No	Information of every subject	
1	Unit name:	ELECTRICAL MACHINE DESIGN
2	Code:	EP 41021
3	Classification:	Engineering subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/4
6	Pre-requisite:	
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 magnetic circuit, electric circuit and design theory involved in the design of electrical machines. • To describe the ampere turns requirement and calculation for the electrical machine • To explain all important aspect of windings of rotating electrical machine • To design the transformers with required specification.	
11	Synopsis of unit: EP-4021: The course covers the design the machines. The course introduces four chapters. Chapter 4 is devoted to explain the magnetic circuit calculations involved in the design of electrical machines. A small chapter is include as chapter 5. In chapter 6 all important aspect of windings of rotating electrical machine has been take up. The design of transformer is explained in chapter 7.Complete sample designs of distribution and power transformers are work out. This course is also intended to serve the need of Electrical Engineers in the field of Electrical Machine industries.	

	Topic: **Chapter Title**
	Chapter. 4 Magnetic Circuit Calculations 4.1 Review of magnetic circuit formulas 4.2 Magnetization characteristics 4.3 Core loos 4.3.1 Hysteresis loss 4.3.2 Eddy current loss 4.3.3 Total iron loss 4.3.4 Iron loss curve 4.4 Permissible flux densities 4.5 Estimation of total mmf 4.5.1 Mmf for the air gap 4.5.2 mmf for teeth 4.5.3 Estimation of mmf for tapered teeth 4.5.4 True and apparent tooth densities 4.6 Magnetizing current 4.7 Magnetic circuit leakage and calculation 4.7.1 Leakage flux 4.7.2 Leakage reactance 4.7.3 Leakage reactance in transformer 4.7.4 Leakage reactance in rotation machine **Chapter. 5 Electromagnetic** 5.1 Introduction 5.2 Magnetic pull or force 5.3 The ampere turn requirement 5.4 Temperature rise **Chapter. 6 Electrical Circuits: Armature windings** 6.1 Introduction 6.2 Armature type 6.3 Winding type 6.4 D.C armature winding 6.5 A.C armature winding

	6.6 The e.m.f equation 6.7 Armature reaction 6.8 Power loss in conductors **Chapter.7 Transformer** Introduction Transformer type Constructional parts Core Core sections Core assembly Yoke section Windings Standard conductors The leads Bushings Cooling Tank Transformer oil Specification Output equation Staking factor Design of core section Selection of design constant Yoke dimensions Over all core dimensions Dimension of shall type transformer Design of winding Choice of winding Design of insulation Estimation of operating characteristics Mechanical stresses Effect of frequency variation Design of cooling system

	Major design problem Design of welding transformer
14	Main references: EP-31021 &32021 Electrical Machine and Operation
15	Additional references: Electrical Machine, R.K.RAJPUT, Third Edition Principle of Electric Machine and Power Electronic, P.C.SEN, Second Edition Electric Machine and Electromechanics, SYED A.NASAR, Second Edition

No	Course Information	
1	Unit name:	Linear Control System I
2	Code:	EP 41027
3	Classification:	Engineering subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/4
6	Pre-requisite:	3011(EECA)
7	Mode of delivery:	Lecture, Tutorial
8	Assessment system and breakdown of marks:	
	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 definitions of the components of the functional block diagram for Control System ➢ to apply the loop and node equations with the state and output equations of the electric and mechanical circuit with independent variables ➢ to apply state transition matrix(STM) in State-Variable Equations	
11	Synopsis of unit: The course covers the linear system. The course introduces students to control system, definitions of control system, electric circuit and components, state concepts, transfer function and block diagram, Lagrange's equation, standard input to control systems, transient response: classical method, CAD accuracy checks (CADAC), state-variable equations, evaluating the transition matrix and complete solution of the state equation.	

