BASAVESHWAR ENGINEERING COLLEGE(AUTONOMOUS), BAGALKOT

DEPARTMENT ELECTRICAL AND ELECTRONICS ENGINEERING

COURSEPLAN

Title of Course	**:**	**Power Systems-III**	**Course Code**	**:**	**21UEE605C**
Credits	**:**	**03**	**Contact Hours/ Week**	**:**	**03**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**-**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**50**
Semester	**:**	**VII**	**Year**	**:**	**2024**

Prerequisites: Basic concept of generation, transmission and distribution systems. Types of transmission line and its characteristics, representation of power system using single line diagram and per unit calculation. Basic concept of network topology: terms like graph, subgraph, tree, cotree and concept like tie-set and cut-set

Course Objectives:

	The Course objectives are:
1	To impart the knowledge of Graph Theory applied to power systems and to develop incidence matrix of power systems network that represents interconnection of the lines and line power flow. To construct the Ybus matrix using inspection and singular transformation method that represent entire characteristics of power systems
2	To impart the knowledge of concept of load flow analysis, Power Flow Equation, Classification of Buses, Operating Constraints, Data for Load Flow: System data, Generator bus data, Load Data. To develop algorithm for GS method and Newton Raphson (NR) load flow method in polar coordinates and rectangular coordinates. To impart the knowledge of modification of algorithm GS and NR for PV buses, Q- limit violations and acceleration factor for convergence
3	To impart the knowledge about the concept of economic scheduling and Performance curves of thermal generators. To impart the knowledge of formulation of minimization of cost objective function along with constraints. To develop the solution technique to obtain necessary condition for cost minimization of thermal generator during scheduling without considering losses. To impart the knowledge for obtaining optimum condition of thermal generators considering losses. To understand the concept of penalty factor and its approximation during scheduling. To impart the knowledge of importance of power loss expression and derive the expression for loss formula using current distribution factors
4	To provide the knowledge regarding concept of transient stability of power system. To understand the importance of swing equation during transient stability. To derive the swing equation and develop mathematical models of machine and power system equations. To understand the concept of solution techniques solving swing equation for transient stability. To provide the knowledge about modelling of excitation systems, DC Excitation system and AC Excitation system. To understand concept about the computer model of Type 1, Type 2 and Type 3 excitation. To understand concept about the Load Model: Static, Dynamic load models

Course Outcomes:

	After completion of the course, students shall be able to:
1	apply suitable network topology, primitive network, types of power system buses for load flow studies and economic scheduling algorithms and excitation systems for power system operation.
2	Investigate performance of the power systems using load flow analysis, optimum scheduling the of thermal generators and excitation systems.
3	calculate Y_{BUS} matrix, real power, reactive power and power flow for a given power systems using load flow studies and optimum cost of generation of thermal power plants using economic scheduling study and components of excitation systems.
4	formulate the load flow models, economic scheduling of thermal generators

Course Articulation Matrix: Mapping of Course Outcomes (CO) with Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Outcomes - Programme Outcomes Mapping Table

Sl.	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO.1	3							1		1		1	2	1	
2	CO.2	3	1						1		1		1	1	2	1
3	CO.3	3	3	2	2	1			1		1		1	3	1	1
4	CO.4	3	3	3	3	1			1	1	1		2		1	

Unit Learning Outcomes (ULO):

Sl.	Unit Learning Outcome (ULO)	CO's	BLL
	Unit -I		
1.	Students shall be able to understand the importance of the computer in solving the power system problems	**1**	**1**
2.	Students shall be able to understand the significance of network topology in solving the power system problem	**1**	**1**
3.	Students shall be able to define/describe the terms such as graph, tree, cotree, cut set and tie set	**1**	**2**
4.	Students shall be able to draw graph, tree, cotree for given power system network	**1**	**2**
5.	Students shall be able to apply cut-set and tie-set method for constructing of incidence matrix for given power system network	**1**	**3**
6.	Students shall be able to solve numerical on obtaining incidence matrix for a given network using fundamental cut set and tie set methods	**1**	**4**
7.	Students shall be able to understand the concept of primitive network using impedance frame and admittance of reference	**1**	**2**
8.	Students shall be able to construct primitive network for a given power system network with and without mutual coupling	**1**	**3**
9.	Students shall be able to derive the YBUS matrix for given power system network using singular transformation and inspection method	**2**	**3**
10.	Students shall be able to solve the numerical on obtaining Y_{BUS} matrix for given power system network using singular transformation and inspection method	**2**	**4**
	Unit -II		
11.	Students shall be able to understand the concept and significance of load flow analysis in power system	**2**	**1**
12.	Students shall be able to classify and identify the various types of buses available in power system	**2**	**2**
13.	Students shall be able to understand the concept of bus loading equation in load flow studies	**2**	**2**
14.	Students shall be able to develop computer program for load flow studies	**2**	**4**
15.	Students shall be able to formulate load flow problem using gauss seidel method for P-Q	**2**	**3**
16.	Students shall be able to understand the concept of acceleration factor	**1**	**21**
17.	Students shall be able to solve the numerical on obtaining real power flow and reactive power flow only for P-Q buses using gauss seidel method	**1**	**4**
18.	Students shall be able to understand the modification of gauss seidel method for PV bus	**2**	**1**
19.	Students shall be able to understand importance of limitation of Q for PV bus	**2**	**1**
20.	Students shall be able to solve the numerical on obtaining real power flow and reactive power flow for P-V bus using gauss seidel method	**2**	**4**
21.	Students shall be able to explain the limitations of gauss seidel algorithm	**2**	**2**
22.	Students shall be able to formulate load flow problem using Newton Raphson method for P-Q and PV buses in cartesian and polar coordinates	**3**	**2**
23.	Students shall be able to solve the numerical on obtaining real power flow and reactive power flow for P-V bus using Newton Raphson method	**3**	**4**
24.	Students shall be able to explain the merits and demerits of Newton Raphson method	**2**	**2**
25.	Students shall be able to understand the need of fast decoupled load flow analysis	**1**	**1**
26.	Students shall be able to formulate fast decouple load flow problem for a given power systems	**4**	**4**

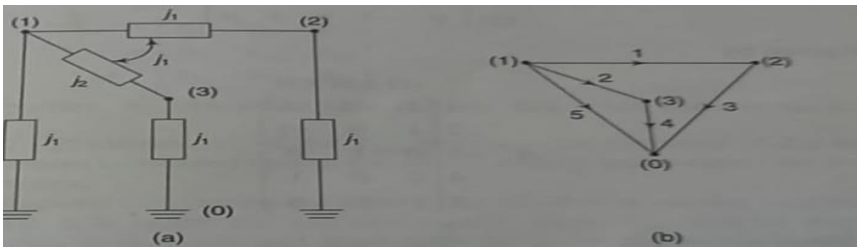
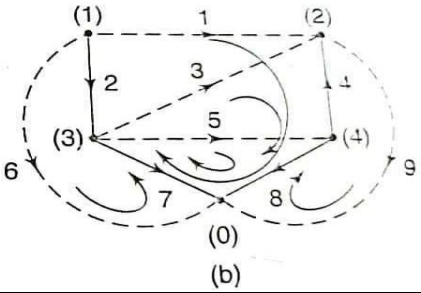
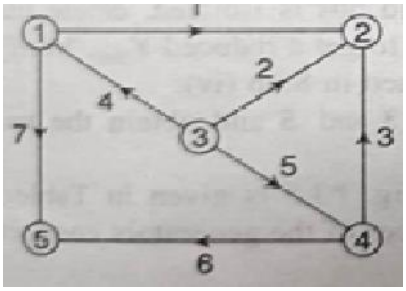
	Unit-III		
27	Students shall be able to understand the concept of economic scheduling of thermal generators	**1**	**2**
28.	Students shall be able to define the input-output and Incremental characteristics of thermal generators	**1**	**1**
29.	Students shall be able to formulate the objective function for minimization of energy cost of thermal generators with the constraints on the individual generator	**4**	**3**
30.	Students shall be able to apply optimization method to derive the necessary and sufficient conditions for the economic scheduling of thermal generators without considering transmission loss	**4**	**4**
31.	Students shall be able to solve the numerical on economic scheduling of thermal generators without considering transmission loss	**3**	**4**
32.	Students shall be able to derive the necessary and sufficient conditions for the economic scheduling of thermal generators considering transmission loss	**3**	**3**
33.	Students shall be able to illustrate the importance of penalty factor on thermal generator	**2**	**2**
34.	Students shall be able to apply Taylors iterative series to solve the necessary equation for scheduling thermal generator at optimum cost considering transmission loss	**3**	**3**
35	Students shall be able to solve the numerical on economic scheduling of thermal generators considering transmission loss using iterative technique	**4**	**4**
36.	Students shall be able understand current distribution factor and derive the expression of Loss formula.	**2**	**2**
37.	Students shall be able to solve the numerical for obtaining B-Coefficient of loss formula tors	**4**	**4**
38.	Students shall be able to understand the need of hydrothermal scheduling of generators	**2**	**2**
39.	Students shall be able to formulate the problem, provide solution and specify algorithm for hydrothermal scheduling of generators	**3**	**3**
	Unit-IV		
40.	Students shall be able to understand definition and concept of Transient Stability of power system	**1**	**1**
41.	Students shall be able to understand role of transient and quadrature axis reactance during transient stability	**2**	**2**
42.	Students shall be able to derive the swing equation describing the motion of the machine motors	**3**	**3**
43.	Students shall be able to model the synchronous machine in terms of quadrature component of voltage due to transient reactance	**3**	**3**
44.	Students shall be able to model induction motor as a load during transient stability	**3**	**3**
45.	Students shall be able to represent of the load and network performance equation during transient stability	**2**	**2**
46.	Students shall be able to apply numerical technique algorithm to check the stability of power system during transient stability	**4**	**4**
47.	Students shall be able to understand principle operation of excitation systems along with block diagram	**2**	**2**
48.	Students shall be able to understant various types of AC and DC excitation systems, Brushless and static exciation systems	**2**	**2**
49.	Students shall be able to analyze the computer model of excitation systems Type-1, Type-2 and Type-3	**4**	**4**
50.	Students shall be able to understand Load Model: Static, Dynamic load models	**1**	**1**

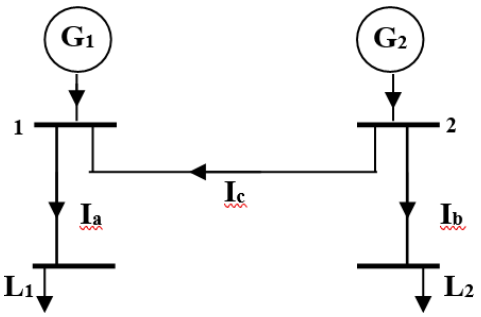
Course Content Delivery

Day	Dates	Content	Mode of Delivery
1		Brief Introduction of the course, information regarding the course outcome of the course, program specific outcome and program outcome	
2		Introduction to computer application to power systems, Steps involved to solve power system algorithms such has problem formulations, objectives, Solution techniques and Programming	Chalk and talk in classroom
3		Importance of Bus frame of reference (Z-Bus) and Node frame of reference (Y-Bus). Selection of programming language.	
4		Introduction of elementary graph theory, Definitions and concept of connected graph, sub graph Loop, Cut-set, Tree, Co- tree, Basic loops, Basic cut-set	
5		Numerical examples for constructing graph, sub graph Loop, Cut-set, Tree, Co-tree, Basic loops, Basic cut-set for given power system network	
6		Concept of Incidence Matrices: Element-node incidence matrix A (Bus-incidence matrix), Branch path incidence matrix K,	
7		Concept of Basic (Fundamental) cut-set incidence matrix B, Augmented cut-set matrix, Basic loop incidence matrix C, Augmented loop incidence matrix.	
8		Numerical examples of Element-node incidence matrix A (Bus-incidence matrix), Branch path incidence matrix K, Basic (Fundamental) cut-set incidence matrix B, Augmented cut-set matrix, Basic loop incidence matrix C, Augmented loop incidence matrix	
9		General primitive element, Impedance and Admittance form of the primitive element, Primitive network matrices. Introduction, Derivation of $Y_{bus}= [A][y][A]^T$	
10		Numericals on Ybus matrix using singular transformation method	
11		Formation of Y_{bus} by inspection method and Numerical	
12		Introduction, Power Flow Equation, Classification of Buses, Operating Constraints, Data for Load Flow: System data, Generator bus data, Load Data, Transmission line data, Transformer data and Shunt element data.	Chalk and talk in classroom
13		Derivation of bus loading equation, formulation of Gauss seidel method for load flow problem for P-Q bus	
14		Numerical for obtaining bus voltage, line flow and power flow using Gauss seidel method for 3 iterations and importance of acceleration factor is explained.	
15		Modification of GS algorithm to include PV buses, Q-limit violations, Acceleration of convergence	
16		Numericals on Load flow analysis for PQ & PV buses using GS method	
17		Introduction to NR method, Formulation of NR method in rectangular coordinates for PQ-Bus.	
18		Formulation of NR method in polar coordinates for PQ-Bus and Numerical of obtaining bus voltages using NR method in rectangular	
19		Numerical of obtaining bus voltages using NR method in polar form for PQ	

