SONA COLLEGE OF TECHNOLOGY, SALEM-5

(An Autonomous Institution)

M.E-Electrical and Electronics Engineering

(Power Electronics and Drives)

CURRICULUM and SYLLABI

[For students admitted in 2019-2020]

M.E / M.Tech Regulation 2019

Approved by BOS and Academic Council meetings

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME I Semester under Regulations 2019
Electrical and Electronics Engineering
Branch: M.E. Power Electronics and Drives

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P19PED101	Power Electronic Converters	3	0	0	3
2	P19PED102	Modeling and Analysis of Electrical Machines	3	0	0	3
3	P19PED103	Switched Mode and Resonant Converters	3	0	0	3
4	P19PED501	**Elective-** Power Quality Engineering	3	0	0	3
5	P19PED502	**Elective-** Mathematical Methods for Power Engineering	2	1	0	3
6	P19GE101	Research Methodology and IPR	2	0	0	2
7	P19GE701	**Audit Course-**English for Research Paper Writing	2	0	0	0
Practical						
8	P19PED104	Power Converters Laboratory	0	0	4	2
					Total Credits	**22**

Approved by

Chairperson, **Electrical and Electronics Engineering BOS**
Dr.S.Padma

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

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HOD/EEE, First Semester ME PED Students and Staff, COE

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME II Semester under Regulations 2019
Electrical and Electronics Engineering
Branch: M.E. Power Electronics and Drives

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P19PED201	Solid State DC Drives	3	1	0	4
2	P19PED202	Solid State AC Drives	3	1	0	4
3	P19PED203	Special Electrical Machines and their Controllers	3	0	0	3
4	P19PED506	**Elective -** Smart Grid	3	0	0	3
5	P19PED508	**Elective -** Microcontrollers and DSP based System Design	3	0	0	3
6	P19GE702	**Audit Course –** Stress Management by Yoga	2	0	0	0
Practical						
7	P19PED204	Power Electronics and Drives Laboratory	0	0	4	2
					Total Credits	**19**

Approved by

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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME III Semester under Regulations 2019
Electrical and Electronics Engineering
Branch: M.E. Power Electronics and Drives

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P19PED511	**Elective -** FACTS and Custom Power Devices	3	0	0	3
2	P19ISE601	**Open Elective –** Transport Safety	3	0	0	3
Practical						
3	P19PED301	Project Work Phase - I	0	0	16	8
					Total Credits	**14**

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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME IV Semester under Regulations 2019
Electrical and Electronics Engineering

Branch: M.E. Power Electronics and Drives

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Practical						
1	P19PED401	Project Work Phase – II	0	0	28	14
					Total Credits	**14**

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Copy to:-
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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME I Semester under Regulations 2019
Electrical and Electronics Engineering
Branch: M.E. Power Electronics and Drives

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P19PED101	Power Electronic Converters	3	0	0	3
2	P19PED102	Modeling and Analysis of Electrical Machines	3	0	0	3
3	P19PED103	Switched Mode and Resonant Converters	3	0	0	3
4	P19PED501	**Elective-** Power Quality Engineering	3	0	0	3
5	P19PED502	**Elective-** Mathematical Methods for Power Engineering	2	1	0	3
6	P19GE101	Research Methodology and IPR	2	0	0	2
7	P19GE701	**Audit Course-**English for Research Paper Writing	2	0	0	0
Practical						
8	P19PED104	Power Converters Laboratory	0	0	4	2
					Total Credits	**22**

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P19PED101 POWER ELECTRONIC CONVERTER 3 0 0 3

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Analyze the switching circuits.
2. Analyze and study about the controlled rectifiers.
3. Discuss the various modes of operation of Dc- Dc switch mode converters.
4. Analyze the various types of Choppers.
5. Explain the principles and operations of regulators and cycloconverters.

UNIT I SINGLE PHASE AC-DC CONVERTER 9

Static Characteristics of power diode, SCR and GTO, half controlled and fully controlled converters with RL, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation – inverter operation –Sequence control of converters – performance parameters: harmonics, ripple, distortion, power factor – effect of source impedance and overlap-reactive power and power balance in converter circuits-problems.

UNIT II THREE PHASE AC-DC CONVERTER 9

Semi and fully controlled converter with R, R-L, R-L-E - loads and freewheeling diodes – inverter operation and its limit – performance parameters – effect of source impedance and overlap – 12 pulse converter-Problems-Single-Phase and Three-Phase AC to DC converters-Half controlled configurations-operating domains of three phase full converters and semi-converters-Reactive power considerations

UNIT III DC-DC CONVERTERS 9

Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost and Cuk converters – time ratio and current limit control – Full bridge converter – Resonant and quasi –Resonant converters-Problems

UNIT IV INVERTERS 9

Single phase and three phase inverters-Voltage source and Current source inverters-Voltage control and harmonic minimization in inverters.

UNIT V AC VOLTAGE CONTROLLERS 9

AC to AC power conversion using voltage regulators-Choppers and cyclo-converters-Consideration of harmonics, introduction to Matrix converters-Design aspects of converters, Few practical applications.

