Walchand College of Engineering, Sangli

(*Government Aided Autonomous Institute*)

1947

Credit System and Course Content

Final Year B. Tech. (Electrical Engineering)

Semester VII & VIII

Academic Year 2022-23

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Credit System for Final Year B.Tech. (Electrical Engineering) Sem-VII AY 2022-23

Sr.No.	Category	Course Code	Course Name	L	T	P	I	Hrs	Cr	MSE/ LA1	ISE/ LA2	ESE	Ext
Professional Core (Theory)													
1	PC	5EL401	Power System Operation and Control	3	0	0	0	3	3	30	20	50	
2	PC	5EL402	Power System Harmonics	2	0	0	0	2	2	30	20	50	
3	HS	5EL403	Humanities-4 Legal, IPR and Safety	1	0	0	0	1	1	15	10	25	
Professional Core (Lab)													
4	PC	5EL451	Power System Operation and Control Lab	0	0	2	0	2	1	30	30	40	OE
5	PC	5EL452	Power System Harmonics Lab	0	0	2	0	2	1	30	30	40	OE
6	PR	5EL453	Techno-Socio Activity	0	0	0	1	1	1	15	15	20	
7	PR	5EL446	Project-I	0	0	6	0	6	3	30	30	40	POE
8	HS	5EL455	Humanities-3 Project Management	0	0	0	1	1	1	15	15	20	
Professional Elective (Theory)													
9	PE	Refer list	Elective-4	3	0	0	0	3	3	30	20	50	
Professional Elective (Lab)													
10	PE	Refer list	Elective-4 Lab	0	0	2	0	2	1	30	30	40	
11	OE	Refer list	Open Elective-5	3	0	0	0	3	3	30	20	50	
AICTE Mandatory Courses													
12	MC	5IC401	Constitution of India	2	0	0	0	2	0	30	20	50	
			Total	**14**	**0**	**12**	**2**	**28**	**20**				

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing.
For Lab courses: There shall be continuous assessment (LA1, LA2, ESE). The ESE is a separate head of passing. The Y in the PoE indicates external component for ESE.Minimum two AICTE mandatory courses need to be completed for award of degree.
The contact hours of guide for Final Year BTech project are 4 hrs for Sem VII and 8 hours/week for Sem VIII, for 9 students.

For further details, refer to Academic and Examination rules and regulations.

Walchand College of Engineering, Sangli

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Elective Course List for Final Year B.Tech. (Electrical Engineering) Sem-VII AY 2022-23

Sr.No.	Track	Course Code	Course Name
Elective- 4			
1	Power System	5EL411	HVDC
2	Control System	5EL412	PLC and SCADA
3	Power Electronics and Drives	5EL413	Advanced Power Electronics
Elective- 4 Lab			
1	Power System	5EL456	HVDC Lab
2	Control System	5EL457	PLC and SCADA Lab
3	Power Electronics and Drives	5EL458	Advanced Power Electronics Lab

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Open Elective Course List for Final Year B.Tech. (Electrical Engineering) Sem-VII AY 2022-23

Sr.No.	Offering Dept	Sem	Course Code	Course Name
Open Elective 5				
1	Mech	7	5OE429	Industrial Automation
2	Eln	7	5OE457	Medical Image Processing
3	CSE	7	5OE471	Cyber Security
4	IT	7	5OE485	Data Visualization & Interpretation
5	Mech	7	5OE429	Industrial Automation
6	Eln	7	5OE457	Medical Image Processing
7	CSE	7	5OE471	Cyber Security
8	IT	7	5OE485	Data Visualization & Interpretation
9	Mech	7	5OE429	Industrial Automation
10	Mech	7	5OE429	Industrial Automation
11	Eln	7	5OE457	Medical Image Processing
12	Eln	7	5OE457	Medical Image Processing
13	CSE	7	5OE471	Cyber Security
14	IT	7	5OE485	Data Visualization & Interpretation
15	CSE	7	5OE471	Cyber Security
16	IT	7	5OE485	Data Visualization & Interpretation

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Credit System for Final Year B.Tech. (Electrical Engineering) Sem-VIII AY 2022-23

