BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE

DEPARTMENT ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE PLAN

Titleof Course	**:**	**Power System Operation and Control**	**Course Code**	**:**	**21UEE827E**
Credits	**:**	**03**	**Hours/Week**	**:**	**03**
TotalHours	**:**	**40**	**TutorialHours**	**:**	**-**
CIEMarks	**:**	**50**	**SEEMarks**	**:**	**50**
Semester	**:**	**VIII**	**Year**	**:**	**2024-25**

Prerequisites: Generation, transmission and distribution, power system analysis, stability analysis, concepts of computer techniques in power system

CourseObjectives:

	TheCourseobjectivesare:
1	To understand and analyze power system control mechanisms, including Automatic Load Frequency Control (ALFC), voltage control, and reactive power management, to maintain system stability and reliability.
2	To gain knowledge of Unit Commitment and Economic Power Interchange, including various constraints, optimization techniques, and their impact on power system operation.
3	To evaluate power system security and state estimation techniques, focusing on contingency analysis, network sensitivity methods, and bad data detection for improved system reliability.
4	To learn the fundamentals of SCADA systems and Intelligent Electronic Devices (IEDs), including their architecture, communication systems, and real-world applications in power system automation.
5	To apply theoretical concepts to practical scenarios, using case studies and problem-solving techniques to enhance decision-making in modern power system operations

CourseOutcomes:

	Aftercompletionofthecourse,studentsshallbeableto:
1	Apply suitable compensating device, method of unit commitment, SCADA system and economy interchange of power for power system operation.
2	Investigate performance of the power systems using ALFC model, reliability and cost of generators, power trading, power system security and state estimation.
3	Calculate cost of generation using unit commitment, degree of compensation for transmission lines, various parameters of ALFC and state estimators of power systems
4	Formulate/develop SCADA system for power system, scheduling for thermal generator using unit commitment concept based on load profile.

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	21UEE827E.1	3	1	1	1	3	1		1		1		1	1	2	1
2	21UEE827E.2	3	2	1	1				1		1		1	2	3	1
3	21UEE827E.3	3	2	2	2	1		1	1		1		1	1	2	1
4	21UEE827E.4	3	3	3	2	1			1	1	1	1	2	1	1	1

UnitLearningOutcomes(ULO):

Sl.	UnitLearningOutcome(ULO)
UNIT - I	**After completing this unit, students will be able to:** 1. Understand the concept of Automatic Load Frequency Control (ALFC) and its significance in maintaining power system stability. 2. Model and analyze the ALFC of single-area and two-area power systems, including tie-line flow and frequency deviation. 3. Evaluate the performance of ALFC and understand the impact of supplementary control actions in generation control. 4. Explain the principles of tie-line control and generation allocation in interconnected power systems. 5. Analyze the generation and absorption of reactive power and its effects on voltage regulation. 6. Describe different methods of voltage control, including shunt reactors, shunt capacitors, series capacitors, and transformer-based methods. 7. Compare and contrast various compensating devices, such as Static VAR Compensators (SVC), Thyristor-Controlled Reactors (TCR), Thyristor-Switched Capacitors (TSC), and STATCOM. 8. Interpret PV and QV curves and analyze their role in voltage stability assessment. 9. Explain the causes and consequences of voltage collapse and identify preventive measures to enhance system reliability. 10. Apply theoretical knowledge to solve real-world problems related to frequency control, voltage regulation, and reactive power management in modern power systems.
UNIT-II	**After completing this unit, students will be able to:** 1. Understand the concept of Unit Commitment (UC) and explain its importance in optimizing power system operation. 2. Analyze the key constraints in unit commitment, including spinning reserve, thermal unit constraints, hydro constraints, must-run units, and fuel limitations. 3. Compare different Unit Commitment solution methods, such as Priority-List methods and Dynamic Programming solutions. 4. Explain the role of reliability considerations in Unit Commitment and understand the application of Patton's Security Function. 5. Evaluate the impact of security constraints on optimal Unit Commitment, ensuring stable and reliable power system operations. 6. Understand the concept of Power and Energy Interchange and its significance in interconnected power systems. 7. Analyze economic energy interchange between utilities, including cost-benefit evaluations and multiple-utility interchange transactions. 8. Explain the structure and functioning of power pools and their role in optimizing power generation and distribution. 9. Examine the effects of transmission constraints on power interchange and discuss methods to mitigate their impact. 10. Apply theoretical knowledge to real-world scenarios, formulating strategies for secure and economic power system operation while considering unit commitment and power interchange challenges.

UNIT-III	**After completing this unit, students will be able to:** 1. Understand the concept of power system security and its role in ensuring the reliable operation of power networks. 2. Identify and analyze the key factors affecting power system security, including generation, transmission constraints, and load variations. 3. Perform power system contingency analysis and assess the impact of different contingency scenarios on system stability. 4. Apply network sensitivity methods to detect and evaluate network problems in power systems. 5. Calculate network sensitivity factors and use them for contingency ranking and security assessment. 6. Understand the fundamentals of power system state estimation and its importance in real-time power system monitoring. 7. Explain the concept of maximum likelihood weighted least-square estimation and apply it to power system state estimation. 8. Develop matrix formulations for power system state estimation and solve state estimation problems. 9. Detect and identify bad measurements in power system state estimation and apply corrective techniques to improve accuracy. 10. Apply state estimation and contingency analysis techniques to improve decision-making in power system operation and control.
UNIT-IV	**After completing this unit, students will be able to:** 1. Understand the fundamentals of SCADA systems and their role in power system monitoring, control, and automation. 2. Identify and describe the building blocks of a SCADA system, including Remote Terminal Units (RTUs), Intelligent Electronic Devices (IEDs), communication networks, and Human Machine Interfaces (HMIs). 3. Explain the evolution and components of RTUs, including the communication, logic, termination, and HMI subsystems. 4. Analyze the functionalities of Intelligent Electronic Devices (IEDs) and describe their hardware and software architecture. 5. Examine the role of data concentrators and merging units in SCADA-based power system operations. 6. Understand SCADA communication systems, including various protocols used for data transmission between field devices and control centers. 7. Describe the structure and functions of a Master Station and its role in real-time power system control. 8. Explain the classification of SCADA systems and compare their applications in different industries. 9. Demonstrate knowledge of SCADA system implementation, including design, integration, and maintenance. 10. Analyze real-world SCADA case studies and evaluate the benefits and challenges of SCADA applications in power systems.

