loci for digital control systems - steady state error analysis of digital control systems.

Controllability and Observability

Theorems on controllability - theorems on observability (time invariant systems) - relation between controllability - observability and transfer function - controllability and observability vs. sampling period.

Design

Digital PID controller - pole placement through state feedback.

Text Books :

1. B. C. Kuo, “Digital Control Systems”, Oxford University Press, USA, 2nd edition, 1995
2. M.Gopal, “Digital Control Systems”, Wiley; 1st edition, 1988
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 5th edition, 2010

Reference Books :

1. Ioan Doré Landau, Gianluca Zito, "Digital Control Systems: Design, Identification and Implementation", Springer Science & Business Media

Web References:

1. https://link.springer.com/book/10.1007%2F978-1-84628-056-6
2. http://www.sciencedirect.com/science/book/9780123943910
3. http://faculty.ksu.edu.sa/hedjar/Documents/CEN455/Digital%20Control%20Systems.pdf
4. http://www.springer.com/in/book/9781846280559
5. http://www.springer.com/in/book/9783642864193
6. http://nptel.ac.in/courses/108103008/
7. https://www.coursehero.com/file/13785953/DIGITAL-CONTROL-SYSTEMSpdf/
8. http://een.iust.ac.ir/profs/Esmaeilzadeh/MSc.%20Digital%20Control%20Systems/Digital%20Control%20System_PhilipsNagle.pdf

Question Paper Pattern:

Internal Assessment: The question paper for internal examination shall consist of **Six** questions and the student has to answer any **Four** questions.

End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

NON LINEAR CONTROL SYSTEMS (NLCS)

I Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE812	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understandstate space equations and draw state diagrams for physical systems

CO2: Understand state equations of linear, nonlinear, time invariant and time varying systems

CO3: Verify the given system is controllable, observable, detectable, stabilizable and reducable

Introduction to Linearization Process

Common Nonlinear behavior, Common Nonlinearities - Autonomy - Equilibrium points of nonlinear systems, Feedback Linearization, Series Approximation Methods.

Describing Function

Describing function for different nonlinearities - ideal relay, hysteresis, dead zone, saturation - Stability analysis of systems by describing function - Stable and unstable limit cycle - Dual Input describing function - DIDF for typical nonlinearities.

Phase Plane Analysis

Contents of Singular points - Construction of phase plane using Isocline, Lienard, Delta and Pell's methods - Poincare index and Bendixon theorems - Stability, determination - Limit cycles - Nonlinear performance analysis of piecewise linear system.the chapter

Stability Analysis

Lyapunov Stability, ON - OFF Control System: Solution of equation - Relay with lead circuit - Popov method - Generation of Lyapunov function - Gradient, Lure and Krasoviski method.

Sliding Mode Control

Variable structure systems - Basic concepts - Sliding modes in variable structure system conditions for existence of sliding regions – Case Study - Sliding mode approach to speed control of DC motors.

Text Books :

1. John E. Gibson, “Non linear Automatic Control”, McGraw Hill Inc., 1963.
2. M.Gopal, “Digital Control and State Variable Methods”, TMH, 2006
3. Hasen K. Khalil, "Nonlinear Systems", Prentice Hall Inc., New York, 3rd edition, 2002.
4. Jean Jacques E. Slotine, Weiping Autor Li, “Applied Nonlinear Control”, Prentice Hall Inc., 1991

Reference Books :

1. K. Ogata, “Modern Control Engineering”, Prentice Hall, 5th edition, 2010

Web References:

1. http://dl.offdownload.ir/ali/Analysis%20and%20Design%20of%20Nonlinear%20Control%20Systems.pdf

2. http://www.gipsa-lab.grenoble-inp.fr/~nicolas.marchand/teaching/Nonlinear_PSPI.pdf
3. http://nptel.ac.in/courses/108106024/

Question Paper Pattern:

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End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

MODERN CONTROL THEORY (MCT)

I Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE813	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Analyze dynamics of a linear system by solving system model/equation or applying domain transformation.

