BASAVESHWAR ENGINEERING COLLEGE(AUTONOMOUS), BAGALKOT

DEPARTMENT ELECTRICAL AND ELECTRONICSENGINEERING

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	**:**	**VI**	**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 Theoryapplied 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)

CourseOutcomes -ProgrammeOutcomesMappingTable

Sl.	CourseOutcomes	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 numericalon 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**

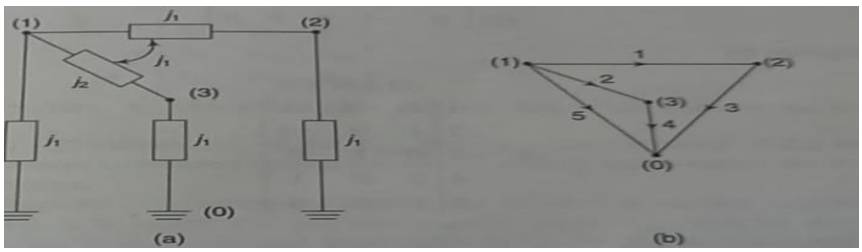
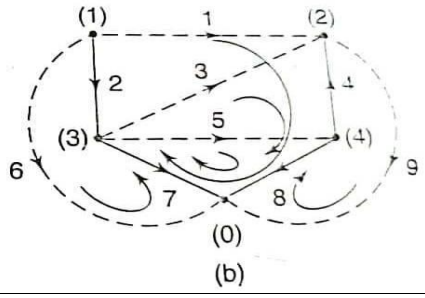
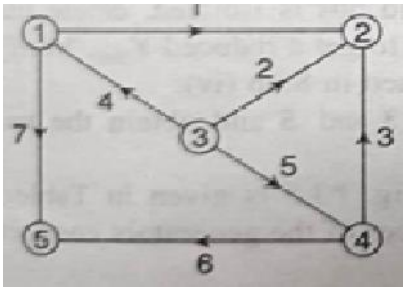
	Unit-III		
27	Students shall be able to understand the concept of economic scheduling of thermal generators	**1**	**2**
28.	Students shall be able to define the input-output and Incremental characteristics of thermal generators	**1**	**1**
29.	Students shall be able to formulate the objective function 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**

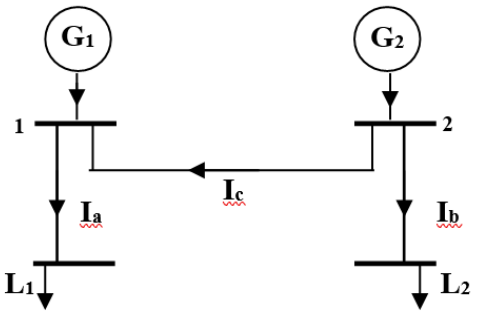
Course Content Delivery

Day	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	
13	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
14	Derivation of bus loading equation, formulation of Gauss seidel method for load flow problem for P-Q bus	
15	Numerical for obtaining bus voltage, line flow and power flow using Gauss seidel method for 3 iterations and importance of acceleration factor is explained.	
16	Modification of GS algorithm to include PV buses, Q-limit violations, Acceleration of convergence	
17	Numericals on Load flow analysis for PQ & PV buses using GS method	
18	Introduction to NR method, Formulation of NR method in rectangular coordinates for PQ-Bus.	
19	Formulation of NR method in polar coordinates for PQ-Bus and Numerical of	