Lecture: 45, Tutorial: 0, Total: 45

REFERENCE BOOKS:

1. Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and design", John's Wiley Publication, 3rd Edition, 2007
2. M.H.Rashid, "Power Electronics", Prentice Hall of India, 4th edition, 2014.
3. Gobal K.Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House,2nd edition, 2010
4. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 2nd edition 2011.
5. P.C Sen "Thyristor DC Drives", John wiely and sons, New York, 1981.

P19PED102 MODELING AND ANALYSIS OF ELECTRICAL MACHINES 3 0 0 3

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Analyze the various electrical parameters in mathematical form.
2. Differentiate the types of reference frame theories and transformation relationships.
3. Compute the electrical machine equivalent circuit parameters and modeling of synchronous machines
4. Explain vector based control and flux linkages in induction machines
5. Describe various practical issues of different machines.

UNIT I MODELING OF DC MACHINES 9

Principles of Electromagnetic Energy Conversion-Induced EMF-Field excitation: separate, shunt, series and compound excitation-Commutator action-Calculation of air gap mmf of a single turn full pitch distributed armature windings - Per phase full pitched and short pitched armature coils (AC machines) - Calculation of air gap mmf of a DC machine - Introduction to direct axis and quadrature axis theory in salient pole machines -Calculation of air gap inductances of a synchronous machine.

UNIT II DYNAMIC MODELING OF INDUCTION MACHINES 9

Equivalent circuits- Steady state performance equations-Dynamic modeling of induction machines: Real time model of a two phase induction machines, Three phase to two phase transformation-Electromagnetic torque-generalized model in arbitrary reference frames-stator reference frames model-rotor reference frames model-synchronously rotating reference frame model.

UNIT III DYNAMIC MODELING OF SYNCHRONOUS MACHINES 9

Application of reference frame theory to three phase synchronous machine-dynamic model analysis-Park‟s equation - Voltage and torque equations - Deviation of steady state phasor relationship from dynamic model - Generalized theory of rotating electrical machine and Kron‟s primitive machine.

UNIT IV VECTOR CONTROLLED INDUCTION MACHINES 9

Principle of vector control-Direct vector control: flux and torque processor-DVC in stator reference frames with space vector modulation. Indirect vector control scheme: Derivation and implementation. Flux weakening operation: principle-flux weakening in stator flux linkage and rotor flux linkage.

UNIT V SPECIAL MACHINES 9

Permanent magnet – Airgap line- Demagnetizing characteristics – Energy density -synchronous machines with PMs: Machine configuration-flux density distribution-types of PMSM-Vector control of PMSM - Variable Reluctance Machines: Basics-analysis-practical configuration-circuit wave forms for torque production- stepping motors.

Lecture: 45, Tutorial: 0, Total: 45

REFERENCE BOOKS:

1. Charles Kingsle,Jr., A.E. Fitzgerald, Stephen D.Umans, “Electric Machinery”, Mcgraw Hill, 6th edition, 2005
2. R. Krishnan, “Electric Motor & Drives: Modeling, Analysis and Control”, Prentice Hall of India, 2001
3. Miller, T.J.E., “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press
4. P.C.Krause “Analysis of Electric Machine” Wiley IEEE Press 2nd Edition, 2010

P19PED103 SWITCHED MODE AND RESONANT CONVERTERS 3 0 0 3

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Understand working of different types of converters.
2. Understand components, switch mode topologies & control methods
3. Understand the properties of batteries and its types
4. Perform design calculations of resonant converter topologies
5. Understand the various filter design.

UNIT I DC TO DC CONVERTER TOPOLOGIES 9

Buck, Boost, Buck-Boost-SMPS Topologies- Basic Operation-Waveforms - modes of operation -switching stresses-Switching and conduction losses-Optimum switching frequency-Practical -voltage, current and power limits - design relations-Voltage mode control principles- Push-Pull and Forward Converter Topologies - Basic Operation, Waveforms-Flux Imbalance Problem and Solutions

UNIT II DESIGN OF SWITCHES 9

Transformer Design-Output Filter Design-Switching Stresses and Losses-Forward Converter Magnetics-Voltage Mode Control- Half and Full Bridge Converters-Basic Operation and Waveforms-Magnetics, Output Filter, Flux Imbalance, Switching Stresses and Losses, Power Limits, Voltage Mode Control.

UNIT III RESONANT CONVERTERS 9

Classification of Resonant Converters-Basic Resonant Circuit Concepts-Load Resonant Converter, Resonant Switch Converter, Zero-Voltage Switching Clamped Voltage Topologies-Resonant DC Link Inverters with Zero Voltage Switching-High Frequency Link Integral Half Cycle Converter-Fly back Converter-discontinuous mode operation, waveforms, control-Magnetics- Switching Stresses and Losses, Disadvantages – Continuous Mode Operation, waveforms, control, design relations

UNIT IV SWITCHED MODE POWER SUPPLIES 9

Voltage Mode Control of SMPS- Loop Gain and Stability Considerations-Error Amp– frequency Response and Transfer Function-Trans-conductance Current Mode Control of SMPS-Current Mode Control-Advantages- Comparison of Current Mode and Voltage Mode-Current Mode Deficiencies-Slope Compensation-Study of a typical Current Mode PWM Control IC UC3842-Modeling of SMPS-Small Signal Approximation- General Second Order Linear Equivalent Circuits.

