Semester- VII

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. VII
Course Code	6EL401
Course Name	Power System Operation and Control
Desired Requisites:	Power System Analysis and Stability, Control System 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 provide the knowledge of Power System Operation
2	To impart knowledge of various controls in power systems.
3	Introduce the recent trends in power systems
4	To inform the students about responsibilities of various levels of controls

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 the concepts of operation of power system considering various constraints of power apparatus.	II	Understanding
CO2	Analyze different power flow control methods.	III	Applying
CO3	Summarize the load dispatch centre functions	IV	Analyzing
CO4	Explain the effects of control system.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction to Characteristics of Modern Power Systems:** Physical Structure, Operation and Control Functions and Hierarchies, Design and Operating Criteria, comparison between ac and dc transmission.	4
II	**Equipment and Stability Constraints:** Capabilities and Constraints of Generators/Exciters/Turbines/Network Elements (Lines, Transformers etc.),Constraints of Energy Supply Systems, Load Characteristics, Introduction to Angle/Voltage Instability phenomena, Stability Constraints	9
III	**Frequency Control:** Advantages of Interconnections, role of system frequency in real power control, philosophy of real and reactive power control, single area load frequency control(AGC) Primary Control of Frequency : Governors, Secondary Control of Frequency : AGC Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases - LFC of two area system, state variability model - integration of economic dispatch control with LFC.	8

IV	**Voltage control:** Definition of reactive power, positive and negative reactive power, reactive power requirements during peak and off peak hours, line voltage regulation and compensation, sources of reactive power. Automatic Voltage Regulators (generators), Shunt Compensation, SVC and excitation control system.	8
V	**Introduction to Power Flow Control:** HVDC, FACTS, Load Curves, Unit Commitment, Introduction to the use of Optimization Methods.	6
VI	**Load Dispatch Centre Functions:** Contingency Analysis, Preventive, Emergency and Restorative Control, recent trends in generation transmission and distribution, power former, GITL, deregulated energy system.	4

Textbooks	
1	Power System Analysis: Operation and Control by S. Sivanagaraju Pearson Education India, 2009
2	Power System Operation and Control by Prabha Kundur.
References	
1	Power System Operation and Control Robert Herschel Miller, McGraw Hill Professional, 1994
2	Power System Operation and Control by DR. K. UMA RAO, Wiley India, 2010
3	Power System Operation and Control by N. V. Ramana Pearson Education India, 2010
4	Power System Operation and Control Robert Herschel Miller, McGraw Hill Professional, 1994
Useful Links	
1	https://archive.nptel.ac.in/courses/108/104/108104052/

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	Dr V. P. Mohale

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. VII
Course Code	6EL402
Course Name	Power System Harmonics
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	Equip students with fundamental knowledge about power quality, including its significance, standards, and the various classes of power quality problems.
2	Provide a comprehensive understanding of harmonic distortion, its sources, effects, and methods for locating harmonic sources in commercial and industrial settings.
3	Educate students on both passive and active harmonic mitigation techniques, including the design, operation, and control of filters.
4	Teach students the definitions and calculations of power in single-phase and three-phase circuits under various conditions, adhering to IEEE standards.

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 basic concepts of Power Quality disturbances, power definitions and other figures of merit under distorted operation.	II	Understanding
CO2	Apply power definitions and calculations for single-phase and three-phase circuits, under sinusoidal, non-sinusoidal, balanced, and unbalanced conditions, using IEEE 1459 standards.	III	Applying
CO3	Analyse voltage and current harmonic distortions, understanding their sources, and evaluating their effects on power systems.	IV	Analysing
CO4	Evaluate the design of passive and active filters for harmonic mitigation, including performing numerical analysis and case studies.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to Power Quality** What is Power Quality? Power Quality -- Voltage Quality, Why Are We Concerned About Power Quality, Power Quality standards, General Classes of Power Quality Problems, Transients, Long-Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion Voltage Fluctuation, Power Frequency Variations, Power Quality Terms	6
II	**Fundamentals of Harmonics** Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads, Locating Harmonic Sources, System Response Characteristics, Effects of Harmonic Distortion, Interharmonics, Parallel resonance, case study on parallel resonance.	7