	obtaining bus voltages using NR method in rectangular	
20	Numerical of obtaining bus voltages using NR method in polar form for PQ	
21	Numerical of obtaining bus voltages using NR method in polar form for PQ-PV systems	
22	Concept of Decoupled Load Flow&Fast Decoupled Load Flow.Derivation of Jacobian matrix using Fast Decoupled load flow	
23	Introduction of economic scheduling of thermal generators, Importance of Performance curves in scheduling of thermal generators.	Power Point Presentation
24	Derivation of necessary condition of economic scheduling of thermal generators neglecting losses and generator limits	
25	Examples for obataining of power output of generators using scheduling algorithm without power limits	
26	Examples for obataining of power output of generators using scheduling algorithm with power limits	Chalk and talk in classroom
27	Derivation of necessary condition of economic scheduling of thermal generation considering transmission losses	Chalk and talk in classroom
28	Concept and impact of penalty factor on thermal generators, numerical	
29	Derivation of Iterative technique for the scheduling of thermal generators considering losses and Numerical	
30	Derivation of transmission loss formula using current distribution factors and numerical	
31	Numerical for obatining B-Coefficents of given power systems	Power Point Presentation
32	Introduction to optimal scheduling for hydrothermal plants. Problem formulation, solution procedure and algorithm	
33	Introduction of excitation systems, AC and DC excitation systems,	
34	Concept of Brushless and static exciation systems	Power Point Presentation
35	Concept of Power system stablizer, modeling of Type-1 and Type-2 excitationsystems	
36	Modeling of Type-3 excitation systems	
37	Load Model: Static, Dynamic load models	
38	power system stabilizer, load compensation, underexcitation limiter, overexcitation limiter.	
39	Modelling of AVR,	
40	Steady state and dynamic performance analysis of AVR	
41	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.  (b)	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
Quiz-1	1.25	1,2,3
Quiz-2	1.25	1,2,3

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	4	1.5	--	02
	2	Primitive Network	2			
	3	Network Matrices	4			
II	4	Introduction to Load flow Analysis	1	1.5	---	02
	5	Gauss Seidel Load Flow	4			
	6	Newton Raphson Load Flow	5			
III	7	Economic Operation of Thermal Generators	9	--	1.5	02
IV	8	Types of Excitation Systems	5	---	1.5	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-22UEE606C

Title of Course	**:**	**Microcontrollers**	**Course Code**	**:**	**22UEE606C**
Credits	**:**	**3**	**Contac Hours/Week**	**:**	**3**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**--**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**50**
Semester	**:**	**VI**	**Year**	**:**	**2024-2025**

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	Comprehend architecture of 8051 microcontrollers, instruction set, directives, addressing modes.
2	Illustrate arithmetic, logical, jump and call instructions, formulate and develop assembly language programs.
3	Illustrate serial communication, assess program execution time by calculating number of machine cycles and develop programs for timers and serial port.
4	Interface peripheral devices and develop programs for given application using assembly language and 8051C.

Course Articulation Matrix:

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

Sl.	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	22UEE606C.1	3											1		1	1
2	22UEE606C.2	3	1										1		3	1
3	22UEE606C.3	3	3	2	2	1							1		1	1
4	22UEE606C.4	3	3	3	3	1				2			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	1.3	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 & 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
			2.1.2	Identify engineering systems, variables and parameters to solve the problems
3.	3.1	Demonstrate an ability to define a complex/ open-ended problem in engineering terms	3.1.3	Synthesize engineering requirements from a review of the state-of-the-art
			3.1.6	Determine design objectives, functional requirements and arrive at specifications
	3.2	Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions
			3.2.2	Buildmodels/prototypes to develop a diverse set of design solutions
4.	4.2	Demonstrate an ability to design experiments to solve open-ended problems	4.2.1	Design and develop an experimental approach, specify appropriate equipment and procedures
	4.3	Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data
			4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
			4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions
5.	5.1	Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.1	Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities
9.	9.1	Demonstrate an ability to form a team and define a role for each member	9.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
	9.3	Demonstrate success in a team-based project	9.3.1	Present results as a team, with smooth integration of contributions 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	12.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

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 differentiate between microcontrollers and microprocessors.	**1**	**1**	**1.3.1**
3.	Students shall be able to describe the architecture of various microcontrollers	**2**	**2**	**2.1.1**
4.	Students shall be able to understand the role of the CPU, memory (RAM and ROM), I/O ports, timers and serial communication interfaces	**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 Data Moves	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: a. MOV b. ADD c. SUBB d. 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**

Prof. B. S. Hadapad

BASAVESHWAR ENGINEERING COLLEGE(AUTONOMOUS), BAGALKOT

MODEL COURSE PLAN

Title of Course	:	Digital Signal Processing	Course Code	:	22UEE607C
Credits	:	03 (3:0:0)	Contact Hours/ Week	:	03hrs/Week
Total Hours	:	40 Hrs (Theory)		:	
CIE Marks	:	50	SEE Marks	:	50
Semester	:	VI	Year	:	2024-25(Even)

Prerequisites: Basic mathematics

Course Objectives:

Objective: To provide fundamental knowledge of DSP and to understand various design techniques and realization methods of FIR/IIR filters.