Sr.No.	Category	Course Code	Course Name	L	T	P	I	Hrs	Cr	MSE/LA1	ISE/LA2	ESE	Ext
Professional Core (Theory)													
1	PC	5EL421	Energy Audit and Management	2	1	0	0	3	3	30	20	50	
Professional Core (Lab)													
2	PR	5EL491	Project-II	0	0	12	0	12	6	30	30	40	POE
Professional Elective (Theory)													
3	PE	Refer list	Elective-5	2	0	0	0	2	2	30	20	50	
4	PE	Refer list	Elective-6	3	0	0	0	3	3	30	20	50	
5	PE	Refer list	Elective-7	3	0	0	0	3	3	30	20	50	
Professional Elective (Lab)													
6	PE	Refer list	Elective-5 Lab	0	0	2	0	2	1	30	30	40	
			Total	**10**	**1**	**14**	**0**	**25**	**18**				

Notes:

For Theory courses: There shall be MSE, ISE and ESE. The ESE is a separate head of passing.
For Lab courses: There shall be continuous assessment (LA1, LA2, ESE). The ESE is a separate head of passing. The Y in the PoE indicates external component for ESE.Minimum two AICTE mandatory courses need to be completed for award of degree.
The contact hours of guide for Final Year BTech project are 4 hrs for Sem VII and 8 hours/week for Sem VIII, for 9 students.

For further details, refer to Academic and Examination rules and regulations.

Elective Course List for Final Year B.Tech. (Electrical Engineering) Sem-VIII AY 2022-23

Sr.No.	Track	Course Code	Course Name
Elective-5			
1	Power System	5EL431	Advanced Electrical Machines Design
2	Control System	5EL432	Intelligent Systems and Its Applications
3	Power Electronics and Drives	5EL433	SMART Gride
Elective-5 Lab			
1	Power System	5EL471	Advanced Electrical Machines Design Lab
2	Control System	5EL472	Intelligent Systems and Its Applications Lab
3	Power Electronics and Drives	5EL473	SMART Grid Lab
Elective-6			
1	Power System	5EL434	EHVAC
2	Control System	5EL435	Introduction to Embedded System
3	Power Electronics and Drives	5EL436	Solar and Wind Power Generation
Elective-7			
1	Power System	5EL437	Neural Network and Applications with Software
2	Control System	5EL438	Process Control
3	Power Electronics and Drives	5EL439	FACTS

Semester - VII

Professional Core (Theory) Courses

Walchand College of Engineering, Sangli

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AY 2022-23

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	5EL401
Course Name	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	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		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	6
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.	6
III	**Frequency Control** Primary Control of Frequency : Governors, Secondary Control of Frequency : AGC	6
IV	**Voltage control** Automatic Voltage Regulators (generators), Shunt Compensation, SVC	6
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.	6

Text Books	
1	S. Sivanagaraju ,*"Power System Analysis: Operation and Control*" , Pearson Education India, 2009
References	
1	Robert Herschel Miller ,"*Power System Operation and Control*", McGraw Hill Professional, 1994.
2	DR. K. UMA RAO , "*Power System Operation and Control*" , Wiley India, 2010
3	N.V.Ramana , "*Power System Operation and Control*", 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
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 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)

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AY 2022-23

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	5EL402
Course Name	Power System Harmonics
Desired Requisites:	Power Systems, Power Electronics

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

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	**Apply** various definitions of power components for Single Phase and Three Phase circuits to **analyze** figures of merit in harmonic environments..	Applying Analyze
CO3	To **Design** and **evaluate** the performance of harmonic filters to mitigate power quality problems.	Evaluating, 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	4
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, Inter	4

	harmonics, Parallel resonance, case study on parallel resonance.	
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	4
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	4
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.	4
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	4
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
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 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)

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AY 2022-23

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	4EL403
Course Name	Humanities -4 Legal, IPR, Safety
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	1 Hrs/Week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	10	10	30	50
		Credits: 1			

Course Objectives

1	To introduce the students about Legal, IPR, Safety laws.
2	To disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
3	To be aware about current trends in IPR and Govt. steps in fostering IPR.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand about Indian industry Legal, IPR, Safety laws	Understand
CO2	Interpret patent and copyright in innovative research work.	Apply
CO3	Illustrate the importance of Indian industry Legal, IPR, Safety laws	Analyze

Module	**Module Contents**	**Hours**
I	Overview of Bureau of Indian Standards Act 1986	2
II	The Right to Information Act of 2005, In order to promote public education and public safety	2
III	Intellectual Property, Patents, Copyrights, Trademarks etc	3
IV	Other forms of IP, Current Contour,	2
V	The Factories Act 1948, The Mines Act 1952, The Dock Workers (Safety, Health &Welfare) Act 1986.	3
VI	The Electricity Act 2003	1

Text Books

1	Nithyananda, K. V. (2019). Intellectual Property Rights :Protection and Management. India, IN:C engage Learning India Private Limited.
2	D. S. S. Ganguly and C S Changeriya Labor & Industrial Acts & Laws (Safety Management)

References	
1	Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis
Useful Links	
1	Cell for IPR Promotion and Management (http://cipam.gov.in/)
2	https://law.resource.org/pub/in/bis/manifest.med.html
3	World Intellectual Property Organization (https://www.wipo.int/about-ip/en/)
4	Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
5	https://labour.gov.in/industrial-safety-health

CO-PO Mapping

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

Professional Core (Lab) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	5EL451
Course Name	Power System Operation and Control Lab
Desired Requisites:	Power System Engineering, Power System Analysis and Stability, Control System Engineering, Power Electronics.

