Semester- VIII

Professional Core Theory Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL421
Course Name	Flexible AC Transmission Systems
Desired Requisites:	Power Electronics , Power System Analysis and Stability

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 **Hrs/week**	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To make students understand the concept of FACTs envisages the use of power electronics to improve system operation by fast & reliable control.
2	To cover concepts of FACTs including the description, principle of working and analysis of various FACTs controllers.
3	To strengthen the control of FACTs and system interactions.
4	To Use the suitable FACTS controller for a particular application.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Describe necessity, operating principles and benefits of various FACTS device.	II	Understanding
CO2	Use the suitable shunt/series FACTS controller for a particular application.	III	Applying
CO3	Use the suitable switching converter type FACTS controller for a particular application.	III	Applying
CO4	Analyse the functioning and control of various FACTS Controller	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Introduction** Transmission Interconnections, Need of Transmission Interconnections, Opportunities for FACTS, Flow of Power in an AC System , Power Flow in Parallel Paths , Power Flow in Meshed System, Limits of the Loading Capability, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters , Basic Types of FACTS Controllers, Relative Importance of Different Types of Controllers, Brief Description and Definitions of FACTS Controllers , Shunt Connected Controllers, Series Connected Controllers , Combined Shunt and Series Connected Controllers, Other Controllers, Benefits from FACTS Technology	**7**
II	**Static Shunt Compensation** Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, Improvement of Transient Stability ,Power Oscillation Damping, Summary of Compensator Requirements, Methods of Controllable Var Generation, Variable Impedance Type Static Var Generators, The Thyristor-Controlled	**7**

	Reactor (TCR), Operating Characteristics of a TCR, The Thyristor-Controlled Transformer (TCT), The Fixed Capacitor–Thyristor-Controlled Reactor (FC–TCR), The Mechanically Switched Capacitor–Thyristor-Controlled Reactor (MSC–TCR), The Thyristor-Switched Capacitor (TSC), The Thyristor-Switched Capacitor–Thyristor-Controlled Reactor (TSC–TCR), A Comparison of Different SVCs.	
III	**Static Series Compensation** Objectives of Series Compensation, Concept of Series Capacitive Compensation, Voltage Stability , Improvement of Transient Stability, Power Oscillation Damping, Subsynchronous Oscillation Damping, Summary of Functional Requirements, Approaches to Controlled Series Compensation, Variable Impedance Type Series Compensators , GTO Thyristor-Controlled Series Capacitor (GCSC) , Thyristor-Switched Series Capacitor (TSSC), Thyristor-Controlled Series Capacitor (TCSC), Subsynchronous Characteristics , Basic Operating Control Schemes for GCSC, TSSC, and TCSC	**7**
IV	**Switching Converter Type Shunt Var Generators** Basic Operating Principles,Basic Control Approaches, Static Var Compensators: SVC and STATCOM, The Regulation Slope, Transfer Function and Dynamic Performance, Transient Stability Enhancement and Power Oscillation Damping , Var Reserve (Operating Point) Control, Comparison Between STATCOM and SVC ,V-I and V-Q Characteristics , Transient Stability, Response Time , Capability to Exchange Real Power, Operation With Unbalanced AC System, Loss Versus Var Output Characteristic, Physical Size and Installation, Merits of Hybrid Compensator	**6**
V	**Switching Converter Type Series Compensators** The Static Synchronous Series Compensator (SSSC), Transmitted Power Versus Transmission Angle Characteristic, Control Range and VA Rating, Capability to Provide Real Power Compensation, Immunity to Subsynchronous Resonance, Internal Control, External (System) Control for Series Reactive Compensators	**6**
VI	**Combined Compensators: Unified Power Flow Controller (UPFC) and Interline Power Flow Controller (IPFC)** Introduction , The Unified Power Flow Controller, Basic Operating Principles Conventional Transmission Control Capabilities Independent Real and Reactive Power Flow Control , Comparison of UPFC to Series Compensators and Phase Angle Regulators, Control Structure , Basic Control System for P and Q Control , Dynamic Performance , Hybrid Arrangements: UPFC with a Phase, Shifting Transformer , The Interline Power Flow Controller (IPFC) Basic Operating Principles and Characteristics , Control Structure	**6**
Text Books		
1	Narain G.Hingorani, Laszio. Gyugyi, *Understanding FACTS Concepts and Technology of Flexible AC Transmission System*, Standard Publishers, Delhi, 2001.	
References		
1	A.T. John, *Flexible AC Transmission System*, Institution of Electrical and Electronic Engineers (IEEE), 1999.	
2	R. Mohan Mathur, Rajiv. K. Varma, *Thyristor – Based Facts Controllers for Electrical Transmission Systems*, IEEE press and John Wiley & Sons Inc., 2002	
Useful Links		
c	https://nptel.ac.in/courses/108/107/108107114/	