Course Outcomes:

	At the end of the course the student will be able to:
1	Derive DFT properties and determine output of systems using convolution approach and DFT properties.
2	Assess the output of systems by deriving and developing fast Fourier algorithms.
3	Evaluate transfer function, frequency response, and output of a system by designing FIR/ IIR filters for required filter specifications.
4	Realize the discrete LTI system in direct form I & II, cascade and parallel forms.

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	CO-1	3				1	1						1	1	3	2
2	CO-2	3	1										1	1	2	1
3	CO-3	3	3	2	2								1		2	1
4	CO-4	3	3	3	3	1		1					2	1	2	1

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.

PSOs

PSO1: Specify, formulate and analyze concepts used in power systems and electrical machines as per requirements of power & energy sector.

PSO2: Identify, analyze, design and test technologies used in power electronics, electronic & signal processing circuits and control systems

PSO3: Apply conventional concepts and contemporary tools to design, simulate and analyze electrical and electronic systems for real time applications through hands on learning gained in SCADA, energy systems and power electronics laboratories

Sl.No.	Hours Required	Topic to be covered	Mode of Delivery
		Unit-1	Chalk and talk in classroom/Lecture combined with discussions
1	1L	DFT and IDFT	
2	1L	Exercises on DFT & IDFT	
3	1L	Properties of DFT	
4	1L	Exercises on properties of DFT	
5	1L	Circular convolution.	
6	1L	Exercises on circular convolution	
7	1L	Linear convolution of long duration sequences using overlap-add method.	
8	1L	Linear convolution of long duration sequences using overlap-save method.	
10	1L	Exercises on the above methods.	
		Unit-2	
11	1L	Introduction of radix-2 FFT and IFFT algorithms. DIT-FFT and DIT-IFFT algorithms.	
12	1L	Exercises on DIT-FFT algorithms	
13	1L	Exercises on DIT-IFFT algorithms	
14	1L	DIF-FFT and DIF-IFFT algorithms	
15	1L	Exercises on DIF-FFT algorithms	

16	1L	Exercises on DIF-IFFT algorithms	Chalk and talk in classroom/Lecture combined with discussions
17	1L	Introduction to FIR filter design.	
18	1L	Windowing techniques, Rectangular window, Hamming window.	
19	1L	Exercises on FIR filter design.	
20	1L	Exercises on FIR filter design.	
		Unit-3	
21	1L	Introduction to IIR filter design.	
22	1L	Design of Butterworth filter.	
23	1L	Exercises on design of Butterworth filter.	
24	1L	Design of Chebyshev-I filter.	
25	1L	Exercises on design of Chebyshev-I filter.	
26	1L	Bilinear Transformation,	
27	1L	Design of digital filters;.	
28	1L	Exercises on digital filters.	
29	1L	Frequency transformations	
30	1L	Exercises on digital filters using frequency transformations.	
		Unit-4 Realization of Digital Systems: Introduction, block diagrams and SFG's, Realization of IIR systems- direct form, cascade form, Parallel form, Realization of FIR systems- direct form, cascade form, Linear phase realizations	
31	1L	Realization of Digital Systems: Introduction	
32	1L	Block diagrams and SFGs	
33	1L	Realization of IIR systems- direct form-I and direct form-II , cascade form, Parallel form.	
34	1L	Realization of IIR systems- cascade form,	
35	1L	Exercises on realization of FIR systems.	
36	1L	Realization of IIR systems- Parallel form.	
37	1L	Realization of FIR systems- direct form-I and direct form-II	
38	1L	Realization of FIR systems-cascade form	
39	1L	Realization of FIR systems- Linear phase realizations	
40	1L	Exercises on realization of FIR systems.	