III	**Harmonic Mitigation Techniques- Passive Filters** Shunt passive filters, types, Design considerations of single tuned filters, Detuned filters, Design considerations of Detuned filters, High pass filters, Design considerations of HP filters, Case studies and numerical examples	6
IV	**Harmonic Mitigation Techniques-Shunt Active Power Filters** Introduction, State of the Art on Shunt Active Power Filters, Classification of Shunt Active Power Filters, Principle of Operation and Control of Shunt Active Power Filters, Analysis and Design of Shunt Active Power Filters, Numerical Examples	7
V	**Power Definitions in Single Phase Circuits** Definitions of various powers, power factor and other figures of merit under sinusoidal and non-sinusoidal conditions applicable to single phase circuits.	6
VI	**Power Definitions in Three Phase Circuits** Definitions of various powers, power factor and other figures of merit under balanced, unbalanced and non-sinusoidal conditions. IEEE 1459 power definitions applicable to three phase circuits	7
Textbooks		
1	Roger C. Dugan, Mark F. McGranton and H. Wayne Beety, "*Electrical Power Systems Quality*" McGraw Hill.	
2	Dr. Mahesh Kumar, IIT Chennai, *Power Quality in Distribution Systems*.	
References		
1	George J. Wakileh, "*Power System Harmonics* - Fundamentals, Analysis & Filter Design" Springer.	
2	Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, *Power Quality Problems and Mitigation Techniques*, Wiley, 2015.	
Useful Links		
1	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	2												2	
CO2	2												2	
CO3		2											2	
CO4			2										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	Seema P Diwan
Syllabus Checked By	Swapnil 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. VII
Course Code	6EL403
Course Name	Electrical Machine Design
Desired Requisites:	DC Machine and Transformers, AC Machines

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 provide basic knowledge of design process of Electrical Machines.
2	It is aimed to impart skills to perform and apply basics of Electrical Engineering for design of Electrical machines.
3	To develop knowledge on cooling and ventilation schemes of static and rotating machines.
4	To solve design problems related to static and rotating machines.

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	Summarize the design procedure for electrical machine.	II	Understanding
CO2	Solve different problems related to design of electrical machines.	III	Applying
CO3	Analyze the performance of machine based on design details.	IV	Analyzing
CO4	Design transformer, induction motor and synchronous machine.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Constructional Details And Design of Transformers** Output equation, EMF per turn. Ratio of iron loss to copper loss, Relation between core area and weights of iron and copper, optimum designs, Core design. Design of windings.	6
II	**Performance Evaluation of Transformer** Calculation of no-load current. Equivalent circuit and performance characteristics. Temperature rise. Design of tank and radiators.	6
III	**Constructional Details And Design of Three Phase Induction Motors** Output equation. Specific electric and magnetic loadings. Efficiency and power factor, main dimensions. Type of winding and connection .Turns per phase, shape of stator slots. Number of stator slots, design of stators.	7
IV	**Operating Characteristics of Three Phase Induction Motors** No load current Magnetizing current, loss component short circuit current. Use of circle diagram to obtain performance figures. Calculation of static torque, maximum torque, maximum output, maximum power factor. Dispersion coefficient.	7

V	**Design of Synchronous Machines** Construction of water wheel and turbo alternators. Different parts and materials used for Synchronous machine, choice of electric and magnetic loadings, Output equation. Determination of diameter and length, effect of short circuit ratio on machine performance.	7
VI	**Computer Aided Design of Electrical Machines** Benefits of computer in machine design, methods of approach, optimization and computer aided design of induction motor and three phase transformer, Testing as per IS.	6

Textbooks	
1	"A Course in Electrical Machine Design" - by A. K. Sawhney, Dhanpat Rai and Sons, Delhi, 6th Edition, 2006.
2	"Design of Electrical Machines", by V.N. Mittle and A. Mittle, Standard Publications & Distributors, Delhi, 2002.
References	
1	"Principles of Electrical Machine Design", by R. K. Agarwal, S. K. Kataria and Sons, Delhi, 2002.
2	"Principles of Electrical Machine Design with Computer Programmes" S.K. Sen, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.
Useful Links	
1	Design of Electric Motors (NPTEL): https://nptel.ac.in/courses/108108191
2	Computer-Aided Design of Electrical Machines (NPTEL): https://nptel.ac.in/courses/108102372

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2	3	2												
CO3		3												
CO4			3											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. S. S. Medhekar
Syllabus Checked By	Dr. R. P. Hasabe

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech. Sem. VII
Course Code	6EL404
Course Name	Research Methodology and IPR
Desired Requisites:	NIL

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 2			

Course Objectives

1	To prepare students for undergoing research, identify and formulate the research problems, state the hypothesis, design a research layout, set a research process and methodology.
2	To be aware about current trends in IPR and Govt. steps in fostering IPR.
3	To enable student interpret the results, propose theories, suggest possible/alternative solutions, solve, and prove the solution adapted–logically and analytically, conclude the research findings.
4	To impart knowledge to analyse critically the literature and publish research in conferences, journals and to expose students to research ethics, IPR and Patents

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	Demonstrate a research solution in respective engineering domain using appropriate Engineering research process and research methodology.	III	Apply
CO2	Interpret patent and copyright in innovative research work.	III	Apply
CO3	Device feasible solution to a research problem in respective engineering domain based on economic, social and legal aspects using appropriate research procedures and practices.	IV	Analyse
CO4	Write research publication, Dissertation, IPR and patent document.	VI	Create