CourseContents:

Chalk and talk in classroom /Lecturecombinedwithdiscussions/ppt

Hours	Session No.	Topictobecovered
01	1.	Automatic load frequency control: introduction
01	2.	Control loops of power systems
01	3.	Modeling of Automatic Load Frequency Control (ALFC) of single area systems, performance of ALFC, ALFC of two area systems
01	4.	Expression for tie-line flow and frequency deviation
01	5.	Generation Control: Supplementary Control Action, Tie line Control, Generation Allocation
01	6.	Control of Voltage and Reactive Power: Introduction,
	7.	Generation and absorption of reactive power
01	8.	Methods of voltage control: Shunt reactor, shunt capacitor, series capacitor
01	9.	Tap changing transformer and booster transformer
01	10.	Compensating Devices-Characteristics of SVC, TCR, TSC and STATCOM
01	11.	Voltage stability, PV and QV curves, voltage collapse, prevention of voltage collapse
01	12.	Unit Commitment: Statement of the problem
01	13.	Need and importance of unit, constraints in unit commitment
01	14.	Spinning reserve, Thermal Unit Constraints, Hydro constraints, Must Run, Fuel constraints
01	15.	Unit commitment Solution methods: Priority-List methods,
	16.	Dynamic Programming solution
01	17.	Reliability considerations, patton's security function,
	18.	Security constrained Optimal Unit Commitment
01	19.	Interchange of Power and Energy: Introduction, Economy Interchange between Interconnected Utilities
01	20.	Infertility economy energy evaluation, multiple-utility interchange transaction
01	21.	Power pools, Transmissions Effects and Issues
01	22.	Power System Security: Introduction, factors affecting power system security
01	23.	Power system contingency analysis, detection of network problems
01	24.	Network sensitivity methods, calculation of network sensitivity factor
01	25.	Contingency ranking
01	26.	Power System State Estimation: Introduction, power system state estimation
01	27.	Maximum likeli-hood weighted least-square estimation
01	28.	Maximum likeli- hood concept with example, matrix formulations
01	29.	Detection and Identification of bad measurements
01	30.	Power System SCADA: Introduction, building blocks of SCADA
01	31.	Remote Terminal Unit (RTU)-Evolution and Components of RTU,
01	32.	Communication subsystem

01	33.	Logic subsystem, Termination subsystem,
01	34.	HMI subsystem, Advanced RTU functionalities
01	35.	Intelligent Electronic Device (IED)-IED functional block diagram
01	36.	Hardware and software architecture of IED, IED communication systems
01	37.	Data concentrator and merging units, SCADA communication system
01	38.	Master station, Human Machine Interface (HMI), Building SCADA system
01	39.	Classification of SCADA,SCADA implementation and Case studies in SCADA

ReviewQuestions:

UNIT-I

Automatic Load Frequency Control (ALFC)

1. Explain the concept of Automatic Load Frequency Control (ALFC) and its role in power system stability.
2. Describe the control loops of a power system involved in load frequency regulation.
3. Derive the mathematical model of ALFC for a single-area system and discuss its performance.
4. Explain the working of governor control and its effect on frequency regulation.
5. What are the main objectives of ALFC in power systems?

ALFC of Two-Area Systems

6. Derive the expression for tie-line power flow between two interconnected areas.
7. Discuss the concept of frequency deviation and its impact on system performance.
8. Explain the Area Control Error (ACE) and its significance in ALFC.
9. What are the advantages and challenges of two-area ALFC?
10. Discuss the role of parallel operation in interconnected power systems.

Generation Control

11. What is generation control, and why is it necessary in power systems?
12. Explain the concept of supplementary control action in ALFC.
13. Describe the function of tie-line control in interconnected power systems.
14. How is generation allocated among different units in a power system?
15. Discuss the importance of economic load dispatch in power generation.

Generation and Absorption of Reactive Power

16. Explain the need for voltage control and reactive power compensation in power systems.
17. Discuss the methods of reactive power generation and absorption in power systems.
18. Describe the role of synchronous condensers in reactive power compensation.

Methods of Voltage Control

19. Explain the working principle of a shunt reactor and its role in voltage control.
20. How do shunt capacitors improve voltage stability in a power system?
21. Describe the function of series capacitors in power system voltage regulation.

22. Explain how tap-changing transformers are used for voltage control.
23. What is the role of a booster transformer in voltage regulation?

Compensating Devices

24. Describe the characteristics of Static VAR Compensators (SVC) in reactive power management.
25. Explain the working of Thyristor-Controlled Reactor (TCR) and Thyristor-Switched Capacitor (TSC).
26. Discuss the role of STATCOM (Static Synchronous Compensator) in modern power systems.

Voltage Stability and Collapse

27. What are the key factors affecting voltage stability in a power system?
28. Explain the significance of PV and QV curves in voltage stability analysis.
29. Define voltage collapse and explain its causes and consequences.
30. What are the methods to prevent voltage collapse in power systems?

UNIT-II

Unit Commitment

31. Define unit commitment and explain its importance in power system operation.
32. What are the key constraints in unit commitment? Explain the significance of:
    - Spinning Reserve
    - Thermal Unit Constraints
    - Hydro Constraints
    - Must-Run Units
    - Fuel Constraints
33. Explain the priority-list method for solving the unit commitment problem.
34. Describe the dynamic programming approach for unit commitment. What are its advantages and limitations?
35. Discuss the role of reliability considerations in unit commitment.
36. Explain Patton's Security Function and its application in unit commitment.
37. What is Security-Constrained Optimal Unit Commitment? Why is it necessary?
38. Compare unit commitment and economic dispatch. How do they differ in terms of objective and constraints?
39. Consider a system with three thermal units with different fuel costs and startup costs. Formulate the unit commitment problem for a 24-hour schedule.
40. Explain the impact of renewable energy sources on unit commitment planning.

Interchange of Power and Energy

41. Explain the concept of economy interchange in interconnected power utilities.
42. How is economic energy exchange evaluated between utilities? Discuss the cost-benefit analysis.
43. What are the advantages and challenges of multiple-utility interchange transactions?
44. Define power pools. How do power pooling mechanisms improve system efficiency?

45. Discuss the impact of transmission constraints on power interchange.
46. Explain the different types of power exchange agreements between utilities.
47. What is inadvertent energy interchange, and how is it managed?
48. Discuss the role of Independent System Operators (ISOs) in power and energy interchange.
49. How do transmission effects influence economic power interchange?
50. Explain how security constraints impact power interchange agreements.

