Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Course Content of

Final Year B. Tech. (Electrical Engineering) Sem- VII (ODD)

2021-22

Professional Core (Theory) Courses

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	HVDC Transmission
Desired Requisites:	Power Electronics**,** Power System Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**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.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Analyze** HVDC systems	Analyse
CO2	**Justify** various control and protection schemes for HVDC transmission system.	Evaluate
CO3	**Explain** recent trends in HVDC transmission system.	Understand

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.	6
III	**HVDCTS control features** Control modes, control schemes and their comparisons, energization and de-energization of bridges, starting and stopping of D C link.	6
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.	6
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.

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

Assessment
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10		10	20
3	Apply				
4	Analyse	10	10	10	30
5	Evaluate		10	40	50
6	Create				
Total		**20**	**20**	**60**	**100**

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	Power System Harmonics
Desired Requisites:	Power systems, Power Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	To introduce terms and definitions of power quality disturbances, and their causes, detrimental effects and solutions.
2	It also aims to provide a theoretical background to correctly approach the problem of reactive, harmonic and unbalance compensation, in the context of the applicable power theory.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** the basic concepts of Power Quality disturbances, power definitions and other figures of merit under distorted operation.	Understanding
CO2	To **Study** and **Select** appropriate harmonic filters for particular applications.	Analyzing, Evaluation
CO3	To **Design** and **Apply** harmonic filters to mitigate power quality problems.	Applying, Creating

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.	6
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	6

	Active Power Filters, Analysis and Design of Shunt Active Power Filters, Numerical Examples	
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	6
Text Books		
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	3
CO1	1	1													
CO2		2			2										
CO3			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.

Assessment

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand	5		10	15
3	Apply	5	5	10	20
4	Analyse	5	5	10	20
5	Evaluate	5	5	10	20
6	Create		5	20	25
Total		**20**	**20**	**60**	**100**

Professional Core (Lab) Courses

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	Power System Harmonics Lab
Desired Requisites:	Power systems, Power Electronics

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

Course Objectives

1	To demonstrate Power Quality issues and their solutions.
2	It also imparts skills to design harmonic filtering systems suitable for particular application in power systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Identify** power quality problems and its solutions.	Applying
CO2	**Calculate** power complement definitions in single phase and three phase circuits.	Applying
CO3	**Design** suitable harmonic filtering systems for particular applications and analyze the results.	Creating

List of Experiments / Lab Activities

List of Experiments:

1. Classification of Power Quality Disturbances.
2. Determine the K rating of the load
3. Predict the parallel resonance frequency and solve for the magnified currents and voltages in the circuit.
4. Design of Single Tuned Harmonic Filter for mitigation of Harmonics.
5. Simulation of Shunt active power filter using p-q theory.
6. Simulation of Shunt active power filter using d-q theory.
7. Analysis of Power Component definitions in single phase circuits with Nonlinear load.
8. Analysis of Power Component definitions in single phase circuits with non-Sinusoidal supply and Nonlinear load.
9. Analysis of Power Component definitions in three phase circuits with a balanced Sinusoidal supply and Nonlinear load.

Text Books

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	3
CO1		1													
CO2				3											
CO3			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				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	20	10	20	**50**
Analyse				
Evaluate				
Create	10	20	20	**50**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli
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AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	Project 1 and Seminar
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	6 Hrs/Week				
Interaction	-	**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,

CO1	**Explain** the conceptual idea behind the project.	Understand
CO2	**Analyze** the research papers/ magazine articles and their impact on global, economic, environmental and societal issues.	Analyse
CO3	**Evaluate** and present the research papers/ magazine articles and outline the important points in the papers/ articles.	Evaluate
CO4	**Interpret** and communicate different contributions in Electrical Engineering and identify promising directions in the same.	Apply

List of Experiments / Lab Activities

List of Experiments:

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.

Text Books

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	3
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.															