CO2: Realize the structure of a discrete time system and model its action mathematically.

CO3: Examine a system for its stability, controllability and observability.

CO4: Implement basic principles and techniques in designing linear control systems.

CO5: Formulate and solve deterministic optimal control problems in terms of performance indices.

CO6: Apply knowledge of control theory for practical implementations in engineering and network analysis

Introduction to control systems

Introduction to control systems - properties of signals and systems - convolution integral - ordinary differential equation - Transfer function - Pole zero concepts - effect of pole location on performance specification - System models in state space, canonical model, MIMO systems - Solution of state equation - stability of systems in state space.

Linear System Analysis

Linear algebra, vector spaces, span and change of basis - linear transformations - Gram Schmidt orthogonalization criterion - QR decomposition – Singular value decomposition. Computing eAT controllability - Observability controller design, observer design, reduced order observers, properties of controllability - Computing numerical rank of a matrix - Kalman canonical forms, partial pole assignment using static pole output feedback - Design of non-interacting systems.

Non-linear system analysis

Non-linear system behavior - different methods of linearization - Lyapnov stability criterion - Phase plane analysis, singular points, constructing phase portraits, existence of limit cycle.

Describing function analysis

Fundamentals, assumptions, definitions - Describing functions of common non-linearities -Describing function analysis of non-linear system - Stability of limit cycles, reliability of describing function analysis.

Text Books :

1. Robert E. Skelton, “Dynamic System Control and Linear System Analysis and Synthesis”, John Wiley and Sons Inc., New Delhi, 1988.
2. B. C. Kuo, “Automatic Control Systems”, PHI Learning, 7th edition, 1995
3. M.Gopal, “Modern Control Systems”, New Age International, 2nd edition, 1993
4. Brogan W. L., “Modern Control Theory”, Prentice Hall International, New Jersey, 1991.

Reference Books :

1. Jean Jacques E. Slotine, Weiping Autor Li, "Applied Nonlinear Control", Prentice Hall Inc., 1991
2. M. Vidyasagar, "Nonlinear System Analysis", Prentice Hall Inc., 2nd Edition, , 1993

Web References:

1. portal.tpu.ru:7777/SHARED/s/SMIKE/Uchebnaya/.../Modern_Control_Engineering.pdf
2. www.znu.ac.ir/data/members/pirmohamadi_ali/Control/Brogan(BookZZ.org).pdf
3. sv.20file.org/up1/951_0.pdf

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NEURAL NETWORKS AND FUZZY LOGIC (NNFL)

I Semester : POWER ELECTRONICS				Scheme : 2017			
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE814	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs				**End Exam Duration: 3 Hrs**			

Course Outcomes : At the end of the course the student will be able to

CO1: Understand the basic concept of biological neural networks

CO2: Understand the basic concept of artificial neural networks

CO3: Create Neural Network models for electrical engineering.

CO4: Understand the basic concepts of fuzzy logic.

CO5: Create Fuzzy models for electrical engineering.

Biological Neural Network

Organization of human brain - Neuron functions, cell body, dendrites, axon, cell membrane, computers and human brains.

Artificial Neural Networks (ANN)

Characteristics, single layer and multi-layer ANN, Training: objective, supervised and unsupervised training, learning rules, overview.

Perceptrons

Single Layer Perceptron Classifiers, Classification model, features, discriminant functions, single layer continuous perceptron networks, Single layer continuous perceptron networks for linearly seperable classifications.

Multilayer feed forward Network

Network structure , Delta Learning rule for multi perceptron layer, Training the Kohonen and Grossberg layers, full counter propagation network – Applications.

Associative Memories

Basic concepts, Linear Associator.
Hopfield Networks: Recurrent network configurations, applications.
Bi-directional Associative Memories (BAM): structure, association encoding and decoding, stability considerations, Memory capability.
Adaptive Resonance Theory (ART): Architecture and implementation training example, characteristics, Self organizing maps (SOM).
Applications of Neural Networks to Electrical Engineering (any one problem).