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												2	
CO2	3												2	
CO3	3												2	
CO4		2											2	
The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.														

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Syllabus Prepared By	Mrs. S. P. Diwan
Syllabus Checked By	Dr. S. D. Patil

Professional Core Laboratory Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL492
Course Name	Project-II
Desired Requisites:	--

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	12 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 6			

Course Objectives	
1	To acquire the skills of electrical, electronic circuit design and mechanical assembly.
2	To develop the skills of analysis and fault diagnosis of the electrical, electronic circuit and mechanical assembly as per design
3	To test the electrical, electronic circuit and mechanical assembly.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Analyse and infer the reference literature/ research papers critically and efficiently.	IV	Analyzing
CO2	Evaluate the performance of the project.	V	Evaluating
CO3	Construct the model of the project.	VI	Creating
CO4	Write and Present the report of the project.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Visit to a local industry for the study of problems of industry as per the Project- I.
2. Prepare the problem based hardware Project.
3. Prepare a report on the same.

Textbooks	
1	As per topic Selected and Journal papers, Conference papers, Handbooks

References	
1	As per topic Selected and Journal papers, Conference papers, Handbooks

Useful Links	
1	Online resources in the selected domain areas.

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									3	2				
CO2			3	3										
CO3						3					2			
CO4							3							
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.														

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

Syllabus Prepared By	Mr. N.V. Patel
Syllabus Checked By	Mrs. A. A. Dhamangaonkar

Professional Elective Theory Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL431
Course Name	Professional Elective 4: EHVAC
Desired Requisites:	Electrical Transmission and Distribution, Power system Analysis & Stability

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	Student will understand parameters of EHVAC line
2	Student will develop a skill to understand power frequency over voltages developed in EHVAC line
3	Student will develop a skill to understand lightening and lightning protection.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understand various aspects of EHVAC line and power frequency over voltages in EHVAC line	II	Understanding
CO2	Solve line inductance, capacitance and voltage gradient for EHVAC transmission	III	Applying
CO3	Explain lightning strokes and protection against lightning.	IV	Analyzing
CO4	Evaluate line and ground parameters associate with EHVAC line	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction** Engineering aspects and growth of EHVAC transmission line trends and preliminaries, power transferability, transient stability limit and surge impedance loading	6
II	**Calculation of Line and Ground Parameters** Resistance, power loss, temperature rise, properties of bundled conductors, inductances, and capacitances, calculation of sequence inductance and capacitance line parameters of modes of propagations, resistance and inductance of ground return	7
III	**Corona Effects** I^2R and corona loss, corona loss formulae, charge voltage diagram with corona. Attenuation of traveling waves due to corona loss Audible noise; corona pulses; their generation and properties, limits for radio interface fields.	6

IV	**Lightning and Lightning Protection** Lightning strokes to lines, their mechanism, general principals of lightning protection problem, tower footing resistance, lightning arresters and protective characteristics, different arresters and their characteristics.	7
V	**Over Voltage in EHV Systems Covered by Switching Operations** Over voltages their types, recovery voltage and circuit breaker, Ferro resonance over voltages calculation of switching surges single phase equivalents	6
VI	**Power Frequency Voltage Control and Over Voltages** Generalized constants, charging current, power circle diagram and its use, voltage control shunt and series compensation, sub synchronous resonance in series capacitor compensated lines and static reactive compensating systems.	7