Module	**Module Contents**	**Hours**
I	**Engineering Research Process** Research problem- meaning, sources, criteria and characteristics Definition, scope and objectives of research problem, Errors in selecting a research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation.	4
II	**Research Methodology** Problem statement formulation, resources identification for solution, Experimental and Analytical modelling, Simulations, Numerical and Statistical methods in engineering research. Hypothesis and its testing by different techniques: Z-test etc.,	4
III	**Research Methods** Uni and Multivariate Analysis: ANOVA, Design of Experiments/Taguchi Method, Regression Analysis. Software tools like spread sheets. Processing and Analysis of Data: Processing Operations, Types of Analysis Presentation and Interpretation of Data Editing, Classification and Tabulation Interpretation. Analyse your results and draw conclusions.	5

IV	**Research Practices** Effective literature studies approaches, critical analysis, Plagiarism, Research ethics, Medley - Reference Management Software. Research communication- Effective Technical Writing, Writing a research article for Journal/conference paper, Technical report, Dissertation/ Thesis report writing, Software used for report writing ,Presentation techniques for paper/report/seminar, Publishing article.	5
V	**Intellectual Property Rights (IPR)** Nature of Intellectual Property: Patents, Designs, Trade and Copyright, Ownership of copyright, Term of copyright, Technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. New developments in IPR, Traditional knowledge, Various Case Studies.	4
VI	**Patents** Patent Rights: Scope of Patent Rights. Various Patent databases. Geographical Indications. Procedure for grants of patents, Patenting under PCT. Licensing and transfer of technology. Administration of Patent System. Introduction to International Scenario: WIPO, TRIPs, Patenting under PCT.	4

Textbooks	
1	Kothari C. R, "Research Methodology", 2nd Edition, New Age International, 2004
2	Melville Stuart and Goddard Wayne, "Research Methodology: An Introduction for Science & Engineering Students" Juta and Company Ltd, 2000.
3	Kumar Ranjit, "Research Methodology: A Step-by-Step Guide for beginners", SAGE Publications, 4th Ed.-2014.

References	
1	Merges Robert, Menell Peter, Lemley Mark, "Intellectual Property in New Technological Age", ASPEN Publishers, 2016.
2	Ramappa T., "Intellectual Property Rights Under WTO", S. Chand, 2008
3	Mayall, "Industrial Design", McGraw Hill, 1992.
4	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007
5	Deepak Chopra and Neena Sondhi, Research Methodology : Concepts and cases, Vikas Publishing House, New Delhi

Useful Links	
1	NPTEL :: General - NOC:Introduction to Research
2	Introduction to Research - Course (nptel.ac.in)
3	Qualitative Research Methods And Research Writing - Course (nptel.ac.in)
4	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing
5	https://www.scopus.com/search/form.uri?display=basic#basic
6	https://onlinecourses.nptel.ac.in/noc21_ge12/preview - Qualitative Research Methods And Research Writing
7	https://onlinecourses.nptel.ac.in/noc21_hs44/preview - Effective Writing
8	https://webofscienceacademy.clarivate.com/learn
9	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing
10	https://nptel.ac.in/courses/121/106/121106007/
11	https://nptel.ac.in/courses/121/106/121106007/

CO-PO Mapping		
	Programme Outcomes (PO)	**PSO**

	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2											
CO2						3		3						
CO3					2			3						
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	Mrs. A. A. Dhamangaonkar
Syllabus Checked By	

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 VII
Course Code	6EL451
Course Name	Power System Operation and Control Lab
Desired Requisites:	Power System Analysis and Stability Lab

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To provide the knowledge of Power System Operation.
2	To impart knowledge of various controls in power systems.
3	To develop simulation skills for power system operation and control
4	To explain the functions of various dispatch centre in control hierarchy.

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	Assemble experimental set-up for collection and analysis of data for power system operation.	III	Applying
CO2	Conduct simulation studies for evaluating different power flow control methods.	IV	Analysing
CO3	Tell the load dispatch centre functions as group task.	IV	Analysing
CO4	Discuss strategies of power system operation and control for given load conditions.	IV	Analysing

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Modeling of single area and multi-line load frequency control in Simulink
2. Modeling AVR in Simulink
3. Study of effect of faults (LG, LL and DLG) on a single machine connected to infinite Bus
4. Solution of swing equation by any one method
5. To compute voltage, current, power factor, regulation, and efficiency at the receiving end of a three phase transmission line when the voltage and power
6. To evaluate performance of long transmission line without compensation
7. To evaluate performance of long transmission line with shunt compensation
8. To control load frequency of a two area power system without & with pi controller
9. To simulate transient stability analysis of power system.

Textbooks

1	Power System Analysis: Operation and Control by S. Sivanagaraju Pearson Education India, 2009

References

1	Power System Operation and Control Robert Herschel Miller, McGraw Hill Professional, 1994
2	Power System Operation and Control by DR. K. UMA RAO, Wiley India, 2010

3	Power System Operation and Control by N. V. Ramana Pearson Education India, 2010
Useful Links	
1	https://www.mahatransco.in/information/details/load_despatch
2.	https://www.powergrid.in/

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									
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	Mrs. S.L Shaikh
Syllabus Checked By	Dr V. P. Mohale

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information

Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6EL452
Course Name	Power System Harmonics Lab
Desired Requisites:	Power Electronics, Power System Analysis and Stability

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	Equip students with the skills to comprehensively model and simulate various power quality disturbances, including transients, harmonics, and voltage variations.
2	Provide a deep understanding of power component definitions in both single-phase and three-phase circuits, especially with nonlinear loads.
3	Educate students on the design and analysis of harmonic mitigation techniques, including single tuned filters, composite passive harmonic filters, and active power filters.
4	Develop students' ability to apply theoretical concepts in practical scenarios, including calculating K factor and derating factors, solving for resonance frequencies, and developing MATLAB programs for filter design.

