Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

M. Tech. in Power Electronics & Power Systems

FIRST SEMESTER

S. No.	Board of Study	Subject Code	Subject	Periods per week			Scheme of Exam			Total Marks	Credit L+(T+P)/2
				L	T	P	Theory/Practical				
							ESE	CT	TA		
1.	Electrical & Electronics Engg.	559112 (24)	Computer Aided Power System	3	1	-	100	20	20	140	4
2.	Electrical & Electronics Engg.	559114 (24)	Flexible AC Transmission System	3	1	-	100	20	20	140	4
3.	Electrical & Electronics Engg.	597111 (25)	Advanced Power Electronics	3	1	-	100	20	20	140	4
4.	Electrical & Electronics Engg.	597113 (25)	Power System Dynamics & Control	3	1	-	100	20	20	140	4
5.	**Refer Table-I**		**Elective-I**	3	1	-	100	20	20	140	4
6.	Electrical & Electronics Engg	597121 (25)	Advanced Power Electronics Lab	-	-	3	75	-	75	150	2
7.	Electrical & Electronics Engg	597122 (25)	Power System Dynamics & Control Lab	-	-	3	75	-	75	150	2
Total				**15**	**5**	**6**	**650**	**100**	**250**	**1000**	**24**

Table – I

Elective - I			
S.No.	**Board of Study**	**Subject Code**	**Subject**
1	Electrical & Electronics Engg.	597131 (25)	Micro and Smart Grid
2	Electrical & Electronics Engg.	597132 (25)	Power Electronics for Renewable Energy Systems
3	Electrical & Electronics Engg.	597133 (25)	Application of DSP to Power System

L-Lecture T- Tutorial P-Practical
CT- Class Test TA- Teachers Assessment ESE- End Semester Exam

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

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: M. Tech. 1st

Subject: **Computer Aided Power System Analysis**

Total Theory Periods**: 40**

Total Marks in End Semester Exam. : **100**

Minimum number of class test to be conducted: 02

Specialization: Power Electronics and Power Systems

Branch: **Electrical & Electronics Engineering**

Code: **559112 (24)**

Total Tutorial Periods: **12**

Course Objectives:

This course will cover the

1. Modeling issues and analysis methods for the power flow, short circuit, contingency and stability analyses, required to be carried out for the power systems.
2. Necessary details of numerical techniques to solve nonlinear algebraic as well as differential equations will also be included
3. Different types of stability phenomena have been observed in the power systems, which need to be critically analyzed, utilizing appropriate dynamic model of the system.

Course Outcomes:

On completion of the course the student will be able to:

1. Use software packages for design and analysis of electrical power networks and investigate typical case study problems.
2. Develop computer based tools for specific applications in power system analysis, design and operation.

Unit-I

Network equations: Graph theory, Bus admittance matrix by step by step method, primitive network, Bus incidence matrix, Formation of Y bus by singular transformation, Bus impedance matrix by inversion of Y bus, algorithm for bus impedance matrix, addition of a branch, addition of link, modification of Z bus by changes in primitive network, Concept of using these matrices for load flow study and fault study.

Unit-II

Fault Analysis: Bus Impedance [Z_{bus}] Building algorithm, Sequence matrices, Symmetrical and Unsymmetrical Short-Circuit Analysis of Large Power Systems, Phase Shift in sequence quantities due to transformers.

Unit-III

Load Flow Study: Introduction, Power System Equations, Solution Techniques, Gauss Seidel, Newton Raphson and Fast Decoupled Load Flow, Incorporation of Voltage Controlled Busses, Representation of Transformer, Introduction to Optimal Load Flow Technique.

Unit-IV

Transient Stability Studies: Introduction, Swing Equation, Machine Equations, Power System Equations, Solution Techniques, Example of Transient Stability Calculations, Exciter and Governor Control Systems, Description of Transient Stability Program.

Unit-V

Power System Security: Factors affecting Security, State Transition Diagram, Contingency Analysis Using Network Sensitivity Method and AC Power Flow Method, Correcting the Generation Dispatch Using Sensitivity Methods, Introduction to State Estimation.

