GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. in Power Electronics & Electrical Drives

PROPOSED TEACHING SCHEME

Semester - II

(w.e.f 28/02/2012)

SUBJECT CODE	SUBJECT	TEACHING SCHEME (HOURS)			CREDITS
		THEORY	TUTORIAL	PRACTICAL	
1720001	Principles of Management	3	0	0	3
1724501	Solid State AC Drives	4	0	2	5
1724502	Power Electronics-2	4	0	2	4
1724508	Electrical Drive Simulation Laboratory	0	0	4	2
	Major Elective - II	3	0	2	4
	Major Elective - III	3	0	0	3
	Inter Disciplinary Elective - I	3	0	2	4
	TOTAL	**17**	**0**	**16**	**25**

Subject Code	Major Elective-II
1724503	Enhance Power Quality AC/DC Converters
1724504	Advance Electrical Machines

Subject Code	Major Elective-III
1724505	Power Quality
1724506	Intelligent Control

Inter Disciplinary Elective - I

Subject Code	Inter Disciplinary Elective - I
714501	Power Electronics-I

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E SEMESTER – 2

Power Electronics & Electrical Drives

Subject Name: **SOLID STATE AC DRIVES**
Subject Code: **1724501**

Sr. No.	Course Content
1	**CONVENTIONAL CONTROL OF INDUCTION MOTORS** Review of Induction Machine operation – Equivalent circuit – Performance of the machine with variable voltage, rotor resistance variation, pole changing and cascaded induction machines, slip power recovery – Static Kramer Drive.
2	**VSI AND CSI FED INDUCTION MOTOR CONTROL** AC voltage controller fed induction machine operation – Energy conservation issues – V/f operation theory – requirement for slip and stator voltage compensation. CSI fed induction machine, Operation and characteristics.
3	**ORIENTED CONTROL** Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation.
4	**DIRECT TORQUE CONTROL** Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.
5	**SYNCHRONOUS MOTOR CONTROL** Synchronous motor control - Brush and Brushless excitation – Load commutated inverter fed drive.

References:

1.Bimal K Bose, “Modern Power Electronics and AC Drives”, Pearson Education Asia 2002.

2. Vedam Subramanyam, “Electric Drives – Concepts and Applications”, Tata McGraw Hill,1994.

3. W.Leonhard, “Control of Electrical Drives”, Narosa Publishing House, 1992.

4. Murphy J.M.D and Turnbull, “Thyristor Control of AC Motors”, Pergamon Press, Oxford, Delhi,2001.

5. P. Vas – Vector control of ac machines, Clarandon Press, Oxford.

6. G. K. Dubey – Power semiconductor controlled drives, Prentice-Hall, Eaglewood cliffs.

7. T.J.E. Miller – Brushless PM and Reluctance Motor Drives, clarendon Press Oxford.

8. Recent IEEE publication &transactions on power electronics, industry applications and power delivery.

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E SEMESTER – 2

Power Electronics & Electrical Drives

Subject Name: **Power Electronics-II**

Subject Code: **1724502**

Sr.No	Course Content
1	**Unity Power Factor Conversion:** Topologies, Steady-Sate Analysis, Dynamic Analysis, Modeling And Applications.
2	**Resonant Converter:** Introduction, Classification, Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant Switch Converter, Zero Voltage And Zero Current Switching, Clamped Voltage Topologies, Resonant Dc Link Inverter, High Frequency Link Integral Half Cycle Converters.
3	**Multilevel Converters:** Principle, Topologies, Control And Applications.
4	**Other Advanced Converters:** Multi-Pulse Converters, Matrix Converters, Applications
5	**Design Considerations:** Design And Selection Of Magnetic Components, Inductor, High-Frequency Transformers, Line And Emi Filters.

References:

1. Rashid, M. H., "Power Electronics Handbook", Elsevier Academic Press, 2001.
2. Ned Mohan, Tore M. Undeland and William P. Robbins, “Power Electronics Converters, Applications, and Design”, John Willey & Sons, Inc., 2nd Edition, 1995.
3. Agrawal, J. P., "Power electronic systems: Theory and design" Addison Wesley Longman (Singapore) Pte. Ltd. New Delhi, 2001.
4. Rashid, M. H., "Introduction to P Spice Using or CAD for Circuits and Electronics, Prentice-Hall of India Pvt. Ltd., New Delhi, Eastern Economy Edition, Third Edition 2006.
5. Joseph Vithayathil, "Power Electronics: Principles and Applications", McGraw-Hill, 1995.

