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

SCHEME OF EXAMINATION

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

M.Tech. in Electrical Devices & Power System Engineering

2nd SEMESTER

S. NO.	Board of Study	Subject Code	Subject	Period per Week			Scheme of exam			Total Marks	Credit L+(T+P)/2
							Theory/Practical				
				L	T	P	ESE	CT	TA		
1	Electrical Engg.	559211 (24)	EHV-AC & DC	3	1	-	100	20	20	140	4
2	Electrical Engg.	559213 (24)	Power System Stability and Control	3	1	-	100	20	20	140	4
3	Electrical and Electronics Engg	570211 (25)	Power System Automation	3	1	-	100	20	20	140	4
4	Electrical and Electronics Engg.	570212 (25)	Electro Mechanical Devices	3	1	-	100	20	20	140	4
5	Refer Table-II		Elective-II	3	1	-	100	20	20	140	4
6	Electrical and Electronics Engg.	570221(25)	Power System Automation Lab	-	-	3	75	-	75	150	2
7	Electrical Engg.	570222 (25)	Power System Simulation Lab	-	-	3	75	-	75	150	2
Total				**15**	**5**	**6**	**650**	**100**	**250**	**1000**	**24**

Table II

Elective- I			
S. No.	**Board of Study**	**Subject Code**	**Subject**
1	Electrical and Electronics Engg.	570231 (25)	Power Quality and conditioning
2	Electrical and Electronics Engg.	570232 (25)	Artificial Intelligence and Neural Networking
3	Electrical and Electronics Engg.	570233 (25)	Processcontrol

Lecture T- Tutorial P- Practical ESE- End Semester Exam

CT- Class Test TA- Teachers Assessment

Note (1) – 1/4th of total strength of students subject to minimum of eighteen 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 (C.G.)

Semester: **M.TECH. 2nd**
Subject: **EHV-AC & DC**
Total Theory Periods: **40**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: **02**

Specialization: Electrical Devices and Power System Engg.
Branch: **Electrical and Electronics Engineering**
Code: **559211 (24)**
Total Tutorial Periods: **12**

UNIT-1
Sequential impedances of AC systems EHVAC transmission over voltages, insulation design of lightning and switching over voltages, High voltage testing of AC equipments, Reactive Power compensation of EHV AC lines.

UNIT-2
DC Power Transmission Technology: Application of DC Transmission, Description of DC Transmission System, Planning for HVDC Transmission, Modern Trends in DC Transmission, Thyristor Device, Thyristor Valve, Valve Tests, Recent Trends in valves. Comparison of EHV AC & DC transmission.

UNIT-3
HVDC Converters: Pulse Number, Choice of Converter Configuration, Simplified Analysis of Graetz Circuit, Converter Bridge Characteristics. Characteristics of a Twelve Pulse Converter, Detailed Analysis of Converters

HVDC System Control: Principal of DC Link Control, Converter Control Characteristics, System Control Hierarchy, Firing Angle Control, Current and Extinction Angle Control, Starting and Stopping of DC Link, Power Control, Higher Level Controllers, Telecommunication Requirements

UNIT-4
Converter Faults and Protection: Converter Faults , Protection Against Overcurrents, Over voltages in a Converter Station , Surge Arresters, Protection Against Over voltages.
Smoothing Reactor and DC Line: Smoothing Reactors, DC Line, Transient over Voltages In DC Line, Protection of DC Line, DC Breakers, Monopolar Operation, Effects of Proximity of AC and DC Transmission Lines

UNIT-5
Reactive Power Control: Reactive Power Requirements in Steady State, Sources of Reactive Power, Static Var Systems, Reactive Power Control during Transients

Harmonics and Filters: Generation of Harmonics, Design of AC Filters, DC Filters, Carrier Frequency and RI Noise

Text:
1. HVDC Power Transmission System: K.R. Padiyar , Wiley Eastern Limited.

Reference:
1. Power System Stability and Control by Prabha Kundur- EPRI. Mc Graw Hill Inc.

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

Semester: **M.TECH. 2nd** Specialization: Electrical Devices and Power System Engg.
Subject: **Power System Stability & Control** Branch: **Electrical and Electronics Engineering**
Total Theory Periods: **40** Code: **559213 (24)**
Total Marks in End Semester Exam. : **100** Total Tutorial Periods: **12**
Minimum number of class test to be conducted: **02**

Unit 1

Power System Structure: Operating states, control problem, control loops. Power System Stability classification, terms and definitions.

Power system components: H ydraulic and steam turbine, Effect of exciter and governor. Excitation system – requirements, functions, types and modeling of excitation systems, IEEE standards and models.

Unit 2

Control of Power and Frequency: Power, Frequency characteristics, Division of load, Load frequency control, Generator, load and Prime mover models, Governor models, AGC in a two area system, AGC in a multi area system parameter setting constants, Tie- line bias control, AGC with optimal dispatch of Generation, AGC including Excitation system, Conventional PI and PID controllers
for AGC, AI applications automatic generation control.