UNIT-III

Power System Security

51. Define power system security and explain its significance in modern power grids.
52. What are the major factors affecting power system security? Explain their impact on system stability.
53. Explain power system contingency analysis and its role in ensuring a reliable power supply.
54. Discuss the methods used for detecting network problems in power systems.
55. What is network sensitivity analysis? How is it used in power system security assessment?
56. Derive the expression for network sensitivity factors and explain their role in contingency analysis.
57. What is contingency ranking, and how does it help in prioritizing security threats in power systems?
58. Consider a power system with N generating units. Explain how N-1 contingency analysis is performed to ensure system security.
59. Discuss the impact of renewable energy integration on power system security.
60. Explain the role of Wide Area Monitoring Systems (WAMS) in enhancing power system security.

Power System State Estimation

61. Define power system state estimation and explain its importance in power system operation.
62. Explain the maximum likelihood weighted least-square (WLS) estimation technique used in state estimation.
63. Describe the maximum likelihood estimation concept with a numerical example.
64. Derive the matrix formulation for the least-square estimation method in power system state estimation.
65. What are the key differences between state estimation and conventional power flow analysis?
66. Explain the process of bad data detection and identification in state estimation.
67. Discuss the impact of measurement errors on state estimation accuracy.
68. What are the different types of measurement redundancy techniques used in state estimation?
69. Explain how Phasor Measurement Units (PMUs) improve the accuracy of power system state estimation.

70.	What are the challenges in implementing real-time state estimation in large interconnected power systems?

UNIT-IV

Power System SCADA

71. Define SCADA (Supervisory Control and Data Acquisition) and explain its role in power system monitoring and control.
72. Describe the building blocks of a SCADA system with a neat block diagram.
73. Explain the functions of a Remote Terminal Unit (RTU) in a SCADA system.
74. Discuss the evolution of RTU and how modern RTUs differ from traditional ones.
75. Explain the components of RTU, including:
    - Communication Subsystem
    - Logic Subsystem
    - Termination Subsystem
    - HMI Subsystem
76. What are the advanced functionalities of modern RTUs in power system SCADA?

Intelligent Electronic Devices (IEDs)

77. Define Intelligent Electronic Devices (IEDs) and explain their significance in SCADA-based power systems.
78. Draw and explain the functional block diagram of an IED.
79. Describe the hardware and software architecture of an IED.
80. Discuss the communication protocols used in IEDs for power system monitoring.

SCADA Communication & Data Management

81. What is a Data Concentrator? How does it improve SCADA system performance?
82. Explain the role of merging units in modern SCADA systems.
83. Describe the SCADA communication system and its importance in power system operation.
84. Explain the functions of a Master Station in a SCADA system.
85. What is Human Machine Interface (HMI) in SCADA? Discuss its functionalities.

SCADA System Implementation & Applications

86. What are the steps involved in building a SCADA system for power utilities?
87. Classify different types of SCADA systems and explain their applications.
88. Discuss the challenges in SCADA implementation in power systems.
89. Explain the role of SCADA in substation automation with an example.
90. Conduct a case study on SCADA implementation in a power system (e.g., National Grid, Smart Grids, or Industrial SCADA applications).

Sl.	Additional ReviewQuestions for Assignments	BLL
1	DerivethecompletemodelofALFCtoregulatethefrequencyforthechangeintheload?Performsteadystate anddynamicstate analysesontheALFCmodel	L4

2	Mention the control strategies for deviation of frequency and change in the demand of intertie powerflow between two area systems? Derive the expression for Area Control Error and represent using theblock diagram	L3
3	DevelopthemodelofAVRusingtransferfunction?Howtherootsaffecttheperformanceofthe AVRduringdynamicchangeinthedemand?Explain	L4
4	A100MVAsynchronousgeneratoroperatesonfullloadatafrequencyof50Hz.Theloadsuddenlyreducedto50MW.Duetotimelagingovernorsystem,thesystem valvebeginstocloseafter0.4s,Determine thechange infrequencythatoccursin thistime,H=5KWs/kVAofgeneratorcapacity	L4
5	Twogeneratorrated200MWand400MWareoperatinginparallel.Thedropcharacteristicsoftheirgovernorsare4%and5%respectively,fromnoloadtofullload. Assumingthatthegeneratorsareoperatingat50Hzatnoload,howwouldaloadof 600MWbesharedbetweenthem?Whatwillbesystemfrequency atthisload?	L3
6	Specifyvariouspowersystemcomponentsresponsibleofgenerationandabsorptionofthereactivepower?Whentheshuntreactoris preferred inthepower system?	L2
7	DevelopthemodelofSVSforthereactivepowercompensationinpowersystem? Demonstrateitsprincipleofoperationfortheregulationbusvoltage	L3
8	DerivetheexpressionofcurrentflowingthroughthereactorasafunctionofgatingangleofTCR?Discussthevariationofsusceptanceas gatingsignalvaries from0to180degree	L3
9	Three supply points A, B and C are connected to a common bus bar M. Supply point A is maintained ata nominal 275 KV and is connected to M through a 275/132 KV transformer (0.1 p.u reactance) and a132 KV line of reactance 50 Ω. Supply point B is nominally at 132 kV and is connected to M through a132KV line of 50Ω reactance. Supply point C is nominally at 275 kV and is connected to M by a 275/132kV transformer (0.1 p. u reactance) and is 132 kV line of 50 Ω. If, at a particular system load, the linevoltage of M falls below its nominal value by 5 kV, Calculate the magnitude of the reactive volt-ampereinjectionrequiredat Mtore-establishthe original voltage.The p.uvalues are expressedona500MVA baseandresistancemaybeneglectedthroughout	L4
10	Derivetheoptimumconditionsforthetransientfreeoperationofthyristorswitchedcapacitor	L4
11	Discussthevariouscontrolstrategiesfor themitigationofharmonicgeneratedbyTCR	L3
13	DeriveandspecifytheassumptionsconsideredforobtainingtheB-Coefficientsusingcurrentdistributionfactor	L3
15	Specifytheimportanceoftheincrementalcharacteristicsduringtheschedulingofthermalgeneratorsandobtainthenecessaryconditionsofschedulingofthermal generators	L2
17	Specifytheimportanceofspinningreserveduringunitcommitment?Identifysuitablestarting methodofthermalgeneratorisused ifitisturnedoffforlongperiod	L2
18	Whythemonitoringofthepowersystemisconsideredashighestpriorityforsecurityofpowersystem?Justify	L2
19	HowthespeedofACpowerflowsolutionandnumberofcontingencycasesarehandledbythesecurityalgorithm?Discuss	L2