20		Numerical of obtaining bus voltages using NR method in polar form for PQ-PV systems	
21		Concept of Decoupled Load Flow & Fast Decoupled Load Flow. Derivation of Jacobian matrix using Fast Decoupled load flow	
22		Introduction of economic scheduling of thermal generators, Importance of Performance curves in scheduling of thermal generators.	Power Point Presentation
23		Derivation of necessary condition of economic scheduling of thermal generators neglecting losses and generator limits	
24		Examples for obataining of power output of generators using scheduling algorithm without power limits	
25		Examples for obataining of power output of generators using scheduling algorithm with power limits	Chalk and talk in classroom
26		Derivation of necessary condition of economic scheduling of thermal generation considering transmission losses	Chalk and talk in classroom
27		Concept and impact of penalty factor on thermal generators, numerical	
28		Derivation of Iterative technique for the scheduling of thermal generators considering losses and Numerical	
29		Derivation of transmission loss formula using current distribution factors and numerical	
30		Numerical for obatining B-Coefficents of given power systems	Power Point Presentation
31		Introduction to optimal scheduling for hydrothermal plants. Problem formulation, solution procedure and algorithm	
32		Introduction of Transient Stability of power system, Derivation of swing equation using machine dynamics.	
33		Modelling of Synchronous salient and non-salient machine and induction machine	Power Point Presentation
34		Power system equations in-terms of admittance frame of reference and solution techniques with flow chart.	
35		Introduction of excitation systems, AC and DC excitation systems,	
36		Concept of Brushless and static exciation systems	
37		Concept of Power system stablizer, modeling of Type-1 and Type-2 excitationsystems	
38		Modeling of Type-3 excitation systems	
39		Load Model: Static, Dynamic load models	
40		Revision of syllabus	

Review Questions:

Sl.	Review Questions	BLL
1	Consider the network shown in Fig.1 a where two branches have mutual coupling as shown. Find the primitive impedance matrices z, y and the Y_{bus} matrix. Choose (0) as reference bus.  Fig.1.0	L3
2	The oriented graph shown in Fig. 2.0 select the tree *T* (6, 7, 8, 9) and the write the B. C matrices. Verify the orthogonality relations. Choosing ground as reference bus, write the A matrix. 	L4
3	For the graph in Fig. 3.0 select the tree *T* (2, 4, 5, 6)  Fig.3.0 • Write the fundamental loop matrix C and the fundamental cutset matrix B. Verify the relation BC^T and $C_b = -B^T$ • Write the augmented incidence matrix A_a and the incidence matrix A by choosing 4 as reference node. Arrange A as $[A_a\ A,]$ corresponding to the tree	L3
4	The fuel cost functions in Rs/h for three thermal plants are given by $F_1=350+7.2P_1+0.004P_1^2$, $F_2=500+7.3P_2+0.0025P_2^2$, $F_3=600+6.74P_3+0.003P_3^2$ P_1, P_2, P_3 are in MW. Find the optimal scheduling using iterative technique for P_D=800MW, initial value of λ=8 Rs/MWh	L3

5	Compute the loss coefficients for the network shown in Fig using the given data $I_a = 1.0 - j0.15$ pu $Z_a = 0.02 - j0.15$ pu $I_b = 0.5 - j0.10$ pu $Z_a = 0.02 - j0.15$ pu $I_c = 0.2 - j0.005$ pu $Z_c = 0.02 - j0.25$ pu 	L3
6	Derive and specify the assumptions considered for obtaining the B-Coefficients using current distribution factor	L2
7	Specify the importance of the incremental characteristics during the scheduling of thermal generators and obtain the necessary conditions of scheduling of thermal generators	L2
8	Develop MATLAB program for Load flow analysis using gauss seidel and NR method for P-Q and PV buses	L4
9	Develop MATLAB program for economic scheduling for thermal power plants	L4

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	**45**	**22.5**
CIE-II	**45**	**22.5**
Assignments/ Quizzes	**05**	**5.0**
SEE	**100**	**50**
Total	**195**	**100**

Details of Assignment:

Assignment	Marks (05)	CO
Assignment 1	1.25	3 & 4
Assignment 2	1.25	3 & 4
Assignment 3	1.25	3 & 4
Assignment 4	1.25	3 & 4

SEE Model Question Paper:

SEE Scheme

Semester end assessment (SEE) is written examination of three hours duration of 100 marks with 50% weightage

Course Utilization for CIE and SEE

Unit	Chapter		Teaching Hours	Number of Questions		
				CIE-I	CIE-II	SEE
I	1	Network Topology	5	02	--	02
	2	Primitive Network	2			
	3	Network Matrices	4			
II	4	Introduction to Load flow Analysis	1	02	---	02
	5	Gauss Seidel Load Flow	4			
	6	Newton Raphson Load Flow	5			
III	7	Economic Operation of Thermal Generators	9	--	02	02
IV	8	Transient Stability Studies	5	---	02	02
	9	Modelling of Excitation System	5			

Course End Survey

1	Are you able to apply suitable network topology, primitive network, types of power system buses for load flow studies and economic scheduling algorithms and excitation systems for power system operation
	Answer Choice- Always/Very often/Sometimes/Rarely
2	To what extent you are able to Investigate performance of the power systems using load flow analysis, optimum scheduling the of thermal generators and excitation systems
	Answer Choice- Excellent/ Good/Satisfactory/Poor
3	Are you able to calculate Y_{BUS} matrix, real power, reactive power and power flow for a given power systems using load flow studies and optimum cost of generation of thermal power
	Answer Choice- Always/Very often/Sometimes/Rarely
4	Are you able to formulate the load flow models, economic scheduling of thermal generators
	Answer Choice- Always/Very often/Sometimes/Rarely

COURSE PLAN-21UEE606C

Title of Course	**:**	**Microcontrollers**	**Course Code**	**:**	**21UEE606C**
Credits	**:**	**3**	**Contac Hours/Week**	**:**	**3**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**--**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**50**
Semester	**:**	**VI**	**Year**	**:**	**2023-2024**

Course Objectives:

	The Course objectives are:
1	Understand the basic concepts of microcontrollers, peripherals and addressing modes
2	Select the instructions to construct a program
3	Draw the flowchart and write the algorithm for the given problem
4	Write assembly and C program for the given problem statement

Course Outcomes:

	At the end of the course the students should be able to:
1	List and define the features of microcontrollers, instruction set, peripheral devices, addressing modes.
2	Illustrate and explain architecture of microcontroller, functions of registers, pins, addressing modes, directives, programming instructions, interrupts, and peripheral devices
3	Identify the instructions/addressing modes, codes for selecting register banks/timer registers and to make use of appropriate instructions for programs and delay calculation Create, inspect & debug the assembly language instructions/program and re-correct code & assess number of bytes
4	Formulate the flowchart & develop assembly level/8051C programme for given problem

Course Articulation Matrix: Mapping of Course Outcomes (CO) with Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Sl.	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	UEE652C.1	3	3	3	3	3	1	1	1	1	2	2	3	1	3	3
2	UEE652C.2	3	3	3	3	3	1	1	1	1	2	2	3	1	3	3
3	UEE652C.3	3	3	3	3	3	1	1	1	1	2	2	3	1	3	3
4	UEE652C.4	3	3	3	3	3	1	1	1	1	2	2	3	1	3	3

Competencies Addressed in the course and Corresponding Performance Indicators

Programme Outcome: Any of 1 to 12 PO's:

PO	Competency		Performance Indicators	
1	1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply elements of electrical engineering principles and laws
	1.4	Demonstrate competence in Electrical engineering knowledge	1.4.1	Apply discipline specific laws and principles to solve an engineering problem
2	2.1	Demonstrate an ability to identify and Characterize an engineering problem	2.1.1	Evaluate problem statements and Identify objectives
4	4.1	Demonstrate an ability to conduct investigations of technical issues consistent with their level of Knowledge and understanding	4.1.1	Define a problem for purpose of investigation, its scope and importance
	4.3	Demonstrate an ability to critically analyze data to reach a valid conclusion	4.3.1	Use appropriate procedures, tools and techniques to collect and analyse data

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and ITtools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities andnorms of the engineering practice.
PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receiveclear instructions.
PO11.**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member andleader in a team, to manage projects and in multidisciplinary environments.
PO12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Unit Learning Outcomes (ULO):

Sl.	Unit Learning Outcome (ULO)	CO's	BLL	PI addressed
	Unit–I			
1.	Students shall be able to identify and explain the fundamental components of a microcontroller	**1**	**1**	**1.4.1**
2.	Students shall be able to describe the architecture of various microcontrollers	**1**	**1**	**1.3.1**
3.	Students shall be able to understand the role of the CPU, memory (RAM and ROM), I/O ports, timers, and serial communication interfaces	**2**	**2**	**2.1.1**
4.	Students shall be able to differentiate between microcontrollers and microprocessors.	**2**	**3**	**4.1.1**
5.	Students shall be able select the various addressing modes for the given problem	**2**	**3**	**4.3.1**
	Unit–II			
6.	Students shall be able to differentiate various instructions of 8051 microcontroller	**2**	**2**	**1.4.1**
7.	Students shall be able to identify the error in the given 8051 instructions	**3**	**3**	**2.1.1**
8.	Students shall be able to write a program for timers to obtain required amount of time delay	**3**	**4**	**4.3.1**
9.	Students shall be able to carry out analysis of the given program to identify the amount of delay generated.	**3**	**4**	**4.3.1**
	Unit–III			
10.	Students shall be able to develop and debug the assembly and C programs	**3**	**1**	**4.1.1**
11.	Students shall be able to write and test the programs in high level language C	**3**	**2**	**4.3.1**
12.	Students shall be able to interface microcontrollers with various external devices	**3**	**3**	**4.3.1**
13.	Students shall be able to diagnose and fix issues in microcontroller circuits and code	**3**	**3**	**4.3.1**
	Unit–IV			
13.	Students shall be able to understand the basic concepts of serial data communication.	**2**	**2**	**2.1.1**
14.	Students shall be able to write and debug program for serial data transmission/reception	**4**	**3**	**4.3.1**
15.	Students shall be able to use debugging tools and techniques to troubleshoot hardware and software problems	**4**	**3**	**4.1.1**

Course Content:

Hours Required	Topic to be covered	Mode of Delivery
01	**Basics of Microcontrollers:** Features, Block diagram	Chalk & Talk, PpT

