STRUCTURE FOR

M.E. ELECTRICAL (POWER ELECTRONICS AND DRIVES) PROGRAMME

UNDER FACULTY OF ENGINEERING

EFFECTIVE FROM JUNE 2013

UNIVERSITY OF PUNE

THE SYLLABUS IS PREPARED BY :

BOS- Electrical Engineering,

University of Pune.

PEER REVIEW BY :

- Prof. Dr. Mrs. G.A. Vaidya, (Chairman)
- Dr.N. Gopalakrishnan,
  (Academic Expert)
- Dr.J.G.Ghodekar,
  Ex-Dean FOE, Shivaji University, Kolhapur
- Shri Pradeep Kurulkar, (Expert from Industry)

Structure for M.E. (Electrical) Power Electronics and Drives 2013 Course

SEMESTER I

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./ Pr	Paper		TW	Oral/presentation	Total	
			In Semester Assessment	End Semester Assessment				
503301	Modelling and Analysis of Electrical Machines	4	50	50	-	-	100	4
503302	Energy management and power quality in Electrical drives	4	50	50	-	-	100	4
503303	Power Converters	4	50	50	-	-	100	4
503304	Research Methodology	4	50	50	-	-	100	4
503305	Elective I	5	50	50	-	-	100	5
503306	Lab Practice I	4	-	-	50	50	100	4
Total		25	250	250	50	50	600	25

SEMESTER II

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Lect./Pr	Paper		TW	Oral/presentation	Total	
			In Semester Assessment	End Semester Assessment				
503307	AC and DC Drives	4	50	50	-	-	100	4
503308	Design of Power Electronic systems	4	50	50	-	-	100	4
503309	Advanced Control Systems	4	50	50	-	-	100	4
503310	Elective II	5	50	50	-	-	100	5
503311	Lab Practice II	4	-	-	50	50	100	4
503312	Seminar I	4	-	-	50	50	100	4
Total		25	200	200	100	100	600	25

SEMESTER III

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
			Paper		TW	Oral/presentation	Total	
		Lect./ Pr	In Semester Assessment	End Semester Assessment				
603301	Power Electronics Applications	4	50	50	-	-	100	4
603302	Power Electronics in Smart grid	4	50	50	-	-	100	4
603303	Elective III	5	50	50	-	-	100	5
603304	Seminar II	4	-	-	50	50	100	4
603305	Project Stage I	08	-	-	50	50	100	8
Total		25	150	150	100	100	500	25

SEMESTER IV

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME				CREDITS
		Lect./ Pr	Paper	TW	Oral/presentation	Total	
603306	Seminar III	5	-	50	50	100	5
603307	Project Work Stage II	20	-	150	50	200	20
Total		25	-	200	100	300	25

List of Elective Subjects

Note: Select any one subject from module I and one subject from module II for each Elective.

Elective-I (5 credits)		**Elective-II (5 credits)**		**Elective-III (5 credits)**	
Module I (credits=4)	Module II (credit=1)	Module I (credits=4)	Module II (credit=1)	Module I (credits=4)	Module II (credit=1)
1) DSP and its Applications	1) Project Management	1) Automation in Industrial drives	1) Electric Vehicles	1)Artificial Intelligence in Electrical drives	1) Artificial Intelligent tools
2) Data Acquisition and Signal conditioning	2) IPR and Patent Law	2)Embedded system design	2) Fundamentals of Cyber Security	2) Industrial Automation	2) Intelligent Sensors and instrumentation
-	3) Technical communication	-	3) Disaster Management	-	3) Human Rights
-	4) Smart Grid Technologies	-	4) Communication protocols in SCADA System	-	4) Green building design
-	-	-	-	-	5) Biomedical Instrumentation

EXAMINATION SCHEME GUIDELINES

A) Compulsory subjects: Credits 4

Total marks: 100

To be done at Institute Level		**University Exam**	
In semester assessment Units 1 - 4		**End semester assessment**	
Class tests	30 Marks	Units 1- 4	18 Marks
Assignments / Mini Project	20 Marks	Unit 5	16 Marks
		Unit 6	16 Marks
Total	50 Marks	Total	50 Marks

B) Elective subjects: Credits 5

Total marks: 100

Module 1 (Credits – 4)			
In semester assessment Units 1-4		**End semester assessment**	
Class tests	15 Marks	Units 1 & 2	12 Marks
Assignments/PPT presentations	10 Marks	Units 3 & 4	14 Marks
		Unit 5	12 Marks
		Unit 6	12 Marks
Total	25 Marks	Total	50 Marks

Module 2 (Credit – 1)	
In semester assessment	Units 1-2
Class tests / Assignments	25 Marks

Chairman
B.O.S.
Electrical Engineering

503301: MODELING AND ANALYSIS OF ELECTRICAL MACHINES

Teaching Scheme
4 Hours / Week
Credits : 4

Examination Scheme
In Semester Assessment: 50
End Semester Assessment: 50

Unit I: Generalized Machine Theory:
Elements of generalized circuit theory, basic electrical machine, conventions used, Kron's primitive machine, leakage flux in machines with more than two windings, voltage equations, matrix form, torque equations, power in AC circuits. (08 Hrs)

Unit II: Linear Transformations in machines:
Linear Transformations in machines: Power invariance, transformations from displaced brush axis, transformations from 3-phase to 2-phase, transformation from rotating axes to stationary axes, Transformed impendence matrix. (08 Hrs)

Unit III: DC Machine :
Separately excited DC motor-steady state and transient state analysis, sudden application of inertia load, transfer function of separately excited DC motor, mathematical model of dc series motor, shunt motor. (08Hrs)

Unit IV: Modeling of three phase Induction machine
Generalized model in arbitrary frame, Voltage, torque equations, Induction motor models-stator reference frame model, rotor reference frame model, synchronously rotating reference frame model, equations in flux linkages, per unit model, dynamic simulation. (08 Hrs)

Unit V: Modeling of Synchronous Machines
Introduction, voltage equations and torque equation in machine variables, stator voltage equations in arbitrary and rotor reference frame variables, Park's equations, rotor angle, per unit system, analysis of steady state operation. (08 Hrs)

Unit VI: Linearised machine equations
Linearization of machine equations, Small displacement stability: Eigen values, Eigen values of typical induction machine and synchronous machine . (08Hrs)

Text Books:

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis & Control", PHI Learning Private Ltd, 2009.
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive Systems",
3. P.S.Bimbra, "Generalized Theory of Electrical Machines", Khanna Publications,.

Reference Books:

1. Chee-Mun Ong, "Dynamic Simulation of Electric Machinery using Matlab / Simulink", Prentice Hall, 1998.
2. Matrix Analysis of Electric machines, N.N. Hancock, Pergamon Press.
3. Matrix Analysis of Electric machines by Mukhopadhyay

503302: ENERGY MANAGEMENT AND POWER QUALITY IN ELECTRICAL DRIVES

Teaching Scheme
4 Hours / Week
Credits : 4

Examination Scheme
In Semester Assessment: 50
End Semester Assessment: 50

Unit I: Electric motors
Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis- Energy efficient /high efficient Motors-Case study; Load Matching and selection of motors. Variable speed drives; Pumps and Fans-Efficient Control strategies- Optimal selection and sizing -Optimal operation and Storage; Case study. (08Hrs)

Unit II: Transformer Loading
Efficiency analysis, Feeder/cable loss evaluation, case study. Reactive Power management-Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-Placement-Maintenance case study; Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study. (08 Hrs)

Unit III: Power Quality

Introduction to Power Quality, types of power quality disturbances, Causes and effects of power quality disturbances, Voltage sags and interruptions. (08 Hrs)

Unit IV: Transient over voltages
Sources of transient over voltages, overvoltage protection systems, Ferro resonance management, tools for transient analysis. Causes of harmonics generation, harmonic indices, harmonic sources, effect of harmonic distortion, inter harmonics. (08 Hrs)

Unit V: Harmonics
Harmonic distortion evaluation, controlling harmonic distortion, harmonic filter design case study, voltage regulation devices, voltage flicker, Power quality benchmarking, voltage variation indices, power quality state estimations. (08 Hrs)

Unit VI: Power Quality Monitoring
Monitoring considerations, Power quality measuring equipment, application of intelligent systems, power quality monitoring standards. (08 Hrs)

Text Books:

1. M. H. J. Bollen, "Understanding Power Quality Problems, Voltage Sag & Interruptions", New York: IEEE Press, 2000, Series On Power Engineering
2. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Pub.
3. J. Arrillaga, M. R. Watson, S. Chan, "Power System Quality Assessment", John Wiley and Sons

References Books:

1. G. J. Heydt, "Electric Power Quality", Stars in a Circule Publications.
2. Enriques Acha, Manuel Madrigal, "Power System Harmonics: Computer Modeling & Analysis", John Wiley and Sons Ltd.