Textbooks	
1	Rakosh Das Begamudre, "EHVAC Transmission Engineering", Wiley Eastern Limited, 3rd Edition 2008.
2	S.V. Rao "EHV –AC and HVDC Transmission Engineering &Practice"
References	
1	Twian Gonen, "EHVAC and HVDC Transmission System Engineering – Analysis and Design", John Wiley and Sons 1988.
Useful Links	
1	https://nptel.ac.in/courses/108/108/108108099/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												3	
CO2	3	2											3	
CO3				3										
CO4	2	3											2	

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Syllabus Prepared By	Dr. V. P. Mohale
Syllabus Checked By	Mr. V. S. Sathe

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL432
Course Name	Professional Elective-4: Intelligent Systems and its applications
Desired Requisites:	-

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs./week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	This course intends to develop an understanding of the basic concepts of Artificial intelligence.
2	It will make students to learn different modern computational intelligent algorithms like adaptive systems, Fuzzy logic and neural network algorithms.
3	It will make students to study expert systems and Neuro –intelligent algorithms.
4	It will make students to study hybrid Intelligent Systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Outline the principles of Artificial intelligence.	II	Understanding
CO2	Describe intelligent algorithms like adaptive systems, machine learning, Fuzzy logic and neural network.	II	Understanding
CO3	Discuss expert systems and Neuro –intelligent algorithms.	II	Understanding
CO4	Use of different intelligent algorithms and combination of them.	III	Applying

Module	**Module Contents**	**Hours**
I	**Introduction to Intelligent Systems** Artificial intelligence, need and concepts, historical development, computational intelligence, comparison with conventional logic and design approach, engineering complex systems and limitations of traditional design, AI and ML approach.	6
II	**Adaptive systems** Introduction, conventional logic limitations, adaptive algorithms, design approach using modern techniques, intelligent adaptive systems, Electrical system using adaptive algorithm, different applications in engineering.	6
III	**Artificial Neural Network** Introduction to Artificial Neural Network, Biological Neuron, Biological and Artificial Neuron Models, Types of Neuron Activation Function, ANN Architectures Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules. Perceptron Models.	7
IV	**Multilayer feed forward Neural Networks** Introduction, Backpropagation, Associative Memory, BAM, Storage and Recall Algorithm, BAM Energy Function, Self Organizing Maps (SOM) , applications.	6

V	**Fuzzy Expert System** Introduction, Fuzzy versus crisp, fuzzy sets: membership function, Basic fuzzy set operations, properties of fuzzy sets, fuzzy relations. fuzzy logic (Fuzzy quantifiers, fuzzy Inference), fuzzy rule based system, fuzzification methods, application to Electrical systems.	8
VI	**Application of Intelligent Systems** Control system, security assessment, Study of Intelligent system application in Electrical engineering, Application of Intelligent Systems in Schedule Maintenance of Electrical Power Transmission Networks and Intelligent Systems for Demand Forecasting.	6

Textbooks	
1	S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Network Using MATLAB 6.0", Tata McGraw-Hill, New Delhi, 2006.
2	Timothy S.Ross, "Fuzzy Logic with engineering applications", Weily India Pvt. Ltd., 2011.
References	
1	Crina Grosan, Ajith Abraham, "Intelligent Systems: A Modern Approach" , Springer Verlag, 2011.
2	Adrian A. Hopgood, "Intelligent systems for engineers and scientists", Second Edition, CRC press, 2001.
Useful Links	
1	http://nptel.ac.in/downloads

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	2													
CO3		2												
CO4		3												

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Syllabus Prepared By	Mr. A.B. Patil
Syllabus Checked By	Dr. R. P. Hasabe

Walchand College of Engineering, Sangli
(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL433
Course Name	Professional Elective-4: SMART Grid
Desired Requisites:	Power System Protection