Unit 3

Control of voltage and Reactive Power: Relation between voltage, power and reactive power, Generation and absorption of reactive power, voltage control and voltage stability analysis, V-Q curves and sensiti vity analysis, Voltage stability indices, Factors affecting voltage instability and voltage collapse.

Unit 4

Stability Studies: Concepts, steady state and transient stability, small signal stability analysis, excitation system, Dynamic and transient stability analysis of single machine and multi -machine systems, power system stabilizer design and analysis for stability problem. Transient Stability: Solution
of swing equations, swing curves, stability criterion.

Unit 5

Techniques for the improvement of stability: operation under abnormal and distressed condition, Enhancement of small signal stability: use of power system stabilizers, supplementary control of Static VAr compensators, supplementary control of HVDC links, Techniques for improvement of transient stability, Integrated analysis of Voltage and Angle stability, Control of voltage instability, concepts of load shedding.

Text Books:

Prabha Kundur, "Power System Stability and Control" Mc-Graw Hill Inc, New York,
1993. Taylor C.W.," Power System Voltage Stability" Mc-Graw Hill Inc, New York,
1993.

Reference Books:

K.R.Padiyar,.Power System Dynamic . Stability and Control., Inter Publishing(P) Ltd., Bangalore,
1999 .
P.S.R. Murthy , " Power System Operation and Control," Tata Mc-Graw ,New Delhi
1984. Nagrath IJ, Kothari ., " Power System Engineering ," Tata Mc-Graw ,New Delhi
1994.
Weedy B.M. " Electric Power System" John Wiley and Sons ,3rd edition .
O.1 Elgerd," Electric Energy System Theory : an Introduction," Mc-Graw Hill, NX, 1983 (Mainy for Unit –II)

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

Semester: **M.TECH. 2nd**
Subject: **Power System Automation**
Total Theory Periods: **40**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: **02**

Specialization: Electrical Devices and Power System Engg..
Branch: **Electrical and Electronics Engineering**
Code: **570211 (25)**
Total Tutorial Periods: **12**

UNIT-I

System design, optimization, direct digital control, distributed control, Fuzzy technique of control; Auidics: Fluid control device, bi-stable amplifier, control valve flow meter; Turbine.

UNIT-II

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. Control and protection; Numerical control; major classes and operating principle.

UNIT III

Communications & fault finding: An introduction to communication options available for the type of PLCs includes also how to find hardware faults and probable causes.

UNIT IV

MMI

Introduction to MMI, its need, operation details and fundamentals of MMI, fault display in MMI, timer counter setting from MMI. Interfacing with PLC.

UNIT V

SCADA: Introduction to SCADA, configuration of different drivers, gateway, Database of tags and its use. Interfacing with PLC and simulation of PLC application in SC **AC Drive** Fundamentals of AC Drive, block diagram of AC drive, configuration of different drives. Control of drive with and without PLC. Various applications of AC Drive. Interfacing with PLC

***TEXT BOOKS*:**

1. B.K. Bose, Power Electronics and variable frequency drives, Prentice Hall, New Jersey.
2. T.J.E. Miller, Brushless permanent magnet and reluctance motor drives, Oxford University Press, UK
3. S.A. Nasar, Linear induction motor, John Wiley, New York

Reference Books:

4. J.C. Andreas, Energy Efficient Motors, Marcel Dekker
5. J.M.P. Murphy, Power Electronics control of AC Drives, Pergamon Press

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

Semester: **M.TECH. 2nd**
Specialization: Electrical Devices and Power System Engg..
Subject: **Electro Mechanical Devices**
Branch: **Electrical and Electronics Engineering**
Total Theory Periods: **40**
Code: **570212 (25)**
Total Marks in End Semester Exam. : **100**
Total Tutorial Periods: **12**
Minimum number of class test to be conducted: **02**

UNIT-I

Linear electro-mechanical devices of different geometry; levitation machines, Force machines and Energy machines.

UNIT-II

Linear induction motor; Edge and end effects; depth of penetration and its effects. Mathematical modeling. Constructional aspects, design and analysis of reluctance, shaded pole, hysteresis, printed circuit, claw motors, Servomotors and A.C. tacho-generators, Introduction of permanent magnet materials. Angled field and axial field devices; cross-field machines, special forms of rotating amplifiers. Electromagnetic clutches, coupling and brakes, Eddy current devices.

UNIT-III

Review of adjustable speed drives, square wave and sine wave permanent magnet, Brushless machines and drives systems. Reluctance motors; Stepper motor; control circuit and operational characteristics. Disc and claw motors; Hysterisis motors.