Review Questions:

Sr.No.	Review Questions		BLL
1	What is meant by electrical network?		1
2	Distinguish between voltage source and current source.		2
3	State superposition theorem.		1
4	Define tree and co-tree.		1
5	What is principle of duality?		2
6	What is condition of maximum power transfer?		1
7	What are limitations of reciprocity theorem?		1
8	What is The venin's theorem?.		1
9	What are initial conditions? .		1
10	How does inductor behave during initial conditions?		2

11	Why do we need Laplace transform?		1
12	Obtain the Laplace transform of step, ramp and impulse functions.		2
13	State initial value theorem.		1
14	State final value theorem.		2
15	Define bandwidth of a resonant circuit.		2
16	Define Q-factor.		1
17	What is the purpose of two-port network??		1
18	Define h-parameters with regard to two-port network.		1
19	Define input driving point impedance.		2
20	Why ABCD parameters are also called as transmission parameters?		2

Evaluation Scheme:

Evaluation Scheme:

Assessment	**Marks**	**Weight age**
CIE-I	**20**	**20%**
CIE-II	**20**	**20%**
Assignment/Quizzes/Seminar/Survey	**10**	**10%**
SEE	**50**	**50%**
Total	**100**	**100%**

BASAVESHWAR ENGINEERING COLLEGE(AUTONOMOUS), BAGALKOT

DEPARTMENT OF Electrical and ElectronicsENGINEERING

COURSEPLAN

Title of Course	**:**	**Modern Control Theory**	**Course Code**	**:**	**22UEE626E**
Credits	**:**	**03**	**Contact Hours/ Week**	**:**	03
Total Hours	**:**	**03**	**Tutorial Hours**	**:**	**00**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**50**
Semester	**:**	**VI**	**Year**	**:**	**2024-25**

Prerequisites: Calculus Integral - Basic (Special Integrals). Differential - Intermediate (Differential Equations). Linear Algebra: Matrix Theory - Inverse, Transpose, Multiplication. Vector - Spaces, Orthogonalisation, Diagonalization.

Course Outcomes:

	At the end of the course the student should be able to:
1	Students shall be able to Conceptualize on controller, state space, controllability, observability, nonlinearity and describing function and able to examine a system for its controllability and observability.
2	Students shall be able to Propose, design, and realize appropriate compensator for the given specifications.
3	Students shall be able to design state feedback controller and observer via pole-placement
4	Students shall be able to test linear control systems for complete controllability and observability.

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
1	Students shall be able to Conceptualize on controller, state space, controllability, observability, nonlinearity and describing function and able to examine a system for its controllability and observability.	**3**	**1**	**1**	**2**	**3**	**1**	**-**	**1**	**1**	**2**	**2**	**1**
2	Students shall be able to Propose, design, and realize appropriate compensator for the given specifications.	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**1**	**2**	**3**	**3**	**1**
3	Students shall be able to design state feedback controller and observer via pole-placement	**3**	**2**	**2**	**2**	**1**	**-**	**1**	**1**	**1**	**2**	**2**	**1**
4	Students shall be able to test linear control systems for complete controllability and observability.	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**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	1.1	Demonstrate the competence in solving engineering mathematical problems	1.1.1	Apply fundamentals of mathematics to solve problems
			1.1.2	Apply advanced mathematical techniques to modelling and problem solving in electrical engineering
	1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply elements of electrical engineering principles and laws
2	2.1	Demonstrate an ability to identify and characterize an engineering problem	2.1.1	Evaluate problem statements and Identify objectives
			2.1.2	Identify engineering systems, variables, and parameters to solve the problems
			2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
	2.2	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.2	Identify, assemble and evaluate information and resources.
	2.3	Demonstrate an ability to formulate and interpret a system / model	2.3.1	Combine scientific and engineering principles to formulate models (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.