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To provide the advance knowledge in the field of SMART – grid technology
2	To make the students aware of research avenues in the field of SMART grid technology
3	To develop the skills of simulation and analysis of SMART grid systems.
4	To understand the load flow and protection issues in SMART grid systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain various concepts associated with SMART grid.	II	Understanding
CO2	Apply SMART grid concept to power system monitoring, communication and protection.	III	Applying
CO3	Analyze tools for SMART grid's performance, stability and computational analysis.	IV	Analyzing
CO4	Evaluate the performance of DC-AC Hybrid Micro grid.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**SMART Grid Architecture** Introduction, SMART grid verses today's grid, computational intelligence, power system enhancement, SMART grid market drivers, architecture of SMART grid, and function of SMART grid components.	6
II	**SMART Grid Technologies** Introduction to SMART Meters, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV) & more, Substation Automation, Feeder Automation, Geographic Information System (GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection	7
III	**Transmission Aspects** Wide area Monitoring Systems (WAMS), PMU and PDCs, PMU placement, linear state estimation, System security under SMART grid environment, Concept of Resilient & Self-Healing Grid, adaptive relaying using PMUs	6
IV	**Communication Aspects** Elements of communication and networking: architectures, standards and adaptation of power line communication (PLCC), zigbee, GSM, and more; machine to machine communication models for the SMART grid; Home area networks (HAN) and neighborhood area networks (NAN); reliability, redundancy and security aspects.	7

V	**Smart Grid load flow and Protection** Load flow in SMART grid, load flow methods, congestion management flow effect, load flow for SMART grid design Smart Grid Protection.	6
VI	**AC DC and Hybrid Micro grid** Basics of AC and DC Micro grid, operation and control of DC Micro Grid, AC Micro Grid and AC DC hybrid micro grid. Demand side management and Demand response analysis of smart Grid.	7

Textbooks	
1	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "SMART Grid: Technology and Applications", Wiley
2	G. M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons Inc., 2004.
3	NPTEL Video Lectures on Smart Grid.
References	
1	Gilbert N. Sorebo, Michael C. Echols, SMART grid security: An end to end view of security in new Electrical grid, CRC press, Taylor &Fancis group, 2011.
2	S. P. Chowdhary, P. Crosley and S. Chowdhary, Micro-grids and active distribution networks, The institution of engineering and technology, London, 2009.
3	J. S. Thorp, A.G. Phadke, Synchronized Phasor Measurement and Their Applications Springer 2008.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc23_ee60/preview

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		2												
CO3					2								2	
CO4				2										

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Syllabus Prepared By	Dr. D. S. More
Syllabus Checked By	Dr. Mrs. A. S. Karvekar

Walchand College of Engineering, Sangli
(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL434
Course Name	Professional Elective-4: De-regulation and Energy Markets
Desired Requisites:	Power System Operation and Control.

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To explain the difference between integrated & restructured power system.
2	To introduce various trading models, market architecture & market power.
3	To impart knowledge of transmission pricing & various methods calculate these costs.
4	To introduce the concept of congestion management considering the physical constraints of transmission.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain the recent changes occurring in the structure of power supply utilities & electric supply market.	II	Understanding
CO2	Demonstrate the problem associated with deregulation.	III	Applying
CO3	Devise economic pricing based on congestion management.	IV	Analyzing
CO4	Explain the concepts of transmission pricing & various methods to calculate these costs.	III	Applying

Module	**Module Contents**	**Hours**
I	**Introduction -** Basic concept and definitions, privatization, restructuring, transmission open access, wheeling, deregulation, components of deregulated system, advantages of competitive system.	7
II	**Power System Restructuring** An overview of the restructured power system, Difference between integrated power system and restructured power system. Explanation with suitable practical examples.	7
III	**Deregulation of Power Sector** Separation of ownership and operation, Deregulated models, pool model, pool and bilateral trade model, multilateral trade model.	7
IV	**Competitive Electricity Market** Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing, Market power and its Mitigation Techniques, Bilateral trading, Ancillary services	6
V	**Transmission Pricing** Marginal pricing of electricity, nodal pricing, zonal pricing, embedded cost, Postage stamp method, Contract path method, Boundary flow method, MW-mile method, MVA – mile method, Comparison of different methods	6