20	WhatisamaximumLikelihoodconceptofstateestimationinpowersystem?Explainwithasuitableexample.	L2
21	Whatisthecontingencyanalysisinpowersystem?Howthecontingencyselectionsiscarriedoutandexplainwithflow chart1P1Q contingencyselection method?	L2
22	Derivematrixformulationofstateestimationfordifferentconditionofmeasurement	L3
23	Discusstheimportanceofprobabilitydensityfunctionchi-squareddistributionindetectionandidentificationofbaddataduring stateestimation ofpower systemvariables	L3

EvaluationScheme:

Assessment	Marks	Weightage
CIE-I	**40**	**40**
CIE-II	**40**	**40**
Written Assignments/Quizzes	**10**	**10**
SEE	**100**	**50**

DetailsofAssignment:

Assignment	Marks(10)	CO
Assignment1	02	Unit 1
Assignment2	02	Unit 2
Assignment3	02	Unit 3
Assignment4	02	Unit 4
Quiz	02	Unit 1 to 4

Faculty In-charge

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BASAVESHWAR ENGINEERING COLLEGE(AUTONOMOUS), BAGALKOT

MODEL COURSE PLAN

Title of Course	**:**	**Solar Photovoltaic System Design**	**Course Code**	**:**	**21UEE733E**
Credits	**:**	**3**	**Contact Hours/ Week**	**:**	**3**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**40**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**100**
Semester	**:**	**VII**	**Year**	**:**	**2023**

Prerequisites:

Course Objectives:

	The Course objectives are:
1	To list the different components and features of SPV system for installation, O&M, troubleshooting and safety aspects.
2	To formulate the SPV systems for different loads and applications.
3	To compare and contrast the different solar SPV systems.
4	To design a solar PV system for standalone and grid connected operations.

Course Outcomes:

	At the end of the course the student should be able to:
1	Apply fundamental concepts of solar energy and radiation to evaluate solar power potential and interpret radiation measurement data.
2	Analyze the performance characteristics of solar cells, modules, and arrays, including their configurations and the factors affecting electricity generation.
3	Evaluate the role and specifications of Balance of System (BoS) components, including batteries, charge controllers, MPPT, and inverters, to optimize solar PV systems.
4	Create efficient designs for standalone, grid-connected, and hybrid solar PV systems, considering installation, safety, troubleshooting, and integration methodologies.

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

No	Programme Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
The students will be able to:																
1	UEE754E.1	**3**	**2**	**2**	**2**						**1**		**1**	**3**		**2**
2	UEE754E.2	**3**	**2**	**2**	**2**	**1**		**1**			**1**		**2**	**3**		**2**
3	UEE754E.3	**2**	**3**	**3**	**2**	**1**					**3**		**3**	**2**	**1**	**2**
4	UEE754E.4	**1**	**3**	**3**	**3**		**1**	**1**	**1**	**1**	**3**		**1**	**1**	**2**	**2**

Competencies Addressed in the course and Corresponding Performance Indicators

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

Competency		Indicators
• Knowledge of Solar Energy Fundamentals:		• Understand the principles of solar energy conversion. • Explain the characteristics of sunlight, solar radiation, and its variability. • Describe the solar spectrum and how it affects PV cell performance.
• PV System Components and Types:		• Identify different PV module technologies and their advantages/disadvantages. • Understand the function and selection of inverters, charge controllers, batteries, and mounting structures. • Differentiate between grid-tied, off-grid, and hybrid PV systems.
• System Sizing and Design		• Calculate the size of a PV system based on energy demand, location, and available space. • Design PV arrays for optimal orientation and tilt angle. • Determine the appropriate battery bank size (if off-grid).
• Testing and Evaluation		• Proficiency in testing the performance of standalone PV systems using test methods and procedures that assess the performance of PV modules, charge controllers, batteries, and loads.

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 should be able to define basic terms associated with solar energy	**1**	**1**	**1.1.1**
2.	Students shall be able to differentiate between diffuse and beam radiation	**2**	**2**	**2.1.2**
3.	Students shall be able to assess the scenario of solar energy in global and India.	**2**	**2**	**1.1.1**
4.	Students shall be able to state and illustrate the I-V & P-V characteristics of solar cell	**2**	**2**	**1.1.1**
5.	Students shall be able to define the I-V equation of solar cell	**2**	**2**	**1.1.1**
6.	Students shall be able to solve numerical problems associated with SPV	**4**	**4**	**1.2.1, 2.1.1**
	Unit -II			

7.	Students shall be able to define basic terms associated with SPV module – Ratings, standard parameters	**1**	**1**	**1.1.1**
8.	Students shall be able to describe I-V & P-V characteristics of solar module	**2**	**2**	**1.1.1**
9.	Students shall be able to derive the I-V equation of SPV module	**3**	**3**	**1.1.1**
10.	Students shall be able to describe Mismatch in series and parallel connections	**2**	**2**	**1.1.1**
11.	Students shall be able to define Balance of System (BoS) – Batteries, charge controllers and inverter	**3**	**3**	**1.1.1**
12.	Students shall be able to list and illustrate the different types of inverters	**2**	**2**	**2.1.2**
13.	Students shall be able to solve numerical problems associated with SPV module.	**4**	**4**	**1.2.1, 2.1.1**
Unit -III				
14.	Students shall be able to explain the wires	**2**	**2**	**1.1.1**
15.	Students shall be able to describe the construction and operating principle for AC and DC generators	**2**	**2**	**1.1.1**
16.	Students shall be able to list and describe different types of wires, sizing and junction box	**2**	**2**	**2.1.2**
17.	Students shall be able to troubleshooting of stand-alone and grid connected solar PV power systems	**3**	**3**	**3.1.2**
18.	Students shall be able to test the SPV systems	**4**	**4**	**3.4.2**
Unit -IV				
19.	Students shall be able to design the standalone SPV system	**2**	**2**	**1.1.1**
20.	Students shall be able to list types of SPV systems	**1**	**4**	**2.1.2**
21.	Students shall be able describe the configuration of Grid connected Solar PV Power Systems (GCSPVPS)	**2**	**2**	**1.1.1**
22.	Students shall be able to design the GCSPVPS for small applications and for power plants	**1**	**1**	**2.1.2**

Course Content:

Hours Required	Topic to be covered	Mode of Delivery
01	Solar Energy – Introduction	Chalk and talk in classroom/ Lecture combined with discussions/Lecture with a quiz/ Tutorial/ Assignments/ Demonstration/ Invited lectures/ Group Assignment/
01	Scenario of India and global	
01	Solar Radiation – solar radiation spectrum diffuse & beam radiation solar radiation measurement.	
01	Solar Cells – I-V & P-V characteristics	
01	Solar Cells Technologies;	
01	Parameters;	
01	Factors affecting electricity generated	
01	Series, parallel of SPV	
01	Continuation of series & parallel connections	
01	Numerical problems	
01	SPV module – Ratings standard parameters	
01	factors affecting electricity generated	
01	I-V & P-V Characteristics;	