UNIT V FILTER DESIGN 9

DC Transformer, Voltage Mode SMPS Transfer Function- General Control Law Consideration- EMI Generation and Filtering in SMPS - Conducted and Radiated- Emission Mechanisms in SMPS-Techniques to reduce Emissions, Control of Switching Loci-Shielding and Grounding, Power Circuit Layout for minimum EMI-EMI Filtering at Input and Output, Effect of EMI Filter on SMPS Control Dynamics. Introduction to Resonant Converters.

Lecture: 45, Tutorial: 0, Total: 45

REFERENCE BOOKS:

1. Abraham I Pressman, "Switching Power Supply Design,". McGraw Hill Publishing Company, 2009.
2. Daniel M Mitchell, "DC-DC Switching Regulator Analysis," McGraw Hill Publishing Company-1988.
3. Ned Mohan et.al, "Power Electronics," John Wiley and Sons, 2007.

P19PED104 **POWER CONVERTERS LABORATORY** **0 0 4 2**

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Model power electronic converter system and ability to implement in simulation tool.
2. Design and implement inverter for power electronic control applications.
3. Design and operate a power converter in buck and boost mode.

LIST OF EXPERIMENTS

1. Modeling of MOSFET/IGBT
2. Simulation of single phase Semi converter
   (i) R Load (ii) RL Load (iii) RLE (motor) Load
3. Simulation of single phase fully controlled converter
   (i) R Load (ii) RL Load (iii) RLE (motor) Load
4. Simulation of single phase dual converter
5. Simulation of three phase semi converter.
6. Simulation of three phase fully controlled converter
7. Simulation of Single phase full bridge Inverter
8. Simulation of three phase full bridge inverter.
   i. 180 degree mode operation
   ii. 120 degree mode operation
9. Simulation of three phases AC Voltage Controller.
   i. Lamp load
   ii. Motor load
10. Simulation of PWM inverter fed three phase induction motor control.
11. Simulation of Buck and Boost Converter with Open Loop Operation.
12. Simulation of Z-Source Inverter.

(Software experiments are performed using MATLAB)

Total : 60 Hours

P19PED501 POWER QUALITY ENGINEERING 3 0 0 3

COURSE OUTCOMES:

At the end of this course the students will be able to,

1. Describe the basic power quality issues.
2. Discuss about voltage related problems.
3. Evaluate harmonics in power system due to power electronic devices.
4. Evaluate power quality using measuring equipment.
5. Improve the power quality using different types of filters.

UNIT I INTRODUCTION 9

Power quality, Voltage quality – power quality evaluation procedure – overview of power quality phenomena – classification of power quality problems – power quality measures and standards – THD-TIF-DIN-C-message weights – flicker factor – occurrence of power quality problems – power acceptability curves – overview of EMC and IEEE standards.

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

Long Interruptions: Causes – generation, transmission and distribution reliability – basic concepts of reliability evaluation techniques – costs.

Short Interruptions: Origin – influence on motors and electronic equipment – single phase tripping.

Sags:Introduction – sag magnitude, duration – load influence on voltage sags – sags in adjustable speed AC and DC drives.

UNIT III HARMONIC DISTORTION 9

Harmonic distortion – harmonics versus transients – harmonic indices – harmonic sources from commercial and industrial loads – locating harmonic sources – SMPS – Three phase power converters – arcing devices – Harmonic Distortion of fluorescent lamps – effects of harmonic distortion – inter-harmonics – principles for controlling harmonics –devices for controlling harmonic distortion.

UNIT IV POWER QUALITY MONITORING 9

Monitoring considerations –power quality measurement equipment – power quality data assessment – basic design of an expert system for monitoring applications – power quality monitoring in internet.

UNIT V POWER QUALITY IMPROVEMENT 9

Static compensator – Distribution static compensator – Dynamic voltage restorer – Power factor corrector – Active filters – Shunt active filters – applications – PSCAD / EMTDC – simulation of Active filters.

Lecture: 45, Tutorial: 0, Total: 45 Hrs

REFERENCE BOOKS:

1. Math H.J. Bollen, "Understanding Power Quality Problems: Voltage sags and interruptions", IEEE press, 2011.
2. Roger C. Dugan, "Electrical power Systems Quality", McGraw Hill Education, Third edition, 2012.
3. Arrillaga J, Watson NR, Chen S, "Power System Quality Assessment", John Wiley & Sons, 2011.
4. Heydt G T, "Electric Power Quality", Stars in a Circle Publications, 1991.