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	Identify power quality problems and its solutions.	II	Understanding
CO2	Calculate power complement definitions in single phase and three phase circuits.	III	Applying
CO3	Investigate the performance of single phase and three phase circuits with non-linear loads.	IV	Analysing
CO4	Design suitable harmonic filtering systems for particular applications.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. A Comprehensive Modeling and Simulation of Power Quality Disturbances. (Transients and Harmonics)
2. A Comprehensive Modeling and Simulation of Power Quality Disturbances. (Short duration voltage variations)
3. Analysis of Power components definitions in single phase circuits with nonlinear loads.
4. Calculate K factor of load and transformer derating factor.
5. Calculate the parallel resonance frequency and solve for the magnified currents and voltages in the circuit.
6. Design and analysis of 5th Harmonic Single Tuned Filter for Harmonic Mitigation.
7. Design and analysis of Detuned Filter for Harmonic Mitigation.
8. Design and analysis of Composite Passive Harmonic Filter for Harmonic Mitigation.
9. Simulation of Shunt active power filter using p-q theory.
10. Simulation of Shunt active power filter using d-q theory.
11. Develop MATLAB program(*.m) for design of single tuned and high pass filters
12. Analysis of Power Component definitions in three phase circuits with a balanced Sinusoidal supply and Nonlinear load.

Textbooks	
1	Roger C. Dugan, Mark F. McGranton and H. Wayne Beety, "*Electrical Power Systems Quality*" McGraw Hill.
2	Dr. Mahesh Kumar, IIT Chennai, *Power Quality in Distribution Systems*.

References	
1	George J. Wakileh, "*Power System Harmonics* - Fundamentals, Analysis & Filter Design" Springer.
2	Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, *Power Quality Problems and Mitigation Techniques*, Wiley, 2015.

Useful Links	
1	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	2												2	
CO2	2												2	
CO3		2											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, 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	Seema P Diwan
Syllabus Checked By	Swapnil Patil

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information

Programme	B. Tech. Electrical Engineering
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	6EL453
Course Name	Electrical Machine Design Lab
Desired Requisites:	AC Machines, Advanced Simulation Lab

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	This course intends to provide basic knowledge of draw and design process of simple Electrical machines.
2	It is aimed to impart skills to perform and apply basics of Electrical Engineering for draw and design of Electrical machines.
3	To solve design problems related to static and rotating machines.
4	To understand different computer aided techniques in design of static and rotating machines.

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	Summarize the design procedure for electrical machine.	II	Understanding
CO2	Solve different design problems using computer aided techniques	III	Applying
CO3	Analyze the performance of machine based on design details.	IV	Analyzing
CO4	Design transformer, induction motor and synchronous machine.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Design the transformer with given suitable data.
2. Calculate the radiators for transformer.
3. Design the Induction Motor stator with provided input data.
4. Design the Induction Motor rotor with applications.
5. Design the Synchronous Machine parts.
6. Drawing sheets on Transformer parts, Transformer Design.
7. Drawing sheets on Induction motor parts, Induction Motor design.
8. Design the machines with computer aided Methods.
9. Assignments using software or problem solving, seminars, and any other work based on syllabus.
10. Use Software for design of Electrical Machine parts.

Textbooks

1	"A Course in Electrical Machine Design" - by A. K. Sawhney, Dhanpat Rai and Sons, Delhi, 6th Edition, 2006.
2	"Design of Electrical Machines", by V.N. Mittle and A. Mittle, Standard Publications & Distributors, Delhi, 2002.

References

1	“Principles of Electrical Machine Design” , by R.K. Agarwal, S.K. Kataria and Sons, Delhi, 2002
2	“Principles of Electrical Machine Design with Computer Programmes” S. K. Sen, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.
Useful Links	
1	Design Of Electric Motors (NPTEL): https://nptel.ac.in/courses/108108191
2	Computer-Aided Design of Electrical Machines (NPTEL): https://nptel.ac.in/courses/108102372

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	2												
CO3		3												
CO4			2											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. S. S. Medhekar
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. VII
Course Code	6EL491
Course Name	Project-I
Desired Requisites:	--

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	6 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 3			

Course Objectives	
1	This course is intended to review and demonstrate their understanding of the selected specific topic.
2	It is aimed to enable students to interpret, analyze and infer research papers and understand how they are written critically and efficiently
3	It provides the ability to review the research papers and present the understanding of a new field.
4	It is expected to identify new directions in Electrical Engineering and illustrate its importance.

