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

Scheme of Teaching, Examination & Evaluation

M.Tech/M.E. in Power System and Control

Department: Electrical Engineering

3rd Semester

S. No	Board of Study	Subject Code	Subject	Period s per Week			Scheme of Examination			Total Mark s	Credit L+(T+P) / 2
							Theory / Practical				
				L	T	P	ESE	CT	TA		
1	Electrical Engg.	575311 (24)	Digital Control Systems	3	1	-	100	20	20	140	4
2	**Refer Table - III**		**Elective – III**	3	1	-	100	20	20	140	4
3	Electrical Engg.	575321 (24)	Preliminary Project	-	-	28	100	-	100	200	14
4	Electrical Engg.	575322 (24)	Seminar	-	-	3	-	-	20	20	2
Total				**6**	**2**	**31**	**300**	**40**	**160**	**500**	**24**

L- Lecture T- Tutorial P- Practical ESE- End Semester Exam CT- Class Test TA- Teacher's Assessment

TABLE –III			
ELECTIVE -III			
S. No	**Board of Study**	**Subject Code**	**Subject**
1	Electrical Engg.	559331 (24)	Energy Conservation & Audit
2	Electrical Engg.	559332 (24)	ANN & FUZZY Techniques
3	Electrical Engg.	559333 (24)	Power System Reliability
4	Electrical Engg.	575331 (24)	Adaptive control System

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 Vivekananda Technical University, Bhilai (C.G.)

Semester: **M.Tech/M.E. III Sem.** Branch: **Electrical Engg.**
Subject : Digital Control Systems Specialization: **Power Systems & Control Engg.**

Total Theory Periods: 40 Code: **575311 (24)**
Total Marks in End Semester Exam. : **100** Total Tutorial Periods: **12**
Minimum number of class test to be conducted: **02**

UNIT-I : **Sampling and Reconstruction**

Introduction, Examples of data control systems – Digital to analog conversion and Analog to digital conversion, sample and hold operations

The Z-transforms

Introduction, Linear difference equation, pulse response, Z-transforms, Theorems of Z-transforms, Inverse Z-transforms, Modified Z-transforms

Z-plane analysis of discrete time control system

Z-transform methos for solving deifference equations, pulse transform function, block diagram analysis of sampled data system, mapping between S-plane and Z-plane

UNIT-II : State Space Analysis

State Space representation of discrete time systems, pulse transfer function matrix solving discrete time state space equations, State transition matrix and its properties, methods for computation of state transition matrix, discretization of continous time state-space equations

Controllability and Observability

concepts of controllability and observability, test for controllability and observability, duality between controllability and observability, controllability and observability conditions for pulse transfer function.

UNIT-III : Stability Analysis

Mapping between the s-plane and z-plane – primary strips and complementary strips – constant frequency loci, constant damping ratio loci, stability analysis of closed loop system in the Z-plane, jury stability test-stability analysis by use of bilinear transformation and routh stability criterion, Liapunov stability analysis.

UNIT-IV : Design of discrete time control system by classical methods

Transient and steady state response analysis – design based on frequency response method – bilinear transformation and design procedure in the w-plane, lead, lag and lead lag compensator and digital PID controllers.

UNIT-V : State feedback controllers and observers

Design of state feedback controller through pole placement-necessary and sufficient conditions, Ackerman s fomula, state observer – full order and reduced order observers.

Names of Text Books: 1. Discrete time control systems, K. Ogata, Pearson Edu./PHI, 2nd Edition

Name of Reference Books: 1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003

2. Digital Control and State Variable Methods by M. Gopal, TMH

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Semester: **M.Tech/M.E. III Sem.** Branch: **Electrical Engg.**
Subject : Energy Conservation & Audit Specialization: **Power Systems & Control Engg.**
Total Theory Periods: 40 Code: **559331(24)**
Total Marks in End Semester Exam. : **100** Total Tutorial Periods: **12**
Minimum number of class test to be conducted: **02**

Unit 1
System approach and End use approach to efficient use of Electricity; Electricity tariff types; Energy auditing: Types and objectives -audit instruments- ECO assessment and Economic methods –specific energy analysis-Minimum energy paths-consumption models-Case study.

Unit 2
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 operati on and Storage; Case study.

Unit 3
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.

Unit -4
Lighting- Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballast- Power quality issues -Luminaries, case study; Cogeneration - Definition and scope, topping and bottoming cycles, cogeneration technologies, industry suitable for cogeneration, sale of electricity to utility, impact of pricing on cogeneration, integrated energy system, potential of cogeneration in India.