Classical & Fuzzy Sets

Introduction to classical sets - properties – Fuzzy vs crsip - Fuzzy sets , Membership functions, basic fuzzy set operation ,properties of fuzzy sets - Fuzzy relations – Fuzzy Cartesian product, operations on fuzzy relations.

Fuzzy Logic System Components

Fuzzification – Fuzzy quantifiers, fuzzy inference, fuzzy rule based system - development of rule base and decision making system - Defuzzification to crisp sets - Fuzzification and Defuzzification methods.
Applications of Fuzzy logic systems in Electrical Engineering (any one problem)

Text Books :

1. Jacek M. Zurada , "introduction to artificial neural systems", Jaico Publishing House, 6th edition, 2003
2. George J. Autor Klir, Tina A Autor Folger, "Fuzzy sets, Uncertainty and Information", PHI, 1988
3. Bart Kosko, "Neural Networks and Fuzzy Systems", PHI, 1992
4. S. Rajasekaran, G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic, Genetic Algorithms: Synthesis and Applications", PHI Publication, 2003
5. Timothy J. Ross, "Fuzzy Logic with Engg. Applications", John Wiley & Sons, 3rd edition, 2010

Reference Books :

1. Philip D. Wasserman, "Neural Computing, Theory and Practice", Van Nostrand Reinhold Pub., 1989.
2. Laurene V. Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", PHI, 1994

Web References:

1. http://nptel.ac.in/courses/108104049/16
2. http://uni-obuda.hu/users/fuller.robert/nfs.html
3. http://nptel.ac.in/courses/117108048/module8/Lecture26.pdf
4. http://www.dkriesel.com/_media/science/neuronalenetze-en-zeta2-1col-dkrieselcom.pdf
5. https://page.mi.fu-berlin.de/rojas/neural/neuron.pdf
6. http://www.wearealgerians.com/up/uploads/139955152739491.pdf
7. https://docs.google.com/file/d/0B5vXY4-Kg5GeMmg4U2N6ZlR4Qm8/edit

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End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

SOFT COMPUTING TECHNIQUES (SCT)

I Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE815	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand how to design Fuzzy controller..

CO2: Understand how to design artificial Neural Network System.

CO3: Understand how to design the hybrid system for different applications in electrical engineering.

Introduction to Fuzzy logic

Fuzzy sets - Fuzzy set operations - Fuzzy relations - Cardinality of Fuzzy relations -Operations on Fuzzy relations - Properties of Fuzzy relations - Membership functions-Features of Membership functions – Fuzzification - Methods of Membership Value Assignments - Fuzzy Rule Base – Defuzzification - Defuzzification methods - Fuzzy logic controller(Block Diagram)

Artificial Neural Networks

Basic concepts - Neural network Architectures - Single layer feed forward network - Multilayer feed forward network - Recurrent Networks - Characteristics of Neural Networks - Learning methods - Perceptron networks - Back Propagation networks - Radial base function network - Hopfield network - Kohonen self organizing maps - ART

Fundamentals of genetic algorithms

Basic concepts - Working principle – Encoding – different methods – Fitness function – Reproduction - different methods - Genetic modeling – Inheritance - Crossover mutation-Convergence of genetic algorithm.

Hybrid systems

Neural network, fuzzy logic and genetic algorithm hybrids – Neuro fuzzy hybrids- Neuro genetic hybrids - Fuzzy genetic hybrids - Genetic algorithm based back propagation network - Fuzzy back propagation networks - Fuzzy logic controlled Genetic Algorithms.

Applications

Neural Networks Applications (any two electrical problems) - Fuzzy control and defuzzification techniques - Genetic algorithms and hybrid systems applied to Electrical Engineering.