3. IEEE Std. 519-1992, IEEE recommended practices and requirements for harmonics control in electrical power system.
4. Donald R. W., Energy Efficiency Manual., Energy Institute Press.
5. Partab H., 'Art and Science of Utilisation of Electrical Energy', Dhanpat Rai and Sons, New Delhi.
6. Tripathy S.C.,'Electric Energy Utilization And Conservation', Tata McGraw Hill.
7. Turner, Wayne C., .Energy Management Handbook., 2nd ed.
8. Lilburn, GA: The Fairmont Press Inc., 1993.
9. UNESCAP-Guide Book on Promotion of Sustainable Energy Consumption.
10. (www.unescap.org/enrd/energy)
11. E.F.Fuchs, M.A.S Masoum " Power quality in Power systems and Electrical Machines", Elsevier, Academic Press.

503303: POWER CONVERTERS

Teaching Scheme
4 Hours / Week
Credits: 4

Examination Scheme
In Semester Assessment: 50
End Semester Assessment: 50

Unit I: DC to DC Converters
Buck, boost, buck-boost and Cuk converter topologies- continuous and discontinuous modes of operation, Voltage and current commutated choppers, effect of source Inductance, Filter circuits. (06 Hrs)

Unit II: AC to DC Converters
1-phase and 3-phase half controlled and Fully controlled bridge converters with RLE loads, freewheeling diodes, Dual Converter, sequence control of converter-inverter operation, Effect of source inductance on commutation, Harmonic analysis of source current. (08Hrs)

Unit III: Inverter-Generic Topology
General topology of 1-phase and 3-phase voltage source and Current source inverters, Selection of switching frequency & switching device. (08 Hrs)

Unit IV: PWM Inverters
1-phase VSI –sine-triangle PWM. 3-phase VSI sine-triangle PWM: under modulation and over modulation, region of operation. Other Inverter Switching schemes: Programmed harmonic elimination, Current regulated modulation (Hysteresis control), Space vector modulation: brief overview. (09 Hrs)

Unit V: Resonant Converters
Classification, basic resonant circuit concepts, loads resonant converters, ZVS, Soft switching concepts. (08 Hrs)

Unit VI: AC-AC Converters
1-phase and 3-phase AC controllers, Principle of operation, single phase and three phase cycloconverters ,harmonics, power factor. (09 Hrs)

Text Books:
1. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Second Edition, New Delhi,.
2. “Power Electronics: Converters, Design and Applications”, Ned Mohan, Undeland, Robbins. John Wiley and Sons, 2004.

Reference Books:
1. Power Electronics by M.D.Singh and Khanchandani.
2. Power Electronics by Vedam Subramanyam, Tata Mc Graw Hill.
3. “Modern Power Electronics and AC drives”, B.K.Bose, Pearson Education Inc., 2002.

503304: RESEARCH METHODOLOGY

Teaching Scheme
Lectures: 4 Hours / Week
Credits: 4

Examination Scheme
In Semester Assessment: 50
End Semester Assessment : 50

Unit I:
Definition, Research Characteristics, Research Need, Objectives and types of research: Motivation and objectives – Research methods vs Methodology, Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.

[8 Hrs]

Unit II:
Research Formulation – Defining and formulating the research problem -Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis. Summarizing a Technical Paper - summary template
Online tools - Google, CiteSeer, ACM Digital Library, IEEE, The on-line Computer Science bibliography, Searching patents [8 Hrs]

Unit III:
Research design, sampling design and scaling techniques – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design, basic principles of experimental designs, implications of sample design, steps in sample design, criteria of selecting sampling procedure, characteristics of good sampling design, different types of sample design. Scaling techniques: measurement scales, sources of error, technique of developing measurement tool, important scaling techniques, scale construction techniques.

[8 Hrs]

Unit IV:
Data Collection and analysis:- Observation and Collection of primary and secondary data - Methods of data collection, processing operations, types of analysis, statistics in research, measures of central tendency, measures of dispersion, measures of asymmetry, measures of relationships, simple regression analysis, multiple correlation and regression, partial correlation.

[8 Hrs]

Unit V:
Reporting and thesis writing – Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation – Planning – Preparation –Practice – Making presentation – Use of visual aids - Importance of effective communication - Documentation and presentation tools: LATEX

[8 Hrs]

Unit VI:

Types of technical papers - Journal papers, Conference papers, Survey papers, Poster papers, Review papers Comparison, Structure of a survey, conference and journal paper, Organization and flow of thesis/ Project report, Research proposal: preparation, budgeting, presentation, funding agencies for engineering research, Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights. [8 Hrs]

Text Books :

1. Kothari, C.R., Research Methodology: Methods and Techniques. New Age International
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., An introduction to Research Methodology, RBSA Publishers.
3. Suresh Sinha, Anil K Dhiman,Research Methodology, ESS Publications,Volumes 2
4. Day R.A., How to Write and Publish a Scientific Paper, Cambridge University Press
5. Wadehra, B.L. Law relating to patents, Trade Marks, copyright designs and geographical indications. Universal Law Publishing.

Reference Books:

1. Louis Cohen, Lawrence Manion and Keith Morrison, Research Methods in Education, 7th Edition, Cambridge University Press, ISBN – 978-0415-58336-7
2. Anthony, M., Graziano, A.M. and Raulin, M.L., Research Methods: A Process of Inquiry, Allyn and Bacon.
3. Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners, 2nd Edition, APH Publishing Corporation.
4. Leedy, P.D. and Ormrod, J.E., Practical Research: Planning and Design, Prentice Hall.
5. Fink, A., Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
6. Leslie Lamport, ' Latex: A document preparation system' Addison Wesley, Reading, Massachusetts, second edition, 1994, ISBN 0-201-52983-1.

503305: (ELECTIVE- I)

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Paper		TW	Oral / Presentation	Total	
503305	Lect/week	In semester Assessment	End Semester Assessment				
	5	50	50	-	-	100	5

Code No.	Modules of 4 credit (Select any one)	Code No.	Modules of 1 credit (Select any one)
503305 M1(i)	DSP and its applications	503305 M2(i)	Project Management
503305 M1(ii)	Data Acquisition and Signal conditioning	503305 M2(ii)	IPR and Patent Law
-	-	503305 M2(iii)	Technical communication
-	-	503305 M2(iv)	Smart Grid Technologies

503305 M1 (i) : DSP AND ITS APPLICATIONS

Teaching Scheme
Lectures: 4 Hrs./Week
Credits: 4

Examination Scheme
In-Semester Examination : 25 Marks
End Semester Examination:50 Marks

Prerequisite: Fourier series, Fourier transform, Z transform

Unit I: Discrete Signals and systems
Sampling of continuous time signals, quantization, aliasing, Sampling Theorem, Elementary discrete-time signals, classification, sequence operations, Discrete-time systems and Classification, impulse response, linear convolution and its properties, Z transform: basics, properties, inverse Z transform using power series and partial fraction. (08Hrs)

Unit II: Frequency response of discrete time systems
Discrete-time systems described by difference equations, Analysis of LTI discrete systems using z transform, frequency response of first order and second order systems, transfer function, steady state and transient response, phase and group delays, ideal filters and their pole zero locations, zero phase and linear phase transfer functions. (08Hrs)

Unit III: Frequency analysis of discrete time signals
Exponential representation of Fourier series and Fourier transform of continuous time signals, The Fourier series for discrete-Time periodic signals (only concept), The Fourier transform of discrete-time a periodic signals (only concept), Discrete Fourier Transform, Properties: periodicity, linearity, and symmetry properties, Circular convolution, Linear convolution using circular convolution, Fast Fourier Transform: Radix 2 DIT and DIF algorithms. (08Hrs)

Unit IV: IIR filters
Advantages and disadvantages of digital filter over analog filters, classification of digital filters: FIR and IIR, design of analog low pass Butterworth filter, Chebyshev filter, design of IIR filters from analog filters using bilinear transformation, impulse invariance. Realization of IIR filters: direct form I, direct form II, cascade and parallel. (08Hrs)

Unit V: FIR filters
Comparison between FIR and IIR filters, symmetric and anti-symmetric FIR filters, design of linear phase FIR filters using windows method and frequency sampling method, Realization of FIR filters by direct form, cascade form and parallel form. (08Hrs)

Unit VI: Applications of DSP
Application of DSP in rotating Electric Machines - speed control and condition Monitoring, Application of DSP in transmission line protection, Transformer protection. Harmonic analysis. (08 Hrs)

Text Books:

1. Proakis J.G. and Manolakis D.G., Digital Signal Processing, PHI, New Delhi.
2. Oppenhein A.V. and Schafer R. W., Digital Signal Processing. PHI, New Delhi.