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

Course Objectives

1	This course provides the knowledge of Power System Operation.
2	It gives the knowledge of various control techniques used in Power Systems

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Illustrate** the use of different techniques for power system operation, in simulated environment.	Apply
CO2	**Analyze** the performance of power system under various operating constraints, through simulation.	Apply
CO3	**Evaluate** different power flow control methods through simulation	Evaluate

List of Experiments / Lab Activities

List of Experiments:

1. Computation of Complex Power flow and verification of effect of load angle on active power flow.
2. Computation of power delivered by a generator connected to infinite bus.
3. Computation of maximum power capacity of lossless line and loadability limits.
4. Load flow study of IEEE-30 bus system using Gauss-Seidel, Newton-Raphson and fast decoupled methods.
5. Computation of Optimal dispatch of power for generator units in a plant. Computation of Optimal dispatch of power for generator units in a plant.
6. Computation of Optimal dispatch of power for generator units in a plant by considering losses & generator limits.
7. Short circuit study of generator under faults.
8. Computation of steady state stability under small disturbances.
9. Transient stability study for single machine and multi-machine systems.

Text Books

1	Hadi Saadat , "*Power System Analysis*", McGraw-Hill, International edition, 1999.

References

1	Glover, Sarma & Overbye , "*Power System Analysis & Design*", Nelson Engineering; 4th edition, 2007
2	User manuals – MiPower Power System Analysis software, PRDC, Bengaluru.

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
CO1				3										
CO2				3	2									
CO3			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.(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.				

Walchand College of Engineering, Sangli

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AY 2022-23

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	5EL452
Course Name	Power System Harmonics Lab
Desired Requisites:	Power systems, Power Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs /week	**LA1**	**LA2**	**ESE**	**Total**
Interaction	-	30	30	40	100
		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 Analyze

List of Experiments / Lab Activities

List of Experiments:

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 Composite Passive Harmonic Filter for Harmonic Mitigation.
8. Simulation of Shunt active power filter using p-q theory.
9. Simulation of Shunt active power filter using d-q theory.
10. Develop MATLAB program(*.m) for design of single tuned and high pass filters.
11. 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
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.(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.				

Walchand College of Engineering, Sangli

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AY 2022-23

Course Information	
Programme	B. Tech (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	5EL453
Course Name	Techno-Socio Activity
Desired Requisites:	

Teaching Scheme (Hrs)		**Examination Scheme (Marks)**			
Practical	-	**LA1**	**LA2**	**ESE**	**Total**
Interaction	1 Hr/Week	15	15	20	50
		Credits: 1			

Course Objectives	
1	To record student performance in co-curricular and extra-curricular activities over two years will be considered.
2	To encourage the students to participate in activities that help develop leadership skills, team integrity, coordination skills, Time management, Communications skills, Interviewing skills etc.
3	To highlight importance of social responsibility.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Notice** an improvement in his/her understanding and presentation skills.	Apply
CO2	**Understand** and value the importance of working in a diversified team.	Analyze
CO3	**Demonstrate** the soft skills like presentation skills, technical report writing etc.	Evaluate

Course Contents

The guide will be mentoring a given student batch for the duration of one Semester. The students shall submit proof of their achievements in various extra and co-curricular activities related to technical, cultural and social causes from first year to second year. The faculty will evaluate the students' performance at the end of 7thsemester, based on the rubrics provided by the department from time to time.

Text Books	
1	As per topic Selected, e-books, Handbooks, Case studies etc.

References	
1	As per topic Selected, e-books, Handbooks, Case studies etc

Useful Links	
1	https://www.aicte-india.org/atal
2	https://nptel.ac.in/
3	https://swayam.gov.in/

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			
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.(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	15
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	15
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	20
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.				

Walchand College of Engineering, Sangli

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Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	5EL446
Course Name	Project I
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	6 Hrs/Week	**LA1**	**LA2**	**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,

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
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

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.