SEMESTER – I	**MATHEMATICAL METHODS FOR POWER ENGINEERING**	L	T	P	C
P19PED502		2	1	0	3

COURSE OUTCOMES

At the end of the course, the students will be able to

1 find the rank of the matrix and solve linear system of equations by direct and indirect methods.

2. apply the concepts of eigen values and eigen vectors of a real matrix and their properties in diagonalization.

3. find the power spectral density for the wide sense stationary process.

4. apply the suitable methods to solve linear programming problem.

5. apply the appropriate methods to solve nonlinear programming problem.

UNIT – I LINEAR SYSTEM OF EQUATIONS 9

Rank of a matrix – Solution of linear system of equations by matrix method, Gauss elimination, Gauss – Jordan, Gauss – Jacobi and Gauss – Seidel methods.

UNIT – II EIGEN VALUES AND EIGEN VECTORS 9

Eigen values and eigen vectors – Properties of eigen values and eigen vectors – Cayley-Hamilton theorem – Diagonalization of symmetric matrices .

UNIT – III RANDOM PROCESSES 9

Classification of random processes – First order, second order, strictly stationary, wide-sense stationary processes – Auto correlation function and its properties – Power spectral density function and its properties.

UNIT – IV LINEAR PROGRAMMING 9

Simplex algorithm – Big–M method – Transportation problem – Assignment problem.

UNIT – V NONLINEAR PROGRAMMING 9

Formulation of nonlinear programming problem – Constrained optimization with equality constraints – Constrained optimization with inequality constraints – Kuhn-Tucker conditions with non-negative constraints.

Theory: **30 Hours** Tutorial: **15 Hours** Total**: 45 Hours**

TEXT BOOKS:

1. P. K. Gupta and D. S. Hira, "Problems in Operation Research", Sultan Chand and Sons Publishers, 4th Edition, 2015.
2. T. Veerarajan, "Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks", McGraw Hill Publishers, 4th Edition, 7th Reprint, 2018.
3. T. Veerarajan, "Linear Algebra and Calculus", McGraw Hill Publishers, 2019.

REFERENCE BOOKS:

1. H. A. Taha, "Operation Research: An Introduction", Pearson Publishers, 9th Edition, 2014.
2. M. K. Venkataraman, "Higher Mathematics for Engineering and Science", National Publishers, 2000.
3. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2018.

P19GE101 RESEARCH METHODOLOGY AND IPR 2 0 0 2

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Review the literature of the research problem
2. Choose appropriate data collection and sampling method according to the research problem.
3. Interpret the results of research and communicate effectively with their peers
4. Explain the Importance of intellectual property rights
5. Evaluate trade mark, develop and register patents

UNIT 1 INTRODUCTION TO RESEARCH METHODS 6

Definition and Objective of Research, Various steps in Scientific Research, Types of Research, Criteria for Good Research, Defining Research Problem, Research Design , Case Study Collection of Primary and Secondary Data, Collection Methods: Observation, Interview, Questionnaires, Schedules,

UNIT 2 SAMPLING DESIGN AND HYPOTHESIS TESTING 6

steps in Sampling Design, Types of Sample Designs, Measurements and Scaling Techniques - Testing of hypotheses concerning means (one mean and difference between two means -one tailed and two tailed tests), concerning variance – one tailed Chi-square test.

UNIT 3 INTERPRETATION AND REPORT WRITING 6

Techniques of Interpretation, Precaution in Interpretation, Layout of Research Report, Types of Reports, Oral Presentation, Mechanics of Writing Research Report

UNIT 4 INTRODUCTION TO INTELLECTUAL PROPERTY 6

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights, Innovations and Inventions trade related intellectual property rights.

UNIT 5 TRADE MARKS, COPY RIGHTS AND PATENTS 6

Purpose and function of trade marks, acquisition of trade mark rights, trade mark registration processes, trademark claims –trademark Litigations- International trademark law

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

THEORY: 30 Hours TUTORIAL: - PRACTICAL: - TOTAL: 30 Hours

TEXT BOOKS

1. C.R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques ,4th Edition, New Age International Publishers, 2019.
2. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets”, Delmar Cengage Learning, 4th Edition, 2012.
3. Prabuddha Ganguli, “Intellectual Property Rights: Unleashing the Knowledge Economy”, Tata Mc Graw Hill Education, 1st Edition, 2008.

REFERENCE BOOKS

1. Panneerselvam, R., Research Methodology, Second Edition, Prentice-Hall of India, New Delhi, 2013.
2. Ranjith Kumar, Research Methodology – A step by step Guide for Begineers, 4th edition, Sage publisher, 2014.
3. D Llewelyn & T Aplin W Cornish, "Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights", Sweet and Maxwell, 1st Edition, 2016.
4. Ananth Padmanabhan, "Intellectual Property Rights-Infringement and Remedies", Lexis Nexis, 1st Edition, 2012.
5. Ramakrishna B and Anil Kumar H.S, "Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers", Notion Press, 1st Edition, 2017.
6. M.Ashok Kumar and Mohd.Iqbal Ali :"Intellectual Property Rights" Serials Pub

P19GE701 **English for Research Paper Writing**

2 0 0 0

Course Outcomes:

At the end of the course, the students will be able to

- Demonstrate research writing skills both for research articles and thesis
- Frame suitable title and captions as sub-headings for articles and thesis
- Write each section in a research paper and thesis coherently
- Use language appropriately and proficiently for effective written communication
- Exhibit professional proof-reading skills to make the writing error free

Unit – I **6**

Planning and preparation, word order, breaking up long sentences, organising ideas into paragraphs and sentences, being concise and avoiding redundancy, ambiguity and vagueness

Unit – II **6**

Interpreting research findings, understanding and avoiding plagiarism, paraphrasing sections

of a paper/ abstract.