Text Books:-

1. George L. Kusic, Computer Aided Power System Analysis, Prentice Hall of India (P) Ltd., New Delhi, 1989.
2. J. Arrilaga, C.P. Arnold, B.J. Harker, Computer Analysis of Power Systems, John Wiley & Sons, Ltd., 1990.
3. G. W. Stagg and A. H. El- Abiad, Computer methods in Power System Analysis, Mc-Graw Hill Kogakusha Ltd., 1968.

References Books:-

1. A.K. Mahaianabis, D.P. Kothari, S.I. Ahson, Computer Aided Power System Analysis & Control, Tata McGraw Hill, New Delhi, 1988.
2. A. Sadat, Power System Analysis, McGraw Hill Co. Ltd., India, 2000.
3. I.J. Nagarath, D.P. Kothari, Modern Power System Analysis, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: M. Tech. 1st
Subject: **Flexible AC Transmission System**
Total Theory Periods**: 40**
Total Marks in End Semester Exam. : **100**

Specialization: Power Electronics and Power Systems
Branch: **Electrical & Electronics Engineering**
Code: **559114 (24)**
Total Tutorial Periods: **12**

Minimum number of class test to be conducted: 02

Course Objectives:

1. To understand the concept of flexible AC transmission and the associated problems.
2. To review the static devices for series and shunt control.
3. To study the operation of controllers for enhancing the transmission capability.

Course Outcomes:

1. Engineering Students from Transmission Utilities involved in the design, Interconnected EHV/HV System.
2. Students will also gain the knowledge of Advanced Power Electronics devices.

Unit-I

FACTS Concept and General System Considerations, Power Flow in AC System, Definitions on FACTS, Basic Types of FACTS Controllers.

Converters for Static Compensation, Three Phase Converters and Standard Modulation Strategies (Programmed Harmonic Elimination and SPWM), GTO Inverters, Multi-Pulse Converters and Interface Magnetics.

Unit-II

Transformer Connections for 12, 24 and 48 pulse operation, 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-III

Static Shunt Compensators, SVC and STATCOM, Operation and Control of TSC, TCR, STATCOM, Compensator Control, Comparison between SVC and STATCOM, STATCOM for transient and dynamic stability enhancement

Unit-IV

Static Series Compensation, GCSC, TSSC, TCSC and SSSC, Operation and Control, External System Control for Series Compensators, SSR and its damping, Static Voltage and Phase Angle Regulators, TCVR and TCPAR, Operation and Control

Unit-V

UPFC and IPFC, The Unified Power Flow Controller, Operation, Comparison with other FACTS devices, control of P and Q, Dynamic Performance, Special Purpose FACTS Controllers, Interline Power Flow Controller, Operation and Control.

Text Books:

1. N.G. Hingorani & L. Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, 2000.
2. T.J.E Miller, Reactive Power Control in Electric Systems, John Wiley & Sons, 2003.

Reference Books:

1. Ned Mohan et.al: Power Electronics: Converters, Application and Design, 3rd Edition, John Wiley and Sons, 2003.
2. Dr Ashok S & K S Suresh Kumar, FACTS Controllers and applications, course book for SUP, 2003.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: M. Tech. 1st
Specialization: Power Electronics and Power Systems
Subject: **Advanced Power Electronics**
Branch: **Electrical & Electronics Engineering**
Total Theory Periods**: 40**
Code: **597111 (25)**
Total Marks in End Semester Exam. : **100**
Total Tutorial Periods: **12**
Minimum number of class test to be conducted: 02

Course Objectives:

The main objectives of the course are to:

1. Analyze the performance of various voltage regulators
2. Learn resonant and multilevel converters applied in industrial applications.
3. Learn the modeling and simulation techniques of various power electronic circuits.
4. Understand the performance of drive system with their application.

Course Outcomes:

At the end of the course, the students can:

1. Evaluate different dc-dc voltage regulators.
2. Understand and analyze and resonant converters.
3. Evaluate various multi-level inverter configurations.
4. Design and simulate various power electronic circuits.
5. Understand electrical drives based on various power electronic devices.

Unit-I
Switching Voltage Regulators: Introduction, Review of linear power supply and basic dc-dc voltage regulator configurations, Buck converters, Boost converters, Buck-Boost converters and their analysis for continuous and discontinuous conduction mode, Other converter configurations like Fly back converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter.