Assessment
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	5	5	15	25
3	Apply	5	5	15	25
4	Analyse	5	5	15	25
5	Evaluate	5	5	15	25
6	Create				
Total		**20**	**20**	**60**	**100**

Professional Elective (Theory) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	
Course Name	Professional Elective 4: Intelligent Systems and Its Applications
Desired Requisites:	NIL

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs./week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical					
Interaction	-	**Credits: 3**			

Course Objectives

1	To enhance basic knowledge of intelligence system.
2	To impart knowledge about Artificial neural network and fuzzy logic programming for electrical engineering applications.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Compare** various Intelligent Systems tools.	Understanding
CO2	**Implement** algorithms for Intelligent Systems tools.	Applying
CO3	**Study** Intelligent Systems tools for Applications in electrical engineering.	Analyzing

Module	**Module Contents**	**Hours**
I	Introduction to Artificial Neural Network: Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Historical Developments. Essentials of Artificial Neural Networks: Artificial Neuron Model, operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures.	6
II	Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules. Perceptron Models: Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem. Multilayer feed forward Neural Networks	6
III	Associative Memory, Bi-directional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART).	6
IV	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, defuzzification methods	6
V	Application of Intelligent Systems in Voltage Control, security assessment etc. Study different flow chart of Intelligent system application in Electrical engineering.	6
VI	Application of Intelligent Systems in Schedule Maintenance of Electrical Power Transmission Networks and Intelligent Systems for Demand Forecasting.	6

Text Books

1	Kosko B, *"Neural Networks and Fuzzy Systems: A dynamical system approach to machine intelligence"*, Prentice Hall of India, 2009.
2	Crina Grosan, Ajith Abraham, "*Intelligent Systems: A Modern Approach"* , Springer Verlag, 2011
3	Timothy S.Ross, *"Fuzzy Logic with engineering applications",* Weily India Pvt. Ltd., 2011
4	S. N. Sivanandam, S. Sumathi, S. N. Deepa, *"Introduction to Neural Network Using MATLAB 6.0",* Tata McGraw-Hill, New Delhi, 2006
References	
1	Dan W. Patterson, *"Introduction to Artificial Intelligence and Expert Systems"*, 1st Edition, Pearson Education, 2015
2	Abraham-Kandel, Gideon-Langholz, "*Hybrid-Architectures for Intelligent Systems"*, CRC-Press, 1992.
3	Adrian A. Hopgood, "Intelligent systems for engineers and scientists", Second Edition, CRC press, 2001
Useful Links	
1	http://nptel.ac.in/downloads
2	http://www.nptelvideos.in
3	https://ocw.mit.edu/courses

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			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.															

Assessment
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	5		10	15
3	Apply	5	10	20	35
4	Analyse	10	10	30	50
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli
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AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	Professional Elective 4: Process Control
Desired Requisites:	Control System Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	This course intends to provide basics for mathematical model of the process.
2	It imparts the knowledge of various types of controllers for single loop and multi loop control system.
3	It provides over view of advanced controllers used in process control and multivariable predictive control.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Produce** the models of industrial processes.	Apply
CO2	**Analyse** the problems associated with open loop and close loop process control system.	Analyze
CO3	**Evaluate** the performance of processes with various conventional and advanced controllers.	Evaluate
CO4	**Design** the processes with various conventional and advanced controllers.	Create

Module	**Module Contents**	**Hours**
I	**Introduction to Process Control** Introduction, Design aspects of a process control system, Hardware for a process control system. Mathematical modelling and analysis of processes, development of a mathematical model, Modelling considerations for control purposes, the input-output model, degree of freedom.	6
II	**Modelling of Process** Computer Simulation and linearization of nonlinear systems, Transfer functions and the Input-output models. Dynamic behaviour of first-order systems, second-order system and higher order systems.	6
III	**Feedback Control of Process** Elements of feedback control system, types of feedback controllers, sensors, Transmission lines, final control elements. Dynamic behavior of feedback-controlled process, Effect of proportional (p) control, Integral (I) control and derivative (D) control on the response of controlled process, effect of composite control actions.	6
IV	**Multi Loop Control** Feedback control of system with large dead time or inverse response, processes with large Dead time, Dead time compensation, and control of systems with inverse response. Control systems with multiple loops, cascade control, split-range control, feed forward control, Ratio-control, problem in designing feed forward controllers, practical aspects on the design of feed forward controllers, F/F – F/B control.	6