VI	**Congestion Management** Congestion management in normal operation, explanation with suitable example, Total Transfer Capability (TTC), Available Transfer Capability (ATC)	6
Textbooks		
1	"Power System Restructuring And Deregulation: Trading, Performance and Information Technology", Loi Lei Lai, John Wiley & Sons Ltd. UK	
2	"Understanding Electric Utilities And Deregulation" Lorrin Philipson and H. Lee Willis, Marcel Dekker Inc, New York.	
References		
1	"Operation of Restructured Power Systems" K. Bhattacharya, M.H.J. Bollen and J. E. Daalder, Kulwer Academic Publishers, Massachausetts, USA	
2	"Market of Operations in Electric Power Systems: Forecasting Scheduling, and Risk Management.", M. Shahidhpour, H. Yamin and Z. Li, John Wiley & Sons Ltd. New York	
3	"Restructured Electrical power systems: Operating, Trading and Volatility", M. Shahidhpour and M. Alomoush, Marcel Dekker INC, New York.	
4	"Distributed Power Generation : Planning and Evaluation" H. Lee, Willis and W. G. Scott, Marcel Dekker Inc, New York	
Useful Links		
1	https://www.epa.gov/greenpower/understanding-electricity-market-frameworks-policies	

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		3												3
CO3				2										3
CO4		3												

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Syllabus Prepared By	Mrs. S. L. Shaikh
Syllabus Checked By	Mr M S Mahagaokar

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL435
Course Name	Professional Elective-5: Solar and Wind Power Generation
Desired Requisites:	Power Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To create awareness about the importance of renewable energy technology for sustainable future.
2	Impart the knowledge of solar power generation and wind power generation.
3	To acquaint students with possible storage systems in renewable power generation.
4	Introduce recent trends in renewable energy system to students.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Illustrate importance, potential and harnessing technologies for various renewable energy sources.	III	Applying
CO2	Apply various technologies to harness the power from solar PV energy sources.	III	Applying
CO3	Apply various technologies to harness the power from wind energy sources.	III	Applying
CO4	Illustrate the modern trends in energy storages, fuel cells and renewable energy systems.	III	Applying

Module	**Module Contents**	**Hours**
I	**Introduction to Renewable Energy Sources** Global and Indian scenario of RES, need for alternative energy sources, advantages &disadvantages of RES, classification of RES & comparison, key factors affecting RES. **Case Study:** PM Kusum Yojana and PM Suryoday Yojana	6
II	**Solar Energy** Solar thermal power generation, solar photovoltaic power generation, basics of PV cell, materials used for PV cell, efficiency of PV cell, equivalent electrical circuit, open circuit voltage and short circuit current, I-V & P-V curves, effects of different electrical parameters on I-V & P-V curves, measurement of solar insolation, solar concentrator, flat plate &concentrating collectors.	6
III	**Solar Photovoltaic Energy Conversion & Utilization** Configuration of PV power generation system- off-grid system & grid-connected PV system, single stage & two stage converters for power transfer, single phase & three phase inverters for PV, control of grid connected PV system, **Net Metring:** working, application in grid connected PV system and benefits.	7

IV	**Wind Resource Assessment** Power available in wind, wind turbine power & torque characteristics, types of rotors, characteristics of wind rotor, local effects, wind shear, turbulence & acceleration effects, measurement of wind, wind speed statistics, statistical model for wind data analysis, energy estimation of wind regimes, capacity factor, aerodynamics of wind turbines, aerofoil, lift & drag characteristics, power coefficient & tip speed ratio characteristics, electrical generator machines in wind energy systems. Control of Grid connected wind power generation systems Maximum power point tracking of wind power generation	7
V	**Storage and Fuel Cell Technologies** Introduction, need for storage for RES, traditional energy storage system- battery, fuel cell, principle of operation, types of fuel cell, hydrogen generation methods, storage technologies.	6
VI	**Emerging Trends in Renewable Energy** Introduction to Smart Grid (SG), SG in Indian context, architecture of SG, advantages &disadvantages, key challenges for SG, SG technologies, AMI, PMU, WAMS, standards & codes for grid integration of Distributed Generation systems.	7