01	pin diagram, program model, Architecture	Chalk &Talk ,Ppt
01	PSW, PC, SP, Memory Organization	Chalk &Talk, Ppt
01	**Addressing Modes:** Introduction, Addressing modes, External Data Moves, Code Memory Read Only DataMoves	Chalk & Talk, Discussions
01	Indexed Addressing Mode, Programs, PUSH and POP exchanges-Programs	Chalk & Talk, Discussions
01	**Logical and Arithmetic Operations:** Introduction, Arithmetic instructions, incrementing and decrementing	Chalk & Talk, Ppt
01	Addition, subtraction, multiplication and division	Chalk & Talk, Ppt
01	decimal arithmetic-Programs, Byte level Logical instructions	Chalk & Talk, Ppt
01	Bit level logical instructions, Rotate and swap instructions	Chalk & Talk, Ppt
01	Programs	Chalk & Talk, Discussions
01	**Jump and Call Instructions:** The jump and call program range	Chalk & Talk, Ppt
01	jump and call instructions	Chalk & Talk, Ppt
01	machine cycle and time delays generation	Chalk & Talk, Ppt
01	Programs	Chalk & Talk, Discussions
01	**8051 I/O and Timer Programming:** Introduction	Chalk & Talk, Discussions
01	I/O programming	Chalk & Talk, Ppt
01	I/O Bit Manipulation Programming	Chalk & Talk, Ppt
01	Programming timers 0 in 8051 assembly	Chalk & Talk, Ppt
01	Programming timer 1 in 8051 assembly	Chalk & Talk, Discussions
01	Counter programming	Chalk & Talk, Discussions
01	**8051 Interfacing and Applications:** Interfacing 8051 to LCD	Chalk & Talk, Ppt
01	Programs to interface LCD	Chalk & Talk,Ppt
01	DAC interface	Chalk & Talk, Ppt
01	Stepper motor interface	Chalk & Talk, Ppt
01	DC motor interface	Chalk & Talk, Discussions
01	**Programming in C for 8051:** Introduction	Chalk & Talk, Ppt
01	C data types	Chalk & Talk, Ppt
01	Programs on time delays	Chalk & Talk, Ppt
01	Programs on time delays	Chalk & Talk, Discussions
01	I/Oprogramming	Chalk & Talk, Discussions
01	**8051 Serial Port and Interrupt Programming:** Basics of serial communication	Chalk & Talk, Ppt
01	8051 connections to RS-232	Chalk & Talk, Ppt
01	Serial port programming in8051 assembly	Chalk & Talk,Ppt
01	Serial port programming in8051 assembly	Chalk & Talk,Ppt
01	Introduction to interrupts	Chalk & Talk, Discussions
01	**Introduction to RaspberryPi:** Basics of RaspberryPi	Chalk & Talk, Ppt
01	Hardware Layout	Chalk & Talk, Ppt
01	Operating Systems on RaspberryPi	Chalk & Talk, Ppt
01	Configuring RaspberryPi	Chalk & Talk, Ppt
01	Programming RaspberryPi with Python	Chalk & Talk, Discussions

Review Questions:

Review Questions

1. Explain the architecture of the 8051 microcontroller.
2. Describe the different types of memory organization in the 8051 microcontroller.
3. What are the special function registers (SFRs) in the 8051 microcontroller?
4. Write an assembly language program to toggle all the bits of Port 1 continuously with a delay of 5 sec. Create the delay with timer.
5. Describe the different addressing modes supported by the 8051 microcontroller.
6. Explain the purpose and functioning of the following instructions:
    - MOV
    - ADD
    - SUBB
    - DJNZ
7. How does the 8051 microcontroller handle interrupts?
8. Write a program to interface an LED with the 8051 microcontroller.
9. Discuss the use of timers and counters in the 8051 microcontroller.
10. What is serial communication in the context of the 8051 microcontroller?
11. Describe the interfacing of an LCD with the 8051 microcontroller. Provide the steps required to display a message on first line.
12. Design a digital clock using the 8051 microcontroller.
13. Explain the process of interfacing a temperature sensor with the 8051 microcontroller.
14. Discuss the role of the 8051 microcontroller in embedded systems.

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	20	20
CIE-II	20	20
Assignments/ Quizzes/CaseStudy/Course Project/ Term Paper/Field Work	10	10
SEE	100	50
Total	150	100

Dr. Chayalakshmi C. L.

BASAVESHWAR ENGINEERING COLLEGE(AUTONOMOUS), BAGALKOT

COURSEPLAN

Title of Course	**:**	**Electrical Machine Design**	**Course Code**	**:**	**21UEE611E**
Credits	**:**	**3**	**Contact Hours/ Week**	**:**	**3**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**--**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**50**
Semester	**:**	**VI**	**Year**	**:**	**2023-24**

Prerequisites: Classification, different types and properties of engineering materials like mechanical, electrical, magnetic and insulating materials. Construction and working of machines, types and different parts of electrical machines (AC & DC) and transformers.

Course Objectives:

	The Course objectives are:
1	To discuss design factors, limitations in design and modern trends in design and manufacturing of electrical machines.
2	To discuss the properties of electrical, magnetic and insulating materials used in the design of electrical machines.
3	To derive the output equation of DC machine, single phase, three phase transformers, induction motor and synchronous machine.
4	To discuss the selection of specific loadings, for various machines.
5	To discuss separation of main dimensions for different electrical machines
6	To discuss design of field windings for DC machines and synchronous machines. To evaluate the performance parameters of transformer, induction motor.
7	To design of cooling tubes for the transformer for a given temperature rise.
8	To explain design of rotor of squirrel cage rotor and slip ring rotor.
9	To define short circuit ratio and discuss its effect on machine performance.

Course Outcomes:

	At the end of the course the student should be able to:
1	List and define different types of materials, parts, insulators, and the terms associated to electrical machines and its design terms
2	Explain the specific loadings, design factors for electrical machines.
3	Calculate the design parameters of an electrical machine for a given set of specifications and necessary assumptions as per the Indian standards.
4	Derive the equations with respect to specific loadings, dimensions and other design aspects for electrical machines.

Course Articulation Matrix:

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
No	PO's / CO's															
The students will be able to:																
1	21UEE611E.1	3	2	2					1		1		1	3	1	1
2	21UEE611E.2	3	2	2					1		1		1	2	1	1
3	21UEE611E.3	3	3	3	3				1	2	1		1	1	1	1
4	21UEE611E.4	3	3	3	2				1		1		2	1	1	1

Competencies Addressed in the course and Corresponding Performance Indicators

Programme Outcome:Any of 1 to 12 PO's:

P0	Competency		Indicators
1	Knowledge of Electrical and engineering materials.		• Understand the requirements and properties of conducting, magnetic and dielectric materials • Explain the specific electric and magnetic loadings..
2	Output equation of dc and ac machines		• determination of main dimensions of dc and ac machines
3	Overall dimensions of transformer		• Calculate the overall dimensions of transformers • Determine the optimum number of cooling tubes for transformer
4	Design of main dimensions of ac machines		• Determination of Main dimensions and loadings of ac machines.

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Unit Learning Outcomes (ULO):

Sl.	Unit Learning Outcome (ULO)	CO's	BLL	PI addressed
	Unit - I			
1.	Students should be able to define basic requirements for the design of dc and ac machines	**1**	**2**	**1.1.1**
2.	Students should be able to decide the proper selection of conducting, magnetic and insulating materials for design of machines	**2**	**2**	**2.1.1**
3.	Students should be able to calculate the specific magnetic and electric loadings and main dimensions of dc machines	**3**	**4**	**2.1.1**
4.	Students should be able to estimate the armature slot dimensions and ampere turns	**3**	**4**	**2.1.1**
	Unit - II			
5.	Students shall be able to determine the main dimensions of single phase and three phase transformers	**2**	**2**	**2.1.1**
6.	Students should be able to design the transformer tank and calculate cooling tubes	**2**	**4**	**2.1.1**
	Unit - III			
7.	Students should be able to determine the main dimensions of three phase induction motor	**3**	**4**	**2.1.1**
8.	Students should be able to estimate the length of air gap, slots and end ring current	**2**	**2**	**2.1.1**
	Unit - IV			
9.	Students should be able to describe the short circuit ratio	**2**	**2**	**2.1.1**
10.	Students should be able to estimate the dimensions of salient and non salient pole machine	**4**	**4**	**2.1.1**
11.	Students should be able to design the dimensions of rotor of salient pole synchronous machine and non salient machine	**4**	**4**	**2.1.1**

Course Content:

Hours Required	Topic to be covered	Mode of Delivery
01	**Principles of Electrical Machine Design**: Introduction to design of electrical machines,	Chalk and talk in classroom/ Lecture combined with discussions/ Lecture with a quiz/ Tutorial/ Assignments/ Demonstration/ Invited lectures / Group Assignment
01	limitations	
01	Different types of materials	
01	insulators used in electrical machines	
01	General Concepts of Electrical Machine Design	
01	Specific loadings, Electric and Magnetic	
02	Design of DC Machines: Output equation	
01	choice of specific loadings and number of poles, design of main dimensions,	
01	armature slot dimensions and estimation of ampere turns	
01	**Design of Transformers** (Single phase and three phase): Introduction	
01	Output equation for single phase and three phase transformer	
01	choice of specific loadings, expression tor volts/turn	
01	Numericals	
01	determination of main dimensions of the core	
01	types of windings and estimation of number of turns and cross sectional area of Primary and secondary coils	
01	Design of tank and cooling tubes	
03	Numericals	
01	**Design of Induction Motors**: Output equation	
01	choice of specific loadings	
03	Main dimensions of three phase induction motor	
01	stator winding design	
01	choice of length of the air gap	
02	estimation of number of slots for the squirrel cage rotor	
01	end ring current	
03	**Design of Synchronous Machines**: Output equation, choice of specific loadings,	
03	Short circuit ratio, design of main dimensions, armature slots and windings, slot details for the stator of salient and non salient pole synchronous machine.	
04	Design of rotor of salient pole synchronous machines, magnetic circuits and rotor of non salient pole machine.	

Review Questions:

Review Questions	ULO	BLL	PI addressed
What are the major considerations to be accounted for in the design of electrical machines?	1	4	**2.1.1**
Explain the classification of insulating materials based on thermal consideration with two examples each.	2	2	**2.1.1**
Define specific magnetic and electric loadings and mention the usual range of values for each of the loading.	3	2	**2.1.1**
From the first principle deduce an expression for the output equation of a DC machine and mention the units of each term	4	2	**2.1.1**
Calculate the diameter and length of armature for a 7.5 kW, 4 pole, 1000 rpm, 220 V DC shunt motor. Given full load efficiency = 0.83, Maximum flux density =0.9 Wb/m2; specific electric loading = 30000 AC/m, field form factor = 0.7. Assume that the maximum efficiency occurs at full load and field current is 2.5% of rated current. The pole face is square.	5	4	**2.1.1**
Derive the output equation of a single phase transformer.	6	3	**2.1.1**
Derive an expression for-volts/turn of transformer.	6	3	**2.1.1**
Determine the dimensions of core and window for a 5 kVA, 50 Hz, 1-phase, core type transformer. A rectangular core is used with the long side twice as long as the short side. The window height is 3 times the width. Voltage per turn = 1.8 V. Space factor = 0.2. δ=1.8 A/mm2. Bm=1 Wb/m2. Assume Sf=0.9	6	4	**2.1.1**
Write an expression for leakage reactance of a core type transformer and state the assumptions made.	5	2	**2.1.1**
Determine the dimensions of the core and yoke for a 200 kVA, 50 Hz, 1 phase core type transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times the width of core laminations. Assume voltage per turn = 14 V, maximum flux density = 1.1 Wb/m2, window space factor = 0.32, current density = 3 A/mm2 and stacking factor = 0.9. The net iron area is 0.56 d2, where d is the diameter of the circumscribing circle. Also the width of the largest stamping is 0.85 d. Assume CRGO steel.	7	4	**2.1.1**
Discuss the design of the tank and cooling tubes of a transformer.	8	2	**2.1.1**
A 1000 kVA, 6600/440 V, 50 Hz, 3 phase, delta/star core type oil immersed natural-cooled transformer. The design data of the transformer is; Distance between centres of adjacent limbs = 0.47 m, outer diameter of h.v winding = 0.44 m, height of frame = 1.24 m. Core loss = 3.7 kW and I2R loss = 10.5 kW. Design a suitable tank for the transformer. The average temperature rise of oil should not exceed 35OC. The specific heat dissipation from the tank walls is 6 W/m2-OC due to radiation and convection respectively. Assume that the convection is improved by 35 % due to convection.	9	4	**2.1.1**