Unit- III **6**

Key skills to frame a title, to draft an abstract, to give an introduction

Unit – IV **6**

Skills required to organise review of literature, methods, results, discussion and conclusions

Unit – V **6**

Usage of appropriate phrases and key terms to make the writing effective - proof-reading to ensure error-free writing.

Text Books:

1.Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2.HighmanN , Handbook of Writing for the Mathematical Sciences, SIAM.Highman's book, 1998.
3. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006.
4.Goldbort R, Writing for Science, Yale University Press, 2006. (available on Google Books)

Total: 30 hours

REFERENCES

Martin Cutts, Oxford Guide to Plain English, Oxford University Press, Second Edition, 2006

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S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P19PED201	Solid State DC Drives	3	1	0	4
2	P19PED202	Solid State AC Drives	3	1	0	4
3	P19PED203	Special Electrical Machines and their Controllers	3	0	0	3
4	P19PED506	**Elective -** Smart Grid	3	0	0	3
5	P19PED508	**Elective -** Microcontrollers and DSP based System Design	3	0	0	3
6	P19GE702	**Audit Course –** Stress Management by Yoga	2	0	0	0
Practical						
7	P19PED204	Power Electronics and Drives Laboratory	0	0	4	2
					Total Credits	**19**

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P19PED201 SOLID STATE OF DC DRIVES 3 1 0 4

COURSE OUTCOMES:

At the end of the study of this course the students will be able to,

1. Ability to acquire and apply knowledge of mathematics and converter/machine dynamics in Electrical engineering.
2. Ability to understand the steady state operation and transient dynamics of a motor load system.
3. Ability to formulate, design, simulate power supplies for generic load and for machine loads.
4. Analyze and design the current and speed controllers for a closed loop solid state DC motor drive.
5. Design digital control DC drive circuits for various motor control applications.

UNIT I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 12

DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation - Introduction to high speed drives and modern drives. Characteristics of mechanical system – dynamic equations, components of torque, types of load; Requirements of drives characteristics – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT II CONVERTER CONTROL 12

Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Operation with free wheeling diode; Implementation of braking schemes; Drive employing dual converter.

UNIT III CHOPPER CONTROL 12

Introduction to time ratio control and frequency modulation; Class A, B chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Multi-phase chopper;

UNIT IV CLOSED LOOP CONTROL 12

Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison.

UNIT V DIGITAL CONTROL OF D.C DRIVE AND APPLICATIONS 12

Phase Locked Loop and micro-computer control of DC drives; Applications - Rolling mills, Traction, Solar powered pump drives, Battery powered vehicles (Block diagram of subsystems).

Lecture: 45, Tutorial: 15, Total: 60

REFERENCES

1. Gopal K Dubey, “Power Semiconductor controlled Drives”, Prentice Hall Inc., New Yersy, 1989.
2. R. Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
3. Gobal K. Dubey, “Fundamentals of Electrical Drives”, Narosal Publishing House, New Delhi.
4. Vedam Subramanyam, “Electric Drives – Concepts and Applications”, Tata McGraw-Hill publishing company Ltd., New Delhi, 2002.
5. P.C Sen “Thyristor DC Drives”, John wiely and sons, New York, 1981.

P19PED202 **SOLID STATE OF AC DRIVES** **3 1 0 4**

COURSE OUTCOMES:

At the end of the study of this course the students will be able to,

1. Explain the steady state operation and transient dynamics of a motor load system.
2. Apply knowledge of mathematics and converter/machine dynamics in Electrical engineering.
3. Formulate, design, simulate power supplies for generic load and for machine loads.
4. Ability to analyze, comprehend, design and simulate alternating current motor based frequency drives.
5. Analyze the operation of VSI & CSI and field oriented fed induction motor control.

UNIT 1 FUNDAMENTALS OF **AC MOTORS** **12**

Steady state performance equations- Rotating Magnetic Field- Torque production, Equivalent circuit- Performance of the machine with Variable Voltage-Variable frequency operation, constant Volt/Hz operation, Slip power recovery – Static Kramer Drive - Synchronous Drives.

UNIT II VSI AND CSI FED INDUCTION MOTOR CONTROL **12**

AC voltage control circuit- six step inverter voltage control- closed loop variable frequency PWM inverter with dynamic braking- CSI fed IM variable frequency drives- comparison.