UNIT-IV

Servo motors; DC and AC; position control application; Tacho generators, Synchronous analysis. High performance energy efficient machines.

UNIT-V

Advanced Motors and Drive Systems Principle, construction, operation and drive application of Square wave Permanent Magnet (PM) brushless motor drives, sine wave PM brushless motor drives, PM and synchronous reluctance based motors, switched reluctance motors, Energy efficient motors.Special machine associated with wind, solar, tidal, wave, micro hydel and other non-conventional energy sources. Motor for robotic drive application.

TEXT BOOKS:

1. B.K. Bose, Power Electronics and variable frequency drives, Prentice Hall, New Jersey.
2. T.J.E. Miller, Brushless permanent magnet and reluctance motor drives, Oxford University Press, UK
3. S.A. Nasar, Linear induction motor, John Wiley, New York

Reference Books:

4. J.C. Andreas, Energy Efficient Motors, Marcel Dekker
5. J.M.P. Murphy, Power Electronics control of AC Drives, Pergamon Press

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

Semester: **M.TECH. 2nd**
Subject: **Power Quality and Conditioning**
Total Theory Periods: **40**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: **02**

Specialization: Electrical Devices and Power System Engg..
Branch: **Electrical and Electronics Engineering**
Code: **570231 (25)**
Total Tutorial Periods: **12**

UNIT I

Voltage SAG: The voltage sag and voltage swell, the causes of voltage sag and swell, indices to classify voltage sag, the countermeasures.

UNIT II

Power Supply and Applications: Analysis, design and control of SMPS, UPS on line and off line, Power supplies in telecommunication, power supplies in auto-mobiles, linear series and shunt voltage regulators, IC voltage regulators, switching regulators. High frequency induction heating, dielectric heating, microwave heating, electronic ballast, high power factor electronic ballast and applications.

UNIT III

Multilevel Converters and control: modeling and analysis of advance static VAR compensation, multi level inverters, harmonic elimination method, ASVC structure, power converter control using state space average models, SMC, fuzzy logic control.

UNIT IV

Filters: Passive and active filters for harmonic and reactive power compensation in two wire, three wire and four wire AC systems, harmonics standard, power quality, surge suppressors, compensation of arc furnaces and traction loads.

UNIT V

Case studies using DSP control techniques in active filters and power supplies.

TEXT BOOKS:

1. Power conditioning, F.F.Kuo
2. Erickson J., Handbook of Electrical Heating for Industry, IEEE Press
3. Rashid M.H., Power Electronics Handbook, Elsevier Press (Academic Press series)

REFERRENCE BOOKS:

4. Bollen M.H.J., Understanding Power Quality and Voltage Sag, IEEE Press.

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

Semester: **M.TECH. 2nd** Specialization: Electrical Devices and Power System Engg..
Subject**: Artificial intelligence and Neural Networking** Branch: **Electrical and Electronics Engineering**
Total Theory Periods: **40** Code: **570232 (25**)
Total Marks in End Semester Exam. : **100** Total Tutorial Periods: **12**
Minimum number of class test to be conducted: **02**

Unit-I

Introduction to Artificial Neural Networks: Fundamental concept of ANN. Neural Net Architectures. Neural Learning. Generalized leaning rules.

Supervised Learning: Single-Layer networks. Perceptron training algorithm. Single node perceptron. Multi-Layer networks. Back propagation (BP) training algorithm. Multi-layer perceptron (MLP) training leaning factors. Application problems to electric drives.

Unit-II

Associative models: Basic concept & performance analysis of recurrent associative memory & Bi-directional associative memory. Auto-association. Hetero-associators. Recurrent networks-Mathematical foundation of discrete & continuous type Hopfield networks, transient response & relaxation modeling.

Unit-III

Unsupervised Learning: Hamming net & MAXNET Unsupervised learning of clusters. Counter-propagation network, topologically organized networks-Self organizing maps. Adaptive resonance theory, cluster discovery network (ART 1)

Unit-IV

Introduction to Fuzzy logic control: Crisp sets-Overview, Fuzzy sets: Basic concepts & types. Classical set theory, Fuzzy sets versus Crisp sets (Properties). Fuzzy control from an industrial perspective-knowledge based system for process control. Mathematics of fuzzy control- Approximate reasoning representing set of rules. Fuzzy knowledge based design (FKBC) parameters. Structure of FKBC, Introduction to rule and data base inference engine, choice of Fuzzification and Defuzzificaton processes.

Unit V

Operations on Fuzzy Sets: Types of Fuzzy operators, Fuzzy Intersections: t-norms, Fuzzy Unions: t-Conorms, Fuzzy complement & aggregation operations. Fuzzy Arithmetic.

Nonlinear Fuzzy Control: Introduction, Control problem –FKBC as a nonlinear Transfer element. Types of FKBC. Implication and aggregation process.