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 conceptual idea behind the project	II	Understanding
CO2	Interpret and communicate different contributions in Electrical Engineering and identify promising directions in the same.	III	Applying
CO3	Analyze the research papers/ magazine articles and their impact on global, economic, environmental and societal issues.	IV	Analyzing
CO4	Evaluate and present the research papers/ magazine articles and outline the important points in the papers/ articles.	V	Evaluating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

Seminar shall be delivered on one of the advanced topics chosen for project in consultation with the guide after compiling the information from the latest literature and also internet. The concepts must be clearly understood and presented by the student. Student should work on his project. He/She should complete the literature survey and develop the design of the project. All modern methods of presentation should be used by the student. A hard copy of the report on selected project topic (25 to 30 pages A4 size, 12 fonts, Times New Roman, single spacing both side printed as per the format specified by the department) should be submitted to the department. A PDF copy of the report in soft form must be submitted to the guide along with other details if any.

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	----

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1							2			3				
CO2								3						
CO3									3					
CO4					2		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 VII
Course Code	6EL411
Course Name	Professional Elective- 3: HVDC
Desired Requisites:	Power Electronics**,** Electrical Transmission and Distribution

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 the students to analyze concept of HVDC transmission system.
2	It provides the knowledge of appropriate control and protection systems in HVDC transmission systems.
3	It gives the overview of recent trends in HVDC transmission systems.
4	This course intends the students to understand the concept of multi terminal HVDC transmission 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**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Describe the operation of HVDC systems.	II	Understanding
CO2	Explain different configurations of HVDC system	II	Understanding
CO3	Determine various control and protection schemes for HVDC transmission system.	III	Applying
CO4	Categorize multi terminal HVDC transmission system.	IV	Analysing

Module	**Module Contents**	**Hours**

I	**Introduction to HVDC Transmission Technology** Comparison of EHVAC and HVDC Transmission, types of HVDC transmission systems, components of HVDC transmission system.	6
II	**Analysis of HVDC converter** Different modes of valve operation, o/p voltage waveforms and D C voltage in rectification, and inverter operation, valve voltages, equivalent electrical circuit, converter charts.	7
III	**HVDCTS control features** Control modes, control schemes and their comparisons, energization and de-energization of bridges, starting and stopping of D C link.	7
IV	**Faults and over-voltages** Converter mal-operations, commutation failure, over-voltages in HVDCTS, protection of converters, D C reactor and damper circuits.	6
V	**Harmonics and their suppression in HVDCTS** Harmonic analysis, filter design, minimum cost tuned A C filters, reactive power requirements.	7
VI	**Multi terminal HVDCTS** Series and parallel MTDCTS, their control, introduction to HVDC light, recent trends in HVDCTS.	6

Text Books	
1	K.R. Padiyar, "*H.V.D.C. Power Transmission*", Wiley Eastern, New Delhi.
2	E.W. Kimbark, "*Direct Current Transmission*", Win publisher.

References	
1	J. Arrillaga, "*H.V.D.C. Transmission*", Peter limited
2	S.Rao, "*E.H.V.A.C. & H.V.D.C. Transmission*", Khanna Publishers.

Useful Links	
1	https://nptel.ac.in/courses/108104013

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: 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	Mrs. S.L. Shaikh

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. VII
Course Code	6EL412
Course Name	Professional Elective- 3: Industrial Automation with PLC
Desired Requisites:	Electrical Measurement and Instrumentation

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

Course Objectives	
1	The course intends to explore the PLC and Embedded Control for industrial automation
2	The course aims at developing programs using ladder logic for industrial automation
3	It intends to analyze the performance of automation systems employing PLC and Embedded Control
4	The course aims to integrate sensors with PLCs for application development

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	Interpret features of PLC and Embedded Control Systems used for Industrial Automation.	III	Applying
CO2	Use ladder logic programming technique for various PLC applications	III	Applying
CO3	Construct PLC-based control systems for various industrial applications	III	Applying
CO4	Evaluate the performance of PLC network configurations, PLC functions used for different application	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to PLC:** Introduction, Advantages, Disadvantages, Parts of PLC, PLC Input module, PLC Output Module, PLC Architecture, PLC Operation, PLC as a computer, PLC memory and interfacing, Power Supply for PLC	6
II	**PLC programming:** Ladder Logic Symbols, Latching and Unlatching of PLC, Programming on/ off inputs to produce on/off outputs, relation of digital gate logic to contact / coil logic, creating ladder diagrams from process control description.	6
III	**PLC Timer and Counter Functions:** PLC timer functions, Types of PLC timers, Programming of Non-retentive timers for various applications, Programming of ON timers, OFF timers, PLC counter functions, Programming of UP, DOWN counters, Case studies related to Industrial Automations	7
IV	**PLC Arithmetic, Comparison and Branch functions** PLC Arithmetic functions, PLC comparison functions, Conversion functions, Master control relay functions, PLC jump functions, Jump with return and Jump with No return functions, Programs related to Arithmetic, Comparison and Branch functions	7