UNIT III FIELD ORIENTED CONTROL **12**

Field oriented control of induction machines- Theory-DC analogy- Direct or feedback vector control- Indirect or feed forward vector control- Flux vector estimation- Space vector modulation control.

UNIT IV DIRECT TORQUE CONTROL **12**

Direct torque control of induction machines- Torque expression with stator and rotor fluxes, DTC control strategy- Optimum switching vector selection- reduction or torque ripple methods.

UNIT V SYNCHRONOUS MOTOR DRIVES **12**

Wound field cylindrical rotor motor- Equivalent circuit –Performance equations of operation from a voltage source- Power factor control and V curves- Starting and braking, self control – Load commutated Synchronous motor drives – Brush and Brushless excitation.

Lecture: 45, Tutorial: 15, Total: 60

REFERENCES

1. R.Krishnan, 'Electric Motor Drives- Modeling, Analysis and Control', Prentice- Hall of India Pvt. Ltd., New Delhi, 2010.
2. Bimal K Bose, 'Modern Power Electronics and AC Drives', Pearson Education Asia 2002.
3. Gopal K Dubey, 'Power Semiconductor Controlled Drives', Prentice Hall Inc., New Jersey, 1999.
4. P.Vas, ' Sensorless Vector and Direct Torque Control', Oxford University Press, New York 1998.

P19PED203 SPECIAL ELECTRICAL MACHINES AND THEIR CONTROLLERS 3 0 0 3

COURSE OUTCOMES:

At the end of the study of this course the students will be able to,

1. Explain the importance of advanced electrical motors.
2. Discuss the working principle and performance of advanced electrical motors such as stepper motors, Brushless dc motors and Switched Reluctance motors.
3. Design control techniques of electrical motors.
4. Discuss operation and characteristics of permanent magnet synchronous motors.
5. Design the controllers for Special machines.

UNIT I STEPPING MOTORS 9

Principle of operation – Classification – Construction and operation: VR motor, permanent magnet stepping motor, hybrid stepping motor. Monofilar and bifilar windings, Static characteristics – Dynamic characteristics – Modes of excitation- Micro stepping – Applications.

UNIT II SWITCHED RELUCTANCE MOTOR 9

Construction – Principle of operation – SRM Vs stepper motor, poles, phase and windings – Static torque production – Energy conversion loop – Partition of energy and effect of saturation – Converter circuits, Controls: current regulation, commutation, Torque-speed characteristics.

UNIT III BRUSHLESS DC MOTORS 9

Fundamentals of permanent magnets – demagnetization curve – comparison of conventional and brushless dc machine – Position detection using hall element – Basic three phase bipolar driven motor – Multi phase brushless motor – Square wave permanent magnet brushless motor – Torque and emf equations – Torque speed characteristics – Control methods.

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers,Torque speed characteristics, Self-control, Vector control, Current control schemes.

UNIT V CONTROLLER FOR SPECIAL MACHINES 9

Stepper motor: drive systems and circuit for open loop control – closed loop operation system using microprocessor, SRM: microcontroller based control, BLDC: six step commutations for PM Brushless dc motor and sinusoidal commutation drive.

Lecture: 45, Tutorial: 00, Total : 45

REFERENCES

1. Bimal K Bose, "Modern Power Electronics – Evolution, Technology and application", Jaico Publishing House, Mumbai, 2006.
2. JuhaPyrhonen, Valeria Hrabovcova, Scott semken, "Electrical Machines Drives Control – An Introduction", Wiley, 2016
3. Riazollah Firoozian, "Servo Motors and Industrial Control Theory", Springer, 2014.
4. Paul Acarnley, "Stepping Motors a guide to theory and practice" IET, 2007.
5. H A Toliyat, S Campbell, DSP Based Electro Mechanical Motion Control, CRC Press, 2019.

P19PED506 **SMART GRID** **3 0 0 3**

COURSE OUTCOMES:

At the end of this course the students will be able to

1. Distinguish between smart grid and conventional grid.
2. Apply smart metering concepts to industrial and commercial installations.
3. Apply modern communication technologies for smart grid solutions.
4. Explain about the microgrid renewable energy systems.
5. Formulate solutions for the power quality issues in smart grid.

UNIT I INTRODUCTION 9

Introduction to Smart Grid - Evolution of Electric Grid - Concept of Smart Grid, Definitions, Need of Smart Grid- Concept of Robust &Self-Healing Grid - Present development & International policies in Smart Grid.