3. Digital Signal Processing by P.Ramesh Babu, Scitech publications.

Reference Books:

1. Litan – Digital signal processing. Elsevier Publications
2. "A review of Induction motors signature analysis as a medium of fault detection" , Benbouizd M.E.H. IEEE transaction on Industrial Electronics vol 47 Year 2000 Oct. No.5
3. "Experimental investigations on Induction machine condition monitoring and fault diagnosis using digital signal processing techniques", Sa'ad Ahmed Saleh Al Kazzaz , G.K. Singh, Elsevier Electric Power system Research (65) 2003
4. Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill,1998, ISBN 0-07-044705-5.

503305 M1 (ii) : DATA ACQUISITION AND SIGNAL CONDITIONING

Teaching Scheme
Lectures: 4 Hrs./Week
Credits: 4

Examination Scheme
In-Semester Examination : 25 Marks
End Semester Examination:50 Marks

Unit I : Transducers & Data Acquisition
Data Acquisition Systems(DAS)- Introduction . Objectives of DAS . Block Diagram Description of DAS-General configurations - Single and multichannel DAS-Transducers for the measurement of motion, force, pressure, flow, level, dc and ac voltages and currents (CTs, PTs for supply frequency as well as high frequency, Hall Effect Current Sensors, High Voltage Sensors , Optosensors, Rogowski Coil, Ampflex Sensors etc.) (08 Hrs)

Unit II: Signal Conditioning
Requirements - Instrumentation amplifiers: Basic characteristics. Chopped and Modulated DC Amplifiers-Isolation amplifiers - Opto couplers - Buffer amplifiers .Noise Reduction Techniques in Signal Conditioning- Transmitters .Optical Fiber Based Signal Transmission-Piezoelectric Couplers- Intelligent transmitters. (08 Hrs)

Unit III: Filtering and Sampling
Review of Nyquist.s Sampling Theorem-Aliasing . Need for Prefiltering-First and second order filters - classification and types of filters - Low -pass, High-pass, Band-pass and Band-rejection and All Pass: Butterworth, Bessel, Chebyshev and Elliptic filters. Opamp RC Circuits for Second Order Sections-Design of Higher Order Filters using second order sections using Butterworth Approximation-Narrow Bandpass and Notch Filters and their application in DAS. Sample and Hold Amplifiers . (08Hrs)

Unit IV: Signal Conversion and Transmission
Analog-to-Digital Converters (ADC)-Multiplexers and demultiplexers - Digital multiplexer. A/D Conversion . Conversion Processes, Speed, Quantization Errors. Successive Approximation ADC . Dual Slope ADC . Flash ADC . Digital-to-Analog Conversion (DAC) . Techniques, Speed, Conversion Errors, Post Filtering-Weighted Resistor, R-2R, and Weighted Current type of DACs- Multiplying Type DAC-Bipolar DACs-
Data transmission systems-Schmitt Trigger-Pulse code formats- Modulation techniques and systems-Telemetry systems. (08 Hrs)

Unit V: Digital Signal Transmission and Interfacing
DAS Boards-Introduction. Study of a representative DAS Board, Interfacing Issues with DAS Boards, I/O vs Memory Addressing, Software Drivers, Virtual Instruments, Modular Programming Techniques for Robust Systems, Bus standard for communication between instruments - GPIB (IEEE-488bus) - RS-232C- USB-4-to-20mA current loop serial communication systems. Communication via parallel port . Interrupt-based Data Acquisition. (08 Hrs)

Unit VI: Software Design Strategies
Hardware Vs Software Interrupts-Foreground/ background Programming Techniques- Limitations of Polling Circular Queues. (08 Hrs)

Text Books:

1. Ernest O Doeblin., "Measurement Systems: Application and Design", McGraw Hill (Int. edition) 1990, ISBN 0-07-100697-4
2. George C.Barney, "Intelligent Instrumentation", Prentice Hall of India Pvt Ltd., New Delhi, 1988.
3. Ibrahim, K.E., "Instruments and Automatic Test Equipment", Longman Scientific & Technical Group Ltd., UK, 1988.

Reference Books:

1. John Uffrenbeck, "The 80x86 Family, Design, Programming, and Interfacing",
Pearson Education , Asia,
2. Bates Paul, "Practical digital and Data Communications with LSI", Prentice Hall of India, 1987.
3. G.B. Clayton, Operational Amplifiers., Butterworth and Co,
4. A.K Ray et. Al, Advanced Microprocessors and Peripherals., Tata McGrawHill,
Oliver Cage, .Electronic Measurements and Instrumentation, McGraw-Hill, (Int. edition) 1975, ISBN 0-07-085544 -7.

503305 M2 (i) : PROJECT MANAGEMENT

Teaching Scheme
Lectures: 1 Hr./Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I:

Project Scheduling: Gantt chart and its application, AOA (Activity on Arrow diagram), AON (Activity on Node) Diagram, Precedence diagramming methods (PDM), Critical Path Method (CPM), Programme Evaluation and Review Technique (PERT), GERT (Graphical Evaluation and Review Technique), Resource allocation, Line of Balancing and crashing the network.

Project Quality Management: The processes of project quality management, Quality planning, assurance and control, Quality of procured items, Techniques of quality assurance and control, project execution and control, International Project Management. [9Hrs]

Unit II:

Project Risk Management: Introduction, Managing risks in projects, Measurement and assessment of risk, Sources of risks. Risk: - Adjusted discount rate method, certainly equivalent method, correlation coefficient, portfolio risks, diversible & non-diversible risks, CAPM (Capital Asset pricing model) case studies of project management, computer aided project management.

[5Hrs**]**

Text Books:

1. K. Nagarajan, "Project Management", 5th Edition, New Age International Publishers, 2010
2. Prasanna Chandra, "Projects: planning, analysis, selection, implementation and review", 4th Edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 1995
3. Rosy Burke, "Project Management: planning and control technique", Wiley India, 2003
4. S. Chaudhary, "Project Management", Tata McGraw Hill, 1988

Reference Books:

1. J. R. Meredith, S. J. Mantel, "Project Management: A managerial approach", Wiley India, 2010
2. John M. Nicholas, Herman Steyn, "Project Management", 3rd Edition, Elsevier Inc., 2008
3. Samuel Mantel, Jr. J. R. Meredith, S. M. Scafer, M. M. Sutton, M. R. Copalan, "Project Management" 1st Edition, 2011

503305 M2(ii) : IPR AND PATENT LAW

Teaching Scheme
Lectures: 1 Hr/Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I:

Intellectual property, History, Types(Seven types of Intellectual Property Rights) viz. Patent, Industrial Designs, Trademark, Copyright, Geographical Indication, Integrated Circuit Layout, Trade Secrets.
Patents and standards: History of patent law, History of Indian Patent System, Utility model
Procedures: Patent application, Patent infringement and enforcement, Patent licensing, Patent prosecution. Criteria of patentability, Rights granted for IP owners.
Legal requirements: Patentable subject matter, Novelty, Utility (patent), Inventive step and non-obviousness, Industrial applicability, Person skilled in the art, Prior art, Inventor ship, Sufficiency of disclosure, Unity of invention, Intellectual property brokering, Intellectual property education, Intellectual property infringement, Intellectual property valuation. [7 Hrs]

Unit II :

CEN and CENELEC Patent Policy, CEN-CENELEC Guidelines for Implementation of the Common IPR Policy on Patents, Declaration of patents.
Copyright: CEN-CENELEC copyright policy, piracy. Industrial design rights
Trademarks: Geographical indication, Protected designation of origin, Trade dress.
Other types: Database right, Fashion law, Indigenous intellectual property, Industrial design rights (or registered designs), Intellectual rights to magic methods, Internet domain name, Know how, Mask work (or Integrated circuit layout design protection), Open-source software, Orphan drug rights, Personality rights, Plant breeders' rights Patent law by region or country: Indian patent law, Australian patent law, Canadian patent law, Patent law of the People's Republic of China, European patent law, Japanese patent law, United States patent law. [7 Hrs]

Text Books:

1) Intellectual Property Rights - Prabuddha Ganguli, Tata McGraw Hill publishing Company Ltd.
2) Satarkar S.V., Intellectual Property Rights and Copy Right. ESS Publications.