Topic:

Chapter	Title
1.	**Introduction**
	1.1 Introduction 1.2 Introduction to Control Systems 1.3 Definitions 1.4 Historical Background 1.5 Digital Control Development 1.6 Mathematical Background 1.7 The Engineering Control Problem 1.8 Computer Literacy 1.9 Outline of Text
2	**Writing System Equations**
	2.1 Introduction 2.2 Electric Circuits and Components 2.3 State Concepts 2.4 Transfer Function and Block Diagram 2.5 Mechanical Translation Systems 2.6 Analogous Circuits 2.7 Mechanical Rotational Systems 2.8 Effective Moment of Inertia and Damping of a Gear Train 2.9 Thermal Systems 2.10 Hydraulic Linear Actuator 2.11 Liquid-Level System 2.12 Rotating Power Amplifiers 2.13 DC Servomotor 2.14 AC Servomotor 2.15 Lagrange's Equation
3	**Solution of Differential Equations**
	3.1 Introduction 3.2 Standard Inputs to Control Systems 3.3 Steady-State Response: Sinusoidal Input

	3.4 Steady-State Response: Polynomial Input 3.5 Transient Response: Classical Method 3.6 Definition of Time Constant 3.7 Example: Second-Order System Mechanical 3.8 Example: Second-Order System Electrical 3.9 Second-Order Transients 3.10 Time-Response Specifications 3.11 CAD Accuracy Checks (CADAC) 3.12 State-Variable Equations 3.13 Characteristic Values 3.14 Evaluating the State Transition Matrix 1 3.15 Complete Solution of the State Equation
14	Main references: 1 D'Azzo, J.J., and C.H. Houpis: Linear control system analysis and design: conventional and modern, 4th ed., McGraw- Hill, New York, 1995
15	Additional references: Fundamentals of Electric Circuits, 3rd Edition, Alexander and Sadiku

No	Course Information	
1	Unit name:	Programmable Logic Control I
2	Code:	EP 41028
3	Classification:	Engineering subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/4
6	Pre-requisite:	NA
7	Mode of delivery:	Lecture, Practical
8	Assessment system and breakdown of marks:	
	Test	20%
	Mid-term Examination	30%
9	Academic staff teaching unit:	6
10	Course outcome of unit: In this course students will be able • To memorize the basic knowledge of PLC,components of PLC hardware • To memorize the useful numbering system and codes for PLC • To draw the relationship between the relay schematics, ladder logic programs and the equivalent logic gate circuits • To memorize the basic instructions of PLC programming and field devices used in PLC connection and process control • To Apply the components of relay schematic diagrams, compare the PLC connections with I/O modules and built the logic gate circuits by using software	
11	Synopsis of unit: The course covers the fundamental and components of PLC, number systems and logics and input/output control devices commonly found in PLC installations. This course introduces students to PLC, the parts of PLC, input/output control devices commonly found in PLC installations, and fundamental of logics and illustrates the	

	ladder diagram for the process of the machine operation. Topic: **Chapter Title**
	1. Programmable Logic Controllers(PLCs): An Overview • Programmable Logic Controllers • Parts of a PLC • Principles of Operation • Modifying the Operation • PLCs versus Computers • PLC size and Application **2. PLC Hardware Components** • The I/O Section • Discrete I/O Modules • Analog I/O Modules • Special I/O Modules • I/O Specifications • The Central Processing Unit (CPU) • Memory Design • Memory Types • Programming Terminal Devices • Recording and Retrieving Data • Human Machine Interfaces(HMIs) **3. Number Systems and Codes** • Decimal System • Binary System • Negative Numbers • Octal System • Hexadecimal System • Binary Coded Decimal (BCD) System

- Gray Code
- ASCII Code
- Parity Bit
- Binary Arithmetic
- Floating Point Arithmetic

4. Fundamentals of Logic

- The Binary Concept
- AND, OR, and NOT Functions
- Boolean Algebra
- Developing Logic Gate Circuits From Boolean Expressions
- Producing the Boolean Equation for a Give Logic Gate Circuit
- Hardwired Logic Versus Programmed Logic
- Programming Word Level Logic Instructions

5. Basics of PLC Programming

- Processor Memory Organization
- Program Scan
- PLC Programming Languages
- Bit-Level Logic Instructions
- Instruction Addressing
- Branch Instructions
- Internal Relay Instructions
- Programming Examine If Closed and Examine If Open Instructions
- Entering the Ladder Diagram
- Modes of Operation
- Connecting with Analog Devices

6. Developing fundamental PLC Wiring Diagrams and Ladder Logic Programs

- Electromagnetic Control Relays
- Contactors
- Motor Starters
- Manually Operated Switches
- Mechanically Operated Switches
- Sensors
- Output Control Devices
- Seal-In Circuits
- Electrical Interlocking Circuits
- Latching Relays
- Converting Relay Schematics into PLC Ladder Program

	• Writing a Ladder Logic Program Directly from a Narrative Description • Instrumentation
14	Main references: 1. FrankD. Petruzella, Fifth Edition. 2. Previous Editions: 2011, 2005 and 1998.
L	Additional references:

Information on Lab Practical

Job	Title
1.	**Study on equipment of motor control and components of PLC** **Objectives:** - To study some of typical symbols used in motor control circuit diagrams - To state the names of PLC hardware components - To represent motor control drawings and ladder diagram of PLC.
2.	**JOB-2 Direct on line Motor Control System** **Objectives** - To understand the usage of relay logic diagram - To make wiring connection for direct on line motor control system - To explain the operation of the motor control system. **Required equipment** 1. Main and sub feeder isolating circuit breakers 2. Power and control circuit fuses 3. Indicating pilot lamps 4. Pushbuttons (stop , start) 5. Magnetic Contactor 6. Overload Relay 7. 3 phase motor 8. Cables as required

3.	**JOB-3 Logic Circuit Modelling and Simulation with Multisim** **Objectives:** - To understand the binary concept and the functions of logic gates - To be able to drive Boolean equations for logic circuits - To use the NI Multisim software **Required equipment** — **Qty** 1. V_{CC} (5V) — 1 2. Resistor (1kΩ) — 1 3. Indicators (pilot lamps) — 2 4. Switches (SPST) — 3 5. Switches (SPDT) — 1 6. AND gate (7408J) — 2 7. OR gate (7432N) — 1 8. NOT gate (7404N) — 1 9. Output (Lamp 5V_1W) — 1 10. Logic analyzer (XLAI) — 1
4.	**JOB-4 Hardwired Logic versus Programmed Logic** **Objectives** - To understand the operation of relay ladder schematics - To implement hardwired logic by using relays and relay ladder schematics - To convert relay ladder schematics to ladder logic program **Required equipment** 1. Main and sub feeder isolating circuit breakers 2. Power and control circuit fuses 3. Indicating pilot lamps 4. Pushbuttons (stop , start) 5. Magnetic Contactor 6. Overload Relay 7. Cables as required

5.	**JOB-5 Forward-Reverse Motor Operation** **Objectives** - To understand the usage of relay logic diagram - To change the direction of a three phase motor rotation - To learn about the principle of electrical interlocking **Required equipment** 1. Main and sub feeder isolating circuit breakers 2. Power and control circuit fuses 3. Indicating pilot lamps 4. Pushbuttons 5. Magnetic Contactors 6. Overload Relay 7. 3 phase motor 8. Cables as required

No	Course Information	
1	Unit name:	Design and Layout of Power System (I)
2	Code:	EP 41036
3	Classification:	Engineering subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/4
6	Pre-requisite:	Generation Transmission & Distribution
7	Mode of delivery:	Lecture, Assignment
8	Assessment system and breakdown of marks:	
	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 explain the properties of different types of LV, MV and HV power cables, their merits for different applications, cable sizing and loss calculations, useful installation practices and cable management systems • To describe transient disturbances on a transmission system due to lightning strokes and switching operations and determine the proper insulation levels of various components in a power system and their arrangement. • To explain the mechanical design of overhead the transmission lines	
11	Synopsis of unit: • The course covers the fundamental relations of underground and overhead transmission system design.	
	Topic: **Chapter Title** **12. Cables** • Intriduction • Codes and Standard • Types of Cables and Materials	

- Cable Sizing
- Calculation of Losses in Cables
- Fire Properties of Cables
- Control and Communication Cables
- Cable Management Systems

7. Transient Overvoltages and Insulation Coordination

- Introduction
- Traveling Waves
- Effects of Line Terminations
- Junction of Two Lines
- Junction of Several Lines
- Termination in Capacitance and Inductance
- Bewley Lattice Diagram
- Surge Attenuation and Distortion
- Traveling Waves on Three-Phase Lines
- Lightning and Lightning Surges
- Shielding Failures of Transmission Lines
- Effective Shielding
- Determination of Shielding Failure Rate
- Stroke Current Magnitude
- Shielding Design Methods
- Switching and Switching Surges
- Overvoltage Protection
- Insulation Coordination
- Geomagnetic Disturbances and Their Effects on Power System Operations
-

12. Construction of Overhead Lines

- Introduction
- Factors Affecting Mechanical Design of Overhead Lines
- Character of Line Route
- Right-of-Way
- Mechanical Loading