01	connection of modules in series, parallel and series & parallel;	
01	Mismatch in series and parallel connections, Introduction to arrays.	
01	Balance of System (BoS) – Batteries	
01	Charge Controllers	
01	MPPT	
01	Inverters	
01	(BoS to cover functions, working, types, features, typical specifications and cost). Numerical problems	
01	Wires – Introduction	Power point presentation and Chalk and talk mode
01	basics of current conduction, types of wires	
01	measurement of wire dimensions, wire sizing; junction box;	
01	Installation, troubleshooting of stand-alone	
01	grid connected solar PV power systems;	
01	Safety of SPV power plants	
01	Solar PV plant installation check list – Electrical testing of PV array, inverter	
01	Islanding protection	
01	Commissioning and system functioning	
01	Field visits within campus to study installations.	
01	SPV system design	
01	SPV integration	
01	Types of SPV systems	
01	Design Methodology for Stand-alone SPV systems.	
01	Grid connected Solar PV Power Systems (GCSPVPS) – Introduction	
01	GCSPVPS Configurations	
01	Components of GCSPVPS	
01	GCSPVPS Design for small applications	
01	GCSPVPS Design for Power Plants	
01	Summary of SPVSD	

Review Questions:

Review Questions	ULO	BLL	PI addressed
What is the impact of temperature on V_{oc} and I_{sc}? Justify your answer.	1	4	1.1.1
Installed Power capacity of India as on march 2023	3	2	2.1.2
Installed solar capacity of India as on march 2023	3	2	1.1.1
Installed Solar capacity of Karnataka as on 2023	3	2	1.1.1
A 240 W, 30 V solar PV module gives maximum current of 8.6 A and maximum voltage of 37 V. Calculate other parameters of the module.	6	3	1.1.1
A solar PV panel installed at Bagalkot generates 6 kWh of energy per hour. Calculate the energy generated by the same solar panel on 12th September 2019. (Coordinates for Bagalkot are 16.1691° N, 75.6615° E)	6	3	1.2.1, 2.1.1
Open circuit voltage is…………. Maximum power point voltage.	2	1	1.1.1
Is Solar cell conversion efficiency is equal to module efficiency? T/F	4	1	2.1.2
Which among have solar cells have higher conversion efficiency	10	1	1.1.1
Maximum power…………with increase in cell temperature. (increases/ decreases/ remains same)	7	1	1.1.1
Value of Boltzmann constant is	8	1	1.1.1
MVA rating of inverters used in SPV plant at BEC bgk	9	1	1.1.1
List parameters to be checked before selecting power conditioner units for a system. Give brief description of each parameter.	11,12	2	1.1.1
List and explain parameters on which voltage drop in wire depends. Calculate the copper loss in a 132kV transmission line (assume 1-phase) from Bagalkot to Badami with conductor type Zebra and length 20km. (Zebra conductor specifications: 24.82mm, ρ = 0.081857 Ω/km)	14	4	2.1.2
Give the checklist for visual inspection performed during troubleshooting.	17	2	1.1.1
How the choice of appropriate wire while designing a SPV system plays an important role?	16	2	1.1.1
Is installation and commissioning same? Justify your answer. Give the safety measures to be taken during SPV system installation.	15	4	1.1.1
Define 'Islanding' wrt grid connected SPV power plants. What are the main reasons for islanding?	19	2	2.1.2
What is troubleshooting? Explain two common problems that require troubleshooting	18	1	3.1.2
Draw block diagram of a stand-alone solar PV system designed to load during sunshine and non-sunshine hours. How are the ratings of the following components, in a stand-alone solar PV system, designed/selected? (a)Battery (b) Charge controller (c) DC to DC converter, (d) DC to AC converter and (e) MPPT.	21	4	3.4.2
Design a stand-alone solar PV system for the home load given in table-2. Consider following data for design. Battery specifications: C = 150 Ah, V = 12 V, DoD = 70%, Efficiency =	22	4	3.2.3

<table>
<tr>
<td>90% with DoA = 2 days
Inverter losses = 7%
Module specifications: P_{mp} = 50 W, V_{mp} = 12 V, I_{mp}= 4A
Daily sunshine hours = 5 hrs
Table 2: Home load details
<table>
<tr><th>Sl</th><th>Load</th><th>Wattage</th><th>Quantity</th><th>Usage hours</th></tr>
<tr><td>1</td><td>Tube light</td><td>40</td><td>4</td><td>7</td></tr>
<tr><td>2</td><td>Ceiling Fan</td><td>60</td><td>2</td><td>10</td></tr>
<tr><td>3</td><td>Grinder</td><td>1000</td><td>1</td><td>0.25</td></tr>
<tr><td>4</td><td>TV</td><td>145</td><td>1</td><td>8</td></tr>
</table>
</td>
<td></td><td></td><td></td>
</tr>
<tr>
<td>Design a solar power plant that can supply 20 MW power to the grid in summer days (It is found that SPV plant can generate 70% of installed capacity).
Use following data for the design
<table>
<tr>
<td>AC transmission loss = 4%
DC transmission loss = 3%
Transformer 11kV/415V, η = 90%</td>
<td><u>Inverter specifications</u>
Nominal AC o/p power = 500kW
Max DC i/p to inverter = 600kW
Efficiency = 98%
Voltage o/p = 415 V</td>
<td><u>SPV module specifications:</u>
P_m = 320W
I_m = 10A
V_m = 40V</td>
</tr>
</table>
</td>
<td>20</td><td>4</td><td>3.2.1</td>
</tr>
</table>

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:

Dr. Sangamesh Goudappanavar

BASAVESHWAR ENGINEERING COLLEGE(AUTONOMOUS), BAGALKOT

MODEL COURSEPLAN

Title of Course	**:**	**AI Applications to Power System**	**Course Code**	**:**	**21UEE846E**
Credits	**:**	**3**	**Contact Hours/ Week**	**:**	**3**
Total Hours	**:**	**40**	**Tutorial Hours**	**:**	**40**
CIE Marks	**:**	**50**	**SEE Marks**	**:**	**100**
Semester	**:**	**VIII**	**Year**	**:**	**2025**

Prerequisites:

Course Objectives:

	The Course objectives are:
1	To understand the fundamentals of Artificial Intelligence, including its history, applications, and significance in power systems.
2	To apply AI techniques such as Artificial Neural Networks, Fuzzy Logic, and Genetic Algorithms for solving power system challenges like voltage control, security assessment, and demand forecasting
3	To optimize power system operations using AI-based approaches for maintenance scheduling, fault detection, and energy management.
4	To analyse AI-driven models and compare their effectiveness with conventional power system solutions.