Unit-II
Resonant Converters: Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, resonant switch converters, Zero Voltage Switching DC-DC Converters, Zero Current Switching DC-DC Converters, Applications Of Resonant Converters.

Unit-III
Multi-level converters: Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations applications.

Unit-IV
Review of Inverters and Controllers: Review of single phase half bridge, full bridge, bipolar, unipolar, VSI and CSI, review of single phase ac to ac controllers, Phase-Controlled Three-Phase AC Voltage Controllers, Fully Controlled Three-Phase Three-Wire AC Voltage Controllers.

Unit-V
Simulation of Power Electronic Systems: Modeling of Diode in Simulation, Diode with R, R-L, R-C And R-L-C Load with AC Supply, Modeling Of SCR, TRIAC, IGBT and Power Transistors in Simulation, Simulation of Single Phase and Three Phase Uncontrolled and Controlled (SCR) Rectifiers, Converters with Self Commutated Devices, Simulation of Power Factor Correction Schemes, Simulation of Converter Fed DC Motor Drives,

Simulation of Thyristor Choppers with Voltage, Current and Load Commutation Schemes, Simulation Of Chopper Fed DC Motor.

Text Books:

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2009.
3. Modern Power Electronics and AC Drives –B. K. Bose-Pearson Publications, 2002.
4. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009

Reference Books:

1. P.C Sen, 'Thyristor DC Drives', John wiely and sons, New York, 1981.
2. R.Krishnan, 'Electric Motor Drives – Modeling, Analysis and Control', Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
3. Muhammad H. Rashid, "Power Electronics Handbook", Elsevier, 3rd ed., 2011.
4. Bin Wu, "High Power Converters and AC Drives", John Willey & Sons, Inc., 2006.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester : M. Tech. 1st

Specialization: Power Electronics and Power Systems

Subject: **Power System Dynamics & Control**

Branch: **Electrical & Electronics Engineering**

Total Theory Periods**: 40**

Code: **597113 (25)**

Total Marks in End Semester Exam. : **100**

Total Tutorial Periods: **12**

Minimum number of class test to be conducted: 02

Course Objectives:

1. To understand the concept of dynamic model of synchronous machine.
2. To study the multi-machine simulation of dynamic models.
3. To understand the concepts of the small signal stability.
4. To investigate the physical and mathematical aspect of energy function methods.
5. To discuss the concept of voltage stability and sensitivity analysis.

Course Outcomes:

1. The understanding of dynamic model of synchronous machine will be developed.
2. Simulation study of multi-machine dynamic model will be delivered.
3. The concepts of small signal stability will be understood.
4. The different aspect of energy function methods will be investigated.
5. The concept of voltage stability and sensitivity analysis will be understood.

Unit-I

Power System Stability: System Model, States of Operation and System Security, Steady State Stability, Transient Stability, Simple Representation of Excitation Control.

Modeling of Synchronous Machine: Synchronous Machine, Park's Transformation, Transformation of Flux Linkages, Transformation of Stator Voltage Equations and Rotor Equations, Analysis of Steady State Performance, Per Unit Quantities, Equivalent Circuits of Synchronous Machine: Determination of Parameters of Equivalent Circuits.

Unit-II

Excitation System: Excitation System Modeling, Excitation Systems Block Diagram System Representation by State Equations. Prime Mover Control System, Modelling of Transmission Lines and Loads.

Dynamics of a synchronous generator connected to infinite bus: System Model, Synchronous Machine Model, Stator Equations, Rotor Equations, Synchronous Machine Model with Field Circuit and One Equivalent Damper Winding on Q Axis, Calculation of Initial Conditions.

Unit-III

Analysis of Single Machine System: Small Signal Analysis, Applications of Routh-Hurwitz Criterion, Analysis of Synchronizing and Damping Torque, State Equation for Small Signal Model.

Unit-IV

Power System Stabilizers: Basic Concepts in applying Power System Stabilizer (PSS), Control Signals, Structure and Tuning of PSS, Washout Circuit, Dynamic Compensator Analysis Of Single Machine Infinite Bus System with and without PSS.