V	**MIMO Process** Multi-input, multi-output processes, degree of freedom and number of controlled and Manipulated variables, interaction and decoupling of control loops, relative gain array and selection of loops, design of non-interacting control loops. Overview of modern control methodologies: PLC, SCADA, DCS, Adaptive control, variable structure control.	6
VI	**Centralized Multivariable Control** Multivariable model predictive control, single-variable dynamic matrix control (DMC) algorithm, multivariable dynamic matrix control, internal model control, smith predictive, model predictive control, process model based control, implementation guidelines. Process control design: sequence of design steps, statistical process control.	6

Text Books	
1	George Stephanopoulos, "*Chemical Process Control - An introduction to Theory and Practice*", Prentice-Hall of India, 1st Edition 1984.

References	
1	Thomas E. Marlin, "*Process Control - Design Processes and Control System for Dynamic Performance"*, 2nd Edition, Mc Graw Hill publication.
2	F.G. Shinskey, "*Process Control System – Application, Design and Tuning*", McGraw-Hill Publication, 3rd Edition, 1988.
3	Curtis D. Johnson, "*Process Control Instrumentation Technology*", 7th Edition, Pearson Education, 7th Edition. 2003.

Useful Links	
1	http://nptel.ac.in/downloads/117105077
2	http://www.nptelvideos.in/2012/12/digital-communication.html
3	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2													
CO2		2													
CO3		2													
CO4			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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				

3	Apply	10	5	10	25
4	Analyse	10	5	20	35
5	Evaluate			10	10
6	Create		10	20	30
Total		**20**	**20**	**60**	**100**

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	Professional Elective 4: Advanced Power Electronics
Desired Requisites:	Power Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs./week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	This course intends to provide advanced knowledge of different power electronic converters, multi-level inverters and resonant converters.
2	It is aimed to impart skills of analysis for different types of advanced converters and shunt active power filters.
3	Make the students acquainted with control strategies of different types of advanced converters and shunt active power filters.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Distinguish** configuration and working of different advanced power electronic converters.	Understand
CO2	**Analyze** different advanced power electronic converters and systems.	Analyze
CO3	**Evaluate** performance of different power electronic system using power electronic devices and converters.	Evaluate

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.	6
II	**Multilevel inverters** Three phase two level Voltage source inverter, various PWM methods, Multilevel Voltage source inverter, Types: Diode clamp multilevel inverter, flying capacitor multilevel inverter, cascaded multilevel inverter, applications of multilevel inverters, comparison of multilevel inverter. Control method: Multiple carrier PWM for MLI	8
III	**Resonant pulse inverters** Series resonant inverter with unidirectional and bi-directional switches, parallel resonant inverters, voltage control of resonant inverters, zero current and zero voltage switching resonant converters, two-quadrant ZVS resonant converters, resonant DC link inverters and control technique.	8
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, 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.	6

Text Books	
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	NPTEL Video lectures on Advanced power Electronics

CO-PO Mapping

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

Assessment

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10	5	10	25
3	Apply				
4	Analyse	5	10	20	35
5	Evaluate	5	5	30	40
6	Create				
Total		**20**	**20**	**60**	**100**

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	Professional Elective 5: Power System Operation and Control
Desired Requisites:	Power System Engineering, Power System Analysis and Stability, Control System Engineering, Power Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	This course provides the knowledge of Power System Operation.
2	It gives the knowledge of various controls in power systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Explain** the concepts of operation of power system considering various constraints of power apparatus.	Understanding
CO2	**Analyze** different control methods used in power systems.	Analyzing
CO3	**Summarize** recent trends in Power System Operation.	Understanding

Module	**Module Contents**	**Hours**
I	**Introduction to Characteristics of Modern Power Systems** Physical Structure, Operation and Control Functions and Hierarchies, Design and Operating Criteria	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.	8
III	**Frequency Control** Primary Control of Frequency : Governors, Secondary Control of Frequency : AGC	8
IV	**Voltage control** Automatic Voltage Regulators (generators), Shunt Compensation, SVC	8
V	**Introduction to Power Flow Control** HVDC, FACTS, Load Curves, Unit Commitment, Introduction to the use of Optimization Methods	6
VI	**Recent Trends in Power System Operation and Control** Power former, gas insulated transmission lines, deregulation in power systems.	4