Text Books :

1. S. Rajasekaran, G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic, Genetic Algorithms: Synthesis and Applications”, PHI Publication, 2003.
2. S. N. Sivanandam, S. N. Deepa, “Principles of Soft Computing”, John Wiley & Sons, 2007.
3. Timothy J. Ross, “Fuzzy Logic with Engg. Applications”, John Wiley & Sons, 3rd edition, 2010
4. Simon S. Haykins, “Neural Networks a Comprehensive Foundation”, Prentice Hall, 2nd edition, 1999.

Reference Books :

1. D. E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education, 2009
2. Kalyanmoy Deb, "Optimization for Engineering Design: Algorithm & Examples", PHI Learning Pvt. Ltd., 2nd edition, 2012

Web References:

1. www2.cs.uh.edu/~ceick/6367/Soft-Computing.pdf
2. https://www.bioinfopublication.org/files/articles/1_1_2_BSC.pdf

Question Paper Pattern:

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End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

MICROCONTROLLERS AND APPLICATIONS (MCA)

I Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE816	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand how to programme a microcontroller and must be able to gain the knowledge of different architectures of microcontrollers.

CO2: Understand how to interface a microcontroller to different I/O devices.

CO3: Apply for different industries based on the requirements.

8051 Microcontrollers

Introduction to Intel 8 bit & 16 bit Microcontrollers - MCS-51 Architecture - Registers in MCS-51 - 8051 Pin Description - 8051 Connections - 8051 Parallel I/O Ports - Memory Organization

MCS-51 Addressing Modes and Instructions

8051 Addressing Modes - MCS-51 Instruction Set - 8051 Instructions and Simple Programs - Using Stack Pointer - 8051 Assembly Language Programming - Development Systems and Tools - Software Simulators of 8051

MCS-51 Interrupts, Timer/Counters and Serial Communication

Interrupts, Interrupts in MCS-51 - Timers and Counters - Serial Communication - Atmel Microcontrollers (89CXX and 89C20XX) - Architectural Overview of Atmel 89C51 and Atmel 89C2051 - Pin Description of 89C51 and 89C2051 - Using Flash memory devices Atmel 89CXX and 89C20XX

Applications of MCS-51 and Atmel 89C51 and 89C2051 Microcontrollers

Applications of MCS-51 and Atmel 89C51 and 89C2051 Microcontrollers - Square wave generation- Rectangular waves - Pulse generation - Pulse Width Modulation - Staircase ramp generation- Sine wave generation- Pulse Width Measurement- Frequency Counter

Interfacing and Microcontroller Applications

Light Emitting Diodes (LEDs), Push Buttons, Relays and Latch Connections, Keyboard Interfacing, Interfacing 7-Segment Displays, LCD Interfacing, ADC and DAC Interfacing with 89C51 Microcontrollers

Industrial Applications of Microcontrollers

Measurement Applications, Automation and Control Applications

Text Books :

1. Ajay V Deshmukh, "Microcontrollers-Theory and Applications", TMH, 2005
2. Kenneth J. Ayala, "Microcontrollers", Cengage Learning, 3rd edition, 2004
3. C. R. Sarma, "Microprocessor and Microcontrollers", Premier Publishing House, 2000

Reference Books :

1. Myke Predko, "Programming and Customizing the PIC Microcontroller", McGraw Hill

Professional, 2007

Web References:

1. http://ee.sharif.edu/~sakhtar3/books/8051%20Microcontrollers%20An%20Applications%20Based%20Introduction.pdf
2. https://ti.tuwien.ac.at/ecs/teaching/courses/mclu/theory-material/Microcontroller.pdf
3. janaxelson.com/files/microcontroller_idea_book.pdf

Question Paper Pattern:

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End Exam: The question paper for end examination shall consist of **Eight** questions and the student has to answer any **Five** questions.

POWER QUALITY (PQ)

II Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE817	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Apply the knowledge acquired in Mathematics, Basic Sciences and Electrical and Electronics Engineering courses, for the solution of complex problems encountered in the modern Engineering practice.