UNIT II SENSING, MEASUREMENTS, CONTROL AND AUTOMATION TECHNOLOGIES 9

Introduction to Smart Meters, Real Time Prizing, Smart Appliances - Automatic Meter Reading (AMR) - Outage Management System (OMS) - Plug in Hybrid Electric Vehicles(PHEV) - Vehicle to Grid, Smart Sensors - Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation

UNIT III COMMUNICATION TECHNOLOGIES 9

Home Area Network (HAN) - Neighbourhood Area Network (NAN), Wide Area Network (WAN) - Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication - Wireless Mesh Network.Basics of CLOUD Computing &Cyber Security for Smart Grid - Broadband over Power line (BPL). IP based protocols

UNIT IV RENEWABLE ENERGY SYSTEMS AND MICROGRID 9

Plastic & Organic solar cells, Thin film solar cells - speed wind generators, fuel-cells, micro-turbines.
Smart storage like Battery, SMES, Pumped Hydro - Compressed Air Energy Storage - Concept of micro-grid, need & applications of micro-grid - Formation of micro-grid, Issues of interconnection - Protection & control of micro-grid

UNIT V POWER QUALITY IN SMART GRID 9

Power Quality issues of Grid connected Renewable Energy Sources -Power Quality Conditioners for Smart Grid - Web based Power Quality monitoring, Power Quality Audit.

Lecture: 45, Tutorial: 00, Total: 45 Hours

REFERENCES

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2012.
3. Stuart Borlas'e, "Smart Grid: Infrastructure, Technology and solutions "CRC Press, 1st edition, 2012.
4. A.G.Phadke , "Synchronized Phasor Measurement and their Applications", Springer, 2nd edition, 2017

P19PED508 MICROCONTROLLERS AND DSP BASED SYSTEM DESIGN 3 0 0 3

COURSE COUTCOMES:

At the end of the course, the students will be able to,

1. Design and implement Microcontrollers based systems.
2. Analyze PIC micro-Controller Registers, Instruction pipeline, Interrupts and Architecture.
3. Discuss the DSP computational building blocks and special types of addressing modes compared to normal microprocessor.
4. Explain about architecture, Registers, Instruction and features of ARM processor.
5. Apply microcontroller and DSP based design in real time applications concepts.

UNIT I 8051 PROGRAMMING 9

Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming - Interrupt programming – RTOS for 8051 – RTOS Lite – Full RTOS – Task creation and run – LCD digital clock/thermometer using Full RTOS.

UNIT II PIC MICROCONTROLLER 9

Architecture – memory organization – addressing modes – instruction set – PIC progrmming in Assembly & C – I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, MPLAB-Timers – Interrupts, I/O ports - I2C bus-A/D converter - UART- CCP modules - ADC, DAC and Sensor Interfacing – Flash and EEPROM memories.

UNIT III ARM PROCESSORS 9

ARM Programmer's Model – Registers – Processor Modes – State of the processor – Condition Flags – ARM Pipelines – Exception Vector Table – ARM Processor Families – Typical 3 stage pipelined ARM organization–Introduction to ARM Memory Management Unit - ARM Addressing Modes – ARM Instruction Set Overview – Thumb Instruction Set Overview – LPC210X ARM Processor-Features.

UNIT IV DSP CONTROLLERS 9

Digital Signal Processor (DSP) - Architecture – Programming - Controller implementation using TMS 320 F 2407 and TMS 320 F 2812 for AC and DC Motor Control - Introduction to FPGA.

UNIT V SYSTEM DESIGN – CASE STUDY 9

Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control: Stepper Motor Control - DC Motor Control – Servo motor control - AC Power Control – Measurement of frequency – Stand-alone Data Acquisition System.

Lecture: 45, Tutorial: 00, Total :45

REFERENCES:

1. I Scott Mackenzie and Raphael C.W. Phan, "The Micro controller", Pearson, Fourth edition 2012.
2. Rajkamal, "Microcontrollers-Architecture, Programming, Interfacing & System Design", 2ed, Pearson, 2012.
3. WilliamHohl "ARM Assembly Language Fundamental and Techniques" CRC Press Taylor & Francis, 2009.
4. Hamid A.Toliyat, Steven Campbell, 'DSP based electromechanical motion control', CRC Press, 2019.

P19PED204 POWER ELECTRONICS AND DRIVES LABORATORY 0 0 4 2

COURSE OUTCOMES:

At the end of the course, the students will be able to,

1. Comprehensive understanding on the switching behaviour of Power Electronic Switches.
2. Explain the requisite knowledge necessary to appreciate the dynamical equations involved in the analysis of different Power electronics circuits.
3. Analyze, design and simulate different power Electronic Drives of AC and DC Machines.

LIST OF EXPERIMENTS

1. Speed control converter fed DC drive.
2. Speed control of chopper fed DC Drive
3. V/f control of induction motor drive using DSP.
4. FPGA controlled induction motor drive.
5. Micro controller based speed control of stepper motor.
6. DSPIC based speed control of BLDC motor.
7. DSP based speed control of SRM motor.
8. Power quality analysis of single phase & three phase non-linear system
9. Modeling and simulation of converter fed closed loop control of a DC motor
10. Modeling and simulation of dual converter fed DC motor drive
11. Modeling and simulation of chopper fed closed loop control of a AC motor
12. Modeling and simulation of four quadrant operation of three-phase induction motor
13. Modeling and simulation of VSI and CSI fed induction motor drive
14. Modeling and simulation of vector controlled induction motor drive
15. Modeling and simulation of self controlled synchronous motor drive

Total Hours : 60

P19GE702 **Stress Management by Yoga**

2 0 0 0

Course Outcomes:

At the end of completion of this course, students will be able to

1. Develop physical and mental health thus improving social health
2. Increase immunity power of the body and prevent diseases
3. Acceleratememory power
4. Achieve the set goal with confidence and determination
5. Improve stability of mind, pleasing personality and work with awakened wisdom

UNIT – I **6**

Yoga-Introduction - Astanga Yoga- 8 parts-Yam and Niyam etc.- Do`s and Don'ts in life-Benefits of Yoga and Asana- Yoga Exercise- and benefits- Pranayam Yoga- Nadisuthi, Practice and Spinal Sclearance Practice-Regularization of breathing techniques and its effects-Practice and kapalapathy practice.

