No	Courses Information	
1	Unit name:	Power System Stability
2	Code:	EP 51002
3	Classification:	Engineering Subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/5
6	Pre-requisite:	
7	Mode of delivery:	Lecture, Assignment
8	Assessment system and breakdown of marks:	
	Test	20%
	Final Examination	30%
9	Academic staff teaching unit:	3
10	Course outcome of unit: In this course students will be able • To study the power system reliability, security and stability • To apply the swing equation and power angle equation • To describe the control system for small disturbances.	
11	Synopsis of unit: The course covers the fundamental of power system stability and control system .This course introduces students to understand the stability problem , the swing equation and its solution ,the equal area criterion for stability ,and distribution of power impacts.	

	Topic: **Chapter Title**
12	**1.Power System Stability** -Introduction -Requirements of a Reliable Electrical Power Service -Statement of the Problem -Effect of an Impact upon System Components - Methods of Simulation **2.The Elementary Mathematical Model** -Swing Equation -Units -Mechanical Torque -Electrical Torque -Power-Angle Curve of a Synchronous Machine -Natural Frequencies of Oscillation of a Synchronous Machine -System of One Machine against an Infinite Bus-The Classical Model -Equal Area Criterion -Classical Model of a Multi-machine System -Classical Stability Study of a Nine-Bus System -Shortcomings of the Classical Model -Block Diagram of One Machine **3. System Response to Small Disturbances** - Introduction - Types of Problems Studied -The Unregulated Synchronous Machine -Modes of Oscillation of an Unregulated Multi-machine System -Regulated Synchronous Machine -Distribution of Power impacts
13	Main references: 1.Power system Control and Stability , second edition ,P.M.Anderson, A.A.Fouad.
14	Additional references: 1.Kimbark ,E.W. Power System Stability ,Vol 1 .Wiley , New York,1948. 2.Crary , S.B. Power System Stability , Vol 1 ,2 Wiley , New York ,1945,1947. 3.HadiSaadat . Power system analysis , New York ,1999

Approved By: Prepared By:

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No	Course Information	
1	Unit name:	Electrical Machine and Control I
2	Code:	EP 51014
3	Classification:	Engineering subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/5
6	Pre-requisite:	EP21014, Basic Electronics EP31014, Power Electronics
7	Mode of delivery:	Lecture, Practical
8	Assessment system and breakdown of marks:	Tutorial, Practical, Exam
	Test	20%
	Mid-term/ final Examination	30%
9	Academic staff teaching unit:	
10	Course outcome of unit: In this course students will be able ➢ To describe the modern variable speed system ➢ To determine the speed, current, torque response and efficiency of various dc motors by using their modeling and transfer functions. ➢ To represent the performance and design of speed control dc motor drives ➢ To determine the performance of the chopper power circuit ➢ To measure the speed, torque, current and voltage of DC motors	
11	Synopsis of unit: The course covers the electrical machine and control system. The course introduces students to control system, description of the motor-drive applications, the status of power devices, classes of electrical machines, power converters, controllers and mechanical systems. This is followed by a discussion of the theory of operation of separately-excited and permanent-magnet dc brush motors and their modeling and transfer functions. Then, the various dc motor drives and designing the chopper power circuit are discussed.	

Topic:

		3.8 Two-Quadrant DC Motor Drive with Field Weakening 3.9 Four-Quadrant DC Motor Drive 3.10 Converter Selection and Characteristics 3.11 Simulation of the One-Quadrant DC Motor Drive 3.12 Harmonics and Associated Problems 3.13 Sixth-Harmonic Torque 3.14 Application Considerations 3.15 Applications 3.16 Parameter Sensitivity 3.17 Research Status 3.18 Suggested Reading 3.19 Discussion Questions 3.20 Exercise Problems
	4	**Chopper-Controlled DC Motor Drive** 4.1. Introduction 4.2 Principal of Operaation of the Chopper 4.3 Four-Quadrant Chopper Circuit 4.4 Chopper for Invertion 4.5 Chopper with Other Power Devices 4.6 Model of the Chopper 4.7 Input to the Chopper 4.8 Other Chopper Cuicuit 4.9 Steady-State Analysis of Chopper-Controlled DC Motor Drives 4.10 Rating of the Devices 4.11 Pulsating Torques 4.12 Closed-Loop Operation 4.13 Dynamic Simulation of the Speed-Controlled DC Motor Drive 4.14 Application 4.15 Suggested Readings 4.16 Discussion Questions 4.17 Exercise Problem