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E SEMESTER – 2

Power Electronics & Electrical Drives

Subject Name: **Enhanced Power Quality AC-DC Converters**

Subject Code**: 1724503**

Sr.No.	Course Content
1	Review of 2-pulse and 6-pulse converters and their performance with inductive and capacitive loads.
2	Harmonic analysis of phase controlled converters, IEEE standards.
3	Conventional methods of power factor improvement techniques, controlled free-wheeling operation, asymmetrical triggering, sequence control of phase controlled converters, extinction angle control; PWM converters: Single-pulse and multiple pulse modulation techniques.
4	Multi-pulse converters using delta/ zigzag/ Fork /Polygon transformers, nalysis and harmonic calculations.
5	Configurations of passive filters and their design.
6	Shunt, series and hybrid active filters, topologies and their control strategies.
7	High quality single-phase and three-phase converters, control techniques, Buck, Boost control, Power, flow control, hysteresis and carrier wave control, space vector control.
8	Multi-level converters, topologies and control techniques.
9	Snubber circuits and their design.

References:

1. Rashid M. H., “Power Electronics Circuits Devices and Applications”, 3rd Ed., Pearson Education.

2. Dubey G.K., Doradla S.R., Joshi A. and Sinha R.M.K., “Thyristorised Power Controllers”, New Age International Private Limited.

3. Lander Cyril W., “Power Electronics”, Prentice Hall of India Private Limited.

4. Mohan N., Undeland T.M. and Robbins W.P., “Power Electronics- Converters, Applications and Design”, 3rd Ed., Wiley India.

5. Paice D. A., “Power Electronic Converter Harmonics – Multipulse Methods for Clean Power”, IEEE press.

6. Kazmierkpwski M. P., Krishnan R. and Blaabjerg F., “Control in Power Electronics – Selected Problems”, Academic Press.

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E SEMESTER – 2

Power Electronics & Electrical Drives

Subject Name: **Advanced Electrical Machines**

Subject Code**: 1724504**

Sr.No.	Course Content
1	**Brushless DC Machines:** Construction and working principle, Equivalent magnetic circuit, Type of converter and speed control, Comparison between the axial and radial Permanent magnet motors, applications.
2	**Stepper Motors**: Definition and types of stepper motors, Various modes of operation of Variable reluctance (VR) stepper motors, Micro stepping control of stepper motor, Multi stack VR stepper motor construction and working, Construction and working of Permanent Magnet (PM) stepper motor, Construction and working of Hybrid Stepper motor, Torque-angle characteristics of the stepper motor.
3	**Switched Reluctance Motor**: Construction, operating performance, Type of converter and speed control, Applications.
4	**Linear Induction Machines:** Construction, operation, performance, control and applications.
5	**Energy Efficient motors**: Standard motor efficiency, concept of Energy efficient motor. Efficiency evaluation technique, Direct Measurement method, Loss, Segregation method, Comparison, motor efficiency labeling, Energy efficient motor Standards. Motor life cycle, Direct Savings and pay back analysis, Efficiency Evaluation factor.
6	**Wind mill Generator**: Comparision with synchronous generator , constant voltage & frequency generation, reactive power compensation,
7	**Condition Monitoring of Electrical Machines**: Concept of condition monitoring, benefit of condition monitoring, Fault detection & diagnosis techniques for Transformer and Induction motor, Recent Trends in condition monitoring.
8	**Basic principle of electric machine analysis**: Introduction, magnetically coupled circuits, electromechanical energy conversion, machine windings and air-gap MMF-Winding inductances and voltage equations.
9	**Reference frame theory**: Introduction, Equation of transformation, stationary c ircuit variables

	transformed to the arbitrary reference frame- commonly used reference frames- transformation between reference frames, transformation of a balanced set, balanced steady state phasor relationships, balanced steady state voltage equations, variables observed from several frames of reference.

References:

1. “Brushless Permanent-Magnet Motor Design”, Mcgraw Hill- D. C. Hanselman
2. “Stepper Motors: Fundamentals, Applications and Design”, New Age International Pvt. Ltd, 2002- V. V. Athani
3. “Electric Machinery”, TMH Publication, 2002- A. E. Fitzerald, Charles Kingsley and Stephen D Umans
4. “Condition Monitoring of Electrical Machines”, John Wiley & Sons. 1987 - P. Tavner and J. Penam
5. “Principles of Power Electronics”, John Wiley and Sons, 2003- P. C. Sen
6. “Alternating Current Machines” (ELBS publication) - M.G.Say
7. Analysis of electric machinery and drive systems, Second edition, Wiley interscinece- Paul C.Krause, Oleg Wasynnczuk, and S.D. Sudhoff
8. Dynamic simulation of electric machinery, Prentice Hall PTR, 1997- C.M.Ong
9. Wind Electrical Systems by Bhadra, Kastha & Benerajee (OXFORD Higher Education)