UNIT – II **6**

Neuromuscular breathing exercise and Practice- Magarasa Yoga, 14 points Acupressure techniques and practice- Body relaxation practice and its benefits- Raja Yoga- 1.Agna –explanation and practice- Activation of Pituitary- Raja Yoga-2. Santhi Yoga-Practice-Balancing of physical and mental power.

UNIT – III **6**

Raja Yoga-3.Sagasrathara yoga –practice- Activation of dormant brain cells-Kayakalpa-theory- Kayakalpa – practice-Yogic exercise to improve physical and mental health and practice-Asanas –explanation-Practice-benefits

UNIT –IV **6**

Sun namaskar- 12 poses-explanation and practice-Yoga –Asana-Padmasana, vajrasana,chakrasana, viruchasanaetc-Stress management with Yoga-Role of women and Yoga
Equality, nonviolence, Humanity,Self- control- Food and yoga Aware of self-destructive habits
Avoid fault thinking (thought analysis-Practice)-Yoga Free from ANGER (Neutralization of anger)& practice

UNIT – V **6**

Moralisation of Desire & practice- Punctuality-Love-Kindness-CompassionEradication ofworries-Practice - Personality development, positive thinking-Good characters to lead a moral life
How to clear the polluted mind- Benefits of blessing- Five- fold culture –explanation- Karma Yoga Practice In Geetha- Sense of duty-Devotion, self- reliance, confidence, concentration, truthfulness, cleanliness.

Total : 30 hours

Reference Books

1. 'Yogic Asanas for Group Tarining-Part-I" Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME III Semester under Regulations 2019
Electrical and Electronics Engineering
Branch: M.E. Power Electronics and Drives

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P19PED511	**Elective -** FACTS and Custom Power Devices	3	0	0	3
2	P19ISE601	**Open Elective –** Transport Safety	3	0	0	3
Practical						
3	P19PED301	Project Work Phase - I	0	0	16	8
					Total Credits	**14**

Approved by

Chairperson, Electrical and Electronics Engineering BOS
Dr.S.Padma

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

Copy to:-
HOD/EEE, Third Semester ME PED Students and Staff, COE

P19PED511 FACTS AND CUSTOM POWER DEVICES 3 0 0 3

COURSE OUTCOMES

At the end of this course the students will be able to,

1. Explain the need of FACTS technology.
2. Illustrate the static shunt compensation techniques.
3. Emphasize the objectives of Shunt compensation, and basic operation of SVC and STATCOM.
4. Design the UPFC and IPFC controllers
5. Explain static series compensators and controller interactions.

UNIT I INTRODUCTION 9

Electrical transmission network – Need of transmission interconnections – power flow in AC systems – power flow and dynamic stability considerations – Relative importance of controllable parameters – Basic types of FACTS controllers Brief description & definitions – Benefits from FACTS technology.

UNIT II STATIC SHUNT COMPENSATION 9

Objectives of shunt compensation, mid-point voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators switching converter type VAR generators hybrid VAR generators.

UNIT III SVC AND STATCOM 9

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modeling of svc for power flow and transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping – Prevention of voltage instability

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-Enhancement of transient stability - Prevention of voltage instability.

UNIT IV UPFC AND IPFC 9

UPFC - Basic Operations Principles – Conventional transmission control capabilities – Independent real and reactive power flow control – Control Structure- IPFC – Basic Operations Principles and Characteristics – Control Structure.

UNIT V STATIC SERIES COMPENSATORS AND FACTS CONTROLLERS 9

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, and functional requirements of GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC).

Controller interactions –SVC interaction – Co-ordination of multiple controllers using linear control techniques – Control coordination using genetic algorithms.

Lecture: 45, Tutorial: 00, Total: 45 Hours

REFERENCES

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC TransmissionSystems", Standard Publishers Distributors, Delhi- 110 006
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P)Limited, Publishers, New Delhi, 2008
4. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash "Flexible AC Transmission Systems: Modeling and Control", Springer, 2012
5. V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers.

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME IV Semester under Regulations 2019
Electrical and Electronics Engineering

Branch: M.E. Power Electronics and Drives

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Practical						
1	P19PED401	Project Work Phase – II	0	0	28	14
					Total Credits	**14**

Approved by

Chairperson, Electrical and Electronics Engineering BOS
Dr.S.Padma

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

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