Textbooks	
1	Chetan Singh Solanki, "*Solar Photovoltaics , Fundamentals, Technologies and Applications*" , third edition, PHI Learning Private Limited , 2016
2	S. P. Sukhatme and J. K. Nayak "Solar *Energy principles of thermal collection and storage",* Third Edition, McGraw Hill Education (India) Private Limited New Delhi. , 2016
3	Boyle, Godfrey, "*Renewable Energy*", 2nd edition, Oxford University Press, 2004.
4	G.S.Sawhney, "*Non-Conventional Resources of Energy*", PHI Publication 2012
References	
1	Gary-L. Johnson, "*Wind Energy Systems*", Tata Mc-Graw-Hill Book Company.
2	James Manwell, J. F. Manwell , "*Wind Energy Explained: Theory, Design and Application*"
3	Paul Gipe Wind Power, "*Renewable Energy for Home, Farm, and Business*."
Useful Links	
1	https://nptel.ac.in/courses/117/108/117108141/
2	https://onlinecourses.nptel.ac.in/noc20_mm05/preview
3	https://www.helioscope.com/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												2	
CO2	3	1											2	
CO3	3	1											2	
CO4	3												1	

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Syllabus Prepared By	Dr. D. S. More
Syllabus Checked By	Dr. S. D. Patil

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL436
Course Name	Professional Elective-5: Introduction to Embedded Systems
Desired Requisites:	Analog and Digital Circuits

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs./week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To develop basic knowledge of embedded systems and their features.
2	To provide skills for programming DSP for applications in Electrical Engineering.
3	To impart skills for interfacing peripherals to microcontrollers and develop embedded system.
4	It will make students to study and develop different applications of embedded systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain the salient features of embedded systems.	II	Understanding
CO2	Apply programming techniques to develop embedded systems	III	Applying
CO3	Implement the applications related to interface microcontroller with electrical and electronic systems.	III	Applying
CO4	Construct project prototypes using microcontrollers.	III	Applying

Module	**Module Contents**	**Hours**
I	**Introduction to Embedded System** Modular approach to Embedded System Design, Salient Features of Modern Microcontrollers, Selection Criteria for Microcontroller, Elements of Microcontroller Ecosystem	6
II	**MSP 430 Architecture** Power Supply for Embedded Systems, Introduction to MSP 430, MSP 430 Architecture, Programming Methods for MSP 430, Low Power Modes in MSP430.	6
III	**Basic Programming using MSP 430** Interfacing switches, general purpose I/O devices with MSP 430, Switch Debouncing and control, Using Analog to Digital Converters to read switches, Interfacing rotary encoders, seven segment displays	7
IV	**Digital I/O Programming and Interrupts** GIT, MSP430 Digital I/O, MSP430 Digital I/O: Switch Interfacing, MSP430 Clock System and Reset, Interrupts in MSP430, Types and Configuration of Interrupts.	6

V	**Peripheral Interfacing** Interfacing Liquid Crystal Displays(LCD), MSP430 Timer Module: Introduction and Timer Capture, Pulse Width Modulation, PWM using Timer Capture LCD interfacing, Interfacing of Analog to Digital Converters and Digital to Analog Converters.	7
VI	**Serial Communication and Embedded Project Prototyping** Serial Communication Protocols, USCI Module in MSP430, MSP430 Timer in Capture Mode, Building an Electronics Project, Circuit Prototyping Techniques, Single Purpose Computers, Project Demonstration from Concept to Final.	7