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E SEMESTER – 2

Power Electronics & Electrical Drives

Subject Name: **ELECTRICAL DRIVES LABORATORY**

Subject Code: **1724508**

Sr.No.	List of Experiments
1	To simulate and study starting transient response of separately excited dc motor
2	To simulate and study speed control of separately excited dc motor using single phase fully / half controlled bridge converter in discontinuous and continuous current modes.
3	To simulate and study speed control of separately excited dc motor using chopper Control.
4	To study starting transient response of three phase induction motor
5	To study speed control of three phase induction motor using (a) constant/V/F control (b) Constant Voltage and frequency control.
6	To simulate and study speed control of separately excited dc motor using chopper Control.
7	To simulate and study Dynamic braking of D.C shunt motor.
8	To simulate and study Plugging of D.C shunt motor.
9	To simulate and study Plugging of 3-phase Induction motor.
10	To simulate and study speed control of three phase slip ring induction motor using static rotor resistance control using rectifier and chopper

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E SEMESTER – 2

Power Electronics & Electrical Drives

Subject Name: **POWER QUALITY**

Subject Code : **1724505**

Sr. No.	Course Content
1	**UNIT I INTRODUCTION** Importance of power quality, terms and definitions of power quality as per IEEE std.1159. Such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers and transients. Symptoms of poor power quality. Definitions and terminology of grounding. Purpose of groundings. Good grounding practices and problems due to poor grounding.
2	**UNIT II FLICKERS & TRANSIENT VOLTAGES** RMS voltage variations in power system and voltage regulation per unit system, complex power. Principles of voltage regulation. Basic power flow and voltage drop. Various devices used for voltage regulation and impact of reactive power management. Various causes of voltage flicker and their effects. Short term and long term flickers. Various means to reduce flickers. Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages.
3	**UNIT III VOLTAGE SAG, SWELLS AND INTERRUPTIONS** Definitions of voltage sag and interruptions. Voltage sags versus interruptions. Economic impact of voltage sag. Major causes and consequences of voltage sags. Voltage sag characteristics. Voltage sag assessment. Influence of fault location and fault level on voltage sag. Areas of vulnerability. Assessment of equipment sensitivity to voltage sags. Voltage sag *limits for computer equipment, CBEMA, ITIC, SEMI F 42 curves. Representation of the results of voltage sags analysis. Voltage sag indices. Mitigation measures for voltage sags, such as UPS, DVR, SMEs, CVT etc., utility solutions and end user solutions.

4	**UNIT IV WAVEFORM DISTORTION** Definition of harmonics, inter-harmonics, sub-harmonics. Causes and effect of harmonics. Voltage versus current distortion. Overview of Fourier analysis. Harmonic indices. A.C. quantities under non-sinusoidal conditions. Triplen harmonics, characteristics and non characteristics harmonics. Harmonics series and parallel resonances. Consequences of harmonic resonance. Principles for controlling harmonics. Reducing harmonic currents in loads. K-rated transformer. Harmonic study procedure. Computer tools for harmonic analysis. Locating sources of harmonics. Harmonic filtering, passive and active filters. Modifying the system frequency response. IEEE Harmonic standard 519-1992.
5	**UNIT V POWER QUALITY MONITORING** Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements. Initial site survey. Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. System wide and discrete power quality monitoring. Setting thresholds on monitors, data collection and analysis. Selection of transducers. Harmonic monitoring , Transient monitoring, event recording and flicker monitoring.

REFERENCE BOOKS :

1. M. H.J. Bollen “Understanding power quality problems, voltage sag and interruptions” – IEEE press, 2000, series on power engineering.

2. Pogei C. Dugan, Mark F. McGranghan, Surya santoso, H. Wayne Beaty, “Electrical power system quality” - second edition, McGraw Hill Pub.

3. J. Arrillaga, M.R. Watson, S. Chan, “Power system quality assessment” - John Wiley and sons.

4. G. J. Heydt., “Electric power quality”

5. Enriques Acha, Manuel Madrigal, “Power system harmonics: Computer modeling and analysis”, - John wiley and sons ltd.

6. J. Arrillaga & N. Watson, “Power System Harmonics”

7. IEEE std 519-1992/ IEEE std 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E SEMESTER – 2

Power Electronics & Electrical Drives

Subject Name: **INTELLIGENT CONTROL**

Subject Code: **1724506**

Sr.No.	Course contents
1	**UNIT I INTRODUCTION** Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.
2	**UNIT II ARTIFICIAL NEURAL NETWORKS** Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adeline and Madeline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal component analysis and wavelet transformations. Hopfield Network, Self-organizing network and recurrent network. Neural Network based controller
3	**UNIT III GENETIC ALGORITHM** Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.
4	**UNIT IV FUZZY LOGIC SYSTEM** Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modelling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modelling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.
5	**UNIT V APPLICATIONS** GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Mat lab-Neural Network

	toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Mat lab fuzzy-logic toolbox. Stability analysis of fuzzy control system

REFERENCE :

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.

2. KOSKO,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.

3. KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 1993.

4. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.

5. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.