CO2: Design and conduct experiments.

CO3: Design a system, component or process to meet desired needs.

CO4: Identify, formulate and solve engineering problems.

Introduction

Introduction of the Power Quality (PQ) problem - Terms used in PQ: Voltage, Sag, Swell, Surges, Harmonics, Over voltages, Spikes, Voltage fluctuations, Transients, Interruption, Overview of power quality phenomenon - Remedies to improve power quality - Power quality monitoring

Long Interruptions

Interruptions-Definition – Difference between failure, outage, interruptions - causes of Long interruptions – Origin of interruptions - Limits for the interruptions frequency – Limits for the interruption duration – costs of interruption – Overview of Reliability evaluation to power quality - Comparison of observations and reliability evaluation.

Short Interruptions

Short interruptions – Definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing - Voltage during the interruption, monitoring of short interruptions - Difference between medium and low voltage systems - Multiple events, single phase tripping – Voltage and current during fault period, voltage and current at post fault period - Stochastic prediction of short interruptions.

Voltage sag – Characterization – Single phase

Voltage sag – Definition, causes of voltage sag, voltage sag magnitude, monitoring - Theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial system - Meshed systems - Voltage sag duration

Voltage sag - Characterization - Three phase

Three phase faults - Phase angle jumps - Magnitude and phase angle jumps for three phase balanced sags - Load influence on voltage sags.

PQ considerations in Industrial Power Systems

Voltage sag − Equipment behavior of Power Electronics loads - Induction motors, Synchronous motors - Computers consumer electronics, adjustable speed AC drives and its operation - Mitigation of AC Drives - Adjustable speed DC drives and its operation - Mitigation methods of DC drives

Mitigation of Interruption and Voltage Sags

Overview of mitigation methods – from fault to trip - reducing the number of faults, reducing the fault clearing time changing the power system - installing mitigation equipment - improving equipment

immunity - different even and mitigation methods
Wiring and grounding
Reason for grounding - Typical wiring and grounding problems - Solution of wiring and grounding problems.
Text Books :
1. Math H. Bollen, “Understanding Power Quality Problems”, Wiley, 2000 2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, “Electrical Power System Quality”, TMH, 3rd edition, 2012 3. Ghosh Arindam et.al, "Power Quality Enhancement using Custom Power Devices”, Springer (India) Pvt. Limited, 2009
Reference Books :
1. Jos Arrillaga, Neville R. Watson, “Power System Harmonics”, John Wiley & Sons, 2nd edition, 2004 2. C. Sankaran, “Power quality”, CRC Press, 2001
Web References:
1. prof.usb.ve/bueno/Libros/power_quality-0849310407.pdf
2. www.gcebargur.ac.in/sites/gcebargur.ac.in/files/.../electrical_power_systems_quality.pdf
3. www.aeeohio.com/Power%20Quality_CDA_AEE%20102510.pdf
Question Paper Pattern:
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EMI AND EMC ISSUES (EMI)

II Semester : POWER ELECTRONICS					**Scheme : 2017**		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE818	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand fundamentals of EMI/EMC

CO2: Understand electromagnetic Spectrum and Applications.

CO3: Understand shielding of Power Cables.

Introduction

Sources of EMI, Conducted and radiated interference - Characteristics - Designing for electromagnetic compatibility (EMC) - EMC regulation- typical noise path - use of network theory- methods of eliminating interferences.

Method of Hardening

Cabling – capacitive coupling - inductive coupling- shielding to prevent magnetic radiation - shield transfer impedance, Grounding – safety grounds – signal grounds single point and multipoint ground systems- hybrid grounds- functional ground layout – grounding of cable shields- ground loops - guard shields.

Balancing, Filtering and Shielding

Power supply decoupling - decoupling filters-amplifier filtering – high frequency filtering shielding – near and far fields- shielding effectiveness - absorption and reflection loss - Shielding with magnetic material - conductive gaskets, windows and coatings - grounding of shields.