Text Books

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://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	3
CO1		2													
CO2	1	2													
CO3					1								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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	15	10	20	45
3	Apply				
4	Analyse	5	10	40	55
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year Year B. Tech., Sem VII
Course Code	
Course Name	Professional Elective 5 : Introduction to Embedded Systems
Desired Requisites:	Analog and Digital Circuits

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**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.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** the salient features of embedded systems.	Understanding
CO2	**Apply** programming techniques to develop embedded systems	Applying
CO3	**Implement** the applications related to interface microcontroller with electrical and electronics systems.	Applying
CO4	**Construct** project prototypes using microcontrollers.	Applying

Module	**Module Contents**	**Hours**
I	**Introduction** Modular approach to Embedded System Design, Salient Features of Modern Microcontrollers, Selection Criteria for Microcontroller, Elements of Microcontroller Ecosystem	5
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	5
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	6

Text Books	
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	3
CO1			3												
CO2					3										
CO3					3										
CO4			3											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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	5	10	15	30
3	Apply	15	10	45	70
4	Analyse				
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2021-22					
Course Information					
Programme	B.Tech. (Electrical Engineering)				
Class, Semester	Final Year Year B. Tech., Sem VII				
Course Code					
Course Name	Professional Elective 5 :Power Electronics and Motor Control for Electric Vehicle				
Desired Requisites:	Fundamentals of Power Electronics, Electrical Machines				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives	
1	To explain basic knowledge related to power converters required for Electric Vehicles.
2	To provide knowledge related to AC machines and Permanent magnet machines used in Electric vehicles.
3	To implement motor control in Electric vehicles using different techniques.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Explain** the concept of power converters used in Electric Vehicles	Understanding
CO2	**Determine** operation of various electrical machines required for Electrical vehicles.	Applying
CO3	**Outline** suitable control techniques for motors used for Electric vehicles.	Analyzing

Module	**Module Contents**	**Hours**
I	**Power Converters for EV** EV and HEV configuration based on power converters, Classification of converters, Principle of Step Down Operation, Buck Converter with RL, RLE Load and filter, Boost Converter with Resistive Load and EMF Source, Boost Converter with Filter and Resistive Load, Buck-Boost Converter	6
II	**DC-DC Converters in EV** Converter classification, Two Quadrant Converters, First and Second Quadrant Converter, Four Quadrant Chopper, Multi-input DC-DC Converters, Flux Additive DC-DC Converter, Multi-input converter Using High/Low Voltage Sources.	6
III	**DC-AC / AC- DC Converters in EV** DC-AC Converters for EV, Principle of Operation, Single Phase Bridge DC-AC Inverter with R Load, Single Phase Bridge DC-AC Inverter with R-L Load, Three phase AC to DC converter for EV, PWM technique, Park's transformation, Clarke's transformation.	6
IV	**A.C. Electrical Machines for Hybrid and Electric Vehicles** Electrical Machines in EVs and HEVs, Physical Concepts of Torque production, Rotating Magnetic Field, Second Magnetic Field, Electrical and Mechanical Angle, Traction Motors,	6

V	**Permanent magnet (PM) motors for Hybrid and Electric Vehicles** Principle of Operation of PM Machine, Operation of PM Machine Supplied by DC-AC Converter with 120° Mode of Operation, Operation of PM Machine Supplied by DC-AC Converter with 180° Mode of Operation, Steady State Modelling of Permanent Magnet Machines, The d - q axis model of Two Phase Permanent Magnet (PM) Machine, Three Phase to Two Phase Transformation	6
VI	**Motor Control in EV** Induction motor control - Field Oriented Control (FOC), Direct Rotor Oriented FOC , Indirect Rotor Oriented FOC, PM motor control- Control Strategies of PM Machines Constant Torque Angle Control, Constant Mutual Air gap Flux Linkage Control, Optimum Torque per Ampere Control	6