Course Outcomes:

	At the end of the course the student should be able to:
1	Illustrate the problemsolving methods in different sectors tools that are needed to solve real-time problems.
2	Implement fuzzy controllers by modelling the human intelligence into mathematical model.
3	Obtain the optimum solution of well formulated optimization problem using evolutionary approach.
4	Analyze the different feasible languages to interpret in power systems.

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

No	Programme Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
The students will be able to:																
1	UEE836E.1	3	3	2	1	2	2	1	1		1	1	1	3		2
2	UEE836E.2	3	1	2	1	2							1	3		2
3	UEE836E.3	3	3	1	1	1		1	1		2	1	1	2	1	2
4	UEE836E.4	3	3	2	2	1			1		2		1	1	2	2

Competencies Addressed in the course and Corresponding Performance Indicators

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

Competency		Indicators
• Engineering Knowledge		• Apply mathematics and engineering fundamentals to analyze AI-based power system problems.
• Problem Analysis		• Identify power system problems that can be solved using AI techniques. • Develop AI models for security assessment, voltage control, and demand forecasting.
• Design & Development of Solutions		• Design AI-based solutions for real-time power system applications. • Implement fuzzy controllers and optimization models for power system operations.
• Investigation of Complex Problems		• Analyze and compare AI techniques with conventional methods in power systems. • Model and simulate AI-driven power system controllers.
• Modern Tool Usage		• Use AI-based simulation tools such as MATLAB, Python, or OpenDSS for power system analysis. • Evaluate different AI programming languages for solving power system problems.

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.	Define Artificial Intelligence and explain its historical development.	**1**	**1**	**1.1.1**
2.	Illustrate different AI programming methods and techniques used in power systems.	**1**	**2**	**2.1.2**
3.	Compare AI models with conventional computational models in power systems.	**4**	**2**	**1.1.1**
4.	Explain the role of AI in industry and power system applications.	**1**	**2**	**1.1.1**
5.	Discuss current trends and applications of AI in power systems.	**1**	**2**	**1.1.1**
6.	Evaluate the progress of AI and its impact on intelligent power systems.	**4**	**5**	**1.2.1, 2.1.1**
	Unit -II			
7.	Explain the structure and working of Artificial Neural Networks (ANN).	**1**	**1**	**1.1.1**
8.	Compare biological and artificial neuron models.	**4**	**4**	**1.1.1**
9.	Implement Perceptron and ADALINE neural networks for power system applications.	**2**	**3**	**1.1.1**
10.	Develop fuzzy logic-based controllers for voltage control.	**2**	**3**	**1.1.1**

	connections			
11.	Perform fuzzification and defuzzification for power system applications.	**2**	**3**	**1.1.1**
12.	Evaluate the performance of ANN and Fuzzy logic in power systems.	**4**	**5**	**2.1.2**
	Unit -III			
13.	Describe the working principles of Genetic Algorithms (GA).	**2**	**2**	**1.1.1**
14.	Apply genetic algorithms for optimization in power systems.	**2**	**2**	**1.1.1**
15.	Implement genetic representation, mutation, and selection techniques.	**3**	**3**	**2.1.2**
16.	Compare genetic algorithms with conventional optimization techniques.	**4**	**4**	**3.1.2**
17.	Perform evolutionary programming for power system optimization.	**3**	**3**	**3.4.2**
18.	Evaluate the effectiveness of genetic algorithms in power system problems	**4**	**5**	
	Unit -IV			
19.	Implement neural networks for power system security assessment.	**2**	**3**	**1.1.1**
20.	Develop expert systems for voltage control in power grids.	**2**	**3**	**2.1.2**
21.	Apply Genetic Algorithms for maintenance scheduling in electrical networks.	**3**	**3**	**1.1.1**
22.	Analyze demand forecasting using AI-based intelligent systems.	**4**	**4**	**2.1.2**
23.	Compare AI techniques with traditional methods for power system analysis.	**4**	**4**	**2.1.2**
24.	Evaluate the real-time application of AI-based power system tools.	**4**	**5**	**2.1.2**

Course Content:

Hours Required	Topic to be covered	Mode of Delivery
01	**Introduction to Artificial Intelligence (AI)**	Chalk and talk in classroom/Lecture combined with discussions/Lecture with a quiz/ Tutorial/ Assignments/ Demonstration/ Invited lectures/ Group Assignment/
01	History and Evolution of AI	
01	Importance and Applications of AI in Power Systems	
01	Intelligence, Communication, Learning,	
01	Artificial Intelligence, History, Early Works	
01	Importance, Definitions,	
01	Programming Methods, Techniques	
01	Progress of Artificial Intelligence	
01	Growth of AI, AI and Industry, AI and the world,	
01	Current Trends in Applied AI,	
01	Modeling, Simulation and AI, Intelligent Systems, Role of IS, Comparisons with conventional programs.	
01	difference between human machine and intelligence	
01	biological neural network, artificial neuron model;	
01	connection of modulesinseries,parallelandseries∥	
01	Concept of Perceptron, ADALINE	

01	Feedback in Neural Network, Neural Network Architectures	
01	Neural Learning, Application of Neural Network in Power System	
01	**Fuzzy Logic:** Introduction, Foundation of Fuzzy Systems	
01	Representing Fuzzy Elements, Basic Terms and Operations,	
01	Properties of Fuzzy Sets, Fuzzification,Arithmetic Operations of Fuzzy Numbers.	
01	**Genetic Algorithms and Evolutionary Programming:** Introduction	Power point presentation and Chalk and talk mode
01	Genetic Algorithms, Procedure of Genetic Algorithms,	
01	Genetic Representations, Initialization and Selection	
01	Genetic Operators, Mutation,	
01	The Working of Genetic Algorithms,	
01	Evolutionary Programming,	
01	The Working of Evolutionary Programming	
01	**Application of AI in Power Systems:** Application of Neural Network	
01	Expert Systems in Voltage Control	
01	Field visitswithin campustostudyinstallations.	
01	Application of ANN for security assessment	
01	Schedule Maintenance of Electrical Power Transmission Networks using Genetic Algorithm,	
01	TypesofSPVsystems	
01	Numericals	
01	Numericals	
01	Intelligent Systems for Demand Forecasting.	
01	Intelligent Systems for Demand Forecasting.	
01	Examples	
01	Examples	
01	Summary	