Reference books:

www.cen.eu
www.cenelec.eu
www.cencenelec.eu
http://ipindia.nic.in/
http://ipindia.nic.in/ipr/patent/patents.htm
http://www.ipaustralia.gov.au/ (Australian Intellectual property)
http://guides.slv.vic.gov.au/
http://www.cipo.ic.gc.ca (Canadian patent office)
http://www.epo.org(Europian patent office)
http://www.academicleadership.org/emprical_research/The_State_of_Intellectual_Property_Education_Worldwide.shtml (Intellectual property education)
http://www.epo.org/law-practice/legal-texts/html/epc/2010/e/ar69.html
http://www.epo.org/law-practice/legal-texts/html/epc/2010/e/ar64.html
http://www.cas.go.jp/jp/seisaku/hourei/data/PA.pdf
http://nopr.niscair.res.in/bitstream/123456789/12687/1/JIPR%2016%285%29%20377-384.pdf

503305 M2 (iii) : TECHNICAL COMMUNICATION

Teaching Scheme
Lectures: 1 Hr./Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I :

Effective Presentation Strategies

Define the purpose of presentation, Analyzing audience and locale, organizing contents, Preparing an Outline, Visual Aids, Understanding the nuance of delivery, sample speech and practice the presentation [3Hrs]

Listening techniques

Types of listening, listening with a purpose, barriers to listening, listening comprehension, effective listening strategies, listening in conversational interaction, team listening [2Hrs]

Speech techniques

Conversation and oral skills, strategies for good conversation, techniques to develop effective word accent, word stress, primary and secondary stress, use of correct stress pattern, developing voice quality, developing correct tone [2Hrs]

Unit II:

Writing technical reports, research papers, dissertation, thesis and research proposals. Important parts of reports like abstract, results, conclusion. Supplementary parts like list of symbols, list of tables, annexure, references etc. Making title page, writing mathematical equations, including graphics, making tables and writing references using LaTex/ MiKTeX.

Assignment for one technical proposal, one research paper and one technical report should be submitted using LaTex/MikTeX for in semester assessment. [7 Hrs]

Text books

1) Technical Communication-Principals and Practice, Meenakshi Raman, Sangeeta Sharma, OXFORD university Press.
2) Effective Technical Communication, M Ashraf Rizvi, TATA McGRAW HILL

Reference books

1) Leslie Lamport, ' Latex: A document preparation system' Addison Wesley, Reading, Massachusetts, second edition, 1994, ISBN 0-201-52983-1.

503305 M2 (iv) : SMART GRID TECHNOLOGIES

Teaching Scheme
Lectures: 1 Hr. /Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I :
Need of Synchro phasor Measurements, Phasor Measurement Unit : Architecture, Functions, Optimal Placement of PMUs, phasor data concentrators and associated communication system .Visualization tools to enhance visibility and control within transmission system, PMU measurements and sampling rates State Estimation & observability by using PMU, phasor data use for real time operation, frequency stability monitoring and trending, power oscillation, voltage monitoring and trending. Alarming and setting system operating limits. Dynamic line rating and congestion management, outage restoration. Application of PMU for wide area monitoring and control.

[9Hrs]

Unit II :
WAMS (Wind Area Measurement system): Architecture, Components of WAMS, GUI (Graphical User Interface), Applications: Voltage Stability Assessment, Frequency stability Assessment, Power Oscillation Assessment, Communication needs of WAMS, WAMPAC (Wide Area Monitoring Protection & Control), RAS (Remedial Action Scheme). Standards: IEEE 1344, IEEE C37.118 (2005), IEEE Standard C37.111-1999 (COMTRADE), IEC61850 GOOSE.

[5Hrs]

Text Books

1. "Synchronized Phasor Measurements and Their Applications", Arun G. Phadke, J.S. Thorp, Springer Publication.
2. "Event detection and visualization based on phasor measurement units for improved situational awareness", Joseph Euzebe Tate, UMI Dissertation Publishing.
3. "Wide Area Monitoring, Protection and Control: The Gateway to Smart Grids", Fahd Hashiesh, M. M. Mansour , Hossam E. Mostafa Fahd Hashiesh , M. M. Mansour , Hossam E. Mostafa.

Reference Books

1. "Power System State Estimation", Mukhtar Ahmad
2. "Computer Relaying for Power Systems", Dr. Arun G. Phadke, Dr. James S. Thorp, Wiley Publication, Second Edition.
3. "SMART GRID Infrastructure & Networking", KRZYSZTOF INIEWSKI, TATA McGRAW-HILL EDITION.

503306: LAB PRACTICE - I

Teaching Scheme
4 Hrs / Week
Credits : 4

Examination Scheme
TW : 50 Marks
Oral Exam.: 50 Marks

A minimum of eight experiments should be performed under Lab Practice – I. Out of which minimum six experiments should be from the list below. Minimum six experiments should be based on compulsory subjects. A list of experiments that may be performed under various subjects of semester - I is given below as a guideline:

List of Experiments

1. Modeling and simulation of three phase Induction machine and to study the dynamic behavior of the machine for change in load torque.
2. Modeling and simulation of separately excited DC motor and to study the dynamic behavior of the machine for change in load torque.
3. Analysis of harmonics of three phase Induction motor.
4. Analyze THD in inverter output using Harmonic analyzer.
5. To study the harmonic analysis of CFL, electronic fan regulator, electronic choke of tube, computer and remedy for the same.
6. Simulation & analysis of three phase converters with RLE load.
7. Simulation & analysis of Buck/Boost converters with RLE load.
8. Simulation & analysis of three phase PWM inverter with RLE load.
9. FFT analysis of three phase converter.
10. Design, Simulation and Performance analysis of IIR Butterworth filter.
11. Design, Simulation and Performance analysis of FIR filter by Rectangular window method.
12. Signature analysis of induction motor current.

503307: AC AND DC DRIVES

Teaching Scheme	Examination Scheme
4 Hours / Week	In Semester Assessment: 50
Credits : 4	End Semester Assessment: 50

Unit I: Converter Fed DC Drives :
Single phase and three phase drives - separately excited and series motor drives - semi converter and full converter fed drives - General analysis - Evaluation of performance parameters - Dual converter fed drives. (8Hrs)

Unit II: Chopper Fed DC Drives
Single quadrant chopper controlled drives - evaluation of performance parameters for separately excited and series motor drives - Two quadrant and four quadrant chopper controlled drives. (8Hrs)

Unit III : Closed Loop Control of AC Drives
Voltage and current source inverter - inverter control-six step and PWM operation, Control of Induction motor drive: Stator voltage control ,V/F control, slip regulation, static Kramer's drive. (8Hrs)

Unit IV: Vector Control of Induction Motor
Principle of field oriented control, rotor flux oriented control, stator flux oriented control, Rotor flux estimation, Magnetizing flux - oriented control of induction machines. (08Hrs)

Unit V: Special Drives
Brushless DC motor, stepper motor and variable reluctance motor drives. (08Hrs)

Unit VI: Time response Analysis of Motor drive systems
Transfer function and time response analysis using Bode plot and root locus methods for Separately excited DC motor and three phase induction motor. (08Hrs)

Text Books:

1. Sen, P.C. "Thyristor DC Drives", John Wiley & sons, New York, 1981
2. Pillai, S.K. "Analysis of Thyristor Power Conditioned Motors", University Press, 1992
3. Gopal K.Dubey, "Fundamentals of Electric Drives", Narosa Publications, 1995
4. Bimal K.Bose, "Power Electronics and variable Frequency Drives - Technology and Application", IEEE Press, 1997

Reference Books:

1. Peter Vas, "Vector control of Ac machines", Oxford University Press, 1990
2. Bose, B.K.et.al."Microcomputer control of power electronics and drives", IEEE Press,
3. Leonard, W, "Control of Electric Drives", Springer Verlag, 1985.