V	**Advanced PLC Functions** Data move system, data handling functions, Digital bit functions and applications, sequencer functions, Analog input and outputs in PLC , Analog PLC operations, PID control using PLC	7
VI	**PLC Networking** Networking of PLCs, Levels of Industrial Control, Types of Networking, Network Communications, Cell control by PLC Networks, Factors to consider in selecting a PLC	6

Textbooks	
1	John W. Webb, Ronald A. Reis, Programmable logic controllers, principles & applications, PHI publication, Eastern Economic Edition, 1994.
2	Gary dunning, Introduction to PLC, Thomson learning, Edition III, 2006.
3	Frank D. Petruzella ,Programmable Logic Controllers, 3rd Edition, Tata McGraw Hill, New York, 2010
4	Madhuchhanda Mitra, Samarjit Sengupta, Programmable logic controllers and Industrial Automation: An Introduction, Penram International, Edition II, 2017.
References	
1	John R. Hackworth and Peterson, PLC controllers programming methods and applications, PHI, 2004.
2	Stuart A. Boyer , SCADA: Supervisory Control and Data Acquisition Systems, 4th Edition, ISA Press, 2010.
3	William H. Bolton, Programmable logic controllers, Newnes , Edition VI, 2006.
Useful Links	
1	Industrial Automation and Control, IIT Kharagpur Prof. S. Mukhopadhyay, Prof. S. Sen https://nptel.ac.in/courses/108105063
2	NOC:Industrial Automation and Control, IIT Kharagpur: https://nptel.ac.in/courses/108105088

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			3											
CO4			3											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	Dr. S. S. Karvekar
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. VII
Course Code	6EL413
Course Name	Professional Elective- 3: Advanced Power Electronics
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 provide advanced knowledge of different power electronic converters such as PWM voltage source converters, multi-level inverters, resonant converters, solar inverters and matrix converters.
2	To impart skills of analysis for different types of advanced converters and shunt active power filters.
3	To make the students acquainted with control strategies of different types of advanced converters and shunt active power filters.
4	To make the students aware of the recent advances in power electronics and their use in industrial applications.

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	Distinguish configuration and working of different advanced power electronic converters.	II	Understanding
CO2	Identify the appropriate power electronic converter for the given application.	III	Applying
CO3	Analyse different advanced power electronic converters and systems.	IV	Analyzing
CO4	Evaluate performance of different power electronic system using power electronic devices and converters.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**PWM rectifiers** Advantages & disadvantages of three phase thyristor converter, Single phase and three phase VSI PWM converters working, types, Control of PWM rectifiers, analysis and application. Three phase CSI PWM converter, control and applications.	7
II	**Multilevel inverters** Three phase two level Voltage source inverter, various PWM techniques, space vector PWM for two level Inverter, Multilevel Voltage source inverter, Types: Diode clamp multilevel inverter, flying capacitor multilevel inverter, cascaded H Bridge multilevel inverter, applications of multilevel inverters, comparison of multilevel inverter. Control method: Multiple carrier PWM for MLI	7

III	**Resonant pulse inverters** Soft switching of the converters, zero voltage zero current switching, series load resonant converters, parallel load resonant converter voltage control of resonant converters, zero current and zero voltage switching applied to DC-to-DC converters, two-quadrant ZVS converters, resonant DC link inverters and control techniques.	6
IV	**Photovoltaic Inverters** Photovoltaic Inverters structures derived from H bridge topology such as H5 inverter, Heric inverter, REFU inverter, full bridge inverter with DC bypass, inverter structures derived from NPC topology such as neutral point clamped half bridge inverter, conergy NPC inverter, three phase PV inverter.	6
V	**Matrix Converters and Z source inverters** Topology, working and control methods of Matrix converters, Various circuit topologies and control of Z source inverter, Application of Z source in induction motor control.	6
VI	**Active power filters** Power Quality Issues due to power Electronics, total harmonic distortion, Introduction to active power filter, types of active power filters overall control of shunt active power filter, control of shunt active filter based on SRF theory. Control of shunt active filter based on instantaneous power theory. Harmonic compensation & reactive power compensation.	7

Textbooks	
1	M. H. Rashid, "Power Electronics: circuits devices and applications" , Pearson Education, Third edition.
References	
1	B. K. Bose, "Modern Power Electronics & AC drives" , PHIPL, New Delhi.
2	M. B. Patil, V. Ramayanan and V. T. Ranganathan, "Simulation of Power Electronics circuits" , Narosa publication.
3	IEEE Transaction papers.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc23_ee127/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		2												
CO3		2												
CO4			2		1									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. Mrs. A. S. Karvekar

Professional Elective 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 VII
Course Code	6EL454
Course Name	Professional Elective -3: HVDC Lab
Desired Requisites:	Power Electronics, Simulation Lab

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To Understand the advantages of dc transmission over ac transmission.
2	To provide the knowledge of appropriate control and protection systems in HVDC transmission systems
3	To perform MATLAB Simulation of AC/DC side voltage and current waveforms of six pulse converter
4	To perform MATLAB Simulation of AC/DC side voltage and current waveforms of twelve pulse converter