14	Main references: R.Krishnan: Electric Motor Derive: Modeling, Analysis, and Control,
15	Additional references: P.W.Franklin, Theory of DC Motor Controlled by Power Pulses.

Information on Lab Practical

Job No (1) Study on the Characteristics of Separately Excited DC Motor

Objective: To understand the characteristics of separately excited DC motor.

Required Equipments:

EMT DC machine assembly, EMT tabletop structure, EMT 6, EMT 8,EMT 9

Job No (2) Simulation of Single Phase Half Wave Controlled Rectifier

Objective: (1) To measure the dc output voltage of single phase half wave controlled rectifier

(2) To construct the model of single phase half wave controlled rectifier

Required Equipments:

(1) PC 1 set

(2) MATLAB software

Job No (3) Simulation of Single Phase Full-wave Controlled Rectifier

Objective : (1) To measure the dc output voltage of single phase full wave controlled rectifier

(2) To control the dc output voltage by varying the triggering angle

Required Equipments:

(3) PC 1 set

(4) MATLAB software

Job No (4) Simulation of Single Phase Full-wave Controlled Rectifier With Source Impedance

Objective : (1) To measure the dc output voltage of the single phase full wave controlled rectifier with impedance

(2) To control the dc output voltage by varying the triggering angle

Required Equipments:

(1) PC 1 set

(2) MATLAB software

Job No (5) First-Quadrant Chopper DC Drive

Objective : (1) To demonstrate the first-quadrant chopper DC drive during speed

	regulation **Required Equipments:** (1) PC 1 set (2) MATLAB software

No	Course Information	
1	Unit name:	Modern Control System I
2	Code:	EP- 51017
3	Classification:	Engineering subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/5
6	Pre-requisite:	Linear Control System
7	Mode of delivery:	Lecture, Tutorial
8	Assessment system and breakdown of marks:	
	Test	20%
	Mid-term Examination	30%
9	Academic staff teaching unit:	
10	Course outcome of unit: In this course students will be able – to define a control system, describe some applications, the basic features, design objectives and a control system's design process – to find the transfer function from a differential equation and solve the differential equation using the transfer function for linear, time-invariant electrical, mechanical, and electromechanical systems – to analyze the modeling of electrical and mechanical system in state space and convert a state-space representation to a transfer function – to analyze the system transient response and demonstrate application of the system model.	
11	Synopsis of unit: The course introduces students to the theory and practice of control systems engineering. This course is designed to provide the electrical engineering students with an understanding of the modern control system. Each chapter begins with a list of chapter learning outcomes, followed by a list of case study learning outcomes that	

	relate to specific student performance in solving a practical case study problem, such as an antenna azimuth position control system.
	Topic: **Chapter Title** **1. Introduction** - A History of Control System - System configurations - Analysis and Design Objectives - Design Process - Computer- Aided Design - Control System Engineer **2. Modeling in the Frequency Domain** -Introduction -Laplace Transform Review -The transform Function -Electrical Network Transform Function -Translational mechanical System Transfer Function - Rotational mechanical System Transfer Function -Transfer Function for System With Gears - Electromechanical System Transfer Function -Electrical Circuit Analogs -Nonlinearities -Linearization **3. Modeling in the Time Domain** -Introduction -Some observations -The General State-Space Representation -Appling the State-space Representation -Converting a Transfer Function to State Space -Converting from State Space to transfer Function -Linearization