503308: DESIGN OF POWER ELECTRONIC SYSTEMS

Teaching Scheme	**Examination Scheme**
4 Hours / Week	In Semester Assessment: 50
Credits : 4	End Semester Assessment: 50

Unit I: Modeling of Basic devices
Modeling of basic power electronic devices, modeling of 1-ϕ and 3-ϕ converters. (07 Hrs)

Unit II: Modeling of Converter
Modeling of DC-DC converters and Inverters. (07 Hrs)

Unit III: Thermal Design
Thermal design and modeling, Heat sink design and selection of heat sink. (08 Hrs)

Unit IV: Magnetic Design
Magnetic component design – Magnetic materials and cores, Copper windings, Thermal considerations, special inductor design and procedure, transformer design procedure and K-factor transformer design. (09 Hrs)

Unit V: Design of Power Electronic circuit
Design of soft starters, design of converters, design of inverters. (08 Hrs)

Unit VI: Design of snubber & drive circuits
Snubber circuits: Types of Snubber circuits, need of Snubber circuit , Snubber for bridge circuit configurations, GTO -Snubber circuit. Gate and basic drive circuits: Design Consideration, De-coupled drive circuits, Electrically isolated drive circuits, cascade connected drive circuits, Power device protection in drive circuits, circuit layout considerations. (09 Hrs)

Text Books:

1. "Power Electronics: Converters, Design and Applications", Ned Mohan, Undeland, Robbins. John Wiley & Sons, 2000.
2. J P Agarwal, "Power Electronics Converters Applications & Design", .

Reference Books:

1. Power Electronics: Devices, Drivers, Applications and Passive components", B.W.Williams, McGraw-Hill.
2. "Electric Motor Drives- Modeling, Analysis and Control", R.Krishnan, Prentice Hall Inc., 2001.
3. "Fundamentals of Power Electronics", 2nd Edition, Robert W.Erickson, Dragan Maksimovic,
4. "Modern Power Electronics and AC drives", B.K.Bose, Peasron Education Inc., 2002.
5. Power Electronics handbook by M.H.Rashid, CRC Press.

503309: ADVANCED CONTROL SYSTEMS

Teaching Scheme
4 Hours / Week
Credits: 4

Examination Scheme
In Semester Assessment: 50
End Semester Assessment: 50

Unit I:
Review of classical and modern control concepts: PID control and tuning approaches, State space method, analysis and design of control system in state space, pole placement, state observer, design of control system with Luenberger observer. (6 hrs)

Unit II:
Optimal control:
Parameter optimization and optimal control problems, quadratic performance index, analysis and design of finite and infinite time Linear Quadratic Regulators, Introduction to Linear Quadratic Gaussian approach (8 hrs)

Unit III:
Robust Control:
Concept of robust control, description and categorization of system uncertainties. System and signal norms, small gain theorem, robust stability, design of robust control, Introduction to H-∞ control. (8 hrs)

Unit IV :
Nonlinear Control:
Nonlinear Systems and Equilibrium Points , Concepts of Stability, Linearization, Stability analysis of nonlinear systems, Feedback Linearization, Input-output linearization, Input-State Linearization. (8 hrs)

Unit V:
Sliding mode control
Notion of variable structure system and variable structure control, Introduction to sliding mode control, features of sliding mode control, sliding mode control design, concept of sliding surface, control design using reaching laws, stability analysis. (8 hrs)

Unit VI:
Applications to power system/power electronics:
Transfer functions of various power electronic devices like converters (switching model, averaging model), Applications of control theory for control of converters, renewable systems, distribution generation, power quality devices. (10 hrs)

Text Books:
1. 'Modern Control Engineering'- Katsuhiko Ogata, Prentice Hall India, 5th edition 2010.
2. 'Applied Non Linear Control', Jean-Jacques E. Slotine, Prentice Hall Englewood Cliffs, New Jersey.
3. 'Non-linear Systems', by Hassan Khalil, Prentice Hall.

Reference Books:
1. 'Control of Power Inverters in Renewable Energy and Smart Grid Integration', Qing-Chang Zhong, Tomas Hornik, Wiley Publication, 2013
2. 'Sliding-mode Control: Theory and applications' by Sarah K. Spurgeon, Taylor & Francis, 1998
3. 'Digital Control and State Variable Methods' by M. Gopal, Tata-McGraw-Hill Publishing Company Limited
4. 'Optimal Control: Linear Quadratic Methods' Brian D. O. Anderson, John Barratt Moore, Dover Publications, 2007

503310: (ELECTIVE- II)

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Paper		TW	Oral / Presentation	Total	
503310	Lect/week	In semester Assessment	End Semester Assessment				
	5	50	50	-	-	100	5

Code No.	Modules of 4 credit (Select any one)	Code No.	Modules of 1 credit (Select any one)
503310 M1(i)	Automation in Industrial drives	503310 M2(i)	Electric Vehicles
503310 M1(ii)	Embedded system design	503310 M2(ii)	Fundamentals of Cyber Security
-	-	503310 M2(iii)	Disaster Management
-	-	503310 M2(iv)	Communication protocols in SCADA System

503310 M1 (i) : AUTOMATION IN INDUSTRIAL DRIVES

Teaching Scheme
Lectures: 4 Hrs./Week
Credits : 4

Examination Scheme
In-Semester Examination : 25 Marks
End Semester Examination:50 Marks

Unit I: Introduction
Definition, Types of loads, steady state & transient stability of Drive, state of art of power electronics and drives, selection of motor rating. (08Hrs)

Unit II: D.C. Drives
Review of braking and speed control of D.C. motors, multi-quadrant operation, loss minimization in adjustable speed drives. Mathematical modeling of dc drives, stability analysis, modern control techniques: variable structure, adaptive control. (08Hrs)

Unit III: Induction Motor Drives
Review of braking and speed control of induction motors. constant V/F, constant air gap flux, controlled voltage, controlled current and controlled slip operation. (08Hrs)

Unit IV: Modeling and stability analysis
Mathematical modeling of induction motor drives, transient response and stability analysis Introduction to cycloconverter fed induction motor drive. (08Hrs)

Unit V: Synchronous Motor Drives
Adjustable frequency operation, voltage fed drive, current fed self-controlled drive. (08Hrs)

Unit VI: Automation Using Drives
Introduction, various components of automation, different sensors used in automation, PLC introduction and ladder programming, industrial application of automation, sensor less vector control and DTC drive, Recent trends in automation and case studies. (08Hrs)

Text Books:
1. Dubey G.K.,Power Semiconductor Controlled Drive, Prentice Hall, New Jersey
2. Sen P.C., Thyristor Controlled DC Drives, Wiley, New York
3. Murphy J.M.D. and Turnbull F.G., Power Electronics Control of AC Motors, Franklin Book

References:
1. Bose B.K.,Power Electronics and AC Drives, Prentice Hall, New Jersey
2. Bose B.K., Power Electronics and Variable Frequency Drives-Technology and applications, IEEE Press
3. Microcontroller control of drives, IEEE Press.

503310 M1 (ii) : EMBEDDED SYSTEMS DESIGN

Teaching Scheme
Lectures: 4 Hrs./Week
Credits : 4

Examination Scheme
In-Semester Examination : 25 Marks
End Semester Examination:50 Marks

Unit I: Introduction to Embedded System

An embedded system, processor, hardware unit, soft ware embedded into a system, Example of an embedded system, Real time and embedded OS. Structural unit in a processor processor selection for embedded systems. (08Hrs)

Unit II

AVR system - AVR family processors, Architecture, Addressing modes, Instruction overview, Branch, Call, and Time Delay Loop, AVR I/O Port Programming. (08Hrs)

Unit III

Assembly level programming, Higher level language programming, AVR Programming in C, Timer Programming, Interrupt Programming. (08Hrs)

Unit IV

AVR LCD and Keyboard Interfacing, ADC, DAC, and different Sensor Interfacing, Relay, Opt isolator interface. (08Hrs)

Unit V

Stepper Motor Interfacing, Servo motor interfacing, PWM Programming, RTC, PC interface, data acquisition system. (08Hrs)

Unit VI

Case studies
DC motor control, Induction Motor control (VSI and CSI fed) , UPS Applications , Special Machine control (PMBLDC). (08Hrs)

Text Books:

1. M A Mazidi, S Naimi “AVR Microcontroller and Embedded Systems: Using Assembly and C“
2. Rajkamal “Embedded System Architecture: Programming & Design”, TMH Edition, 2007.
3. J. W. Valvano “ Embedded Microcomputer System: Real time interfacing”, Cengage-Engineering, 1st Edition, 2000.

