Chhattisgarh Swami Vivekanand Technical University, Bhilai

Scheme of teaching and examination

M.E.(POWER ELECTRONICS) in the Department of Electrical Engg.

IIIrd SEMESTER

SN	Board of study	Subject code	Subject Name	Periods per week			Scheme of exam			Total Marks	Credit $\frac{L+(T+P)}{2}$
				L	T	P	Theory/Practical				
							ESE	CT	TA		
1	Electrical Engg.	562311(24)	Static VAR Controller & Harmonic Filtering	3	1	-	100	20	20	140	4
5	Refer table 3		Elective – 3	3	1	-	100	20	20	140	4
6	Electrical Engg.	562321(24)	Preliminary Project	-	-	15	100	-	100	200	14
7	Electrical Engg.	562322(24)	Seminar based on Dissertation	-	-	3	-	-	20	20	2
TOTAL				**6**	**2**	**18**	**300**	**40**	**160**	**500**	**24**

L- Lecture, T- Tutorial, P- Practical, ESE- End Semester Examination,

CT - Class Test, TA- Teacher's Assessment.

Note : Duration of all theory papers will be of Three Hours.

Table – 3		
Elective – 3		
Board of Study	**Code**	**Subject**
Electrical Engg.	562331(24)	*Digital Control Theory*
Electrical Engg.	562332(24)	*Advanced Control of PWM Inverters fed Induction Motor.*
Electrical Engg.	562333(24)	*Power Electronics in wind & Solar Power Converters*

Note (1) – 1/4th of total strength of students subject to minimum of twenty students is required to offer an
elective in the college in a Particular academic session .

Note (2) – Choice of elective course once made for an examination cannot be changed in future examinations.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. III** Branch: **Electrical Engg.**
Subject: **Static Var Control & Harmonic Filtering** Code: **562311 (24)**
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit I:
Fundamentals of Load Compensation , Steady-State Reactive Power Control in Electric Transmission Systems , Reactive Power Compensation and Dynamic Performance of Transmission Systems . Power Qulity Issues . Sags, Swells, Unbalance, Flicker , Distortion , Current Harmonics –

Unit II:
Static Reactive Power Compensators and their control. Shunt Compensators, SVCs of Thyristor Switched and Thyristor Controlled types and their control, STATCOMs and their control, Series Compensators of Thyristor Switched and Controlled Type and their Control, SSSC and its Control, Sub-Synchronous Resonance and damping,

Unit III:
Converters for Static Compensation . Single Phase and Three Phase Converters and Standard Modulation Strategies (Programmed Harmonic Elimination and SPWM) . GTO Inverters . Multi-Pulse Converters and Interface Magnetics . Multi-Level Inverters of Diode Clamped Type and Flying Capacitor Type and suitable modulation strategies (includes SVM) . Multi-level inverters of Cascade Type and their modulation . Current Control of Inverters.

Unit IV:
Passive Harmonic Filtering . Single Phase Shunt Current Injection Type Filter and its Control, Three Phase Three-wire Shunt Active Filtering and their control using p-q theory and d-q modelling . Three-phase four-wire shunt active filters . Hybrid Filtering using Shunt Active Filters . Series Active Filtering in Harmonic Cancellation Mode . Series Active Filtering in Harmonic Isolation Mode.

Unit IV:
Sources of Harmonics in Distribution Systems and Its Effects . Use of STATCOMs and SSSCs for Transient and Dynamic Stability Improvement in Power Systems Dynamic Voltage Restorer and its control . Power Quality Conditioner

Text Books:

1. T.J.E Miller : Reactive Power Control in Electric Systems, John Wiley & Sons
2. N.G. Hingorani & L. Gyugyi :Understanding FACTS: Concepts and Technology of Flexible AC Transmission, Systems. IEEE Press, 2000.

Reference Books:

1. Ned Mohan et.al :Power Electronics. John Wiley and Sons.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. III** Branch: **Electrical Engg.**
Subject: **Digital Control Theory** Code: **562331 (24)**
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

UNIT – I: Sampling and Reconstruction

Introduction, sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal. The Z – transforms**:** Introduction, Linear difference equations, pulse response, Z–transforms, Theorems of Z–Transforms, the inverse Z – transforms, Modified Z-Transforms.

UNIT-II : Z- Plane Analysis of Discrete-Time Control System

Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT – III : State Space Analysis

State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

UNIT – IV: Stability Analysis

Stability Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems. Design of digital control based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers. Design digital control through deadbeat response method.

UNIT – V: State Feedback Controllers And Observers

Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula. State Observers – Full order and Reduced order observers, Linear Quadratic Regulators, Min/Max principle, Linear Quadratic Regulators, Kalman filters, State estimation through Kalman filters, introduction to adaptive controls.