			2.3.2	Identify assumptions (mathematical and physical) necessary to allow modelling of a system at the level of accuracy required.
	2.4	Demonstrate an ability to execute a solution, process and analyse results	2.4.3	Identify sources of error in the solution process, and limitations of the solution.
3	3.1	Demonstrate an ability to define a complex open-ended problem in engineering terms	3.1.1	Recognize that good problem definition assists in the design process
			3.1.6	Determine design objectives, functional requirements and arrive at specifications
	3.2	Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.3	Identify the suitable criteria for evaluation of alternate design solutions

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Unit Learning Outcomes (ULO):

Sl.	Unit Learning Outcome (ULO)	CO's	BLL	PI addressed
	Unit -I			
1.	Students shall be able to understand the concept on Design of feedback control systems	**01**	**L1**	**2.1.1**
2.	Students shall be able to analyze the Cascade compensation networks, phase-lead and phase-lag control design approaches using root locus plots	**01**	**L4**	**2.1.1**
3.	Students shall be able to analyze the Cascade compensation networks, phase-lead and phase-lag control design approaches using bode plots	**01**	**L4**	**2.1.3**
4.	Students shall be able to understand the concept on P and PI Controller	**01**	**L1**	**1.1.2**
5.	Students shall be able to understand the concept on PD and PID Controller	**01**	**L1**	**1.1.1**
6.	Students shall be able to Explain briefly on PID Controller with block diagram and mention its properties	**01**	**L2**	**1.1.3**
7.	Students shall be able to Explain the PI controller mode with diagram, stating its characteristics	**01**	**L2**	**1.1.2**
	Unit -II			
8.	Students shall be able to explain the State variable representation.	**02**	**L2**	**1.1.2**
9.	Students shall be able to understand state the various properties of state transition matrix	**02**	**L1**	**1.1.1**
10.	Students shall be able to state the importance of state equation	**02**	**L1**	**1.1.3**
11.	Students shall be able to analyze the concept computation using Laplace transformation, power series.	**02**	**L4**	
12.	Students shall be able to analyze the concept on computation using Laplace transformation, power series.	**02**	**L4**	**1.1.2**
13.	Students shall be able to analyze the concepts of controllability and observability Cayley-Hamilton method.	**02**	**L4**	**1.1.2**
14.	Students shall be able to Students shall be able to Find the state transition matrix of the state equation using inverse transformation method. $\begin{matrix} x1 \\ x2 \end{matrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{matrix} x1 \\ x2 \end{matrix} + \begin{matrix} 1 \\ 1 \end{matrix}$ U	**02**	**L3**	**1.1.2**
	Unit -III			
15.	Students shall be able to analyze the State variable feedback structure	**03**	**L4**	**1.1.2**
16.	Students shall be able to design to pole-placement design using	**03**	**L3**	**2.3.2**

	feedback			
17.	Students shall be able to design state feedback with integral control, critique of pole-placement state feedback control.	**03**	**L3**	**2.3.2**
18.	Students shall be able to design the observer-based on the state feedback control	**03**	**L3**	**2.1.1**
19.	Students shall be able to Usage of MATLAB command-line functions to verify the solution.	**03**	**L1**	**2.1.2**
Unit -IV				
20.	Students shall be able to analyze the nonlinear system behaviours, common nonlinearities in control systems	**04**	**L3**	**2.1.1**
21.	Students shall be able to understand the common nonlinearities in control systems,	**04**	**L1**	**2.1.2**
22.	Students shall be able to describing function of common nonlinearities,	**04**	**L2**	**2.1.1**
23.	Students shall be able to describing function method on stability analysis	**04**	**L2**	**2.3.2**
24.	Students shall be able to Usage of MATLAB command-line functions to verify the solution.	**04**	**L1**	**2.3.2**