Explain the factors which influence the length of the air gap of 3 phase lM and write a few empirical formulas for the length of the air gap.	10	4	**2.1.1**
Determine the main dimensions, number of stator slots. and the number of turns/phase of a 3.7KW, 400V, 3 phase, 4 pole, 50 Hz, squirrel cage I.M to be started by a star-delta starter. Assume flux density in the gap = 0.45 wb/m.sq. ampere conductors per meter = 23000, efficiency = 0.85, p.f = 0.84 choose the main dimensions to give a cheap design. Winding factor = 0.955, stacking factor = 0.9.	11,12	4	**2.1.1**
Define short circuit ratio in connection with 3ph synchronous generators. Explain the factors affecting the short circuit ratio.	13	2	**2.1.1**
Explain the steps for designing of the rotor winding for a turbo alternator	14	2	**2.1.1**
Determine for 500kVA, 6600V, 20Hz, 500 rpm and connected three phase salient pole machine diameter, core length for square pole face, number of stator slots and number of stator conductors for double layer winding. Assume specific magnetic loading = 0.68 tesla, ac = 30000 AC/m and Kws = 0.955.	15	4	**2.1.1**

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	**20**	**20**
CIE-II	**20**	**20**
Assignments/ Quizzes/ Case Study/ Course Project/ Term Paper/Field Work	**10**	**10**
SEE	**100**	**50**
Total	**150**	**100**

Details of Assignment:

Assignment	Marks (10)	CO	PI	CA	PO
Assignment 1: Cross sectional view of dc/ ac machine/ transformer using Auto-CAD	**5**	**1,2,3,4**	**2.1.1**	4.1	1,2
Assignment 2: Poster presentation of All formulae in design of electrical machine	**5**	**1,2,3,4**	**2.1.1**	5.1	2, 4

Faculty In-charge:

Mr. Santhoshkumar S. Kandagal

BASAVESHWAR ENGINEERING COLLEGE (AUTONOMOUS), BAGALKOT
Department OF Electrical and Electronics Engineering

COURSEPLAN

Title of Course	:	**Testing Commissioning of Electrical Equipment**	**Course Code**	:	**21UEE613E**
Credits	:	**03**	**Contact Hours/ Week**	:	**03**
Total Hours	:	**40**	**Tutorial Hours**	:	**00**
CIE Marks	:	**50**	**SEE Marks**	:	**50**
Semester	:	**VI**	**Year**	:	**2023-24**

Prerequisites:

Course Objectives:

	The Course objectives are:
1	The students will acquire the knowledge regarding the fundamentals of Testing and Commissioning of Electrical Equipments.
2	To explore the knowledge of different safety measures to be taken before any electrical Installation.
3	This course will enable the students to understand the concepts, principles and acquire basic skills of installation, commissioning and maintenance of electrical equipments in power stations, substations and industry.

Course Outcomes:

	At the end of the course the student should be able to:
1	Describe the process to plan, control and implement commissioning of electrical equipment's.
2	Differentiate the performance specifications of transformer and induction motor Synchronous machines and switchgear.
3	Demonstrate the routine tests for synchronous machine, induction motor, transformer, switchgears and cables.
4	Describe corrective and preventive maintenance of electrical equipment's. Such as isolators, circuit breakers, cables, induction motor and synchronous machines.

Course Articulation Matrix: Mapping of Course Outcomes (CO) with Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Sl.	Programme Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
1	Describe the process to plan, control and implement commissioning of electrical equipment's.	3	-	-	-	-	-	-	-	-	-	-	1	-	1	1
2	Differentiate the performance specifications of transformer and induction motor Synchronous machines and switchgear.	3	1	-	-	-	-	-	-	-	-	-	1	2	-	1
3	Demonstrate the routine tests for synchronous machine, induction motor, transformer, switchgears and cables.	3	-	2	-	1	-	-	-	-	-	-	1	1	1	1
4	Describe corrective and preventive maintenance of electrical equipment's. Such as isolators, circuit breakers, cables, induction motor and synchronous machines.	3	2	2	2	1	-	-	-	-	-	-	1	1	1	1

Competencies Addressed in the course and Corresponding Performance Indicators

Programme Outcome:Any of 1 to 12 PO's:

PO	Competency		Performance Indicators	
1	1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply elements of electrical engineering principles and laws
	1.4	Demonstrate competence in Electrical engineering knowledge	1.4.1	Apply discipline specific laws and principles to solve an engineering problem
3	3.1	Demonstrate an ability to define a complex open-ended problem in engineering terms	3.1.6	Determine design objectives, functional requirements and arrive at specifications
6	6.1	Demonstrate the ability to describe engineering roles in a broader context, e.g. as pertains to the environment, health, safety, and public welfare	6.1.1	Identify and describe various engineering roles; particularly pertaining to protection of the public and public interest

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply to reason informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO**8. Ethics: ** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Unit Learning Outcomes (ULO):

Sl.	Unit Learning Outcome (ULO)	CO's	BLL	PI addressed
	Unit -I			
1.	Students shall be able to explain the need for standardization of specifications.	**1**	**1**	**3.1.6**
2.	Students shall be able to bring out the standard specification of a power transformer.	**1**	**1**	**3.1.6**
3.	Students shall be able to list the specification of a 3-phase distribution transformer above 100 KVA	**1**	**1**	**3.1.6**
4.	Students shall be able to explain the procurement procedure of the transformer.	**2**	**2**	**1.4.1**
5.	Students shall be able to how the transformer is transported by road, rail, and water.	**2**	**4**	**1.4.1**
6.	Students shall be able to explain the typical rating and terminal plates of a transformer.	**1**	**2**	**3.1.6**
7.	Students shall be able to explain the construction details of tanks and the testing of tanks.	**2**	**3**	**1.4.1**
	Unit -II			
8.	Students shall be able to explain the qualities of good insulating oil.	**2**	**2**	**1.4.1**
9.	Students shall be able to explain different test carried out on power transformer	**3**	**4**	**1.3.1**
10.	Students shall be able to explain the different drying-out methods in power transformer.	**3**	**2**	**1.3.1**
11.	Students shall be able to list the accessories of power transformer.	**2**	**1**	**1.3.1**
12.	Students shall be able to bring out the information to be given during procurement of an induction motor.	**2**	**1**	**1.3.1**
13.	Students shall be able to explain the maintenance of IM	**4**	**2**	**1.4.1**
14.	Students shall be able to explain the foundation details of induction motor.	**5**	**2**	**1.4.1**
15.	Students shall be able to explain the different types of test in IM.	**3**	**4**	**1.3.1**
16.	Students shall be able to explain how rotor balancing is achieved.	**3**	**2**	**1.4.1**
	Unit -III			
17.	Students shall be able to explain the possible troubles, causes and remedies in Induction motor.	**6**	**2**	**6.1.1**
18.	Students shall be able to explain how efficiency of IM is achieved.	**2**	**4**	**1.4.1**

19.	Students shall be able to explain rotor test on IM.	**4**	**2**	**1.3.1**
20.	Students shall be able to explain maintenance of IM is carried out.	**5**	**2**	**1.4.1**
21.	Students shall be able to mention the specification of Synchronous generator.	**1**	**1**	**3.1.6**
22.	Students shall be able to list the steps involved in installation of an alternator.	**4**	**1**	**1.3.1**
23.	Students shall be able to explain the different methods of cooling in alternator.	**2**	**2**	**1.4.1**
24.	Students shall be able to procedure of drying out of synchronous machines.	**2**	**2**	**1.3.1**
Unit -IV				
25.	Students shall be able to inspect the Storage, Transportation and Handling of Cable Equipment.	**4**	**2**	**1.4.1**
26.	Students shall be able to analyse Cable Laying Depths and Clearances from other Services	**3**	**2**	**1.3.1**
27.	Students shall be able to analyse the Cable Jointing and Terminations	**3**	**4**	**1.3.1**
28.	Students shall be able to analyse the Testing and Commissioning of cables.	**1**	**1**	**3.1.6**
29.	Students shall be able to analyse the Location of Faults using Megger,	**3**	**1**	**1.3.1**
30.	Students shall be able to analyse the Effect of Open or Loose Neutral Connections of cables,	**1**	**1**	**3.1.6**

Course Content:

Hrs	Content	Mode of Delivery
1	Introduction to transformer basics	Power Point Presentation
2	Specifications: Power and distribution transformers as per BS standards. Installation: Location, site, selection	
3	foundation details (like bolts size, their number, etc), code of practice for terminal plates,	
4	polarity & phase sequence, oil tanks, drying of windings and general inspection	
5	Following tests as per national & International Standards, volt ratio test, earth resistance,	
6	oil strength, Bucholz& other relays, tap changing gear, fans & pumps, insulation test, impulse test, polarizing index,	
7	load & temperature rise test, Installation	
8	commissioning of transformer, causes and troubles and failures in power	
9	Transformer and maintenance of transformer.	PowerPoint Presentation
10	Transformer and maintenance of transformer.	
11	Specifications: As per BIS standards.	
12	Installation: Physical inspection,	
13	foundation details, alignments, excitation systems,	Lecture combined with discussions
14	cooling and control gear, drying out.	PowerPoint Presentation
15	Commissioning Tests: Insulation, Resistance	
16	measurement of armature & field windings,	
17	waveform & telephone interference tests, line charging capacitance.	Chalk and talk in the classroom
18	Performance tests: Various tests to estimate the performance of generator operations,	
19	slip test, short circuit test, sudden 3 phase short circuit tests,	Lecture combined with discussions
20	vibration test and Abnormal conditions and protection	
21	Specifications: for different types of motors, Duty, I.P. protection. i Installation: Location of the motors	PowerPoint Presentation with AnimatedVideo
22	control apparatus, shaft & alignment for various coupling.	
23	Fitting of pulleys & coupling, drying of windings.	Lecture combined with discussions
24	Mechanical tests for alignment, air gap symmetry, tests or bearings, vibrations & balancing.	PowerPoint Presentation with AnimatedVideo
25	Electrical tests: Insulation test, earth resistance, high voltage test,	PowerPoint Presentation

26	starting up, failure to speed up to take the load,	
27	type of test, routine test	
28	Trouble causes and remedies and protection of induction motor	
29	Trouble causes and remedies and protection of induction motor	PowerPoint Presentation
30	maintenance of motors.	
31	Inspection, Storage, Transportation and Handling of Cables, Cable Handing Equipment,	
32	Cable Laying Depths and Clearances from other Services such as Water Sewerage, Gas, Heating and other Mains,	
33	Series of Power and Telecommunication Cables and Coordination with these Services,	
34	Excavation of Trenches, Cable Jointing and Terminations Testing and Commissioning.	PowerPoint Presentation
35	Location of Faults using Megger,	
36	Effect of Open or Loose Neutral Connections,	
37	Provision of Proper Fuses on Service Lines and Their Effect on System,	
38	Provision of Proper Fuses on Service Lines and Their Effect on System	
39	Causes and Dim, and Flickering Lights	
40	Causes and Dim, and Flickering Lights	

Review Questions:

Sl.	Review Questions	ULO	BLL	PI addressed
1	Explain the various types of cooling of power transformers.	**1**	**2**	**1.4.1**
2	What are the standard specifications of a power transformer?	**1**	**1**	**1.3.1**
3	Mention and explain the typical test carried out on transformer before commissioning.	**4**	**4**	**1.3.1**
4	Explain in detail impulse testing of power insulating oil.	**4**	**2**	**1.3.1**
5	What are the qualities of good insulating oil?	**1**	**1**	**1.3.1**
6	Explain the procedure for drying of windings of transformer with and without oil.	**4**	**2**	**1.4.1**
7	Write a brief note on testing of transformer oil.	**3**	**1**	**1.4.1**
8	Explain the working of a Buchholtz relay with the help of a diagram.	**3**	**2**	**1.3.1**
9	Explain installation, inspection upon arrival at site and storage facility at site.	**3**	**4**	**1.4.1**
10	Explain phasor diagram and phasor groups of a transformer.	**3**	**2**	**1.4.1**
11	Describe testing of transformer oil.	**4**	**4**	**1.3.1**
12	Explain the different drying techniques used in transformers.	**3**	**4**	**1.3.1**
13	What are the precautions to be taken while drying in a transformer?	**3**	**1**	**1.3.1**
14	Explain the various testing techniques used in transformers.	**4**	**2**	**1.3.1**
15	State and explain briefly the types of cooling employed for synchronous generator.	**3**	**2**	**1.4.1**
16	Explain the protection scheme of rotating electric machines.	**3**	**4**	**1.4.1**
17	Describe the negative phase sequence test on synchronous machine.	**3**	**4**	**1.3.1**
18	Explain the different methods of starting of synchronous motors.	**3**	**2**	**1.4.1**
19	Write short note on specification of synchronous motor.	**3**	**1**	**1.4.1**
20	Mention the specification of synchronous generator.	**1**	**1**	**1.4.1**
21	Explain the procedure of inspection of an induction motor prior to its installation at site.	**3**	**2**	**1.3.1**
22	Explain the procedure of erection of induction motor.	**3**	**2**	**1.3.1**
23	Explain the procedure of transport of induction motor.	**3**	**2**	**3.1.6**
24	Explain various mechanical test carried out in induction motor.	**4**	**2**	**1.3.1**
25	State and explain the various ratings of induction motor.	**1**	**2**	**3.1.6**
26	State different types of electrical tests done on induction motor. Explain any one test in detail	**4**	**2**	**1.3.1**
27	Explain the methods of drying out of induction motors.	**3**	**2**	**1.4.1**

28	Explain how to obtain the performance of an induction motor	**3**	**1**	**1.3.1**
29	Explain (i) speed (ii) power factor (iii) efficiency (iv) slip (v) current.	**3**	**2**	**1.3.1**
30	Write explanatory notes on maintenance of circuit breakers.	**5**	**4**	**3.1.6**
31	What are the different methods of laying underground cables?	**3**	**2**	**1.3.1**
32	What is fault detection ? explain fault detection location?	**4**	**2**	**1.3.1**
33	How megger is used to detect faults in underground cables?	**3**	**2**	**1.3.1**
34	Explain the Effect of Open or Loose Neutral Connections in cables	**5**	**4**	**1.4.1**
35	Explain briefly about testing and commissioning of cables	**3**	**2**	**1.3.1**
36	Explain the Causes and Dim, and Flickering Lights	**3**	**2**	**1.3.1**
37	Explain briefly about the handling of cables.	**3**	**2**	**1.3.1**

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	**20**	**20**
CIE-II	**20**	**20**
Assignments/ Quizzes	**10**	**10**
SEE	**100**	**50**
Total	**150**	**100**

Details of Assignment:

Assignment	Marks (5)	CO	PI	CA	PO
Assignment 1	**1**	**1,2,3,4,5,6**	**1.3.1,1.4.1,3.1.6,6.1.1**	**1.3,1.4,3.1.6.1**	**1,3,6**
Quiz 1	**1**	**1,2,3,4,5,6**	**1.3.1,1.4.1,3.1.6,6.1.1**	**1.3,1.4,3.1.6.1**	**1,3,6**

SEE Model Question Paper:

SEE Scheme

Semester end assessment (SEE) is written examination of three hours duration of 100 marks with 50% weightage

Course Utilization for CIE and SEE

Unit	Chapter		Teaching Hours	Number of Questions in SEE		
				CIE-I	CIE-II	
I	**1**	Transformers :	**5**	**01**	**--**	**2**
	2	Commissioning and testing of transformer	**5**	**01**	**--**	
II	**3**	Synchronous Machines	**5**	**01**	**--**	**2**
	4	Commissioning tests	**5**	**01**		
III	**5**	Induction Motors	**5**	**--**	**01**	**2**
	6	Commissioning tests	**5**	**--**	**01**	
IV	**7**	Laying of Underground Cables	**10**	**--**	**02**	**2**

Note:

Consists of **Eight main questions**, minimum one question from each unit and covering entire syllabus, out of which **four questions** are to be answered. All questions carry equal marks of 20 each.

BASAVESHWAR ENGINEERING COLLEGE(AUTONOMOUS), BAGALKOT

MODEL COURSE PLAN

Title of Course	**:**	**Operations Research**	**Course Code**	**:**	**21UEE615E**
Credits	**:**	**3**	**Contact Hours/ Week**	**:**	**3**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**40**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**100**
Semester	**:**	**VI**	**Year**	**:**	**2024**

Prerequisites:

Course Objectives:

	The Course objectives are:
1	To understand the methodology of OR problem solving and formulate linear programming problem.
2	To develop formulation skills in transportation models and finding solutions.
3	To inculcate the game theory formulation in real time problems.
4	To evaluate project management techniques, help in planning and scheduling a project.

Course Outcomes:

	At the end of the course the student should be able to:
1	Identify and develop operational research models from the algebraic linear equations for the real world problems
2	Illustrate the mathematical tools that are needed to solve different optimization problems
3	Find the feasible solution for real time algebraic equationsusing game theory, simplex method & transportation problems
4	Design the PERT network and obtain solution by CPM methods

Course Articulation Matrix: Mapping of Course Outcomes (CO) with Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

		PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
No	Program Outcomes / Course Outcomes															
The students will be able to:																
1	21UEE615E.1	3	1	1			1	1	1		1	1	1	3	1	
2	21UEE615E.2	3	2	2	1	1			1	1	1	1	1	2	3	
3	21UEE615E.3	3	2	3	2				2	2		1	1	1	1	
4	21UEE615E.4	3	3	3	2	1			1	2	2	2	1	1		1

Competencies Addressed in the course and Corresponding Performance Indicators

Programme Outcome:Any of 1 to 12 PO's:

P0	Competency		Indicators
1	Knowledge of Problem-Solving and Analytical Skills		• Ability to identify and define complex operational problems in various contexts (e.g., logistics, manufacturing, healthcare). • Skill in breaking down large-scale problems into manageable components. • Proficiency in formulating appropriate mathematical models to represent real-world scenarios. • Capability to analyse and interpret model results to provide actionable insights.
2	Solution for the numerical using simplex method, Big-M method, Transportation Problem.		• Proficiency in formulating real-world problems as linear programming models. • Identifying special cases such as unboundedness, infeasibility, and degeneracy. • Skill in applying the MODI (Modified Distribution) method or stepping-stone method to optimize transportation costs. •
7	Application of real world examples using game theory and PERT-CPM technique		• Analyzing competitive strategies in business to identify optimal pricing, production, and marketing decisions. • Modeling and resolving conflicts in negotiations and auctions. • Managing large-scale construction projects by optimizing schedules to meet deadlines and budget constraints. • Planning and controlling research and development projects to ensure timely completion and resource utilization.
12	Compare and contrast the		• Differentiate between available optimisation techniques

	different methods of OR		

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Unit Learning Outcomes (ULO):

Sl.	Unit Learning Outcome (ULO)	CO's	BLL	PI addressed
	Unit -I1			
1.	Students should be able to define basic terms associated with models, phases and characteristics of OR	**1**	**1**	**1.1.1**
2.	Students should be able to explain graphical solution, simplex and Big-M method	**2**	**2**	**2.1.2**
3.	Students shouldbe able to assess the scenario of simplex method	**2**	**2**	**1.1.1**
4.	Students should be able to obtain optimal basic feasible solution of OR	**2**	**2**	**1.1.1**

Unit -II				
5.	Students shall be able to formulate duality the available LPP	**1**	**1**	**1.1.1**
6.	Students should be able to find the BFS of dual LPP	**2**	**2**	**1.1.1**
7.	Students should be able to define transportation problem formulation	**2**	**2**	**1.1.4**
8.	Students should be able to obtain solution from stepping stone method, MODI method, theassignmentmodel,travelingsalesmanproblem.	**4**	**4**	**2.2.2**
Unit -III				
9.	Students should be able to describe the formulation of m*n game	**2**	**2**	**1.1.1**
10.	Students should be able to solve the zero-sum game using probability strategy	**2**	**2**	**1.1.1**
11.	Students should be able to obtain solution of real time problems using game theory	**2**	**2**	**2.2.2**
Unit -IV				
12.	Students should be able to describe the working principle of PERT and CPM technique	**2**	**2**	**1.1.1**
13.	Students should be able to represent the network and obtain solution using PERT technique.	**3**	**3**	**2.2.2**
14.	Students should be able to represent the network and obtain solution using CPM technique.	**4**	**4**	**2.2.2**

Course Content:

Hours Required	Topic to be covered	Mode of Delivery
01	Introduction:	Chalk and talk in classroom/Lecture combined with discussions/Lecture with a quiz/ Tutorial/ Assignments/ Demonstration/ Invited lectures/ Group Assignment/
01	Definition, OR models	
01	OR characteristics and phase of OR.	
01	Modeling with linear Programming: formulation of LPP	
01	Graphical LP solution	
01	model in equation from graphical to algebraic solution.	
01	Solution using Simplex method	
01	Solution of electrical examples using simplex method	
01	Solution using Big-M method	
01	Various cases in simplex and Big-M method	
01	Formulation of dual problem primal to dual relationships.	
01	Solution using dual problem primal to dual relationships.	
01	Formulation and Definition of transportation model basic feasible solution by different methods	
01	Optimal solution using Stepping stone method	
01	Optimal solution using MODI method	
01	Optimal solution using assignment method	
01	Optimal solution using Travelling Salesman method	

01	Formulation of two – person	
01	Solution of zero sum games	
01	Solving of m*n game	
01	Obtain the electrical example solution using game theory	
01	Obtain the probability of game theory	
01	Formulation of PERT technique	
01	Network representation using PERT technique	
01	Solution of various networks using PERT technique	
01	Electrical representation using PERT technique	
01	Formulation of CPM technique	
01	Network representation using CPM technique	
01	Solution of various networks using CPM technique	
01	Electrical representation using CPM technique	
01	Various methods in PERT technique	
01	Various methods in CPM technique	
01	Summary of OR	

Review Questions:

<table>
<tr><th>Review Questions</th><th>ULO</th><th>BLL</th><th>PI addressed</th></tr>
<tr><td>Give the different phases of operations research and explain the significance in decision making.</td><td>1</td><td>4</td><td>1.1.1</td></tr>
<tr><td>Briefly outline the various models of operations research</td><td>2</td><td>2</td><td>2.1.2</td></tr>
<tr><td>A paper mill produces two grades of paper namely X and Y. Because of raw material restrictions, it cannot produce more than 400 tons of grade X and 300 tons of grade Y in a week. There are 160 production hours in a week. It requires 0.2 and 0.4 hours to produce a ton of products X and Y respectively with corresponding profits of Rs. 200 and Rs. 500 per ton. Formulate the above as a LPP to maximize profit.</td><td>3</td><td>2</td><td>2.2.2</td></tr>
<tr><td>Explain the solution for the degeneracy in simplex method.</td><td>4</td><td>2</td><td>1.1.1</td></tr>
<tr><td>Solve the following LP problem graphically
Max. $Z= X_1 + X_2$ subject to
$X_1 - X_2 \geq 0$, $-3X_1 + X_2 \geq 3$ and $X_1, X_2 \geq 0$.</td><td>5</td><td>3</td><td>2.2.3</td></tr>
<tr><td>Food X contains 6 units of vitamin A per gram and 7 units of vitamin B per gram and costs 12 paise per gram. Food Y contains 8 units of vitamin A per gram and 12 units of vitamin B and costs 20 paise per gram. The daily minimum requirements of vitamin A and vitamin B are 100 units and 120 units respectively. Find the minimum cost of product mix by Big-M method.</td><td>6</td><td>3</td><td>2.2.3</td></tr>
<tr><td>Obtain the dual of the following LPP,
Min. $Z=2 X_1+3 X_2 + X_3$ subject to $4X_1+ 3X_2+ X_3 =6$, $X_1+2X_2+5X_3=4$, $X_1, X_2, X_3 \geq 0$.</td><td>6</td><td>1</td><td>2.2.2</td></tr>
<tr><td>Explain the mathematical formulation of transportation problem.</td><td>6</td><td>1</td><td>1.1.4</td></tr>
<tr><td>Find the basic feasible solution by Vogel'sapproximation and optimal solution by MODI method:
<table>
<tr><th></th><th>W1</th><th>W2</th><th>W3</th><th>Capacity</th></tr>
<tr><td>O1</td><td>2</td><td>7</td><td>4</td><td>5</td></tr>
<tr><td>O2</td><td>3</td><td>3</td><td>1</td><td>8</td></tr>
<tr><td>O3</td><td>5</td><td>4</td><td>7</td><td>7</td></tr>
<tr><td>O4</td><td>1</td><td>6</td><td>2</td><td>14</td></tr>
<tr><td>Required</td><td>7</td><td>9</td><td>18</td><td>34</td></tr>
</table></td><td>5</td><td>1</td><td>2.2.4</td></tr>
<tr><td>Derive the mathematical formulation of an assignment problem by briefing the objective functions and constraints.</td><td>7</td><td>1</td><td>2.2.3</td></tr>
<tr><td>Obtain the optimum solution of transportation problem using stepping stone method.
<table>
<tr><th>Sources</th><th>D</th><th>E</th><th>F</th><th>G</th><th>Capacity</th></tr>
<tr><td>A</td><td>4</td><td>6</td><td>8</td><td>6</td><td>700</td></tr>
<tr><td>B</td><td>3</td><td>5</td><td>2</td><td>5</td><td>400</td></tr>
<tr><td>C</td><td>3</td><td>9</td><td>6</td><td>5</td><td>600</td></tr>
<tr><td>Requirements</td><td>400</td><td>450</td><td>350</td><td>500</td><td></td></tr>
</table></td><td>8</td><td>1</td><td>2.2.2</td></tr>
<tr><td>Solve the travelling-salesman problem given in the matrix shown below.
From / To
1 2 3 4 5</td><td>10</td><td>2</td><td>2.2.2</td></tr>
</table>

	1	∞	6	12	6	4			
	2	6	∞	10	5	4			
	3	8	7	∞	11	3			
	4	5	4	11	∞	5			
	5	5	2	7	8	∞			

Solve the following problem by revised simplex method, **Max. $Z = X_1 + 2X_2$, subject to** **$X_1 + X_2 \leq 3$, $X_1 + 2X_2 \leq 5$, $3X_1 + X_2 \leq 6$, $X_1, X_2 \geq 0$.**	9	4	2.2.2
Explain the mathematical formulation of dual simplex method.	10	2	1.1.4
In a game of matching coins with two players, suppose one player wins Rs.2 when there are two heads and wins nothing when there are two tails, and losses Rs.1 when there are one head and one tail. Determine the payoff matrix, the best strategies for each player and the value of the game.	11	2	2.2.2
Define the following: Competitive game &payoff matrix.	12	2	1.1.4
Solve the following game graphically **Player B** **Player A** **B1: A1 1, A2 4, A3 9, A4 -3, A5 2** **B2: A1 2, A2 5, A3 -7, A4 -4, A5 1**	12	3	2.2.2
Describe the common errors with neat diagram while developing networks.	13	2	1.1.4
The table given below provides cost and time estimates for a project. **I. Draw the network and indicate critical path** **II. Evaluate the total float and free float for each activity, find the optimum duration of the project and the optimum cost by crashing.**	14	4	4.1.2
The table below shows the jobs of a network along with their time estimates.	14	4	4.1.2

Activity	Preceding Activity	Time estimate(days)		Direct cost estimate	
		Normal	Crash	Normal	Crash
1-2	----	20	17	600	720
1-3	-----	25	25	200	200
2-3	(1-2)	10	8	300	440
2-4	(1-2)	12	6	400	700
3-4	(1-3),(2-3)	5	2	300	420
4-5	(2-4),(3-4)	10	5	300	600

Jobs	1-2	1-6	2-3	2-4	3-5	4-5	6-7	5-8	7-8
a	3	2	6	2	5	3	3	1	4
m	6	5	12	5	11	6	9	4	19
b	15	14	30	8	17	15	27	7	28

(i) Draw the network **(ii) Calculate the length and variance of the critical path** **What is the approximate probability that the jobs on the critical path will be completed in 41 days.**			
List the differences between PERT and CPM	14	3	2.2.3

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	**22.5**	**22.5**
CIE-II	**22.5**	**22.5**
Assignments/ Quizzes	**05**	**05**
SEE	**100**	**50**
Total	**150**	**100**

Details of Assignment:

Assignment	Marks (05)	CO
Assignment 1	1.25	1,3,4
Assignment 2	1.25	2,3,4
Quiz 1	2.5	1,2,3
Quiz 2	2.5	4,3,4

SEE Model Question Paper:

SEE Scheme

Semester end assessment (SEE) is written examination of three hours duration of 100 marks with 50% weightage

Course Utilization for CIE and SEE

Unit	Chapter		Teaching Hours	Number of Questions in		Number of Questions in SEE
				CIE-I	CIE-II	
I	1	OR Models, phases, characteristics, formulation and solution of LPP by graphical method	5	04		2.0
	2	LPP solution by Simplex and Big-M method	5			
II	3	Duality of LPP	5			2.0
	4	TransportationModel:	5			
III	5	Game Theory	10		04	2.0
IV	6	PERT	6	-		2.0
	7	CPM technique	4	-		

BASAVESHWARENGINEERINGCOLLEGE, BAGALKOTE

COURSEPLAN– 21UEE631N

Title of Course	**:**	**Renewable Energy Sources**	**Course Code**	**:**	**21UEE631N**
Credits	**:**	**3**	**Contact Hours/ Week**	**:**	**3**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**40**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**100**
Semester	**:**	**VI**	**Year**	**:**	**2024**

Prerequisites: Basic information on the sources of conventional energy sources.

Course Objectives:

	The Course objectives are:
1	To identify the parameters required for solar, wind, biomass, geothermal and ocean energy conversion systems.
2	To apply and analyse concepts and theory related to solar, wind, biomass, geothermaland ocean energy conversion systems
3	To derive power output of solar and wind energy conversion systems based on thecorresponding solar irradiation and wind speed respectively
4	To analyse pros and cons of solar, wind, biomass, geothermal and ocean energyconversion systems

Course Outcomes:

	At the end of the course the student should be able to:
1	List and define various parameters and features of solar, wind, biomass, geothermal and ocean energy conversion system.
2	Explain the various concepts and theory related to solar, wind, biomass, geothermal and ocean energy conversion system.
3	Evaluate/Calculate various parameters related to solar and wind energy conversion system.
4	Relate/articulate the concepts and theories related to solar, wind, biomass, geothermal and ocean energy conversion system.

Course Articulation Matrix: Mapping of Course Outcomes (CO) with Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

		PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
No	PO'S CO'S															
The students will be able to:																
1	21UEE631N.1	3	1					1	1				1			
2	21UEE631N.2	3	1					2	1				1			
3	21UEE631N.3	3	2					2	1	1			1			
4	21UEE631N.4	3	3					2	1				1			

Competencies Addressed in the course and Corresponding Performance Indicators

Programme Outcome:Any of 1 to 12 PO's:

PO	Competency		Performance Indicators	
1	1.2	Demonstrate the competence in basic sciences	1.2.1	Apply laws of natural science to an engineering problem
	1.3	Demonstrate the competence in engineering fundamentals	1.3.1	Apply fundamental engg. concepts to solve engineering problems
2	2.1	Demonstrate an ability to identify & compose engineering problem	2.1.1	Articulate problem statement and identify objectives
	2.2	Demonstrate an ability to formulate a solution plan and methodology for an engineering plan	2.2.3	Identify existing processes/solution methods for solving problem, including forming justified approximations and assumptions
			2.2.4	Compare and contrast alternative solution processes to select the best process
7	7.1	Demonstrate an understanding of impact of engineering & industrial practices on social, environmental and in economic contexts	7.1.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
	7.2	Demonstrate an ability to apply principles of sustainable design and development	7.2.1	Describe management technique for sustainable development
			7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the

				discipline
8	8.1	Demonstrate an ability to recognize ethical dilemmas	8.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
9	9.1	Demonstrate an ability form a team and define a role for each member	9.1.2	Implement the norms of practice of effective team work to accomplish a goal
	9.3	Demonstrate success in a team-based project	9.3.1	Present result as a team, with smooth integration of contribution from all individual efforts.
12	12.1	Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
	12.2	Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
			12.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in electrical engineering area
	12.3	Demonstrate an ability to identify and access sources for new information	12.3.2	Analyse sourced technical and popular information for feasibility, viability, sustainability etc.

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Unit Learning Outcomes (ULO):

Sl.	Unit Learning Outcome (ULO)	CO's	BLL	PI addressed
	Unit-I			
1.	Students should be able to define basic terms associated with conventional and non-conventional energy sources.	**1**	**1**	**1.2.1**
2.	Students should be able to classify the energy sources based on various parameters such as availability, usability etc.	**1**	**2**	**2.1.1**
3.	Students should be able to distinguish between conventional and non-conventional energy sources.	**1**	**2**	**2.2.3**
4.	Students should be able to survey the scenario of renewable energy sources in global and India.	**1**	**4**	**1.3.1**
5.	Students should be able to define the basic sun earth	**1**	**1**	**2.1.1**

	angles that are important for solar radiation analysis.			
6.	Students should be able to state and illustrate the solar radiation data in terrestrial and extra-terrestrial region.	**2**	**2**	**1.3.1**
7.	Students should be able to explain the construction and working methodology of various equipments used in the measurement of solar radiation.	**2**	**2**	**2.1.1**
8.	Students should be able to solve various sun-earth angles on the horizontal area as well as tilted area with respect to earth's surface.	**3**	**3**	**1.3.1**
9.	Students should be able to outline the principle of conversion of solar radiation into heat energy.	**2**	**2**	**7.2.2**
10.	Students should be able to summarize the constructional features and operation of flat plate solar water heater.	**2**	**2**	**2.2.3**
11.	Students should be able to list and explain the various types of solar cookers.	**2**	**2**	**7.2.2**
12.	Students should be able to compare the working methodologies of solar drier and solar still.	**4**	**2**	**1.2.1**
Unit -II				
13.	Students should be able to list and describe the various solar thermal electric power generation methods.	**2**	**2**	**7.2.2**
14.	Students should be able to summarize the advantages and disadvantages of solar thermal electric power generation methods.	**2**	**2**	**7.2.1**
15.	Students should be able to illustrate the fundamentals of solar cell operation in electricity generation.	**2**	**2**	**7.1.2**
16.	Students should be able distinguish between solar cell, solar panel and solar array.	**4**	**4**	**1.2.1**
17.	Students should be able to develop street lighting, domestic lighting and water pumping system using the solar photovoltaic systems.	**2**	**3**	**7.2.2**
18.	Students should be able to recall the properties of wind and history of wind energy.	**2**	**1**	**1.2.1**
19.	Students should be able to explain the basic principles of wind energy conversion system.	**2**	**2**	**7.2.2**
20.	Students should be able to classify the wind energy conversion system.	**2**	**2**	**7.1.2**
21.	Students should be able to solve for the amount of power that can be obtained from the wind.	**3**	**3**	**7.2.2**
22.	Students should be able to list the advantages and disadvantages of wind energy conversion system.	**2**	**1**	**7.2.1**