Analysis of Multi-Machine System: Simplified model, improved model of the system for linear load, inclusion of dynamics of load and SVC, Introduction to analysis of large power system.

Unit-V

Voltage Stability: Definition, Factors Affecting Voltage Instability and Collapse, Analysis and Comparison of Angle and voltage Stability, Analysis and Comparison, Voltage Instability and Collapse, Control Of Voltage instability.

Text Books:

1. K.R. Padiyar, “Power system dynamics”, B.S. Publications, Hyderabad, 2002.

2.P.M. Anderson and A.A. Fouad, “Power system control and stability”, 2nd edition. B.S. Publications Hyderabad, 2002.

3.Peter W. Sauer &M. A. Pai, Power System Dynamics and Stability, Prentice Hall, 2008.

Reference Books:

1. E.W. Kimbark, Power System Stability, IEEE press, N.Y, Vol. 2, 2000.

2. C. W. Taylor, Power System Voltage Stability, McGraw Hill International student edition, 1994.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: M. Tech. 1st
Subject: **Advanced Power Electronics Lab**
Total Practical Periods**: 40**
Total Marks in End Semester Exam. : **75**

Specialization: Power Electronics and Power Systems
Branch: **Electrical & Electronics Engineering**
Code: **597121 (25)**

List of Experiments:

1. Study of Single Phase Full-converter with R-L load for continuous & discontinuous conduction modes.
2. Study of Thyristor based DC to DC converter (DC chopper).
3. To operate a Buck converter in various modes of operation.
4. To operate a Boost converter in various modes of operation.
5. To operate a Buck- Boost converter in various modes of operation.
6. Operation of single phase full bridge inverter in Unipolar PWM and Bipolar PWM modes.
7. Study of a 3- phase PWM inverter with fixed (50Hz) output frequency and study of a non-PWM type inverter with 120-degree conduction of switches.
8. Study of AC voltage controller using UJT triggering circuit.
9. Simulation of VSI fed three phase induction motor drive.
10. Study of speed control of D.C drive using 3-phase full converter.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: M. Tech. 1st
Subject: **Power System Dynamics & Control Lab**
Total Practical Periods**: 40**
Total Marks in End Semester Exam. : **75**

Specialization: Power Electronics and Power Systems
Branch: **Electrical & Electronics Engineering**
Code: **597122 (25)**

List of Experiments:

1. Simulation and study of Automatic Voltage Controller without and with PID controller.
2. To become familiar with modeling and analysis of the frequency and tie-line flow dynamics of a single area power system without and with load frequency controllers (LFC) and to design better controllers for getting better responses.
3. To become familiar with modeling and analysis of the frequency and tie-line flow dynamics of a two area power system without and with load frequency controllers (LFC) and to design better controllers for getting better responses.
4. Simulation and study of a Power System Stabilizer.
5. Study and Simulation of Transient Stability Analysis of Single-Machine-Infinite Bus (SMIB) system.
6. Study and Simulation of Transient Stability Analysis of multi machine system.
7. Analysis of Reactive Power Compensation.
8. Study the characteristic of long transmission Line and compensation.
9. Study and analysis of PV & QV curves for voltage stability.
10. Study of characteristics of a 12-pulse converter.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: M. Tech. 1st
Subject: **Micro and Smart grid**
Total Theory Periods**: 40**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Specialization: Power Electronics and Power Systems
Branch: **Electrical & Electronics Engineering**
Code: **597131 (25)**
Total Tutorial Periods: **12**

Course Objectives:

1. To understand fundamental concepts of Microgrids, it's Power Electronics Interface, protection and islanding issues.
2. To understand various Power quality issues in Microgrid and introduction to Smart Grid technologies.
3. To understand Renewable Energy and its storage options for smart grid technologies.
4. To understand Smart Grid measurement & communication technology.

Course Outcomes:

After the completion of this course, the students shall be able to

1. Micro grid concepts, Power Electronics interface in AC & DC microgrids, Communication infrastructure, modes of operation and control, Protection and islanding issues, etc.
2. Power quality issues in microgrids like modelling and stability analysis, regulatory standards and economics and basic smart grid concepts.
3. Load and generation power flow analysis, economic dispatch and unit commitment problems and various verticals of smart grid.
4. Smart grid communication and measurement technologies like Phasor Measurement Unit(PMU),Smart meters, Wide Area Monitoring system (WAMS) etc.
5. Penetration of Renewable Energy Sources in Smart Grid and associated issues and their applications in Electric vehicles etc.