Reference Books:

1. Jane W.S. Liu, “Real Time Systems”, Prentice Hall, 2000.
2. David E. Simon, “An Embedded Software Primer”, Pearson Education, 1999.

503310 M2(i) : ELECTRIC VEHICLES

Teaching Scheme
Lectures: 1 Hr/Week
Credit : 1

Examination Scheme
In-Semester Examination: 25 Marks

UNIT-I

History and development of on-road Electric Vehicles (EV). Different configurations of hybrid EVs with block diagram representation, merits & demerits of different configurations in view of vehicle efficiency and energy storage system. [7 Hrs]

UNIT-II

Energy storage systems – Basics of EV batteries, specifications, power density, Energy density, Charging & Discharging cycle and recommended methodologies for charging. Recommended drives for EV and converter topology used in EVs. [7 Hrs]

Text Books:

1] Ron Hodkinson & John Fenton, Light Weight Electric/ Hybrid Vehicle design, Butterworth Publications, Heinemann

2] H. A. Kiehne, Battery Technology Handbook, MARCEDLE KKEIRN,C

Reference books :

1] Sandeep Dhameja , Electric vehicle battery systems , Butterworth–Heinemann

503310 M2(ii) : FUNDAMENTALS OF CYBER SECURITY

Teaching Scheme
Lectures: 1 Hr/Week
Credit: 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I: Introduction cyber security
Ethics and Law, What is a Cyber Crime / Social Theories, Computer Security: Then and Now, Computer System Security / Access Controls, Intrusion Detection: An Overview, Malicious Software Use and Detection [4 Hrs]

Security principles, threats and attack techniques
Introduction to security, Information security, Security triad: Confidential, Integrity, Availability, Focus of control, Security threats and attacks, Security management **[**2 Hrs**]**

Authentication and access control
Identification, Authentication, Authentication by passwords, Protecting passwords, Access control structures, Types of access control **[**2 Hrs**]**

Unit II: Lattice and reference monitors
Security levels and categories, Lattice diagram, Reference monitors, Security kernel, Hardware security features, protecting memory **[**2 Hrs**]**

Security models
Bell-LaPadula, Biba, Non-deducibility, Non-interference, Other models **[**2 Hrs**]**

Cryptography
Cryptographic mechanisms, Digital signatures, Encryption, Certificates **[**2 Hrs**]**

Reference Books

1. Dieter Gollmann, "Computer Security", 2nd ed., John Wiley & Sons, 2006 ISBN: 0-470-86293-9
2. Rick Lehtinen and G.T. Gangemi, "Computer Security Basics", O'Reilly Media, Inc., 2nd 2006 ISBN: 10: 0596006691

WEBSITES:
1) www.cert.org
2) www.microsoft.com/security/
3) www.sans.org
4) www.us.cert.gov

503310 M2 (iii): DISASTER MANAGEMENT

Teaching Scheme
Lectures: 1 Hr/Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I: Disaster, Hazards and Vulnerability
Concept of disaster, different approaches, concept of risk, levels of disasters Disaster phenomena and events, Natural and man-made hazards; response time, frequency and forewarning levels of different hazards, Characteristics and damage potential of natural hazards; hazard assessment , dimensions of vulnerability factors; vulnerability assessment, Vulnerability and disaster risk, Vulnerabilities to flood and earthquake hazards. [7 Hrs]

Unit II: Disaster management mechanism and Planning
Concepts of risk management and crisis management, Disaster management cycle Response and Recovery , Development, Prevention, Mitigation and Preparedness Planning for relief , Strategies for disaster management planning , Steps for formulating a disaster risk reduction plan, Disaster management Act and Policy in India, Organizational structure for disaster management in India, Preparation of state and district disaster management plans. [7Hrs]

- Students shall submit a detailed case study report on any disaster, prevention and preparedness.

Text books :
1. Alexander, D. Natural Disasters, ULC press Ltd, London, 1993.
2. Carter. W. N., Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991.
3. Chakrabarty. U. K., Industrial Disaster Management and Emergency Response, Asian Books Pvt. Ltd., New Delhi 2007.
4. Disaster Management, Lotus Publications Pvt. Ltd.

References:
1. Manual on Natural Disaster Management in India, NCDM, New Delhi, 2001.
2. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.
3. National Policy on Disaster Management, NDMA, New Delhi, 2009.
4. Disaster Management Act. (2005), Ministry of Home Affairs, Government of India, New Delhi, 2005.
5. http://nidm.gov.in/ - National Institute of Disaster Management (NIDM) (Ministry of Home Affairs, Govt. of India) website

503310 M2 (iv) : COMMUNICATION PROTOCOLS IN SCADA SYSTEM

Teaching Scheme
Lectures: 1 Hr./Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I:

SCADA Systems: Introduction and definitions of SCADA,

Basic SCADA system Architecture: Human Machine Interface, Master Terminal Unit, Remote Terminal Unit Communications for SCADA systems, Configuration of SCADA systems, SCADA system applications, SCADA systems in operation and control of interconnected power systems, Functions of SCADA systems, Common features of SCADA systems, Automatic substation control, SCADA configuration, Energy management system, system operating states, system security, State estimation.

(7 Hrs)

Unit II:

Communication in power systems: Inductive coordination, Voice communication, carrier systems, Power line carrier systems, Microwave systems, co axial cable and optical fiber system, two way mobile radio systems.

The Evolution of SCADA Protocols: Overview of Open systems interconnection (OSI) Model, Functions of OSI Model Layers, OSI Protocols, Functions of Transmission control protocol / Internet protocol (TCP/IP) Layers, TCP/IP protocol, MODBUS model, DNP3 protocol, IEC61850 layered architecture, Control area network, Control and Information Protocol (CIP), DeviceNet, ControlNet, EtherNet/IP, Flexible Function Block process (FFB), Process Field bus (Profibus), The Security Implications of the SCADA protocols.

(7 Hrs)

Text Books:

1. Ronald L. Krutz, “Securing SCADA System”, Wiley Publishing
2. Sunil S. Rao, “Switchgear and Protections”, Khanna Publication
3. Robert Miller, James Malinowski “ Power System operation”, McGraw-Hill, Inc.

Reference books:

1. Gordan Clark, Deem Reynders, “Practical Modem SCADA Protocols”
2. Stuart A Boyer, “SCADA supervisory control and data acquisition” International Society of Automation, North Carolina, 4th Edition.

503311: LAB PRACTICE II

Teaching Scheme
4 Hrs / Week
Credits : 4

Examination Scheme
Term Work : 50 Marks
Oral Exam. : 50 Marks

A minimum of eight experiments should be performed under Lab Practice – II. Out of which minimum six experiments should be from the list below. Minimum six experiments should be based on compulsory subjects. A list of experiments that may be performed under various subjects of semester -II is given below as a guideline:

List of Experiments

1. Modeling and simulation of Chopper fed DC drive.
2. To study the performance characteristics of vector controlled three phase Induction motor.
3. To study the performance characteristics of BLDC motor drive.
4. To study the performance characteristics of Switched Reluctance motor.
5. Modeling and analysis of solar photovoltaic system.
6. MPPT of wind turbine using MATLAB.
7. Simulation of three phase voltage regulator.
8. Design and analysis of snubber circuit.
9. Design of heat sink.
10. To develop AVR based data acquisition system.
11. To develop AVR based motor control system.
12. To develop AVR based variable DC supply.
13. Design of Luenberger observer for DC motor drive.
14. State feedback control using Input-Output linearization.
15. Design and simulation of finite time Linear Quadratic Regulator (LQR).
16. Design and simulation of sliding mode control for double integrating system.
17. Design and simulation of H-∞ controller.
18. Analysis of closed loop control of converter based system.