Textbooks	
1	Cem Unsalan and H. Deniz Gurhan , *'Programmable Microcontrollers with Applications: MSP430 LaunchPad with CCS and Grace'*, McGraw Hill Education, 1st Edition, 2018.
2	John Davies, '*MSP430 Microcontroller Basics'*, Elsevier, 1st Edition, 2010.
References	
1	Manuel Jiménez, Rogelio Palomera, Isidoro Couvertier '*Introduction to Embedded Systems: Using Microcontrollers and the MSP430'*, Springer, 1st Edition, 2014.
2	Adrian Fernandez, Dung Dang, '*Getting Started with the MSP430 Launchpad'*, Newnes; 1st edition, 2013.
Useful Links	
1	https://nptel.ac.in/courses/108/102/108102169/
2	https://www.ti.com/microcontrollers-mcus-processors/microcontrollers/msp430-micrcontrollers/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1			3											
CO2					3									
CO3					3									
CO4			3											2

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Syllabus Prepared By	Mr. A.B. Patil
Syllabus Checked By	Dr. S. S. Karvekar

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL437
Course Name	Professional Elective -5: Illumination Engineering
Desired Requisites:	Basic Electrical Engineering, Basic Electronics Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To introduce the fundamentals of Illumination Engineering.
2	To provide lighting sources, standard practices for illumination levels & measurement calculations for designing a system.
3	To impart technology in the analysis & design of architectural lighting system.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Blooms Taxonomy Level	Blooms Taxonomy Description
CO1	Describe basic terms and laws in illumination engineering.	II	Understanding
CO2	Classify different types of lamps used for lighting.	III	Applying
CO3	Apply indoor and outdoor illumination system components	III	Applying
CO4	Interpret different lighting designs & applications.	III	Applying

Module	Module Contents	Hours
I	**Illumination Engineering Basics** Necessity of illumination, visible range of light, optical system of human eye, vision-visual acuity, contrast, sensitivity, visual perception, good & bad effects of lighting, perfect level of luminance, artificial lighting, colour temperature. Definition of luminous flux, luminous intensity, Lumen output, candela , laws of illumination , light distribution curve. Glare, Colour Rendering Index	7
II	**Light sources** Lamp materials. Discharge Lamps: characteristics of low and high mercury and Sodium vapour lamps. Low Vapour Pressure discharge lamps – Mercury Vapour lamp, Fluorescent Lamp, Compact Fluorescent Lamp (CFL) High Vapour Pressure discharge lamps - Mercury Vapour lamp, Sodium Vapour lamp, Metal , Induction lamps..	7
III	**Components of illumination system** Ballast, igniters and dimmers for different types of lamps, Luminaries: types, factors , Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures , luminaries standard (IEC-598-Part I).	6

IV	**Indoor lighting** Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation and factors affecting it, Illumination required for various work planes, Space to mounting height ratio, Interior illumination: Types of fixtures, DLOR and ULOR, Selection of lamp and luminance, utilisation factor, reflection factor and maintenance factor Determination of Lamp Lumen output, Calculation of wattage of each lamp and no of lamps needed, space to mounting height ratio. Layout of lamp luminaire. Indian standard recommendation and standard practices for illumination levels in various areas.	6
V	**Outdoor lighting** Street Lighting : level of illumination required, Types of fixtures used and their suitable application, Various arrangements in street lighting, Selection of lamp and luminaire, Calculation of their wattage, Number and arrangement, space to mounting height ratio, illumination level available on road Flood Lighting : Terms related to flood lighting, Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, space to mounting height ratio, Recommended method for aiming of lamp	7
VI	**Modern trends in illumination** LED luminary designs, Intelligent LED,OLED,QLED fixtures, Natural light conduiting, Organic lighting system, LASERS, characteristics, features and applications, non-lighting lamps, Optical fiber, its construction as a light guide, features and applications	6

Text Books	
1	Joseph B. Murdoch, “Illumination Engineering from Edison’s Lamp to Lasers” Publisher - York, PA: Visions Communications
2	H. S. Mamak, “Book on Lighting”, Publisher International lighting Academy

References	
1	Joseph B. Murdoch, “Illumination Engineering from Edison’s Lamp to Lasers” Publisher - York, PA: Visions Communications
2	M. A. Cayless, A. M. Marsden, “Lamps and Lighting”, Publisher-Butterworth-Heinemann(ISBN978-0-415-50308-2)
3	National Lighting code 2010(SP 72:2010)