Course Content

Off Line classes

SL	Hours	Content	Mode of Delivery
		Unit-01	Chalk and talk in classroom
1	**01**	Design of feedback control systems	
2	**01**	Concepts of design and compensation	
3	**01**	Cascade compensation networks, phase-lead and phase-lag control design approaches using both root locus plots and Bode diagrams.	
4	**01**	Problems on Phase-lag, Phase-lead	
5	**01**	Problems on Phase Lag-Lead	
6	**01**	Problems on Phase Lag-Lead	
7	**01**	Introduction of P, PI,.	
8	**01**	PD and PID Controllers	
9	**01**	PD and PID Controllers	
10	**01**	Usage of MATLAB command-line functions to verify the solution	
		Unit-02	Chalk and talk in classroom
11	**01**	State variable representation,	
12	**01**	Solution of state equations, state transition matrix and its properties,	
13	**01**	Solution of state equations, state transition matrix and its properties,	
14	**01**	Solution of state equations, state transition matrix and its properties,	
15	**01**	computation using Laplace transformation, power series,	
16	**01**	Problems on computation using Laplace transformation, power series,	
17	**01**	Cayley-Hamilton method, concepts of controllability and observability.	
18	**01**	Problems on Cayley-Hamilton method, concepts of controllability and observability.	
19	**01**	Problems on Cayley-Hamilton method, concepts of controllability and observability	
20	**01**	Usage of MATLAB command-line functions to verify the solution	
		Unit-03	Chalk and talk in classroom
21	**01**	State variable feedback structure,	
22	**01**	Pole-placement design using feedback,.	
23	**01**	Problems on Pole placement technique	
24	**01**	Problems on Pole placement technique	
25	**01**	State feedback with integral control, critique of pole-placement	
26	**01**	State feedback with integral control, critique of pole-placement	

27	**01**	state feedback control, observer-based state feedback control	
28	**01**	Problems on state feedback control, observer-based state feedback control	
29	**01**	Problems on state feedback control, observer-based state feedback control	
30	**01**	Usage of MATLAB command-line functions to verify the solution	
		Unit-04	
31	**01**	Some common nonlinear system behaviors, common nonlinearities in control systems,	Chalk and talk in classroom
32	**01**	Some common nonlinear system behaviors, common nonlinearities in control systems,	
33	**01**	Some common nonlinear system behaviors, common nonlinearities in control systems,	
34	**01**	Describing function fundamentals,	
35	**01**	Describing function fundamentals,	
36	**01**	Describing function of common nonlinearities,	
37	**01**	Describing function of common nonlinearities,	
38	**01**	Stability analysis by describing function method.	
39	**01**	Stability analysis by describing function method.	
40	**01**	Usage of MATLAB command-line functions to verify the solution	

Review Questions:

Sl.	Review Questions	ULO	BLL	PI addressed
1	Derive the state model for armature-controlled DC motor.	**02**	**L4**	**2.1.1**
2	With respect to control systems compare modern control theory with classical control theory.	**01**	**L3**	**2.1.2**
3	Consider the matrix $\boldsymbol{A} = \begin{vmatrix} \mathbf{2} & \mathbf{-2} & \mathbf{3} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{-1} \end{vmatrix}$ find (i) Eigen-values and Eigen Vectors (ii) Write the modal matrix A Show that the modal matrix indeed diagonalizes A	**02**	**L3**	**2.1.3**
4	Briefly explain the design of lead compensator network.	**03**	**L2**	**3.1.6**
5	Find the state transition matrix of the state equation using inverse transformation method. $\begin{matrix} x1 \\ x2 \end{matrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{matrix} x1 \\ x2 \end{matrix} + \begin{matrix} 1 \\ 1 \end{matrix}$ U	**02**	**L1**	**1.1.2**
6	Explain the concept of controllability and observability tests.	**02**	**L2**	**1.3.1**
7	Briefly explain the design of Lag Lead compensator network. State its advantages.	**04**	**L2**	**3.1.6**
8	Discuss the Stability in the sense of Liapunov.	**04**	**L3**	**1.3.1**
9	Explain the properties of Non-Linearities.	**03**	**L2**	**1.3.1**
10	Design a Lag-Lead compensator electrical network in frequency domain Analysis.	**03**	**L4**	**3.1.6**
11	Explain briefly on PID Controller with block diagram and mention its properties.	**03**	**L2**	**1.3.1**
12	Discuss the basic features of the fallowing Non- Linearities:- Saturation **(b)** Dead Zone **(c)** Friction **(d)** Backlash	**03**	**L3**	**2.1.2**
13	Consider the Non-Linear system described by the fallowing equation $\dot{x}_1 = x_2$ $\dot{x}_2 = -2x_1 - x_2^2$ Determine the stability of the system using the Liapunov function for Non-Linear system. $V(x) = x_1^2 + x_2^2$	**04**	**L4**	**2.3.1**
14	Derive a state model from the transfer function by using the signal flow graph approach.	**01**	**L3**	**1.1.2**
15	Find the eigenvalues and eigenvectors and modal matrix M. $A = \begin{matrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -4 & -3 \end{matrix}$	**02**	**L1**	**1.1.1**
16	Obtain the state model for system represented $d^3y/dt^3 + 6\, d^2y/dt^2 + 11\, dy/dt + 10y =$	**02**	**L4**	**1.1.2**
17	Construct a state model from a differential equation by using the phase variable approach.	**02**	**L3**	**2.1.2**
18	State and explain controllability & observability with test methods	**02**	**L2**	**1.3.1**
19	Compute the state transition matrix $\mathbf{e^{At}}$ using Cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 1 \\ -2 & -3 \end{bmatrix}$.	**02**	**L3**	**2.1.3**
20	Explain the PI controller mode with diagram, stating its characteristics	**03**	**L2**	**1.3.1**
21	Evaluate the controllability and observability of the fallowing system. **A =** $\begin{bmatrix} -2 & 0 \\ 0 & -1 \end{bmatrix}$ **C =** $[0 \quad 1]$ **B =** $\begin{bmatrix} 3 \\ 1 \end{bmatrix}$	**02**	**L4**	**2.1.2**

22	A system is described by the fallowing state space model. $\dot{X} = Ax + Bu$ **A** = $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -6 & -5 \end{bmatrix}$ **B** = $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ Design a state feedback controller such that the poles are moved to **-1± j, Use** Ackermann's formula.	**04**	**L4**	**3.1.6**
23	Derive the state model for field-controlled DC motor.	**01**	**L3**	**1.3.1**
24	State the advantages of diagonalization of a matrix.	**01**	**L3**	**1.3.1**
25	explain the advantage of state variables with conventional one	**01**	**L2**	**1.3.1**

Evaluation Scheme:

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

Details of Assignment:

Assignment	Marks (05)	CO	PI	CA	PO
Assignment 1	1	1,2,3,4	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.2.2, 2.2.3, 2.2.4, 2.2.3, 2.4.3, 3.2.3, 3.1.6, 3.1.1	1.1,1.3, 1.4, 2.1,2.3, 3.1, 3.2, 2.4	1,2,3,4,5,12
Assignment 2	1	1, 2,3,4	1.1.1, 1.3.1, 1.4.1, 2.1.1, 2.2.2, 2.2.3, 2.2.4, 2.2.3, 2.4.3, 3.2.3, 3.1.6, 3.1.1	1.1,1.3, 1.4, 2.1,2.3, 3.1, 3.2, 2.4	1,2,3,4,5,12

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	Tutorial	Number of Questions in		Number of Questions in
					CIE-I	**CIE-II**	**SEE**
I	1		**5**	**--**	**01**	**---**	**02**
	2		**5**		**01**	**---**	
II	3		**5**	**--**	**01**	**---**	**02**
	4		**5**		**01**	**---**	
III	5		**5**	**--**	**---**	**01**	**02**
	6		**5**		**---**	**01**	
IV	7		**5**	**--**	**---**	**01**	**02**
	8		**5**			**01**	

Note:

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

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOT

COURSE PLAN – 22UEE632N

Title of Course	**:**	**Electrical Safety for Engineers (Open Elective)**	**Course Code**	**:**	**22UEE632N**
Credits	**:**	**3**	**Contact Hours/ Week**	**:**	**3**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**--**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**50**
Semester	**:**	**VI**	**Year**	**:**	**2024-2025**

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

Mr. Santhoshkumar S. Kandagal