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	Apply suitable control strategies used for LCC and VSC based HVDC transmission system.	III	Applying
CO2	Apply reactive power control in HVDC transmission system	III	Applying
CO3	Analyse the Line Commutated Converters and Voltage Source Converters in HVDC Transmission System.	IV	Analysing
CO4	Analyse various passive filters used in LCC based HVDC transmission system	IV	Analysing

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Study of various HVDC transmission system components and its applications.
2. MATLAB Simulation of AC/DC side voltage and current waveforms of six pulse converter system under variable RL Load using simulation.
3. MATLAB Simulation of AC/DC side voltage and current waveforms of twelve pulse converter system under variable R-L Load using simulation.
4. Study of reactive power control in HVDC transmission system.
5. Study of various types of Multi terminal HVDC transmission system.
6. MATLAB Simulation of HVDC power and voltage stability.
7. MATLAB Simulation of DC link control in VSC based HVDC transmission system.
8. Study of various passive filters used in LCC based HVDC transmission system.
9. Operation of VSC for power factor correction at AC side of HVDC system using sinusoidal pulse width modulation.

Textbooks	
1	K.R. Padiyar, “H.V.D.C. Power Transmission”, Wiley Eastern, New Delhi.
2	E.W. Kimbark, “Direct Current Transmission”, Win publisher.
References	
1	J. Arrillaga, “H.V.D.C. Transmission”, Peter limited
2	S.Rao, “E.H.V.A.C. & H.V.D.C. Transmission”, Khanna Publishers.
Useful Links	
1	https://nptel.ac.in/courses/108104013

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									
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. M. S. Mahagaonkar
Syllabus Checked By	Mrs. S. L. Shaikh

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. VII
Course Code	4EL455
Course Name	Professional Elective- 3 Lab: Industrial Automation with PLC Lab
Desired Requisites:	Electrical Measurement and Instrumentation

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	The lab course is aimed to develop programming skills using PLC for Industrial Automation
2	The course intends to introduce the use of PLC for solving real world problems.
3	It will enable students to use PLC for control applications in electrical engineering
4	The lab course will enable students to integrate PLC, SCADA and HMI for various projects in industrial automation

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	Demonstrate skills to design, write, and troubleshoot PLC programs using various programming languages such as ladder logic	III	Applying
CO2	Execute experiments based on PLC and SCADA systems.	III	Applying
CO3	Construct control strategies using PLCs to improve reliability and operational efficiency in industries.	IV	Analyzing
CO4	Design ladder logic programs for various PLC applications.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. To understand and implement the functionality logic gates using PLC
2. Implement ladder diagram for ON/OFF and latching functions.
3. Design of PLC program for motor reversal control.
4. Illustrate stair case lighting using PLC programming.
5. Implement PLC program for building automation.
6. Design of PLC program for various arithmetical functions.
7. Devise the PLC program for traffic control system.
8. Design of ON/ OFF control mechanism using PLC timer functions.
9. Design of basic applications employing PLC counter functions.
10. Design of basic applications employing PLC analog inputs.

Textbooks

1	John W. Webb, Ronald A. Reis, Programmable logic controllers, principles & applications, PHI publication, Eastern Economic Edition, 1994.
2	Gary dunning, Introduction to PLC, Thomson learning, Edition III, 2006.
3	Frank D. Petruzella ,Programmable Logic Controllers, 3rd Edition, Tata McGraw Hill, New York, 2010

4	Madhuchhanda Mitra, Samarjit Sengupta, Programmable logic controllers and Industrial Automation: An Introduction, Penram International, Edition II, 2017.
References	
1	John R. Hackworth and Peterson, PLC controllers programming methods and applications, PHI, 2004.
2	Stuart A. Boyer , SCADA: Supervisory Control and Data Acquisition Systems, 4th Edition, ISA Press, 2010.
3	William H. Bolton, Programmable logic controllers, Newnes , Edition VI, 2006.
Useful Links	
1	Industrial Automation and Control, IIT Kharagpur Prof. S. Mukhopadhyay, Prof. S. Sen https://nptel.ac.in/courses/108105063
2	NOC:Industrial Automation and Control, IIT Kharagpur: https://nptel.ac.in/courses/108105088

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				3					3					
CO4			3		3				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	Dr. S. S. Karvekar
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. VII
Course Code	6EL456
Course Name	Professional Elective- 3 Lab: Advanced Power Electronics Lab
Desired Requisites:	Power Electronics Lab

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To provide the advance knowledge in the field of power electronics.
2	To understand the working of different power electronic converter through simulation and experimentation.
3	To develop the skills of simulation, analysis and design of power electronics system.
4	To make the students conversant with the recent advances in power electronics and their use in industrial applications.