Unit -5
Electric loads of Air conditioning & Refrigeration -Energy conservation measures- Cool storage .Types- Optimal operation-case study; Electric water heating-Gysers-Solar Water Heaters-Power Consumption in Compressors, Energy conservation measures; Electrolytic Process; Computer Controls- softwares-EMS.

Text Books:
1. IEEE Bronze Book- .Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities. IEEE Inc, USA. Giovanni
2. Petrecca, .Industrial Energy Management: Principles and Applications., The Kluwer international series -207,(1999)

References:
1 Anthony J. Pansini, Kenneth D. Smalling, .Guide to Electric Load Management., Pennwell Pub; (1998).
2 Howard E. Jordan, .Energy-Efficient Electric Motors and Their Applications., Plenum Pub Corp; 2nd edition (1994).
3 Turner, Wayne C., .Energy Management Handbook., Lilburn, The Fairmont Press, 2001.
4 Albert Thumann , .Handbook of Energy Audits., Fairmont Pr; 5th edition (1998).
5 Albert Thumann, P.W, Plant Engineers and Managers Guide to Energy Conservation. – Seventh Edition-TWI Press Inc, Terre Haute.
6 Donald R. W., .Energy Efficiency Manual., Energy Institute Press.
7 Tripathy S.C.,'Electric Energy Utilization And Conservation', Tata McGraw Hill.
8 NESCAP -Guide Book on Promotion of Sustainable Energy Consumption.

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Semester: **M.Tech/M.E. III Sem.** Branch: **Electrical Engg.**
Subject : ANN & Fuzzy Techniques Specialization: **Power Systems & Control Engg.**
Total Theory Periods: 40 Code: **559332 (24)**
Total Marks in End Semester Exam. : **100** Total Tutorial Periods: **12**
Minimum number of class test to be conducted: **02**

UNIT I : Biological neurons and their artificial models, models of artificial neural networks, feed forward and feed backward networks, supervised and unsupervised learning, Neural network learning rules - Hebbian rule, perceptron rules, delta rules, Widrow -Hoff rule, correlation rule, winner- take- all rule, outstar learning rule.

UNIT II: Single Layer Perceptron Classifier: Classification model, features, decision regions, discriminant functions, linear machine and minimum distance classification, training and classification using discrete Perceptron algorithm, single layer continuous Perceptron networks for linearly separable classification, multi category single layer Perceptron networks. Multi Layer Feed Forward Networks- Linearly non-separable pattern classification, delta learning rule for multi Perceptron layer, genaralised delta rules, error back propagation training.

UNIT III: Single Layer Feedback Networks: Basic concepts of dynamical systems, mathematical foundation of discrete time Hopfield networks, mathematical foundation of gradient type Hopfield networks transient response of continuous time networks, relaxation modeling in single layer feedback networks, optimization problems. Associative Memories: Basic concepts, linear associator, basic concept of and performance analysis of recurrent auto associative memory, bi-directional associative memory, associative memory of spatio-temporal patterns.

UNIT-IV
Fuzzy sets. Fuzzy set operations . Properties, Membership functions, Fuzzy to crisp conversion. fuzzification and defuzzification methods, applications in engineering problems.

UNIT V :
Fuzzy control systems. Introduction, simple fuzzy logic controllers with examples, special forms of fuzzy logic models, classical fuzzy control problems. Inverter pendulum. image processing . home heating system . Adaptive fuzzy systems, hybrid systems.

Texts
1. J.M. Zurada, .Introduction to artificial neural systems., Jaico Publishers, 1992.
2. Simon Haykins, .Neural Networks . A comprehensive foundation., Macmillan College, Proc, Con, Inc, New York, 1994.

References
1. D. Driankov, H. Hellendorn, M. Reinfrank, .Fuzzy Control . An Introduction., Narora Publishing House, New Delhi, 1993.
2. H.J. Zimmermann, .Fuzzy set theory and its applications., III Edition, Kluwer Academic Publishers, London.
3. G.J. Klir, Boyuan, .Fuzzy sets and fuzzy logic., Prentice Hall of India (P) Ltd., 1997.
4. Stamatios V Kartalopoulos, .Understanding neural networks and fuzzy logic . basic concepts and applications., Prentice Hall of India (P) Ltd., New Delhi, 2000.
5. Timothy J. Ross, .Fuzzy logic with engineering applications., McGraw Hill, New York.
6. Suran Goonatilake, Sukhdev Khebbal (Eds), .Intelligent hybrid systems., John Wiley & Sons, New York, 1995.