Unit-I

Microgrids: Concept and definition of Microgrid, Microgrid Drivers and benefits, Review of Sources of Microgrids, Typical Structure and configuration of a Microgrid, AC And DC Microgrids, Power Electronics Interfaces in DC and AC Microgrids, Communication Infrastructure, Modes of Operation and Control of Microgrid: Grid Connected and Islanded Mode, Active and Reactive Power Control, Protection Issues, Anti-Islanding Schemes: Passive, Active and Communication Based Techniques.

Unit-II

Power Quality Issues in Micro grids: Modelling and Stability analysis of Microgrid, Regulatory Standards, Microgrid Economics, Introduction to Smart Microgrids.

Unit-III

Introduction to Smart grid: Basics of Power Systems: Load and Generation Power Flow Analysis, Economic Dispatch and Unit Commitment Problems, Smart Grid: Definition, Applications, Government and Industry, Standardization, Functions of Smart Grid Components-Wholesale energy market in smart grid smart vehicles in Smart Grid.

Unit-IV

Smart Grid Communications and Measurement Technology: Communication and Measurement - Monitoring, Phasor Measurement Unit (PMU), Smart Meters, Wide area monitoring systems (WAMS) - Advanced metering infrastructure- GIS and Google Mapping Tools, IP-based Systems, Network Architectures.

UNIT -V

Renewable Energy and Storage: Renewable Energy Resources, Sustainable Energy Options for the Smart Grid, Penetration and Variability Issues Associated with Sustainable Energy Technology, Demand Response Issues, Electric Vehicles and Plug-in Hybrids, PHEV Technology, Environmental Implications, Storage Technologies, Grid integration issues of renewable energy sources.

Text/Reference Books:

1. James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, IEEE press 2012.

2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & Sons Inc, 2012.

3. Fereidoon P. Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012.

4. Clark W.Gellings, "The smart grid: Enabling energy efficiency and demand response", Fairmont Press Inc, 2009.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: M. Tech. 1st

Specialization: Power Electronics and Power Systems

Subject: **Power Electronics for Renewable Energy Systems**

Branch: **Electrical& Electronics Engineering**

Total Theory Periods**: 40**

Code: **597132 (25)**

Total Marks in End Semester Exam. : **100**

Total Tutorial Periods: **12**

Minimum number of class test to be conducted: 02

Course Objectives:

The main objective of the course is:

1. To educate scientifically the new developments in non conventional and renewable energy studies.
2. To emphasize the significance of power electronic converters in renewable energy systems.
3. To provide knowledge about the stand alone and grid connected renewable energy systems.

Course Outcomes:

At the end of the course, the students should be able to:

1. Design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
2. Develop various power converter circuits for photovoltaic applications, wind and fuel cell based systems.
3. Design, analyze standalone and grid connected renewable energy systems using power electronic converters.

Unit-I

Overview of Renewable Energy Technology: Recent trends in energy consumption, World energy scenario, Energy sources and their availability, Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems - need to develop new energy technologies.

Unit-II

Solar Energy Conversion: Photovoltaic Energy Conversion: Working principle, Energy conversion, Maximum power tracker, Photovoltaic system components, Factor influencing output, System design, Power electronics for photovoltaic power systems, DC Power conditioning converters, AC power conditioners, Line commutated inverters, synchronized operation with grid supply, Harmonic problem –Applications. Residential PV systems-battery-inverter, Grid connected systems.

Modeling and simulation various power converters for PV fed applications in MATLAB-Simulink/PSCAD environment. Experimental verifications PV characteristic curves.

Unit-III

Wind Energy Conversion: Wind Energy Conversion 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–IG-SCIG-PMSG, Classification of WECS, Power electronics converter for variable speed wind turbines, Matrix ,Multilevel converters for very high power wind turbines, Future trends.

Modeling of power generators like IG –SCIG-PMSG for Wind Energy Conversion System (WECS) Modeling and simulation of power converters, multilevel – matrix and other contemporary topologies.