TEXT BOOKS:

1. Introduction to Artificial Neural systems- Jacek M. Zurada. Jaico Publishing House Mumbai-2003.
2. Elements of Artificial Neural Networks- Kishan Mehrotra, C. K. Mohan, Sanjay Ranka. Penram International Publishing (India)-2000.

REFERENCE BOOKS:

3. Fuzzy Sets and Fuzzy Logic Theory and Applications-George J. Klir & Bo Yuan. Prentice Hall of India, New Delhi-2000.

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

Semester: **M.TECH. 2nd** Specialization: Electrical Devices and Power System Engg..
Subject: **Process Control** Branch: **Electrical and Electronics Engineering**
Total Theory Periods: **40** Code: **570233(25)**
Total Marks in End Semester Exam. : **100** Total Tutorial Periods: **12**
Minimum number of class test to be conducted: **02**

UNIT I

General Concepts: Review of general concepts, terminology, applications of process control .
Simulation and Modelling: Importance of simulation, terms used Simulation, Mathematical modelling, Process dynamics of fluid flow and heat transfer systems, Mass transfer dynamics and distillation column, Reaction kinetics of chemical processes.

UNIT II

Advanced Control Schemes: Structure, analysis and application of Cascade control, Selective control, Ratio Control, Design of steady state and dynamic Feed forward controller, Feed forward combined with feedback control, Structure, analysis and applications of inferential control, dead time and inverse response compensators, Concepts and applications of Adaptive control, Model reference adaptive control, Self tuning regulator .

UNIT III

Design of Multiloop Controllers: Interactions and decoupling of control loops. Design of cross controllers and selection of loops using Relative Gain Array (RGA) ,
Digital Control: Sampling and reconstruction, Transform analysis of sampled-data systems: z transform and its evaluation, inverse z transform, theorems of z transform, modified z-transform, mapping of j plane to z plane, pulse transfer function, stability analysis in z-plane, mapping approximation of z transform, numerical solution of differential equations, implementation of digital controller, case studies .

UNIT IV

Discrete Event System Modeling: Introduction to various methods of modeling, Automata Theory, Introduction to Petri Nets .
State Space Analysis: State space representation of continuous and discrete time control systems, Control theory, State space concepts, State variables, Pole placement design and state observes.

UNIT V

Controllability and Observability: Controllability and Observability of linear time invariant systems and the relation between them.
Stability Analysis: Stability analysis, definition, first and second method of Liapunov, stability analysis of linear systems .
Real Time Control: Characteristics and classes of real-time systems, program classification: sequential, multi tasking, real time, concurrency and synchronization, design strategies, Reliabilty, fault detection and fault tolerance, Real time operating systems, Distributed Computing systems: distributed processing issues in distributed data base systems, distributed control operating system fir digital control.

***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 Co.

***REFERENCE BOOKS*:**

4. Bose B.K., Power Electronics and AC Drives, Prentice Hall, New Jersey
5. Bose B.K., Power Electronics and Variable Frequency Drives-Technology and applications, IEEE Pres

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

Semester: **M.TECH. 2nd**
Subject: **Power system Automation Lab**
Total Theory Periods: **40**
Total Marks in End Semester Exam. : **75**

Specialization: Electrical Devices and Power System Engg..
Branch: **Electrical and Electronics Engineering**
Code: **570221 (25)**

List of Experiments:

1) Fundamental programming of Simatic S7
2) Uploading and down loadig of PLC programming through optibus cable.
3) Fault finding / troubleshooting & documentation
4) Communication with SCADA software
5) Power plant relay co ordination through PLC
6) Process control for bottling plant through PLC
7) AC motor speed control through PLC
8) DC drives control through PLC
9) Plc SCADA communication.
10) DDE communication

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

Semester: **M.TECH. 2nd**
Subject: **Power system Simulation Lab**
Total Theory Periods: **40**
Total Marks in End Semester Exam. : **75**

Specialization: Electrical Devices and Power System Engg.
Branch: **Electrical and Electronics Engineering**
Code: **570222 (25)**

List of Experiments:

Development of algorithms & flowcharts and digital simulation of the following using MATLAB/ETAP5 Software package:

1 Introduction to MATLAB and other Simulation software

2 Z-bus and Y-bus formulation and their inversion.

3 Load flow studies (Gauss-Siedle method, Newton Raphson method)

4 Flow study with Fast Decoupled Method.

5 Fault analysis (balanced and unbalanced)

6 Solution of Swing equations by modified Euler's method.

7 Simulating Power Systems with Simulink

8 Solution of Power System equations using Modified Euler's Method.

9 Solution of Swing equations using Runge – Kutta method (RK4).

10 Power system simulation by MATLAB using the Sim Power Systems Toolbox

11 Harmonic load flow studies.

12 Optimal load flow studies for IEEE 30 Bus.

13 Relay setting and co-ordination.