Text Books	
1	*"Electric motor and control techniques"*, 2 nd Edition, Irving M. Gottlieb, Tata McGraw Hill.
2	*"AC Motor Control and Electrical Vehicle Applications*", Dr. Kwang Hee Nam, CRC press.
3	"*Advanced Electric Drive Vehicles (Energy, Power Electronics, and Machines)",* 1st Edition, Ali Emadi, CRC Press.
References	
1	Power Converters for Electric Vehicles by L.Ashok Kumar, S. Albert Alexander, 1 st edition, CRC Press.
2	R. Erickson, D. Maksimovic, Fundamentals of Power Electronics, Springer 2001
Useful Links	
1	https://nptel.ac.in/courses/108/106/108106170/
2	https://nptel.ac.in/courses/108/103/108103009/

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3														
CO2		2													
CO3			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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10		10	20
3	Apply	10	20	40	70
4	Analyse			10	10
5	Evaluate				

6	Create				
Total		**20**	**20**	**60**	**100**

Professional Elective (Lab) Courses

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	
Course Name	Professional Elective 4: Intelligent Systems and its Applications Lab
Desired Requisites:	NIL

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

Course Objectives

1	To enhance basic knowledge of intelligence system.
2	To impart knowledge about Artificial neural network and fuzzy logic programming for electrical engineering applications.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Compare** various AI tools.	Understanding
CO2	**Implement** algorithms for AI tools.	Applying
CO3	**Study** AI tools for Applications in electrical engineering.	Analyzing

List of Experiments / Lab Activities

List of Experiments:

1. Write program to evaluate output of any given architecture of neural network with different transfer
2. Functions such as linear logsig tanh, threshold function.
3. Verify the fault tolerant nature of neural network by disconnecting few weight link for a given architecture
4. Write program for perceptron learning algorithm.
5. To study some basic neuron models and learning algorithms by using ANN tool
6. Power system failure analysis using ANN tool
7. Predict power factor of four bus system using neural network
8. Predict system analysis for measurements like rms voltage using ANN tool
9. Write supervised and unsupervised ANN program for Signal Frequency Separation using Perceptron
10. Temperature monitoring using fuzzy logic
11. Speed control of DC motor using fuzzy logic
12. Fuzzy logic based washing machine control
13. Fuzzy logic based air conditioner
14. Design of a Fuzzy Multi-Objective Power System Stabilizer via Linear Matrix Inequalities
15. Presentation/mini projects on relevant topics given to students in groups etc.

Text Books

1	S. N. Sivanandam, S. Sumathi, S. N. Deepa, "*Introduction to Neural Network Using MATLAB 6.0"*, Tata McGraw-Hill, New Delhi, 2006
2	Kosko B, *"Neural Networks and Fuzzy Systems: A dynamical system approach to machine intelligence"*, Prentice Hall of India, 2009.
3	Crina Grosan, Ajith Abraham, "*Intelligent Systems: A Modern Approach"* , Springer Verlag, 2011

4	Timothy S.Ross, *"Fuzzy Logic with engineering applications",* Weily India Pvt. Ltd., 2011
References	
1	Dan W. Patterson, *"Introduction to Artificial Intelligence and Expert Systems"*, 1st Edition, Pearson Education, 2015
2	Abraham-Kandel, Gideon-Langholz, "*Hybrid-Architectures for Intelligent Systems"*, CRC-Press, 1992.
3	Adrian A. Hopgood, "*Intelligent systems for engineers and scientists*", Second Edition, CRC press, 2001
Useful Links	
1	http://nptel.ac.in/downloads
2	http://www.nptelvideos.in
3	https://ocw.mit.edu/courses

CO-PO Mapping

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)

Bloom's Taxonomy Level	LA1	LA2	Lab ESE	Total
Remember				
Understand	10			**10**
Apply	20	20	20	**60**
Analyse		10	20	**30**
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	Professional Elective 4 : Process Control Lab
Desired Requisites:	Control Systems Engineering Lab

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

Course Objectives

1	This course intends to provide mathematical model of the process and verification with experimentation.
2	It demonstrate the various types of controllers for SISO system.
3	It provide simulation of various advanced controllers used in process control and multivariable predictive control.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Experiment** on various Process Control systems to evaluate performance.	Apply
CO2	**Apply** the tuning techniques for the controllers.	Apply
CO3	**Evaluate** the performance of given Process Control system.	Evaluate
CO4	**Demonstrate** the use of advance controller.	Apply