503312 : SEMINAR– I

Teaching Scheme	**Examination Scheme**
4 Hrs/Week	Term Work: 50 Marks
Credits: 4	Oral/Presentation : 50Marks

Seminar I **s**hall be on state of the art topic of student's own choice based on relevant specialization approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute.

603301: POWER ELECTRONICS APPLICATIONS

Teaching Scheme
4 Hours / Week
Credits: 4

Examination Scheme
In Semester Assessment: 50
End Semester Assessment: 50

Unit I: Power System Applications

Power system components and characteristics, Power flow controllers-types, Need of power flow controllers, types of it, role of power electronics in power systems, future scope. (08 Hrs)

Unit II: Renewable Energy Systems

Block diagram and components of wind energy systems, Generator control, Power factor improvement, PV conversion system, Synchronized operation with grid. Case study of solar PV system (08 Hrs)

Unit III: HVDC System

Need of HVDC system, comparison between EHVAC & HVDC system, HVDC substation, Use of converters in HVDC system, Analysis of 6 and 12 pulse converters, harmonics and filters. (08 Hrs)

Unit IV: Compensation Techniques

Modeling and control of Thyristorised controlled series compensators. Static VAR Compensation - Basic concepts, Thyristor controlled reactor (TCR), Thyristor switched reactor (TSR), Thyristor switched capacitor, Active filter

(08 Hrs)

Unit V: FACTS and its Applications

Introduction, Concept of FACTS devices, Unified power flow, Unified Power Flow Control - Introduction, Implementation of power flow control using conventional power electronic devices, concept, Implementation of unified power flow controller. Basics of STATCOM, its applications. (08 Hrs)

Unit VI: Utility Applications

Switched Mode Power Supplies, UPS and Battery charging system, applications of Power Electronics in Heating & Welding, Illumination application, Electronic Ballast, AC-DC electric locomotives systems, Hybrid vehicle system (08 Hrs)

Text Book:

1. Padiyar, K.R.,"HVDC Power Transmission Systems", Wiley Eastern Limited, New Delhi, 1992.
2. Rai, G.D.,"Solar Energy Utilisation", Khanna Publishers, New Delhi, 1991.
3. Daniel, Hunt, V."Wind Power - A hand book of WECS", Van Nostrand Co., New York, 1981.
4. Rakesh Das Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern Ltd., New Delhi, Second Edition, 1990.

Reference Books:

1. Kimbark, E.X., “Direct Current Transmission”, Wiley Interscience, New York, 1971
2. Ned Mohan, “Power Electronics Converters Applications & Design”, Wiley India.

3. Modern Electric Traction by Prakash.
4. Keith Billings: Handbook of Switched Mode Power Supplies, McGraw Hill

603302: POWER ELECTRONICS IN SMART GRID

Teaching Scheme
4 Hours / Week
Credits : 4

Examination Scheme
In Semester Assessment: 50
End Semester Assessment: 50

Unit I: Introduction
Introduction to smart grid, electricity network, local energy networks, electric transportation, low carbon central generation, fundamental problems of electrical power systems, power flow control, distributed generation and energy storage, attributes of the smart grid, alternate views of a smart grid. (08 Hrs)

Unit II: Power Control and Quality Problems
Introduction, general problems and solutions of power control, power quality and EMC, power quality issues, monitoring, legal and organizational regulations, mitigation methods, and EMC related phenomena in smart system, EMC cases in distributed power system. (08 Hrs)

Unit III: High frequency AC Power Distribution Platform
Introduction, high frequency in space applications, telecommunications, and computer and commercial electronics systems, automotive and motor drives, micro grids. (08 Hrs)

Unit IV: Integration of Distributed Generation with Power System
Distributed generation past and future, interconnection with a hosting grid, integration and interconnection concerns, Interconnected Grid system and relative problems. (08 Hrs)

Unit V: Communication Technology in Smart Grid
Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi based communication, Basics of CLOUD computing and Cyber security for Smart Grid. (08 Hrs)

Unit VI: Active Power Controllers
Dynamic static synchronous controllers, D –STATCOM, Dynamic static synchronous series controllers, dynamic voltage restorer, AC/AC voltage regulators. (08 Hrs)

Text Book:

1. Clark Gellings: -" The Smart Grid: Enabling energy efficiency and demand response", CRC Press
2. Jean Claude "Smart Grid", Wiley Blackwell
3. Peter Fox Penner-" Smart Power- Climate changes the smart grid and the future of electric utility", Island Press 2010 edition

Reference Books:

1. R.C. Dugan- "Electric Power System Quality", 2nd Edition, McGraw Hill.

2. James Northcote, Green – "Control and Automation of Electric Power Distribution System (Power Engineering)", CRC Press.

603303: (ELECTIVE - III)

CODE	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		Paper		TW	Oral / Presentation	Total	
603303	Lect/week	In semester Assessment	End Semester Assessment				
	5	50	50	-	-	100	5

Code No.	Modules of 4 credit (Select any one)	Code No.	Modules of 1 credit (Select any one)
603303 M1(i)	Artificial Intelligence in Electrical drives	603303 M2(i)	Artificial Intelligent tools
603303 M1(ii)	Industrial Automation	603303 M2(ii)	Intelligent Sensors and instrumentation
-	-	603303 M2(iii)	Human Rights
-	-	603303 M2(iv)	Green building design
-	-	603303 M2(v)	Biomedical Instrumentation

603303 M1(i) : ARTIFICIAL INTELLIGENCE IN ELECTRICAL DRIVES

Teaching Scheme
Lectures: 4 Hrs./Week
Credits : 4

Examination Scheme
In-Semester Examination : 25 Marks
End Semester Examination:50 Marks

Unit I: Artificial Intelligent Based Systems
Natural language system – perception system for vision speech and touch - expert or knowledge based system – knowledge acquisition – knowledge of representation – inference strategy – expert controller. (08Hrs)

Unit II: Artificial Intelligence
Definition, problem solving methods, searching techniques, knowledge representation, reasoning methods, predicate logic, predicate calculus, multivalue logic. (08Hrs)

Unit III: Fuzzy Logic
Concepts, fuzzy relations, membership functions, matrix representation, de-fuzzification methods (08Hrs)

Unit IV: Artificial Neural Network
Introduction, multi-layer feed forward networks, back propagation algorithms, radial basis function and recurrent networks. (08Hrs)

Unit V: Evolutionary Techniques
Introduction and concepts of genetic algorithms and evolutionary programming Hybrid Systems: Introduction and Algorithms for Neuro-Fuzzy, Neuro-Genetic, Genetic-Fuzzy systems. (08Hrs)

Unit VI: VLSI Implementation of Neural Networks
Analog and digital techniques – hybrid systems – special purpose VLSI chips- neuro-fuzzy control system. (08Hrs)

Text Books:

1. Rajasekaran S. and Pai G.A.V., "Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and applications, PHI New Delhi.

2. Lin C. and Lee G., "Neural Fuzzy Systems", Prentice Hall International Inc.

Reference Books:

1. Goldberg D.E. “Genetic Algorithms in Search Optimization & Machine Learning”, Wesley Co., New York.

2. Kosko B., "Neural Networks & Fuzzy Systems A dynamical systems approach to machine intelligence, Prentice Hall of India.

603303 M1(ii) : INDUSTRIAL AUTOMATION

Teaching Scheme
Lectures: 4 Hrs./Week
Credits : 4

Examination Scheme
In-Semester Examination : 25 Marks
End Semester Examination:50 Marks

Unit I:
Introduction: Introduction, structure of automated process control system, Introduction to automation tools PLC, DCS, HMI, SCADA, Hybrid DCS/PLC. Benefits and inconveniences of automation

Unit II
DCS Project: Development of User Requirement Specifications, Functional Design Specifications for automation tool, Good Automated Manufacturing Practise (GAMP).

Unit III:
Programmable Logic Controllers: Introduction of Advanced PLC programming, Selection of PLC Input/output modules, Interfacing of Input/output devices, concept of Object linking and embedding for Process (OPC) , Control, study of SCADA, PLC SCADA Interfacing.