Digital Circuit Noise and Layout

Frequency versus time domain - analog versus digital circuits - digital logic noise - internal noise sources - digital circuit ground noise – power distribution - noise voltage objectives measuring noise voltages - unused inputs - logic families.

Electrostatic Discharge, Standards And Laboratory Techniques

Static Generation - human body model - static discharges - ED protection in equipment design - ESD versus EMC, Industrial and Government standards – FCC requirements – CISPR recommendations - Laboratory techniques - Measurement methods for field strength - EMI.

Text Books :

1. Henry W.Ott, “Noise reduction techniques in Electronic Systems”, John Wiley & Sons, 2nd edition, 1989.
2. B. J. Keiser, “Principles of Electromagnetic Compatibility”, Artech House, 3rd edition, 1987.
3. L. W. Ricketts, Jack E. Bridges, J. Miletta, “EMP Radiation and Protective Techniques”, John Wiley & Sons, 1976.

Reference Books :

1. IEEE National Symposium on “Electromagnetic Compatibility”, IEEE, 1989.

Web References:

1. mdi.desy.de/sites2009/site_mdi/content/e37820/e37920/.../MDI_120302.pdf
2. www.emcchicago.org/rl.pdf
3. dhio.in/wp-content/uploads/2013/01/EMIEMCWOrkshop_Distribution1.pdf

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INDUSTRIAL APPLICATIONS OF POWER ELECTRONICS (IAPE)

II Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	Hours/Week			Credits	Maximum Marks		
EE819	L	T	P	C	Continuous Internal Assessment	End Exam	TOTAL
	3	-	-	3	40	60	100
Sessional Exam Duration : 2 Hrs					End Exam Duration: 3 Hrs		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand electric heating, induction heating and dielectric heating

CO2: Understand wheel welding system

CO3: Understand AC traction using single phase and three phase ac motors and control of DC traction motor

CO4: Understand the power electronic components applications to the industry

Industrial Heating

Advantages and methods of electric heating, types and applications of electric heating equipment, induction heating, dielectric heating.

Industrial Welding

Physical description of wheel welding system, sequence of operations, sequence initiation, interval triggering and gating circuit, interval stepping circuit, interval time counter, heat-cool counter, weld power circuit.

Electric Traction

Traction motors - requirement of traction motors - tractioning series motor - AC traction using single phase and three phase ac motors - linear motors - control of DC traction motor, controllers - energy saving with series parallel

Solid state converter controlled drives, 25kV AC traction using semi converter controlled DC motors, dc traction using choppers - traction using poly phase AC motors - types of diesel electric traction.

Drives for specific applications

Introduction, drives and motors for textile mills, steel rolling mills, cement mills, sugar mills, paper mills, coal mines, centrifugal mills.

Other Applications

Electro chemical application - static excitation system for alternators - static circuit breaker - over voltage protection - simple battery charger - automatic battery charger - SCR current limiting circuit breaker - fan regulator using TRIAC.

Text Books :

1. G. K. Mithal, “Industrial Electronics”, Khanna Publishers, 3rd edition, 1977
2. S. K. Bhattacharya, S. Chatterjee, “Industrial Electronics and Control”, TMH, 1998
3. Vedam Subrahmanyam, “Electric Drives: Concepts and Applications”, TMH, 2nd edition, 2010
4. Timothy J. Maloney, “Industrial Solid State Electronics: Devices and Systems”, Prentice-Hall, 2nd edition, 1985
5. Harish C. Rai, “Industrial & Power Electronics”, Gyan Books Pvt. Ltd., 2011

Reference Books :

1. H. Partab, "Utilization of Electrical Energy", Pritam Surat, 2nd edition, 1975
2. Richard M. Crowder, "Electric Drives and Their Controls", Clarendon Press, 1998.
3. Ned Mohan, Tore M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley and Sons, Second Edition, 2009