Review Questions:

Review Questions	ULO	BLL
What is Artificial Intelligence, and how has it evolved over time?	1	4
How does AI contribute to intelligent power system operations?	3	2
What are some key AI techniques used in power system analysis?	3	2
How do AI-based models improve the efficiency of power networks?	3	2
What are some limitations of AI techniques in power systems?	6	3
What is an Artificial Neural Network (ANN), and how does it work?	6	3
How does an artificial neuron differ from a biological neuron?	2	1
What are the different architectures of neural networks?	4	1
How is ANN used for power system security assessment?	10	1
What are the differences between ANN and fuzzy logic in power system applications?	7	1
What are some real-world applications of ANN and fuzzy logic in electrical power systems?	8	1
How do ANN and fuzzy logic compare in terms of accuracy and computational efficiency?	9	1
What are Genetic Algorithms (GA), and how do they work?	11,12	2
How are selection, crossover, and mutation used in Genetic Algorithms?	14	4
What are the advantages of using Genetic Algorithms in power system optimization?	17	2
What is Evolutionary Programming, and how does it differ from GA?	16	2
How can GA be applied for load flow optimization in power networks?	15	4
What are some real-world applications of Genetic Algorithms in power engineering?	19	2
What are the challenges of implementing GA in real-time power system applications?	18	1
How can AI be used for security assessment in power systems?	21	4
What role does AI play in voltage control and stability?	22	4
How do expert systems contribute to power system protection?	20	4
What are the benefits of using AI for power system fault detection?	21	1
How does AI help in demand forecasting for power grids?	22	2
How can AI optimize maintenance scheduling in power transmission networks?	23	2
What are AI-driven smart grid technologies, and how do they work?	23	3
What are some case studies showcasing the success of AI in power engineering?	24	4
What are the future research areas in AI for power system applications?	24	2

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	CA	PO
Assignment 1	**5**	**1,2,3,4**	1.1, 2.1	1,2
Assignment 2	**5**	**1,2,3,4**	2.1, 4.1	2, 4

Faculty Incharge:

Dr. Sangamesh Goudappanavar

Basaveshwar Engineering College, Bagalkote

Department of Humanities and Social Sciences

Course File

Title of Course	:	Intellectual Property Rights	Course Code	:	21UHS853C
Credits	:	03	Contact Hours/Week	:	03
Total Hours	:	40	Tutorial Hours	:	00
CIE Marks	:	50	SEE Marks	:	50
Semester	:	VIII	Year	:	FourthYear
Faculty Name	:	Dr. Basavarajeshwari. G. Hokarani	HOD Signature		

Course Objectives:

1. To recognize the importance of IP and to educate the students on basic concepts of Intellectual Property Rights.
2. To identify the significance of practice and procedure of the Patents.
3. To make the students to understand the statutory provisions of different forms of IPRs in simple forms.
4. To make the students acquaint with the best practices towards protecting IP violation and enforce strong mechanisms for IPR filing.

Course Outcomes:

On successful completion of this course the student should be able to:

CO1: Identify criteria to fit one's own intellectual work in particular form of IPRs.

CO2: Apply statutory provisions and procedure to protect different forms of IPRs at national and international level.

CO3: Analyse rights and responsibilities of holder of Patent, Copyright, Trademark, Industrial Design etc.

CO4: Develop skill of making search using modern tools and technics.

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

No	Programme Outcomes / Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
The students will be able to:																
1	Identify criteria to fit one's own intellectual work in particular form of IPRs.	-	-	-	-	-	-	-	-	-	-	-	-			
2	Apply statutory provisions and procedure to protect different forms of IPRs at nationaland international level.	-	-	2	-	1	2	2	3	-	2	-	2			
3	Analyse rights and responsibilities of holder of Patent, Copyright, Trademark, Industrial Design etc.	-	-	-	-	-	3	2	2	-	2	-	1			
4	Develop skill of making search using modern tools and technics	-	-	-	-	3	-	-	-	1	1	-	2			

Unit Learning Outcomes

(ULO)

Unit Learning Outcomes(ULO)	CO's	BLL
Unit-I		
1.Describe meaning of property, rights, history and different types of IPRs	1	2
2. Explain role of IPR in R & D	1	2
3.Interpreate the meaning and criteria for patentability	2	2
4. Identifies Rights and responsivities of patent holder	3	3
5.Criteria for patentability	2	4
Unit-II		
1.Realises importance of prior arts search	4	3
2. Expose to different types of tools and techniques of search	4	4
3. Demonstrate different methods to file Patent applications at national and international	2	4
4.Able to prepare documents require for filling	2	4
Unit-III		
1. Meaning, Critria for registration of Trade marks	2	4
2. Different types of trade marks and emerging forms of trade marks	2	4
3. Registration procedure for trade mark	2	4
4.Confidential information-meaning,characteristics and strategies to protect confidential information	3	5
5.Differentiating with patents ,copyrights and general information	2	4
Unit-IV		
1.Understanding various forms of Copy rights with criteria	2	4
2. Various rights and responsibilities of holder of Copyright holder	3	4
3. Able to analyse the registrable industrial design	2	3
4.Clarification of Piracy of design and remedies in case of piracy	3	3

Course Content: Conspectus

Sl. N0.	Hours Required	Topic to be covered	Mode of Delivery
01	01	Introduction to IPRS: Concepts of Property and Rights. History of IPRs.	Chalk and talk/videos/ digital boards in classroom/ Lecture combined with
02	01	Different forms of IPRs. Role of IPRs in R and D.	
03	01	Patents: Meaning of Patent, object and value of patent law. Advantages of patent to the invertors.	
04	01	Criteria for Patentability.	
05	01	Software and Business Methods Patents.	
06	01	Govt use inventions	
07	01	Infringement of patent and remedies for infringement	
08	01	Compulsory license	