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Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	4EL455
Course Name	Humanities 3- Project Management
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	1Hrs/ week	15	15	20	50
		Credits: 1			

Course Objectives

1	To prepare the students to manage projects by exploring both technical and managerial challenges and preparing the budget.
2	To make aware the students about leadership and ethical qualities in dealing with real life project
3	To induce qualities for working in interdisciplinary and cross functional teams with effective communication skills, economical and managerial challenges and commercial management.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Grasp and perceive the project activities with respect to resources required and the constraint for feasibility or completion within time	Understanding
CO2	Estimate and prepare budget for project completion, Understand commercial management	Analyzing
CO3	Figure out and schedule the project and assess for controlling critical path networks	Evaluating

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

1. Introduction to Project Management.
2. Project Cost, Planning, feasibility, risk.
3. Critical Path Networks - Principles of Resource Scheduling.
4. Executing and Controlling.
5. Commercial Management and various regulations.
6. Study and use of software related to Project Management System.

Textbooks

1	Dennis Lock , Project Management - Gower Publishing Limited, 2013
2	Samuel J. Mantel, Jr., Jack R. Meredith, Scott M. Shafer, Margaret M. Sutton, Project Management in Practice - JOHN WILEY & SONS, INC., 2011

3	B.C. Punmia and Khandelwal, Project Planning and Control with PERT and CPM, Lakshmi Publications Pvt. Ltd., 2001
4	HoraldKerzner, Project Management: A systems approach to planning, scheduling and controlling, John Wiley & Sons Inc., 2009
5	The factories act 1948 – Government of India 6. Meri Williams , The Principles of Project Management By – SitepointPvt Ltd., 2008
References	
1	K. Nagarajan, Project Management, New Age Int., 2nd ed. 2004.
2	B.M.Naik, Project Management-Scheduling and Monitoring by PERT/CPM, 1984
3	William R Duncan, A guide to the project management body of knowledge, PMI Publications, 1996
Useful Links	
1	https://www.apm.org.uk/resources/what-is-project-management/
2	https://www.projectmanager.com/project-management

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1								1					1	1
CO2									2					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, 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	15
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	15
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	20
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.				

Professional Elective (Theory) Courses

Walchand College of Engineering, Sangli

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AY 2022-23

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	5EL411
Course Name	Professional Elective- IV: HVDC
Desired Requisites:	Power Electronics**,** Power 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	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.

Useful Links	
1	NPTEL course

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 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)

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Course Information					
Programme	B.Tech. (Electrical Engineering)				
Class, Semester	Final Year B. Tech., Sem VII				
Course Code	5EL412				
Course Name	Professional Elective- IV:PLC and SCADA				
Desired Requisites:	Electrical Measurement, Instrumentation				
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 basics knowledge of PLC and SCADA.
2	To impart programming knowledge for PLC and SCADA based systems.
3	To develop skills for use of PLC and SCADA systems in automation.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Explain** basics components used in PLC and SCADA based systems.	Understanding
CO2	**Apply** ladder logic programming technique for various PLC applications.	Applying
CO3	**Use** different PLC functions like timers, counters, etc. for different applications.	Applying
CO4	**Evaluate** the performance of PLC and SCADA based systems.	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to PLC** Introduction, advantages, disadvantages, Input module, Output Module, memory and interfacing, Power Supplies for PLC, Architecture of PLC, Introduction to input-output devices.	6
II	**PLC programming** Introduction to Ladder logic programming, on – off switching devices, input analog devices, 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 Timers and Counters** PLC timer functions, Types of timers, Programming for On delay timers, off delay timers and Pulse timers, Retentive Timers, PLC counter functions, Up/down counters and their programming, PLC applications with timers and counters.	6

IV	**PLC Intermediate and Data Handling Functions** PLC Arithmetic functions, PLC trigonometric and log functions, PLC basic comparison functions, PLC advanced comparison functions, Master control relay functions, Programming PLC for fail safe operation using Master Control Relay, PLC Jump functions, Jump with return and non-return, PLC data move system, Moving large blocks of PLC data, data handling functions.	6
V	**PLC Bit Functions and PLC Networking** Digital bit functions and applications, Bit patterns in register, Shift Register Functions and applications, Analog PLC operations, Networking of PLCs-Levels of Industrial Control, Types of Networking, Network Communications.	6
VI	**Introduction to SCADA** Components of SCADA, SCADA functions, Co-ordination and control, advantages, Power System Automation using SCADA.	6
Text Books		
1	John W. Webb, Ronald A. Reis "*Programmable logic controllers, principles & applications*" by PHI publication, Eastern Economic Edition.	
2	W.H. Bolton "*Programmable Logic Controllers*", Newness Publication.	
References		
1	John R. Hackworth and Peterson, "*PLC Controllers Programming Methods and Applications*", Pearson Publication	
2	Gary dunning, "*Introduction to PLC*" Cengage Learning.	
Useful Links		
1	Nil	