	4. Time Response -Introduction -Poles, Zeros, and System Response -First-Order Systems -Second-Order System -The General Second- Order System -Underdamped Second- Order System -System Response With Additional Poles - System Response With Zeros -Effects of Nonlinearities Upon Time Response -Laplace Transform Solution of State Equations -Time Domain Solution of State Equations
14	Main references: (1) Control Systems Engineering, Sixth Edition, Norman S. Nise California State Polytechnic University, Pomona
15	Additional references: Linear Control system Analysis and Design With Matlab, Fifth Edition, Revised and Expanded John J. D’Azzo and Constantine H. Houpis, and Stuart N. Sheldon

No	Course Information	
1	Unit name:	Power System Relaying
2	Code:	EP 51022
3	Classification:	Engineering subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/5
6	Pre-requisite:	Generation, Transmission and Distribution
7	Mode of delivery:	Lecture, Tutorial
8	Assessment system and breakdown of marks:	
	Test	20%
	Mid-term Examination	30%
9	Academic staff teaching unit:	
10	Course outcome of unit: In this course students will be able -To describe the fundamentals of protective relaying -To explain the relay operating principles -To explain the current and voltage transformers -To employ nonpilot cvercurrent protection of transmission lines -To employ nonpilot distance protection of transmission lines -To employ pilot protection of transmission lines	
11	Synopsis of unit: The course covers introduction to protective relaying. The course introduces explain the relay operating principles and the current and voltage transformers. The course explains employ nonpilot cvercurrent protection of transmission lines ,nonpilot distance protection of transmission lines and pilot protection of transmission lines.	

	Topic: **Chapter Title**
	1. Introduction to Protective Relaying 1. Power System Structural Considerations 2. Power System Bus Configurations 3. The Nature of Relaying 4. Elements of a Protection System **2. Relay Operating Principles** 1. Detection of Faults 2. Relay Designs 3.Electromechanical Relays 4.Solid-State Relays 5.Computer Relays 6. Other Relay Design Considerations 7. Control Circuits: A Beginning **-**Phase sequence filters **3. Current and Voltage Transformers** 1. Steady-State Performance of Current Transformers 2. Transient Performance of Current Transformers 3. Special Connections of Current Transformers 4. Linear Couplers and Electronic Current Transformers 5. Voltage Transformers 6. Coupling Capacitor Voltage Transformers 7. Transient Performance of CCVTs 8. Electronic Voltage Transformers 4. **Nonpilot Overcurrent Protection of Transmission Lines** 1. Fuses, Sectionalizers, and Reclosers 2. Inverse, Time-Delay Overcurrent Relays 3. Instantaneous Overcurrent Relays 4. Directional Overcurrent Relays 5. Polarizing

	5. **Nonpilot Distance Protection of Transmission Lines** 1.Stepped Distance Protection 2. *R*–*X* Diagram 3. Three-Phase Distance Relays 4. Distance Relay Types 5. Relay Operation with Zero Voltage 6. Polyphase Relays 7. Relays for Multiterminal Lines 8. Protection of Parallel Lines 9. Effect of Transmission Line Compensation Devices 10. Load ability of RelaysStepped Distance Protection 6. **Pilot Protection of Transmission Lines** 1.Communication Channels 2. Tripping Versus Blocking 3. Directional Comparison Blocking 4. Directional Comparison Unblocking 5. Under reaching Transfer Trip 6. Permissive Overreaching Transfer Trip 7. Permissive Under reaching Transfer Trip 8. Phase Comparison Relaying 9. Current Differential 10. Pilot Wire Relaying 11. Multiterminal Lines 12. The Smart Grid
14	Main Reference: Power System Relaying, Fourth Edition, Stanley H. Horowitz, Arun G. Phadke
15	Additional references: Power System Relaying, First, Second, Third Edition, Stanley H. Horowitz, Arun G. Phadke