	• Required Clearances • Type of Supporting Structures • Mechanical Calculations • Grade of Construction • Line Conductors • Insulator Types • Joint use By Other Utilities • Conductor Vibration • Conductor Motion Caused by Fault Currents •
14	Main references: 1. Electric Power Transmission System Engineering Analysis and Design" by Turan Gonen, 2nd Edition, 2009, CRC Press 2. Transmission and Distribution Electrical Engineering" by Dr C. R. Bayliss CEng FIET and B. J. Hardy ACGI CEng FIET, 3rd Edition, 2007, Bayliss, C. R. (Colin R.). 3. Dr. H.M. Rai, K.C. Singhal, Bhavana Jain: Power System I (India)
15	Additional references:

No	Course Information	
1	Unit name:	Power System Analysis I
2	Code:	EP 41042
3	Classification:	Engineering subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/4
6	Pre-requisite:	Generation, Transmission & Distribution
7	Mode of delivery:	Lecture, Assignment
8	Assessment system and breakdown of marks:	
	Test	20%
	Mid-term Examination	30%
9	Academic staff teaching unit:	3
10	Course outcome of unit In this course students will be able: • to calculate the bus admittance and impedance parameter of network • to solve the network models based on the admittance and impedance representations • to analyze the power flow solution by using various iteration methods	
11	Synopsis of unit: The course covers the analysis of power system. This course is discussed the bus admittance and impedance matrix by the building algorithms is formulated and employed for the systematic computation of bus voltages and angles, the comprehensive coverage of the power flow solution of interconnected power system during normal condition.	

12	Topic: **Chapter Title**
	7.The Admittance Model and Network Calculations -Branch and Node Admittances -Mutually Coupled Branches in Y_{bus} - An Equivalent Admittance Network -Modification of Y_{bus} -The Network Incidence Matrix and Y_{bus} -The Method of Successive Elimination -Node Elimination (Kron Reduction) -Triangular Factorization **8.The Impedance Model and Network Calculations** -The Bus Admittance and Impedance Matrices - Thevenin's Theorem and Z_{bus} -Modification of an Existing Z_{bus} -Direct Determination of Z_{bus} -Calculation of Z_{bus} Elements from Y_{bus} - Mutually Coupled Branches in Z_{bus} **9. Power- Flow Solutions** -The Power-Flow Problem -The Gauss-Seidel Method - The Newton-Raphson Method -The Newton-Raphson Power-Flow Solution -Regulating Transformers -The Decoupled Power-Flow Method
13	Main references: Power System Analysis, John J. Grainger, William D. Stevenson, Jr.
14	Additional references: Power System Analysis, Hadi Saadat

No	Course Information	
1	Unit name:	Electrical Machine and Operation
2	Code:	EP-41043
3	Classification:	Engineering subject
4	Credit value:	2.5
5	Semester/ Year Offered:	1/3
6	Pre-requisite:	EP-21021& 22021 Electromechanics
7	Mode of delivery:	Lecture, Practical
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 explain the characteristics of the D.C shunt generator and the function of D.C motor • To calculate the problems of D.C shunt generator and D.C motor • To computethe problems of D.C machineby using various control methods • To identify losses and calculate the efficiency of the D.C machine • To apply the tools for measuring the speed of DC machines	
11	Synopsis of unit: The course covers Electrical Machine and Operation. The course introduces students to direct current generator characteristic, direct current motor, speed control of DC motor, loss efficiency and testing of DC machine.	

12	Topic: **Chapter Title** **1. Direct Current Generator Characteristics** -Characteristics of DC generators -Separately excited generator -Building up the voltage of self-excited shunt generator -Shunt generator characteristics -Series generator -Compound wound generator -Applications of DC generator **2. Direct Current Motor** -General aspects -Principle of operation of DC motor -Back or counter E.M.F -Comparison between motor and generator action -Torque developed in motor -Mechanical power developed by motor armature -Types of DC motor -Speed of a DC motor -Speed regulation -Armature reaction and commutation -Motor characteristics -Comparison of DC motor characteristics -Summary of characteristics and applications of DC motors -DC motor reversing -Starting DC motors -Self-governing properties of DC motor **3.Speed Control of DC Motors** -Factors controlling the speed -Field control method - Rheostatic control

	-Voltage control -Thyristor control of DC motor - Electric braking **4. Losses, Efficiency and Testing of DC Machines** -Losses and efficiency - Testing of DC machines
14	Main references: ELECTRICAL MACHINES 2nd Edition ; R.K. Rajput
15	Additional references: http://mysite.du,edu> tech>elmotors http://www.explainthatstuff.com>how-regener....

Approved by- Prepared by-