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	Articulate working of different advanced power electronic converters.	II	Understanding
CO2	Analyze different advanced power electronic converters and systems.	IV	Analyzing
CO3	Evaluate the performance of different advanced power electronic converters using hardware and simulation software.	V	Evaluating
CO4	Design control circuits for advanced power electronic circuits.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Development of Simulink model and analysis of performance of Single Phase Full and Half controlled converter.
2. Development of Simulink model and analysis of performance of Three Phase Full and Half controlled converter
3. Development of Simulink model and analysis of performance of Cascade type Multilevel Inverter.
4. Development of Simulink model and analysis of performance of Diode clamped Multilevel Inverter.
5. Experimental study of cascade type Multilevel inverter
6. Development and performance analysis of Active power Filter
7. Development of Simulink model and analysis of performance of Z source inverter
8. Study and performance analysis of Matrix converter.

Textbooks

1	M. H.Rashid, Power Electronics: circuits devices and applications, Pearson Education, Third edition.

References	
1	B. K. Bose, Modern Power Electronics & AC drives, PHIPL, New Delhi
2	M. B. Patil, V. Ramayanan and V. T. Ranganathan, Simulation of Power Electronics circuits, Narosa publication.
Useful Links	
1	---

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					1									1
CO4			2		2									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, 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	Dr. D. S. More
Syllabus Checked By	Dr. Mrs. A. S. Karvekar

Open Elective- 5

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. VII
Course Code	6OE443
Course Name	Open Elective-5: Renewable Energy
Desired Requisites:	Basic Mechanical Engineering, Basic Electrical Engineering

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

Course Objectives	
1	Explain the types of renewable energy resources with sustainability.
2	Explain the working of solar, wind, biomass, and geothermal energy systems.
3	Apply various renewable energy sources like biogas, geothermal, and MHD
4	Explain the need and operation of various energy storage technologies.

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 the various renewable energy resources with Sustainability.	II	Understanding
CO2	Describe the working of solar, wind, biomass, and geothermal energy systems.	II	Understanding
CO3	Discuss the need and working of various energy storage, fuel cell, and battery management system technologies.	II	Understanding
CO4	Demonstrate the Grid-connected PV and wind energy system.	III	Applying

Module	**Module Contents**	**Hours**
I	**Introduction to Renewable Energy Sources** Energy sources: classification of energy sources, introduction to renewable energy, renewable energy trends, key factors affecting renewable energy supply, global and Indian scenario of renewable energy sources, policies of the government, sustainable development, challenges, advantages and disadvantages of renewable energy sources, and their uses. **Case Study:** PM Kusum Yojana and PM Suryoday Yojana 2024.	7
II	**Solar Energy** solar earth geometry, solar radiations, and measurement, fundamentals of semi-conductors, absorption of light, solar thermal power generation, heat transfer, solar thermal conversion: basics, solar concentrator, and tracking system, flat plate and concentrating collectors, single axis and two axes axis tracking collectors, selective coatings.	7

III	**Grid Connected PV System** PV power generation, basic principle of power generation in PV cell, solar cell, and its parameters, module and array, the efficiency of PV cell, characteristics curves of PV cell, effects of different electrical parameters on I-V & P-V curves, configuration of PV power generation system - off-grid system & grid-connected PV system, design methodology, stand-alone PV system, grid-connected PV systems.	6
IV	**Wind Energy** Power available in wind, wind turbine power & torque characteristics, types of rotors, characteristics of wind rotor, components of wind turbine, local effects, wind shear, turbulence & acceleration effects, measurement of wind, wind speed statistics, wind power calculations and Betz limit, capacity factor, speed ratio characteristics, grid-connected wind energy system	7
V	**Biomass Energy and other renewable energy systems** Overview of biomass as energy source, physicochemical and thermal characteristics of biomass as fuel, hydrogen generation methods, storage technologies, compression and chemical compounds, applications in energy storage and transportation, addressing safety, environmental impacts, and future trends in research and policy. geothermal energy different components, advantages, limitations.	6
VI	**Energy Storage and Fuel cell technologies** Introduction, need for storage for renewable energy sources, basic thermodynamic and electrochemical principles, classification, traditional energy storage system- battery, fuel cell, principle of operation, types, applications for power generation, battery management system.	6

Textbooks	
1	Boyle, Godfrey, "*Renewable Energy*", (2nd edition), Oxford University Press, 2004.
2	Masters, Gilbert M., "*Renewable and efficient electric power systems*", John Wiley & Sons, 2013.
3	Solanki, Chetan Singh. , "*Solar Photovoltaics: fundamentals, technologies and applications*", PHI Learning Pvt. Ltd., 2015.
References	
1	G.S.Sawhney, "*Non-Conventional Resources of Energy*", PHI Publication 2012. Gary-L. Johnson Wind Energy Systems Tata Mc-Graw-Hill Book Company.
2	S. P. Sukhatme, J. K. Nayak, "*Solar Energy- Principles of Thermal Collection and Storage",* (3rd edition), Tata McGraw-Hill Publication.
Useful Links	
1	https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-ch11/
2	https://www.coursera.org/learn/exploring-renewable-energy

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													

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. N. Inamdar
Syllabus Checked By	Dr. S. D. Patil

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