List of Experiments / Lab Activities

List of Experiments:

1. Step response of first order system (single capacity system).
2. Step response of multi capacity process (coupled tank system).
3. Study of a computer controlled pressure control system.
4. Tuning of P PI and PID controllers based on process reaction curve and Ziegler Nichols method.
5. Study of computer controlled level control system.
6. Study of computer controlled flow control system.
7. Tuning of controllers for level control system.
8. Tuning of controllers for flow control system.
9. Study of cascade controller for a flow control system.
10. Study of PLC and its process controlled applications.

In case of mini-projects, drawing, presentations etc, write the relevant details of the same.

Text Books

1	George Stephanopoulos, "*Chemical Process Control - An introduction to Theory and Practice*", Prentice-Hall of India, 1st Edition 1984.

References

1	Thomas E. Marlin, "*Process Control - Design Processes and Control System for Dynamic Performanc*e", 2nd Edition, Mc Graw Hill publication.
2	F.G. Shinskey, "*Process Control System – Application, Design and Tuning*", McGraw-Hill Publication, 3rd Edition, 1988.

3	Curtis D. Johnson, "*Process Control Instrumentation Technology*", 7th Edition, Pearson Education, 7th Edition. 2003.
Useful Links	
1	http://nptel.ac.in/downloads/117105077
2	http://www.nptelvideos.in/2012/12/digital-communication.html
3	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/

CO-PO Mapping

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

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)

Bloom's Taxonomy Level	LA1	LA2	Lab ESE	Total
Remember				
Understand				
Apply	30	10	20	**60**
Analyse				
Evaluate		20	20	**40**
Create				
Total Marks	**30**	**30**	**40**	**100**

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	Professional Elective 4 :Advanced Power Electronics Lab
Desired Requisites:	Power Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs./Week				
Interaction	-	**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.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Articulate** working of different advanced power electronic converters.	Understand
CO2	**Analyze** different advanced power electronic converters and systems.	Analyze
CO3	**Evaluate** the performance of different advanced power electronic converters using hardware and simulation software.	Evaluate

List of Experiments / Lab Activities

List of Experiments:

1. Analyse the source current of single phase full controlled thyristor converter.
2. Analyse the source current of three phase full controlled thyristor converter.
3. Amaze the performance of single phase PWM Rectifier
4. Amaze the performance of three phase PWM Rectifier
5. Analysis of performance of three phase five level diode clamped Multilevel Inverter.
6. Analysis of performance of three phase five level cascaded H bridge Multilevel Inverter.
7. Evaluate the performance of two level voltage source PWM Inverter.
8. Analyse the performance of three phase z source Inverter
9. Analyse the performance of three phase shunt Active power Filter based on synchronously rotating reference frame theory.
10. Measurement of source current harmonics of three phase diode bridge rectifier.

Text Books

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*, Narosapublication.

Useful Links

1	-

CO-PO Mapping															
	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1				3											
CO2			2												
CO3					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				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	5	10	10	**25**
Apply				
Analyse	20	10	10	**40**
Evaluate	5	10	20	**35**
Create				
Total Marks	**30**	**30**	**40**	**100**

Open Elective 3

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

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	
Course Name	Open Elective 3: Industrial Automation
Desired Requisites:	Nil

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	Nil			
Interaction	-	**Credits: 3**			

Course Objectives

1	This course intends to develop basics of ladder logic programming for PLC.
2	It provides the foundation level knowledge of SCADA System.
3	It gives overview of various types of controller for closed loop control.
4	It provides the applications of variable speed drives in industries.