Useful Links	
1	https://nptel.ac.in/courses/108/105/108105061/

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3													1	
CO2	3													1	
CO3		3	1											1	

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Syllabus Prepared By	Mr. M. S. Mahagaonkar
Syllabus Checked By	Mr. V. S. Sathe

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	6EL438
Course Name	Professional Elective -5: Electrical Utilization and Traction
Desired Requisites:	Basic Electrical Engineering, Basic Electronics Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To understand heating and welding methods for industrial applications
2	To understand concepts of Electrolysis processes and illumination engineering
3	To understand electric traction system and drives

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Discuss different methods of electrical heating and electric welding	II	Understanding
CO2	Explain various techniques for designing indoor & outdoor lighting schemes	II	Understanding
CO3	Interpret the working and applications of various devices used by industry for effective utilization of electrical power	III	Applying
CO4	Choose proper traction systems depending upon application considering economic and technology up-gradation	III	Applying

Module	**Module Contents**	**Hours**
I	**Electrolytic Process** Definition and Basic principle of Electro Deposition, Important terms regarding electrolysis, Faradays Laws of Electrolysis, Definitions of current efficiency, Energy efficiency, Principle of Electro Deposition, Factors affecting the amount of Electro Deposition. Factors governing the electro deposition, State simple example of extraction of metals, Application of Electrolysis.	6
II	**Electrical Heating** Advantages of electrical heating, mode of heat transfer and Stephen's Law, Discuss principle of Resistance heating, Direct Resistance heating, Indirect Resistance heating, working principle of direct arc furnace and indirect arc furnace, Principle of Induction heating, Working principle of direct core type, vertical core type and indirect core type Induction furnace, Principle of coreless induction furnace and skin effect, Principle of dielectric heating and its application, Principle of Microwave heating and its application.	7
III	**Arc Welding** Principles of arc welding, D. C. & A. C. arc phenomenon, D.C. & A. C. arc welding plants of single and multi-operation type, Types of arc welding, principles of resistance welding, Descriptive study of different resistance welding methods.	6

IV	**Illumination – 1** Nature of Radiation and its spectrum, Terms used in Illuminations- i. Luminous intensity, ii. Lumen, iii. Intensity of illumination, iv. MHCP, v. MSCP, vi. MHSCP, vii. Brightness, viii. Solid angle, ix. Luminous efficiency, The inverse square law and the cosine law, polar curves, light distribution and control, maintenance factor and depreciation factors, design of simple lighting schemes and depreciation factor.	6
V	**Illumination – 2** Constructional feature and working of Filament lamps, effect of variation of voltage on working of filament lamps, Discharge lamps, excitation in gas discharge lamps, constructional factures and operation of: - Fluorescent lamp. (PL and PLL Lamps), Sodium vapor lamps, High pressure mercury vapour lamps. Neon sign lamp, High lumen output & low consumption fluorescent lamps, introduction to Dialux software.	7
VI	**Electric Traction** System of traction, System of Track electrification, Running Characteristics of DC and AC traction motor, Explain control of motor, Tapped field control, Rheostatic control, Series parallel control, Metadyne control, Braking of the following types. Regenerative Braking, Braking with 1-phase series motor, Magnetic Braking.	7

Textbooks	
1	Partab, "Art & Science of Utilization of electrical Energy", Dhanpat Rai & Sons.
2	C. L. Wadhwa, "Generation, Distribution and Utilization of electrical Energy", New Age International (P) Limited, Publishers, 1997
3	N. V. Suryanarayana, "Utilization of Electrical Power including Electric drives and Electric Traction", New Age International (P) Limited, Publishers, 1996.
References	
1	E. Openshaw Taylor, "Utilisation of Electric Energy", Orient Longman.
Useful Links	
1	https://nptel.ac.in/courses/108105060
2	https://onlinecourses.nptel.ac.in/noc23_ag06/preview

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1													
CO2		1												
CO3	1													
CO4			1											

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Syllabus Prepared By	Mr. V. S. Sathe
Syllabus Checked By	Mr. M. S. Mahagaonkar