TEXT BOOKS:

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition
2. Digital Control and State Variable Methods by M.Gopal, TMH

REFERENCE BOOKS:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control Engineering, M.Gopal

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Semester: **M. E. II** Branch: **Electrical Engg.**
Subject: **Advanced Control of PWM Inverter-FED Induction Motor** Code: **562332 (24)**
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit :I
Principles for vector and field-oriented control**-**Complex-valued *dq*-model of induction machines. Turns ratio and modified *dq*-models. Principles for field-oriented vector control of ac machines. Current controllers in stationary and synchronous coordinates.

Unit :II
Rotor-flux oriented control of current-regulated induction machine - Dynamic model of IM in rotor-flux coordinates. Indirect rotor-flux oriented control of IM - Direct rotor-flux oriented control of IM.- Methods to estimation of rotor-flux

Unit :III
Generalized flux-vector control using current- and voltage decoupling networks**-** Generalized flux-vector oriented control. Current and voltage decoupling networks. Airgap-oriented control. Voltage-fed vector control. Stator-flux oriented vector control.

Unit :IV
Parameter sensitivity, selection of flux level, and field weakening - Parameter detuning in steady-state operation. Parameter detuning during dynamics. Selection of flux level. Control strategies for used in the over-speed region .

Unit :V
Principles for speed sensor-less control **-** Principles for speed sensor-less control. Sensor-less methods for scalar control. Sensor-less methods for vector control .Introduction to observer-based techniques

References:
[1] Extract of D. W. Novotny and T. A. Lipo, *Vector Control and Dynamics of AC Drives*, Oxford University Press, 1996.
[2] P. L. Jansen and R. D. Lorenz, *A Physically Insightful Approach to the Design and Accuracy Assessment of Flux Observers for Field Oriented Induction Machine Drives*, IEEE Trans. on Industry Applications, Vol. 30, No. 1, Jan./Feb. 1994, pp. 101110.
[3] Extract of I. Boldea and S. A. Nasar *Electric Drives*, CRC Press, 1998.
[4] J. Holtz, *Methods for Speed Sensorless Control of AC Drives, in K. Rajashekara Sensorless Control of AC motors*. IEEE Press Book, 1996. Supplementary literature
[5] R. W. De Doncker and D. W. Novotny, *The Universal Field Oriented Controller*, IEEE Trans. on Industry Applications, Vol. 30, No. 1, Jan./Feb. 1994, pp. 92100.
[6] J. Holtz, *The Representation of AC Machine Dynamics* by Complex Signal Flow Graphs, IEEE Transactions on Industrial Electronics, Vol. 42, No. 3, 1995, pp. 263271.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. II** Branch: **Electrical Engg.**
Subject: **Power Electronics in Wind & Solar Power Conversion** Code: **562333 (24)**
Total Theory Periods**: 40** Total Tutorial Periods:**12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Unit I :
Introduction
Trends in energy consumption - world energy scenario - energy sources and their availability - conventional and renewable sources - need to develop new energy technologies.
Photovoltaic Energy Conversion:
Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with batteries - solar energy availability in India - Switching devices for solar energy conversion - Maximum power point tracking.

Unit II :
Power Conditioning Schemes
DC Power conditioning converters - maximum power point tracking algorithms - AC power conditioners - Line commutated inverters - synchronized operation with grid supply -Harmonic problem.
PV Applications:
Stand alone inverters - Charge controllers - Water pumping, audio visual equipments, street lighting - analysis of PV systems

Unit III :
Wind Energy Systems
Basic Principle of wind energy conversion - nature of wind - wind survey in India - Power in the wind - components of a wind energy - conversion system - Performance of induction generators for WECS - classification of WECS.

Unit IV :
Self-Excited WECS
Self excited induction generator for isolated power generators - Theory of self-excitation - Capacitance requirements - Power conditioning schemes - controllable DC Power from SEIGs - system performance.
Grid Connected WECS:
Grid connectors concepts - wind farm and its accessories – Grid related problems - Generator control - Performance improvements - Different schemes – AC voltage controllers –
Harmonics and PF improvement

Unit V :
Stand Alone (Remote Area) Power Supply Systems
Wind/solar PV integrated systems - selection of power conversion ratio - Optimization of system components - storage - reliability evolution.

Text Books:

1. Rai, G.D. "Non-conventional energy sources", Khanna Publishers, 1993.
2. Rai, G.D.,"Solar energy utilization", Khanna Publishers, 1991.
3. Gray.L.Johnson, "Wind energy systems", Prentice Hall Inc., 1985.

Reference books:

1. Daniel Hunt, V,"Wind Power-A Handbook of WECS", Van Nostrend Co., New York, 1981.