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Compare** the various types of controllers for Industrial Automation.	Understand
CO2	**Apply** the knowledge of PLC and SCADA for Industrial Automation.	Apply
CO3	**Explain** the use of variable speed drives for Industrial Automation.	Understand

Module	**Module Contents**	**Hours**
I	**Measurement of Various Process Parameters** Measurement of quantities such as temperature, pressure, force, displacement, speed, flow, level, humidity, pH etc., signal conditioning, estimation of errors and calibration.	6
II	**Process Control and Various Controllers** Introduction to process control, PID controller and tuning, various control configurations such as cascade control, feed forward control, split range control, ratio control, override control and selective control.	6
III	**Actuators** Introduction to various actuators such as flow control valves, Hydraulic and pneumatic, servo motors, symbols and characteristics.	6
IV	**PLC** Introduction to sequence control and relay ladder logic, basic PLC system, I/O modules, scan cycle, programming of timers, counters and I/O programming.	6
V	**SCADA for Industrial Automaton** Components of SCADA systems, functions, classification of SCADA, networking and communication protocols.	6
VI	**Variable Speed Drives** Role of variable speed drives in automation, DC drives, AC drives and synchronous motor drives applications of variable speed drives.	6

Text Books

1	John W. Webb, Ronald A. Reis "*Programmable logic controllers, principles & applications*" by PHI publication, Eastern Economic Edition.
2	C. D. Johnson, "*Process control & instrumentation techniques*".Pearson Education

References	
1	George Stephanopoulos, "*Chemical Process Control - An introduction to Theory and Practice*", Prentice-Hall of India, 1st Edition 1984.
2	"*Fundamentals of Electrical Drives*", G. K. Dubey, Narosa publication, 2nd edition.
Useful Links	
1	NPTEL Lectures

CO-PO Mapping

	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		2													
CO2		2			2										
CO3						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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand	10		20	30
3	Apply	10	20	40	70
4	Analyse				
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Course Content of

Final Year B. Tech. (Electrical Engineering) Sem- VIII (EVEN)

2021-22

Professional Core (Lab) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	
Course Name	Project 2
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	16 Hrs/Week				
Interaction	-	**Credits: 8**			

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,

CO1	Analyse and infer the reference literature/ research papers critically and efficiently.	Analyse
CO2	Construct the model of the project.	Create
CO3	Evaluate the performance of the project.	Evaluate
CO4	Write and Present the report of the project.	Create

List of Experiments / Lab Activities

List of Experiments:

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

Text Books

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	3
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.															

Assessment
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply				
4	Analyse	5	5	15	25
5	Evaluate	10	10	30	50
6	Create	5	5	15	25
Total		**20**	**20**	**60**	**100**

Professional Elective (Theory) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	
Course Name	Professional Elective 6: Electric Vehicle Design
Desired Requisites:	Control systems, Electrical Machines

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives

1	To develop basic knowledge related to Electric Vehicles subsystem.
2	To provide knowledge related to design aspects of Electric vehicles
3	The course aims at enabling students to design of BMS and battery pack layout.

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Summarize** the design procedure for Electric Vehicles	Understanding
CO2	**Determine** the performance of Electric vehicle based on design details	Applying
CO3	**Analyze** different control system techniques for Electric vehicles	Analyzing

Module	**Module Contents**	**Hours**
I	**Design Principles - I** Definition of hybridness, Hybrid design philosophy, Hybridness: parallel hybrid, series, mixed and range extender (plug-in) hybrids, Range extender, Optimization and hybridness, Battery power and electric motor power	5
II	**Design Principles - II** Power and Mass Computations for Initial Vehicle Sizing, Power Requirements, Acceleration Power, Grade-Climbing Power, Vehicle Mass, Component Sizing, Series HEV Drivetrain Components and Their Connections, Parallel HEV Drivetrain Components and Their Connections.	5
III	**Control Systems for the HEV and EVs** Function of Control System in HEVs and EVs, Elementary of Control Theory, Overview of Control System: The Electronic Control Unit (ECU), Control Area Network, Control Variables	5
IV	**BMS Design for EV** Introduction, Importance of BMS design, Battery pack layout, Design of BMS, Battery pack sensing, Sensing voltage signals-ADC, Sensing Thermistor values, Current values sensing, Battery pack protection, Battery pack interfacing, Communication.	5