09	01	Visiting to various countries patent office web sites	discussions/ Tutorial/ Assignments/ quiz/seminar/ course project/ online
10	01	Revision of the unit	
11	01	Searching of Prior art: Prior art, Tangible versus Intangible prior art	
12	01	Search strategy: key words, structures, sequences, use operators, database for searching free and paid, disclosed versus claimed matters	
13	01	Importance of International research report.	
14	01	Patent Drafting:Scope of invention, definitions, types of specification, descriptions	
15	01	Drawing and claim drafting	
16	01	Forms require for patent filing	
17	01	Filing mechanism through Individual patent office, PCT Route, importance of PTC, Claiming priority from either route	
18	01	Request for re -examination and revocation, term of patent and patent renewal.	
19	01	Demonstration of granted patent and verifying various stages of patent process	
20	01	Revision of the unit	
21	01	Trade-Marks :Meaning and functions of Trade marks.	
22	01	Concept of Distinctiveness and grounds for refusal of trademarks registration.	
23	01	Trademarks- Challenges in Non- Conventional Marks	
24	01	Infringement of trademarks and remedies for infringement.	
25	01	Domain Names Disputes. Well Known Marks.	
26	01	Confidential Information and Trade Secrets: Confidential information and trade secrets -conditions for protection	
27	01	Ingredients for an action for breach of confidence and remedies	
28	01	Distinction between confidential information and general information.	
29	01	Revision of the unit	
30	01	Introduction. Nature of copyright, Originality requirement in Copyright Law	
31	01	Subject-matter requirement in Copyright Law. Neighbouring/ Related, Economic and Moral Rights of Authors.	
32	01	Copyright in the Digital Context. An overview of copy right protection in India.	
33	01	Transfer of copy right-various modes of transfer .	
34	01	Infringement of copy right, Copyright- fair dealing and remedies.	
35	01	Comparison with patent and copyrights	
36	01	Industrial Designs: Definition of a design; Concept of Novelty and Originality.	
37	01	Designs not patentable; - Functional Designs	
38	01	Industrial Design registration in India	
39	01	Infringement of design and remedies for infringement	
40	01	Revision of the unit and summarization of whole syllabus	

Review Questions:

Review Questions	CO	BLL
Explain meaning and different forms of IPR.	1	4
Discuss the Role of IPR in R&D	1	3
With help of flowchart explain registration of patent.	3	3
Explain the grounds for revocation of patent	2	3
Elaborate anatomy of specification.	2	5
When and how government can use patented invention? Explain in detail	2	2
'Common law deals with the idea of passing off'. Examine the conditions of passing off in relation to unregistered trademark .	2	3
When information is called confidential information? What precautions an owner of such information has to take to sustain it as such confidential information?	2	4

How can you keep your trade mark as an ideal and strong trademark? Elaborate with illustrations	2	5
Elaborate remedies in case of breach of confidential information.	2	2
What can be and what cannot be transferred and in Copyright? Discuss.	2	4
Critically examine the scope of literary work as specified under the copyright legislation with examples.	2	4
Explain included and excluded industrial designs.	2	4
'Author is the first owner of copyright'. Enunciate the concept of author and owner of different forms of copyright under the copyright legislation.	3	4
Identify the incidences amounting to the piracy of design	3	4
Distinguish between passing off and infringement of trademark	2	4
With help of flowchart explain registration of trademark.	2	5
'Design should be appealable to eye' justify the statement by covering criteria for registration of design.	2	4
Compare and contrast patent and trademark	2	3
Discuss where does copyright subsist and where does not subsist?	2	4
Identify the author's legal rights	3	3
Summarize when information can take status of confidential information and distinguish it with general information.	2	4
List out acts falling under fair dealing activities.	2	2
What you mean by infringement of copyright and discuss the remedies for infringement of copyright.	3	4
'Originality is required to obtain copyright for certain types of work'. Enumerate various theories relating to originality under the copyright law.	3	4
'Copyrighted work becomes public property after the tenure'. Examine the terms of copyright in relation to various type of work.	2	3

Evaluation Scheme:

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

Details of Assignment :

Assignment	Marks (10)	CO	PO
Assignment 1	Quiz	CO1	
Assignment 2	Daily class based questions per class minimum 1 Maximum 2 questions at least 50 questions to be answered.	CO2,CO3 & CO4	3,5,12
Assignment 3	Project	CO1,CO2,CO3 &CO4	6,8&12

SEE Model Question Papers:

CIE Test Question Paper pattern

- Syllabus for each CIE test is two units
- Max. Marks: 40 Marks (later scaled down to 20 Marks)

Answer any one full Question from each unit

	Unit-	
01	**a)**	20 Marks
	b)	
	c)	
02	**a)**	20 Marks
	b)	
	c)	
	Unit-	
03	**a)**	20 Marks
	b)	
	c)	
04	**a)**	20 Marks
	b)	
	c)	
	Total Marks	**40 Marks**
	40 Marks scaled down to	**20 Marks**

The 10 marks are awarded based on Assignment/Quiz/Course project/Course case study etc.,

Suggested details for the award of 10 marks:

Category	Marks	Remarks
Quiz 1	3	To be conducted for first unit and second unit.
Quiz 2	3	To be conducted for thirdunit and fourth unit.
Seminar,Course project/Course case study etc.,	4	To be conducted from the beginning of the semester and completed before one week of last instruction day.
Total	**10 Marks**	

2. Semester End Examination (SEE) = 50 marks

SEE is carried out through an examination of 3 Hours duration and is evaluated for100 Marks and later scaled down to 50 Marks.

SEEQuestionPaperPattern

S.No	Examination	Syllabus coverage for the Examination	Duration of the examination in hours	Max marks	Question Paper Pattern		
1	Semester End Exam	Full Syllabus	03	100	Part A	One Compulsory question consists20subquestionsof 1markeach/10questions2 markeachcoveringentire syllabus(Allunits)/(50%of questionsmustbeL3andL4 level)	20X1=20/ 10X2=20 marks
					Part B	There shall be **one question** from each unit with internal choice. Each question carries 20 marks. Each Theory course shall consist of **four units** of syllabus. All questions should have same complexity in terms of COs and Bloom's taxonomy level.	20X4 = 80 marks
			Total	100			**100 Marks**

Model Questionpaper

B.E. First Year Semester End Examinations

Duration: 3Hours **Max.Marks:100**

Answer any FIVE full questions selecting at least ONE from each unit							
2		**UNIT-I**	**20**				
			OR				
3			**20**				
		UNIT-II					
4			**20**				
			OR				
5			**20**				
		UNIT-III					
6			**20**				
			OR				
7			**20**				
		UNIT-IV					
8			**20**				
			OR				
9			**20**				

1.Total of Eight Questions with Two from each unit to be set uniformly covering the entire syllabus.

2.Each question should not have more than Four subdivisions.

3. Any Five Full questions are to be answered choosing at least One from each unit

Course Utilization for CIE and SEE

Unit	Chapter	Teaching Hours	Number of Questions in CIE-I	Number of Questions in CIE – II		Number of Questions in SEE
I	1		04			02
I	2					
II	3					02
II	4			04		
III	5					02
III	6					
IV	7					02
IV	8					

Signature of the Faculty