Web References:

1. http://www.zeljezno-polje.com/principles-of-industrial-welding.pdf
2. http://gpmacademics.weebly.com/uploads/2/9/9/3/29933629/electrical_heating.pdf
3. https://www.vssut.ac.in/lecture_notes/lecture1424084684.pdf
4. http://ocw.swjtu.edu.cn/download/resource/143/dean_1367037655092.pdf
5. http://www.electronicshub.org/electric-traction-system/
6. http://www.bookadda.com/books/utilization-electrical-energy-traction-j-b-9350142228-9789350142226
7. http://thebookee.net/el/electrical-power-utilization-and-traction-theraja
8. https://www.infibeam.com/Books/utilization-electric-power-electric-traction-j-b-gupta/9789350142585.html

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RENEWABLE ENERGY SOURCES (RES)

II Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE820	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Understand various renewable energy systems and their principle.

CO2: Understand advantages and disadvantages of various renewable energy sources.

CO3: Understand how to utilize a renewable energy source(s) based upon its availability in a locality.

Principles of Solar Radiation

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

Solar Energy Collection

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Solar Energy Storage and Applications

Different methods, Sensible, latent heat and stratified storage, solar ponds - Solar Applications- Solar heating/coolingtechnique -Solar distillation and drying - Photovoltaic energy conversion.

Wind Energy

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz limit, WECS: classification, characteristics, and applications.

Ocean Energy

Ocean energy resources-ocean energy routes - Principles of ocean thermal energy conversion systems-ocean thermal power plants- Principles of ocean wave energy conversion and tidal energy conversion.

Direct Energy Conversion

Need for DEC, Carnot cycle, limitations and principles of DEC.

Other Sources of Energy

Hydropower, Nuclear fission and fusion - Geothermal energy: Origin, types of geothermal energy sites, site selection, geothermal power plants - Magneto-hydro-dynamic (MHD) energy conversion.

Text Books :

1. G. D. Rai, “Non-Conventional Energy Sources”, Khanna Publishers, 2010
2. John Twidell, Anthony D. Weir, “Renewable Energy Resources”, Taylor & Francis, 2nd edition, 2006
3. S. A. Ahmad, “Renewable Energy Technologies: Ocean Thermal Conversion and Other Sustainable Energy Options”, Narosa Publishing House, 1997
4. D. P. Kothari, K. C. Singhal, R. Ranjan, “Renewable Energy Sources and Emerging Technologies”, PHI, 2008

Reference Books :

1. Mittal, K. M., "Renewable Energy Systems", Wheeler Publishing, 1997
2. G. N. Tiwari, M. K. Ghosal, "Fundamentals of Renewable Energy Sources", Narosa Publishing House, 2007

Web References:

1. maxwell.sze.hu/~marcsa/.../Books/renewable%20energy%20resources.pdf
2. https://www.utanrikisraduneyti.is/media/PDF/Iceland_energy_umbrot_loka2.pdf

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POWER ELECTRONICS IN SOLAR AND WIND ENERGY SYSTEMS (PESWS)

II Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE821	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs				**End Exam Duration: 3 Hrs**			

Course Outcomes : At the end of the course the student will be able to

CO1: Gain adequate knowledge regarding solar energy systems, wind energy systems and its measurement.

CO2: Gain adequate knowledge regarding the application of power electronics converters used in solar and wind connected grid systems and also its issues.

CO3: Gain adequate knowledge regarding MPPT control technique.

Introduction

Brief survey on different renewable energy resources: Solar, wind, ocean, biomass, fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

Principles of Solar Radiation

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

Power Electronic Converters for solar system

Solar: Block diagram of solar photo voltaic system - Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters - Selection of inverter, battery sizing and array sizing.

Analysis of Solar Systems

Stand alone operation of solar system - Grid integrated solar system – Grid connection issues - Maximum Power Point Tracking (MPPT).