V	**Regenerative Braking** Fundamentals of Regenerative Braking, Energy Consumption in Braking, Braking Power and Energy on Front and Rear Wheels, Brake System of EVs and HEVs, Antilock Brake System (ABS)	4
VI	**Drive cycle and EV subsystem** Concept of drive cycle, drive cycles and energy used per km, Design of EV drive train, Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).	4
Text Books		
1	Iqbal Husain ,' *Electric and Hybrid Vehicles: Design Fundamentals* ', CRC Press, 2003	
2	2. C.C. Chan and K.T. Chau, "*Modern Electric Vehicle Technology"*, OXFORD University Press, 2001	
References		
1	Chris Mi, M. Abul Masrur, David Wenzhong Gao, "*Hybrid Electric Vehicles Principles And Applications With Practical Perspectives*," Wiley Publication, 2011.	
Useful Links		
1	https://nptel.ac.in/courses/108/106/108106170/	
2	https://nptel.ac.in/courses/108/103/108103009/	

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

Assessment
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10		10	20
3	Apply	10	20	40	70
4	Analyse			10	10
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

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

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives

1	To create awareness about the importance of renewable 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 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,

CO1	**Determine** need of RES.	Understanding
CO2	**Explain** solar and wind power generation and its utilization.	Understanding
CO3	**Comprehend** storage systems and SMART GRID system.	Understanding

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.	4
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.	4
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.	5

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, airfoil, lift & drag characteristics, power coefficient & tip speed ratio characteristics, electrical generator machines in wind energy systems.	5
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.	3
VI	**Emerging Trends in Renewable Energy** Introduction to 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 DG systems.	5

Text Books	
1	Boyle, Godfrey, "*Renewable Energy", (2nd edition)*, Oxford University Press, 2004.
2	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													
CO2													3		
CO3			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.

Assessment

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	20	20	60	100
3	Apply				
4	Analyse				
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	
Course Name	Professional Elective 7: Flexible AC Transmission Systems
Desired Requisites:	Power System Engineering, Power Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

Course Objectives

1	To make students understand 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.

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Explain** necessity, operating principals and benefits of FACTs devices.	Understanding
CO2	**Choose** the suitable FACTs device/controller for particular application.	Applying
CO3	**Analyze** the characteristics of FACTs Controllers and effect of location of the controller on Power System.	Analyzing

Module	**Module Contents**	**Hours**
I	**Introduction** Transmission Interconnections, Why We Need 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	**5**
II	**Static VAR Compensator (SVC)** 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	**5**

	Generators, The Thyristor-Controlled 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 Compensators** 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	**5**
IV	**Voltage-Sourced Converters and Current sourced converters used in FACTS devices** Voltage-Sourced Converters , Basic Concept of Voltage-Sourced Converters , Single-Phase Full-Wave Bridge Converter Operation, Single Phase-Leg Operation, Square-Wave Voltage Harmonics for a Single-Phase Bridge, Three-Phase Full-Wave Bridge Converter, Converter OPeration, Fundamental and Harmonics for a Three-Phase Bridge Converter, Sequence of Valve Conduction Process in Each Phase-Leg ,Transformer Connections for 12-Pulse Operation 24- and 48-Pulse Operation, Three-Level Voltage-Sourced Converter, Operation of Three-Level Converter, Fundamental and Harmonic Voltages for a Three-Level Converter, Three-Level Converter with Parallel Legs, Pulse-Width Modulation (PWM) Converter,Self- and Line-Commutated Current-Source Converters	**5**
V	**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	**4**
VI	**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	**4**
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	3
CO1			1												
CO2				2											
CO3						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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	10		10	20
3	Apply	10	20	40	70
4	Analyse			10	10
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	
Course Name	Professional Elective 7- Illumination Engineering
Desired Requisites:	Basic Electrical Engineering , Basic Electronics Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**Credits: 2**			

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,

CO1	**Describe** basic terms and laws in illumination engineering.	Remember
CO2	**Classify** different types of lamps used for lighting**.**	Apply
CO3	**Identify** indoor and outdoor illumination system components, its controls & design aspects & **evaluate** different lighting designs & applications.	Evaluate

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	5
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..	4
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, luminary's standard (IEC-598-Part I).	4

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.	5
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	5
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	3

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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember	10		10	20
2	Understand				
3	Apply	10	10	20	40
4	Analyse				
5	Evaluate		10	30	40
6	Create				
Total		**20**	**20**	**60**	**100**