Unit -III				
23.	Students should be able to explain the photosynthesis process.	**2**	**2**	**1.2.1**
24.	Students should be able to outline the Biomass conversion technologies.	**2**	**2**	**2.2.3**
25.	Students should be able to illustrate the principle and working of Gasifiers.	**2**	**2**	**1.3.1**
26.	Students should be able to summarize the biogas production process.	**2**	**2**	**1.2.1**
27.	Students should be able to interpret the factors affecting the biogas generation.	**2**	**2**	**1.3.1**
28.	Students should be able to demonstrate the different types of Biogas plants.	**2**	**2**	**1.2.1**
29.	Students should be able to summarize geothermal energy resources.	**2**	**2**	**1.3.1**
30.	Students should be able to list the advantages and disadvantages of geothermal energy resources.	**4**	**1**	**1.2.1**
31.	Students should be able to infer the applications of geothermal energy resources.	**2**	**2**	**1.3.1**
Unit -IV				
32.	Students should be able to illustrate the working principle of tidal power plant.	**2**	**2**	**7.1.2**
33.	Students should be able to list the components employed in tidal power plant.	**1**	**1**	**7.2.1**
34.	Students should be able to classify the various tidal power plant.	**1**	**2**	**7.2.2**
35.	Students should be able to summarize the advantages and limitations of tidal power plant.	**4**	**2**	**7.1.2**
36.	Students should be able to explain the working principle of ocean thermal energy conversion system.	**2**	**2**	**1.2.1**
37.	Students should be able to illustrate the various power generation methods of ocean thermal energy conversion system.	**2**	**2**	**1.3.1**
38.	Students should be able to summarize the advantages and limitations of ocean thermal energy conversion system.	**4**	**2**	**7.2.2**
39.	Students should be able to explain the working principle of fuel cell technology in electricity generation.	**2**	**2**	**1.3.1**
40.	Students should be able to describe the working principle of wave energy in electricity generation.	**2**	**2**	**1.2.1**

Course Content:

Unit-1	(10 Hours)
Introduction to the Energy Sources: Classification of energy resources, Conventional Energy Resources – Availability and their limitations, Non-Conventional Energy Resources – Classification, Advantages and Limitations, Comparison of Conventional and Non-Conventional Energy Resources. **Solar Energy Basics:** Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representations, solar radiation geometry (only theory), measurement of solar radiation data – Pyranometer and Pyrheliometer. **Solar Thermal System:** Principle of Conversion of Solar Radiation into Heat, Solar Water Heater (Flat Plate Collectors), Solar Cookers – Box Type, Concentrating dish type, Solar driers, Solar Still.	
Unit-2	**(10 Hours)**
Solar Electric Systems: Solar Thermal Electric Power Generation, Solar Pond and Concentrating Solar Collector (Parabolic trough, parabolic dish, central tower collector), Advantages and Disadvantages; Solar photovoltaic – Solar Cell fundamentals, module, panel and array. Solar PV Systems – street lighting, domestic lighting and solar water pumping systems. **Wind Energy:** Wind and its properties, History of wind energy, Basic principles of wind energy conversion system (WECS), classification of WECS, parts of WECS, Derivation for power in the wind, Advantages and Disadvantages of WECS.	
Unit-3	**(10 Hours)**
Bio-Mass Energy: Introduction, Photosynthesis process, Biomass conversion technologies, Biomass gasification – Principle and working of Gasifiers, Biogas – production of biogas, factors affecting biogas generation, types of biogas plants – KVIC and Janata Model. **Geothermal Energy:** Introduction, Geothermal resources (brief description), advantages and disadvantages, Application of Geothermal Energy.	
Unit-4	**(10 Hours)**
Energy from Ocean: Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Advantages and Limitation of TPP. **Ocean Thermal Energy Conversion (OTEC):** Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC), Advantages and limitations of OTEC. **Emerging Technologies:** Fuel Cell, Wave Energy (principle of Energy Generation using block diagram, Advantages and Limitations)	

Course Content Delivery:

Sl No.	Hours Required	Topic to be covered	Mode of Delivery
1	01	Introduction to Energy Sources	PPT, Discussions

2	01	Conventional energy resources	PPT, Discussions
3	01	Non-conventional energy resources	PPT, Discussions
4	01	Comparison of conventional and non-conventional energy resources.	PPT, Discussions
5	01	Introduction to the solar energy	PPT, Discussions
6	01	Basic sun-earth angles	PPT, Discussions
7	01	Numerical on sun-earth angles	PPT, Discussions
8	01	Solar radiation measurement	PPT, Discussions
9	01	Conversion of solar radiation into heat	PPT, Discussions
10	01	Solar Cooker, Solar drier and solar still	PPT, Discussions
11	01	Introduction to solar thermal power generation	PPT, Discussions
12	01	Solar pond and concentrating solar collector	PPT, Discussions
13	01	Introduction to the solar photovoltaic systems	PPT, Discussions
14	02	Solar cell fundamentals and its characteristics	PPT, Discussions
15	01	Difference between solar cell, panel, module & array	PPT, Discussions
16	01	Applications of solar photovoltaic system	PPT, Discussions
17	01	Introduction to the wind and its properties	PPT, Discussions
18	01	Principle of wind energy conversion system (WECS)	PPT, Discussions
19	01	Classification and parts of WECS	PPT, Discussions
20	01	Derivation of power in wind and its numerical	PPT, Discussions
21	01	Introduction to the Biomass energy	PPT, Discussions
22	01	Photosynthesis process	PPT, Discussions
23	01	Biomass conversion technologies	PPT, Discussions
24	01	Biomass gasification	PPT, Discussions
25	01	Principle and working of gasifiers	PPT, Discussions
26	01	Production of biogas	PPT, Discussions
27	01	Types of biogas plants	PPT, Discussions
28	01	Introduction to the geothermal energy	PPT, Discussions
29	01	Geothermal resources	PPT, Discussions
30	01	Advantages, limitations and applications	PPT, Discussions
31	01	Introduction to the tidal energy	PPT, Discussions
32	01	Components of tidal power plant &its working	PPT, Discussions
33	01	Classifications of tidal power plants	PPT, Discussions
34	01	Introduction to ocean thermal energy conversion	PPT, Discussions
35	02	Methods of OTEC power generation	PPT, Discussions
36	01	Advantages, limitations and applications	PPT, Discussions
37	01	Introduction to the fuel cell and wave energy	PPT, Discussions
38	01	Conversion of wave energy & fuel cell into electricity	PPT, Discussions
39	01	Advantages, limitations and applications	PPT, Discussions

Review Questions:

Qn No.	Review Questions	CO	BLL	PI addressed
1	Explain the classification of energy resources	1	2	1.4.1
2	Discuss about Indian renewable energy availability	1	2	2.4.4

3	What are the advantages and disadvantages of non-conventional energy sources?	1	2	2.2.4
4	Explain the process of earth's albedo in sun earth relationship.	2	2	1.3.1
5	With respect to solar radiation geometry, define the following: (i). Declination angle (ii). Latitude angle (iii). Solar altitude angle and (iv). Surface azimuth angle	1	2	1.1.2
6	With a neat diagram, explain how Pyrheliometer can be used to measure beam radiation.	2	2	1.4.1
7	With the help of neat diagram, explain Box type Solar Cooker.	2	2	1.4.1
8	Define solar constant. What are the reasons for variation in solar radiation reaching the earth than received outside the atmosphere?	1	1	2.2.4
9	Compare conventional and non-conventional energy sources.	4	2	2.2.4
10	Write a short note on (i). Solar Dryer and (ii). Solar Cooker	1	2	2.4.4
11	With a neat diagram, explain working of Pyranometer.	2	2	1.4.1
12	What is solar still? With neat diagram explain its working in detail.	1	3	1.4.1
13	Give the detailed classification of solar thermal collectors and with a neat diagram, explain the constructional details of a flat plate collector.	2	2	2.2.4
14	Draw a schematic diagram of solar pond-based power plant and explain its working.	2	2	1.4.4
15	What are the advantages and disadvantages of concentrating collectors over flat plate collectors?	4	2	2.2.4
16	With a neat diagram, explain the working of wind energy conversion systems.	2	2	1.4.1
17	Using the fundamentals of kinetic energy, derive the expression for power in the wind.	3	3	1.2.1
18	Sketch with a neat diagram of horizontal axis wind turbine and explain the function of its main components.	2	2	1.4.1
19	Define solar module, panel and array.	1	2	1.1.2
20	With a neat diagram, write note on domestic and solar water pumping system.	2	2	2.4.4
21	Explain the mechanism of photoconduction in PV cell. List the advantages and disadvantages of solar PV direct energy conversion system over the conventional power generation system.	2	3	2.2.4
22	Explain the process of photosynthesis in detail with necessary reactions used in biomass energy.	4	2	1.4.1
23	Explain the biogas production from waste biomass.	2	2	1.4.1
24	With a neat diagram, explain the working of KVIC biogas plant.	2	2	1.4.1
25	List and explain the factors affecting biogas yield in a	2	3	2.4.4

	biogas digester.			
26	What are the geothermal resources? Explain.	1	2	1.4.1
27	List the advantages and disadvantages of geo thermal energy and explain its applications.	2	4	2.2.4
28	Explain the operation of flash steam geothermal power plant with diagram.	2	4	1.4.1
29	Explain with a neat sketch updraft and down draft gasifiers.	2	2	1.4.1
30	List and discuss the various stages involved in geothermal explorations.	4	3	2.4.4
31	Explain the components of tidal power plants.	2	2	1.4.1
32	Explain the types of ocean thermal energy conversion power generation plants.	2	2	1.4.1
33	Write a short note on OTEC energy utilization	2	1	1.4.1
34	Explain the operation of oscillating water column type of wave energy conversion device with necessary diagram.	1	3	1.4.1
35	List and discuss various fuels used in fuel cells.	2	2	2.2.4
36	List the advantages and limitations of wave energy conversion.	4	1	2.2.4

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	**20**	**20**
CIE-II	**20**	**20**
Assignments/ Quizzes/ Case Study/ Course Project/ Term Paper/Field Work	**10**	**10**
SEE	**100**	**50**
Total	**150**	**100**

Details of Assignment:

Assignment	Marks (10)	CO	PI	CA	PO
Assignment 1	**5**	**3,4**	1.2.1, 2.1.1	1.1, 2.1	1,2
Assignment 2	**5**	**3,4**	2.1.2, 4.1.1	2.1, 4.1	2, 4

Faculty Incharge:

(Mr. Basavaraju S. Hadapad)

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOT

COURSE PLAN - UEE732N

Title of Course	**:**	**Electrical Safety for Engineers (Open Elective)**	**Course Code**	**:**	**21UEE632N**
Credits	**:**	**3**	**Contact Hours/ Week**	**:**	**3**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**--**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**50**
Semester	**:**	**VI**	**Year**	**:**	**2023-2024**

Prerequisites:

Basics of electrical engineering, Concept of current, voltage and potential difference, Concept of AC and DC voltages, Working principle of electrical generator and motors, Transformer,

Course Objectives:

	The Course objectives are:
1	To identify the hazards associated with electricity - shock & fire and decide security measures in electrical safety systems
2	To describe how electricity works regarding hazards on the job and explain approaches to prevent accidents in electrical systems
3	To understand basic safety controls and practices at work and understand the methods to rescue & first aid approaches in case of electrical accidents
4	To identify and explain how to respond to electrical emergencies

Course Outcomes:

	At the end of the course the student should be able to:
1	Identify the type of the electric shock and suggest probable electric safety & security measures in the given electric system
2	Analyse the safety & grounding requirements in Residential, Commercial, Agricultural installations and suggest best practices with use of electricity
3	Carry out detailed fault investigation and suggest the methods to rescue & first aid approaches in case of electrical accidents
4	Analyse the need for safety devices and requirements in the electric systems

Course Articulation Matrix: Mapping of Course Outcomes (CO) with Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Sl.	PO's / CO's															
The students will be able to:																
1	22UEE632N.1	**3**	**1**		**1**		**1**		**1**				**3**			
2	22UEE632N.2	**3**	**3**	**2**	**2**		**1**		**1**				**1**			
3	22UEE632N.3	**3**	**3**	**2**	**2**		**1**		**1**				**1**			
4	22UEE632N.4	**3**	**1**		**1**		**1**		**1**				**1**			

Competencies Addressed in the course and Corresponding Performance Indicators

Programme Outcome: Any of 1 to 12 PO's:

PO	Competency		Performance Indicators	
1	1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply elements of electrical engineering principles and laws
	1.4	Demonstrate competence in Electrical engineering knowledge	1.4.1	Apply discipline specific laws and principlesto solve an engineering problem
2	2.1	Demonstrate an ability to identify and characterize an engineering problem	2.1.1	Evaluate problem statements and Identify objectives
4	4.1	Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1	Define a problem for purpose of investigation, its scope and importance
	4.3	Demonstrate an ability to critically analyze data to reach a valid conclusion	4.3.1	Use appropriate procedures, tools and techniques to collect and analyse data
6	6.1	Demonstrate the ability to describe engineering roles in a broader context, e.g. as pertains to the environment, health, safety, and public welfare	6.1.1	identify and describe various engineering roles; particularly pertaining to protection of the public and public interest
9	9.2	Demonstrate effective individual & team operations -- communication, problem solving, resolution & leadership skills	9.2.1	Demonstrate effective communication, problem solving, conflict resolution and leadership skills

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Unit Learning Outcomes (ULO):

Sl.	Unit Learning Outcome (ULO)	CO's	BLL	PI addressed
	Unit -II			
1.	Students shall be able to define basic terms associated with electrical safety	**1**	**1**	**1.4.1**
2.	Students shall be able to list OSHA standards on electrical safety, objectives of safety and security measures	**1**	**1**	**1.3.1**
3.	Students shall be able to illustrate hazards associated with electric current and voltage	**1**	**2**	**2.1.1**
4.	Students shall be able to identify approaches to prevent accidents	**1**	**3**	**2.1.1**
5.	Students shall be able to list the Indian electricity rules for the said scenario	**1**	**2**	**6.1.1**
6.	Students shall be able to differentiate between primary and secondary electrical shocks	**1**	**2**	**1.4.1**
7.	Students shall be able to carry out medical analysis of electric shocks on the human body	**1**	**3**	**2.1.1**
8.	Students shall be able to suggest safety precautions against contact shocks, flash shocks	**1**	**4**	**9.2.1**
	Unit –II			
9.	Students shall be able to list and suggest first principles of actions after electric shock	**2**	**1**	**1.3.1**
10.	Students shall be able to illustrate first aid-artificial respiration methods	**2**	**2**	**1.4.1**
11.	Students shall be able to carry out accident management and safety management	**2**	**3**	**2.1.1**
12.	Students shall be able to justify the need for earthing, types of earthing	**2**	**3**	**2.1.1**
13.	Students shall be able to distinguish between system grounding and equipment grounding,	**2**	**2**	**4.1.1**
14.	Students shall be able to differentiate shocks due to step and touch potential	**2**	**2**	**4.3.1**
15.	Students shall be able to suggest methods to avoid the step potential shocks	**2**	**4**	**4.3.1**
16.	Students shall be able to list advantage of neutral grounding	**2**	**2**	**2.1.1**
	Unit –III			
17.	Students shall be able to identify the type of domestic wiring methods and installations	**3**	**2**	**2.1.1**
18.	Students shall be able to suggest safety requirements in domestic wiring systems	**3**	**2**	**1.3.1**

19.	Students shall be able to identify the solutions for the shocks from domestic equipment-water taps, wet walls-agricultural pumps	**3**	**3**	**1.4.1**
20.	Students shall be able to identify types of cables and specifications	**3**	**2**	**2.1.1**
21.	Students shall be able to list the best practices with use of electricity	**3**	**2**	**4.3.1**
22.	Students shall be able to conduct and write investigation report	**3**	**4**	**4.3.1**
23.	Students shall be able to conduct case studies of accidents in HESCOM/GESCOM region	**3**	**4**	**4.3.1**
24.	Students shall be able to carry out investigation for the case study taken up at HESCOM or GESCOM	**3**	**4**	**4.3.1**
	Unit –IV			
25.	Students shall be able to describe the needs for safety devices in electrical systems	**4**	**2**	**1.3.1**
26.	Students shall be able to identify safety clearances and creepage distances in electrical plants	**4**	**2**	**2.1.1**
27.	Students shall be able to list types insulators and their significance	**4**	**1**	**2.1.1**
28.	Students shall be able describe arc phenomenon and principles of arc extinction	**4**	**2**	**4.1.1**
29.	Students shall be able to describe operation of oil & air blast breakers	**4**	**2**	**1.3.1**
30.	Students shall be able to describe fundamental requirements of relaying	**4**	**2**	**1.4.1**
31.	Students shall be able describe the protection of alternators, transformers, bus bars and lines	**4**	**2**	**2.1.1**
32.	Students shall be able describe protection against over voltages.	**4**	**2**	**2.1.1**

Course Content:

Hours Required	Topic to be covered	Mode of Delivery
01	Introduction to electrical safety, shocks and prevention	Ppt
01	OSHA standards on electrical safety, objectives of safety	Ppt
01	Hazards associated with electric current and voltage	Ppt
01	Principles of safety, approaches to prevent accidents	Ppt, Discussions
01	Review of IE rules & acts	Ppt
01	Primary and secondary electrical shocks	Ppt
01	Possibilities of getting electrical shock and its severity	Ppt
01	Medical analysis of electric shocks and its effects	Ppt, Discussions
01	Shocks due to flash/ spark over's	Ppt
01	Prevention of shocks	Ppt
01	Safety precautions against contact shocks, flash shocks	Ppt
01	Introduction to first aid in case of electric shock	Ppt
01	First principles of actions after electric shock	Ppt
01	First aid-artificial respiration methods	Ppt
01	Cardiac pulmonary resuscitation	Ppt
01	Accident management and safety management	Ppt, Discussions
01	Earthing, need for earthing, types of earthing	Ppt
01	Distinction between system and equipment grounding	Ppt
01	Functional requirement of earthing system	Ppt
01	Technical consideration of station earthing system	Ppt

01	Step and touch potential	Ppt
01	Neutral grounding and its advantages	Ppt
01	Domestic wiring methods and installations	Ppt
01	Shocks from domestic equipment-water taps	Ppt, Discussions
01	Shocks - wet walls-agricultural pumps	Ppt, Discussions
01	Types of cables and specifications, underground cables	Ppt
01	Best practices with use of electricity	Ppt
01	Investigation of accidents	Ppt, Discussions
01	Investigation report writing	Ppt
01	Case studies of accidents in HESCOM/GESCOM region	Ppt, Discussions
01	Case studies of accidents in HESCOM/GESCOM region	Ppt, Discussions
01	Case studies of accidents in HESCOM/GESCOM region	Ppt, Discussions
01	Safety devices and their characteristics	Ppt
01	Safety clearances & creepage distances in electrical plants	Ppt
01	Line supports and insulators	Ppt
01	Circuit breakers: arc phenomenon, arc extinction	Ppt
01	Oil & air blast breakers	Ppt
01	Fundamental requirements of relaying and classification	Ppt
01	Protection of alternators, transformers, bus bars and lines	Ppt
01	Protection against over voltages	Ppt

Chalk and talk in classroom/Lecture combined with discussions/Lecture with a quiz/ Tutorial/ Assignments/ Demonstration/ Invited lectures/ Group Assignment/ Project / Seminars, Presentations/Group Discussion/Asynchronous Discussion

Review Questions:

Review Questions	ULO	BLL	PI addressed
1. What are electrical accidents? List the causes for electrical accidents. Further, describe the key approaches to prevent accidents.	**4**	**3**	**2.1.1**
2. Give a list of possible accidents during the electrical installations. Further list the probable reasons for such accidents.	**5**	**2**	**6.1.1**
3. Explain the principle of unsafe acts and unsafe conditions behind electrical accident. Give an example.	**8**	**4**	**9.2.1**
4. Describe the resistance of human body under different conditions. Further, illustrate the effect of body resistance on electric shock. Also list the nominal resistance values for various parts of the human body.	**7**	**3**	**2.1.1**
5. With a neat descriptive figure list and explain the electric shock scenarios with 3 phase AC systems and bipolar DC system.	**6**	**2**	**1.4.1**
6. With details of current magnitude and detailed medical analysis of shock, illustrate the effect of electrical current on the human body.	**7**	**3**	**2.1.1**
7. Differentiate between touch potential and step potential? Describe their significance. Further, list the precautions to be taken under the conditions of accidents leading to step potential shocks.	**15**	**4**	**4.3.1**
8. List the first principles of action to be followed to save the life immediately after electric shock.	**9**	**1**	**1.3.1**
9. Explain the process of CPR-Cardiac pulmonary resuscitation and how it helps to prevent death.	**10**	**2**	**1.4.1**

10. List and explain the details of electrical safety measures employed in BEC camps. Further, mention the location of respective safety measures initiated.	**13**	**2**	**4.1.1**
11. Distinguish between system grounding (neutral grounding) and equipment grounding.	**13**	**2**	**4.1.1**
12. List and explain important electrical safety measures with reference to wirings and fittings in domestic systems.	**19**	**3**	**1.4.1**
13. Describe the precautions to be taken while carrying agricultural pump installation and operations to avoid electric accidents.	**19**	**3**	**1.4.1**
14. Describe the reasons and tips to avoid the following types of electric shock scenarios. • Water Tap Giving Shock • Shock From Wet Wall • Table Fan Giving Shock • Shock From Motor-Pump	**19**	**3**	**1.4.1**
15. What is electrical accident Investigation? Illustrate the need for the conducting the investigation.	**22**	**4**	**4.3.1**
16. List the components to be included in the electrical accident investigation kit. Discuss the need for each component.	**22**	**4**	**4.3.1**
17. Write the descriptive note on electrical accident happened with flagpole in Koppal in the year 2019. List the causes for the accident. Further, list precautions to be taken in such scenarios to avoid the electrical accidents.	**22**	**4**	**4.3.1**
18. List and explain the factors affecting the choice of wiring methods for a domestic electricity connection.	**21**	**2**	**4.3.1**
19. List the square mm cross section of electrical conductors and their applications in terms of load connections.	**25**	**2**	**1.3.1**
20. With neat diagram of cross section explain the Aluminum Conductor Steel-Reinforced (ACSR) Cable. List its advantages.	**25**	**2**	**1.3.1**
21. Conduct the critical survey and identify the electrical safety issues in BEC Campus. (With the mention of location in the campus)	**22**	**4**	**4.3.1**
22. Case Study Activity based Learning in HESCOM and GESCOM Region	**22**	**4**	**4.3.1**
23. Discuss the different types of porcelain insulators employed in electrical power systems. Describe the significance of each type.	**25**	**2**	**1.3.1**
24. Explain with a neat diagram the application of Merz-Price circulating current principle for the protection or alternator.	**31**	**2**	**2.1.1**
25. Explain the construction and working principle of SF_6 circuit breakers.	**31**	**2**	**2.1.1**
26. What is protective relay? Explain its function in an electrical system.	**31**	**2**	**2.1.1**

Evaluation Scheme:

Assessment	Marks	Weightage
CIE-I	**20**	**20**
CIE-II	**20**	**20**
Assignments/ Quizzes/ Case Study/ Course Project/ Term Paper/Field Work	**10**	**10**
SEE	**100**	**50**
Total	**150**	**100**

Details of Assignment:

Assignment	Marks (10)	CO	PI	CA	PO
Assignment 1 (Write and Submit)	02	1,2,3,4	1.4.1, 1.3.1, 2.1.1, 4.1.1		Po1, PO2, PO4
Assignment 2 (Write and Submit)	02	1,2,3,4	1.4.1, 1.3.1, 2.1.1, 4.3.1		PO1, PO2, PO4
Assignment 3 (Case Study in BEC)	02	1,2,3,4	4.3.1, 6.1.1		PO4, PO6
Assignment 4 (Case Study ESCOM's)	02	1,2,3,4	4.3.1, 6.1.1		PO4, PO6
Assignment 5 (Quiz)	02	1,2,3,4	1.4.1, 1.3.1, 2.1.1, 4.1.1		PO1, PO2, PO4

Dr. Basanagouda F Ronad