Wind Resource

Wind characteristics: Meteorology of wind – wind speed distribution across the world – spatial and temporal factors – Eolian features - Biological indicators. Wind measurement: Anemometers – balloon trackers. Wind energy conversion systems (WECS) - classifications.

Electrical Machines for wind Energy Conversion

Review of reference theory fundamentals – Principle of operation and analysis: IG, PMSG, SCIG and DFIG.

Power Electronic Converters for wind energy syatems

Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters - Matrix converters.

Analysis of Wind Systems

Standalone operation of fixed and variable speed wind energy conversion systems- Grid connection issues- Grid integrated PMSG and SCIG based WECS.

Text Books :

1. G. D. Rai, “Non-Conventional Energy Sources”, Khanna Publishers, 2010

2. D. Rai," Solar Energy Utilization", Khanna Publishers, 1999.
3. B. H. Khan "Non-Conventional Energy Sources ", TMH, 2nd edition, 2006
4. Robert W. Erickson, Dragan Maksimovic, “Fundamentals of Power Electronics”, Springer International Edition, 2nd edition, 2001.
5. James F. Manwell, Jon G. McGowan, Anthony L. Rogers, “Wind Energy Explained: Theory, Design and Application”, John Wiley & Sons, 2nd edition, 2010
6. Erich Hau, “Wind Turbines: Fundamentals, Technologies, Application and Economics”, Springer, 3rd edition, 2013
7. Gray L. Johnson, "Wind Energy System", Prentice hall Inc., 1985.

Reference Books :

1. Muhammad H. Rashid, “Power Electronics: Handbook”, Elsevier, 3rd Edition, 2011

Web References:

1. www.icit2010.utfsm.cl/doc/plenary/blaabjerg.pdf
2. powerelectronics.teipir.gr/Papers/Trends_of_power_electronics_on_RES.PDF
3. www.ejournal.aessangli.in/ASEEJournals/ELEC56.pdf

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PROGRAMMABLE LOGIC CONTROLLERS (PLC)

II Semester : POWER ELECTRONICS					Scheme : 2017		
Course Code	**Hours/Week**			**Credits**	**Maximum Marks**		
EE822	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
	3	**-**	**-**	**3**	**40**	**60**	**100**
Sessional Exam Duration : 2 Hrs					**End Exam Duration: 3 Hrs**		

Course Outcomes : At the end of the course the student will be able to

CO1: Gain adequate knowledge regarding basics of PLC and its functions and programming.

CO2: Understand how to control a two-axis & three axis Robots with PLC.

CO3: Gain adequate knowledge regarding various applications of PLC in real time.

PLC Basics

PLC system, I/O modules and interfacing, CPU processor, programming Equipment, programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules.

PLC Programming

Input instructions, outputs, operational procedures, programming examples using contacts and coils - Drill press operation.

Digital System

Digital logic gates, programming in the Boolean algebra system, conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system.

PLC Registers

Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.

PLC Functions

Timer functions & Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions

Data Handling functions

SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep functions and their applications

Shift Registers

Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two-axis & three axis Robots with PLC, Matrix functions.

Analog PLC operation

Analog modules& systems, Analog signal processing, Multi bit Data Processing, Analog output Application Examples, PID principles, position indicator with PID control, PID Modules, PID tuning, PID functions.

Text Books :

1. W. Webb & Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications”, Prentice Hall PTR, Fifth Edition, 2003
2. J. R. Hackworth & F. D. Hackworth Jr., “Programmable Logic Controllers- Programming Method and Applications”, Pearson Education, 2008

Reference Books :

1. William Bolton, "Programmable Logic Controllers", Elsevier Publications, 2011.

Web References:

1. www.ieec.uned.es/investigacion/Dipseil/PAC/archivos/introtoplcs_SUPER.pdf
2. www.iasegypt.net/PLC_Theory%20Book.pdf
3. www.festo-didactic.com/ov3/media/customers/1100/093311_web_leseprobe.pdf

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