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

Semester: **M.Tech/M.E. III Sem.** Branch: **Electrical Engg.**
Subject : Power System Reliability Specialization: **Power Systems & Control Engg.**
Total Theory Periods: 40 Code: **559333 (24)**
Total Marks in End Semester Exam. : **100** Total Tutorial Periods: **12**
Minimum number of class test to be conducted: **02**

UNIT 1
Generating Capacity Basic Probability Methods:- Introduction, The generation system model, Generating unit unavailability Capacity outage probability tables, Comparison of deterministic and probabilistic criteria, Recursive algorithm for capacity model building , Recursive algorithm for unit removal, Alternative model –building techniques , Loss of load indices , Concepts and evaluation techniques , Numerical examples, Equivalent forced outage rate, capacity expansion analysis , Evaluation techniques , Perturbation effects, Scheduled outages , Evaluation methods on period bases , Load forecast uncertainty, Forced outage rate uncertainty , Exact method , Approximate method , Application, LOLE computation .

UNIT 2
Generating Capacity, Frequency and Duration Method, Introduction, The generation model, Fundamental development, Recursive algorithm for capacity model building, System risk indices, Individual state load model, Cumulative state load model, Practical system studies, Base case study, System expansion studies, Load forecast uncertainty .

UNIT – III
Interconnected Systems:-Introduction , Probability array method in two interconnected system , Concepts , Evaluation techniques , Equivalent assisting unit approach to two interconnected system, Factors affecting the emergency assistance available through the interconnections, Introduction , Effect of tie capacity , Effect of tie line reliability , Effect of number of tie line , Effect of tie capacity uncertainty, Effect of load forecast uncertainty , Variable reserve versus maximum peak load reserve , Reliability evaluation in three interconnected systems, Direct assistance from two systems, Indirect assistance from two systems.

UNIT – IV
Operating Reserve:- General concepts, PJM method, Concepts, Outage replacement rate, Generation model , Unit commitment , Extensions to PJM method , Load forecast uncertainty, Derased (Partial output) stanes. Modified PJM method, Concepts, Area risk curves. Modelling rapid start unit, Modelling hot reserve units, Unit commitment risk, Numerical examples, Postponable outage, Concepts m Modelling postponable outages, Unit commitment risk , Security function approach , Concepts , Security function model, Response risk, Concepts, Evaluation techniques, Effect of disturbing spinning reserve, Effect of hydro- electric units, Effect of rapid start units, Interconnected systems. .

UNIT- V
Composite Generation and Transmission systems:- Introduction , Radial configurations , Conditional probability approach, Network configurations, State selection, Concepts , Application , System and load point indices , Concepts , Numerical evaluation, Application to practical systems. Data requirements for composite system reliability evaluation , Concepts , Deterministic data, Stochastic data , Independent outages, dependent outages, common mode outages, station originated outages.

Text Book:
1. Reliability Evaluation of Power System by Roy Billinton, Ronald and Allan, Plenun Press, NYLondo.

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

Semester: **M.Tech/M.E. III Sem.** Branch: Electrical **Engg.**
Subject : Adaptive Control System Code: **575331 (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 1

Adaptive Control

Introduction, Linear feedback, Effects of process variations, Adaptive Schemes, the adaptive control problem, applications, conclusions, least squares& regression model, estimating parameters in dynamical system, pole placement design, indirect self tuning regulators, continuous time self tuners, direct self tuning regulators.

UNIT 2 :

Design of minimum variance & moving average controllers, stochastic self tuning regulators, linear quadratic STR, adaptive predictive control, the MIT rule, determination of adaptation gain, Lyapunov theory, Bounded input Bounded output stability, applications to adaptive control.

UNIT 3 :

Nonlinear dynamics, adaptation of a feedforward gain, analysis of indirect discrete time self tuners, stability of direct discrete time algorithms, Averaging, applications of averaging techniques, averaging in stochastic system, robust adaptive control.

UNIT 4 :

Stochastic Adaptive Control & Autotuning

Multistep decision problem, the stochastic adaptive problem, dual control, suboptimal strategies, PID control, auto tuning techniques, transient response methods, methods based on relay feedback, relay oscillations.

UNIT 5:

GAIN SCHEDULING: Principle, design of gain scheduling controllers, nonlinear transformation, applications of gain scheduling.

ROBUST & SELF OSCILLATING SYSTEM : Robust high gain feedback control, self oscillating adaptive system, variable structure systems

TEXT BOOKS

1. K.J. Astrom, B. Wittenmark, Adaptive Control,2nd edition, Pearson Edu. Asia
2. K.S.Narendra & A.M. Annaswamy, Stable adaptive systems, Prentice Hall,1989