Unit IV:
Types of communication interface, Communication Protocols Introduction to Open System Interconnection (OSI) model, Modbus (ASCII/RTU), Functions of Transmission control protocol TCP/IP protocol, DNP3 protocol, IEC61850, Control and Information Protocol (CIP), DeviceNet, ControlNet, EtherNet/IP, Process Field bus (Profibus)

Unit V:
Distributed Control System (DCS): Architecture , Specifications, configuration of DCS blocks for different applications, Interfacing of protocol based sensors, actuators and PLC systems, Plant wide database management, Security and user access management, Enterprise Resources Planning (ERP) Interface.

Unit VI:
Study of Advanced Process control blocks: Statistical Process Control, Model Predictive Control, Fuzzy Logic Based Control, Neural-Network Based Control: Control & Instrumentation for process optimization. Applications of the above techniques to the some processes, Process Safety.

Text Book:

1. Gary Dunning, 'Introduction to Programmable logic Controllers',(Delmar Publisher)
2. Webb & Reis, 'Programmable logic Controllers',(Prentice Hall of India)
3. Jose A. Romagnoli, Ahmet Palazoglu, 'Introduction to process Control' (CRC Tylor and Francisgroup)

Reference Books:

1. Statistical Process Control –ISA Handbook.
2. B.G. Liptak 'Handbook of Instrumentation- Process Control'
3. Installation and user manuals of different DCS, PLC Vendors.

603303 M2(i) : ARTIFICIAL INTELLIGENT TOOLS

Teaching Scheme
Lectures: 1 Hr/Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I: Fuzzy Logic System
Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Case studies and assignment based on applications of fuzzy logic.

[7Hrs]

Unit II Genetic Algorithm
Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Concept on some other search techniques like tabu search and and-colony search techniques for solving optimization problems. GA application to power system optimization problem, Case studies: based on use of GA for optimization. [7Hrs]

Text Books:

1) M. Ganesh “Introduction to Fuzzy Sets and Fuzzy Logic”, Prentice Hall, India.
2) Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.

Reference Books:

1) KOSKO B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.
2) KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 1993.
3) Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.

603303 M2(ii) : INTELLIGENT SENSORS AND INSTRUMENTATION

Teaching Scheme
Lectures: 1 Hr./Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I : Introduction
Sensors: primary sensing principles and measurement variables, sensor performance characteristics and terminology. Instrumentation: transducer measurement circuit, signal conditioning circuit, Data conversion: DAC, ADC, virtual instrumentation with Lab View. [7 Hrs]

Unit II : Smart Sensors
Primary sensors; excitation; compensation; information coding/ processing; data communication; standards for smart sensor interface. Recent trends in sensor technologies: Introduction; film sensors (thick film sensors, thin film sensors); semiconductor IC technology standard methods; Micro Electro-Mechanical Systems (micro-machining, some application examples); nanosensors. [7 Hrs]

Text books:
1 Barney, G. C., "Intelligent Instrumentation", Prentice Hall, 1995.
2 D. Patranabis, "Sensors and Transducers": PHI, 2003.

Reference Book:
1) Alan s. Morris, "Principles of Measurement & Instrumentation", PHI Pvt. Ltd., 1999.

603303 M2(iii): HUMAN RIGHTS

Teaching Scheme
Lectures: 1 Hr./Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I:
Human Rights – Concept, Development, Evolution
- Philosophical, Sociological and Political debates
- Benchmarks of Human Rights Movement.

Human Rights and the Indian Constitution
- Constitutional framework
- Fundamental Rights & Duties
- Directive Principles of State Policy
- Welfare State & Welfare Schemes

Human Rights & State Mechanisms
- Police & Human Rights
- Judiciary & Human Rights
- Prisons & Human Rights
- National and State Human Rights Commissions [7 Hrs]

Unit II :
Human Rights of the Different Sections and contemporary issues
- Unorganized Sector,
- Right to Environment.
-Globalization and Human Rights
- Right to Development,

Citizens' Role and Civil Society
- Social Movements and Non-Governmental Organizations
- Public Interest Litigation
-Role of Non Government organizations in implementation of Human rights.
- Right to Information

Human Rights and the international scene –Primary Information with reference to Engineering Industry.
- UN Documents
- International Mechanisms (UN & Regional)
- International Criminal Court [7Hrs]

References:
1) Study material on UNESCO,UNICEF web site
2) HUMAN RIGHTS IN INDIA A MAPPING, Usha Ramanathan
Available at: http://www.ielrc.org/content/w0103.pdf
3) Introduction to International Humanitarian Law **by** Curtis F. J. Doebbler - CD Publishing **,** 2005 .

4) Freedom of Information by Toby Mendel - UNESCO **,** 2008

603303 M2 (iv) : GREEN BUILDING DESIGN

Teaching Scheme
Lectures: 1 Hr./Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

Unit I : Sustainability and Building design
Sustainability, objectives of sustainable development, Sustainable aspects of habitat design, sustainable buildings, principles, approaches and characteristics, climate data, climate parameters and zones, comparative analysis of various climatic zones, site planning recommended check list for identifying site characteristics, site development and layout. Efficient water management and waste water treatment, solid waste management. [7 Hrs]

Unit II :Energy efficiency :
Solar passive techniques in building design to minimize load on conventional system i.e. heating, cooling, ventilation and lighting. Designing Energy efficient lighting and HVAC systems. Use of renewable energy system to meet part of building load. Green building certification. Overview various green building in India. Policy and regulatory mechanism. [7 Hrs]

Text Book :
Seven wonders of Green Building Technology- Karen Sirvaitis, Twenty first century books.

References :
1. Sustainable Building Design Manual, Volume 2, TERI, New Delhi
2. Energy Efficient Buildings in India, TERI, New Delhi
3. Sustainable Building Design Manual, Volume 1 TERI, New Delhi

603303 M2 (v) : BIOMEDICAL INSTRUMENTATION

Teaching Scheme
Lectures: 1 Hr./Week
Credit : 1

Examination Scheme
In-Semester Examination : 25 Marks

UNIT-I

Basics of bio cell: cell potential, and its measurement. Electrode-Electrolyte interface, half-cell potential l, Polarization- polarisable and non- polarisable electrodes, Ag/AgCl electrodes, Electrode circuit model; motion artifact. Body Surface recording electrodes for ECG, EMG, and EEG. Internal Electrodes- needle and wire electrodes. Micro electrodes- metal microelectrodes, Electrical properties of microelectrodes. Electrodes for electric stimulation of tissue, Selection & specifications for the bio transducers to measure parameters, biosensors. [7 Hrs]

UNIT-II

Cardiovascular System: Heart Structure, Cardiac Cycle, ECG Theory, ECG Electrodes, Electrocardiograph, Vector cardiograph, General block diagram representing ECG measurement. Amplifiers, Transient Protection, Interference Reduction, Movement Artifact Circuits. [7 Hrs]

Reference Books

1. Handbook of Biomedical Instrumentation By R. S. Khandpur, TATA Mc Graw Hill
2. J.J.Carr & J.M.Brown, “Introduction to Biomedical Equipment Technology” Pearson Education, Asia.
3. Cromwell, Weibell & Pfeiffer, “Biomedical Instrumentation & Measurement”, Prentice Hall, India

603304 : SEMINAR– II

Teaching Scheme
4 Hrs / Week
Credits: 04

Examination Scheme
Term Work : 50 Marks
Oral Exam. : 50 Marks

Seminar II shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected by him/her approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

603305: PROJECT STAGE - I

Teaching Scheme
08 Hrs/Week
Credits: 08

Examination Scheme
Term Work: 50 Marks
Oral Exam. : 50 Marks

Project work Stage – I is an integral part of the project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation (Mathematical Model/block diagram/ PERT chart, etc.) and Layout & Design of the hardware Set-up. As a part of the progress report of Project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected dissertation topic.

The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department / Institute.

603306: SEMINAR– III

Teaching Scheme
5 Hrs / week
Credits: 05

Examination Scheme
Term work : 50 Marks
Oral/ Presentation: 50Marks

Seminar III shall preferably be an extension of seminar II**.** The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

603307 : PROJECT WORK STAGE - II

Teaching Scheme
20Hrs / week
Credits: 20

Examination Scheme
Term work : 150 marks
Oral: 50 Marks

In Project Work Stage – II, the student shall complete the remaining part of the project which will consist of simulation & fabrication of hardware set up required for the project work station, conducting experiments and taking results, analysis & validation of results and conclusions (Simulation and Hardware implementation required).

The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.