Unit-IV

Fuel Cell and Micro Hydro for Distributed Generation (DG): Fuel Cell, Working Principle – Distributed generation, Fuel cell based energy system for DG, Power electronic topologies for residential stationary fuel cell energy systems, Issues in fuel cell power conditioning system, Modeling of Fuel cell, power extraction for fuel cell, Stand alone fuel cell system with consumer/load. Small/micro hydro: grid and standalone systems, typical converter applications.

Unit-V

Hybrid Renewable Energy Systems: Need for Hybrid Systems, Types of Hybrid system, optimization of system components in hybrid power system,Various power quality issues in hybrid renewable power system. Modeling and simulation of hybrid renewable power system in MATLAB/PSCAD. Simulation and study of various power quality problems in hybrid /renewable energy power system.

Text Books:

1. Rashid .M. H, "Power Electronics Hand book", Academic press, Second edition, 2006.
2. Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.
3. Gray, L. Johnson, "Wind energy system", Prentice Hall, 1995.
4. Bansal, Kleeman and Meliss, "Renewable Energy Sources and Conversion Techniques", Tata Mc Graw Hill, 1990.

Reference Books:

1. Rai,G.D., "Non- conventional resources of energy", Khanna publishers, Fourth edition, 2010.
2. Rao. S. & Parulekar, "Energy Technology", Khanna publishers, Fourth edition, 2005.
3. Ram N Patel & Ankush Mittal, "Programming in MATLAB: A Problem-Solving Approach", Dorling Kindesley, Pearson Education, 2014.
4. Pai, B. R. and Ram Prasad, "Power Generation through Renewable Sources of Energy", Tata McGraw Hill, New Delhi, 1991.
5. Godfrey Boyl, "Renewable Energy: Power sustainable future", Oxford University Press, Third edition, 2012.
6. Khan B.H., "Non-Conventional Energy Resources", The McGraw Hills, Second edition, 2009.
7. John W Twidell and Anthony D Weir, "Renewable Energy Resources", Taylor and Francis, 2006.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester: M. Tech. 1st
Subject: **Application of DSP to Power System**
Total Theory Periods**: 40**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

Specialization: Power Electronics and Power Systems
Branch: **Electrical & Electronics Engineering**
Code: **597133 (25)**
Total Tutorial Periods: **12**

Course Objectives:

1. To comprehend characteristics of various types of signal processing.
2. To analyze and process signals using wavelet transform techniques.
3. To analyze linear estimation of signals and applications.
4. To illustrate the study of adaptive signal processing.

Course Outcomes:

1. Design multi rate signal processing of signals through systems.
2. Design filters to suit specific requirements for specific applications.
3. Perform statistical analysis and inferences on various types of signal processing

Unit - I
Multirate Signal Processing: Decimation, Interpolation, DFT filter banks, QMF filter banks, Multiresolution Signal analysis, Wavelet theory of sub-band decompositions, Sub-band coding and wavelet transforms, application of wavelet transforms.

Unit - II
Homomorphic Signal Processing: Homomorphic system for convolution, properties of complex spectrum, Applications of homomorphic deconvolution.

Unit - III
Multi-Dimensional Signal Processing: Review of convolution and correlation, 2-D signals and systems.

Unit - IV
Linear estimation of Signals and applications: Random Signals, Linear prediction and applications (deconvolution, least square filters). Recursive estimation and Kalman filters.

Unit- V
Adaptive Signal Processing: Adaptive filters and applications.

Text Books:

1. P PVaidyanathan, Multirate Systems and Filter Banks, Prentice-Hall, 1993.
2. S J Orfanidis, Optimum Signal Processing, McGraw-Hill, 1989
3. Proakis, Manolakis, Introduction to DSP, PHI, 1994/ Pearson, 2002.

Reference Books:

1. E C Ifeachor, B W Jervis, Digital Signal Processing: A Practical Approach, Addison Wesley, 1993.
2. Barrus, Gopinath, Guo, Introduction to Wavelet Transforms, Prentice – Hall, New Jersey, 1998.
3. A V Oppenheim, R W Schafer, Discrete Time Signal Processing, PHI, 1994.