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		2											
CO3		2												
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 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)

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AY 2022-23

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	5EL413
Course Name	Professional Elective IV: 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	This course intends 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	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	**Analyse** different advanced power electronic converters and systems.	Analyse
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 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.	5
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.	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
CO1	1	2												
CO2		2												
CO3			2		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)

Professional Elective Lab Courses

Walchand College of Engineering, Sangli

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Course Information					
Programme	B.Tech. (Electrical Engineering)				
Class, Semester	Final Year B. Tech., Sem VII				
Course Code	4EL456				
Course Name	HVDC Lab				
Desired Requisites:	Power Electronics, Fundamentals of MATLAB				
Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2Hrs/Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction		30	30	40	100
		Credits: 1			

Course Objectives	
1	Understand the advantages of dc transmission over ac transmission.
2	It provides the knowledge of appropriate control and protection systems 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	Apply suitable control strategies used for LCC and VSC based HVDC transmission system.	Apply
CO2	Analysis of Line Commutated Converters and Voltage Source Converters in HVDC Transmission System.	Analyze

List of Experiments / Lab Activities/Topics

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		2												
CO2				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.(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.				

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Course Information					
Programme	B.Tech. (Electrical Engineering)				
Class, Semester	Final Year B. Tech., Sem VII				
Course Code	4EL457				
Course Name	PLC and SCADA Lab				
Desired Requisites:	Electrical Measurement, Instrumentation				
Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2Hrs/Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction		30	30	40	100
		Credits: 1			

Course Objectives	
1	To provide basics of PLC and SCADA.
2	To impart programming knowledge for PLC and SCADA based systems.
3	To develop skills for use of PLC and SCADA systems in automation.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Execute** experiments based on PLC and SCADA systems	Apply
CO2	**Apply** ladder logic programming technique for various PLC applications.	Apply
CO3	**Use** different PLC functions like timers, counters, etc. for different applications.	Apply

List of Experiments / Lab Activities/Topics

1. Study of components of Relay logic and PLC logic.
2. Development of Ladder Diagram for ON/OFF and latching functions.
3. Development of PLC programming for Motor Reversal control.
4. Development of PLC programming for Stair case lighting.
5. Development of PLC programming for Running Lighting.
6. Development of PLC programming for Arithmetical Functions.
7. Development of PLC programming for Traffic control system.
8. Development of PLC programming by using Timer functions.
9. Development of PLC programming for Counter function.

Textbooks	
1.	John W. Webb, Ronald A. "Programmable Logic Controllers, Principles and Applications"PHI publication, Eastern Economic Edition.
2	W.H. Bolton" Programmable Logic Controllers", Newness Publication.

References	
1.	John R. Hackworth and Peterson, "PLC Controllers Programming Methods and Applications", Pearson Publication.
2.	Gary dunning, "Introduction to PLC" Cengage Learning.

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					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, 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.				

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Course Information

Programme		B.Tech. (Electrical Engineering)			
Class, Semester		Final Year B. Tech., Sem VII			
Course Code		4EL458			
Course Name		Advanced Power Electronics Lab			
Desired Requisites:		Power Electronics			
Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2Hrs/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.

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/Topics

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, Narosapublication.
Useful Links	

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

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.				

Open Elective Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	4OE443
Course Name	Open Elective-5: Industrial Automation NPTEL
Desired Requisites:	Nil

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 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	https://onlinecourses.nptel.ac.in/noc21_me67/preview	

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			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 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)

Sem - VIII
Professional Core (Theory) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL421
Course Name	Energy Audit and Management
Desired Requisites:	NIL

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hr/ week	30	20	50	100
		Credits: 3			

Course Objectives	
1	To create awareness in the students about energy conservation and its importance.
2	To develop skills for energy auditing and energy management in industrial environment

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Interpret** energy conservation opportunities in thermal and electrical utilities.	Understanding
CO2	**Apply** various tools for energy audit and management.	Applying
CO3	**Illustrate** the financial analysis for energy economics.	Analyzing

Module	**Module Contents**	**Hours**
I	**Energy Conservation and Management** Energy Conservation and its importance, Energy strategy for future, Energy Conservation Act2001 and its features, Energy Pricing, Energy Sector Reforms, Energy And Environment, Energy Security, Objectives and Principles of Energy Management.	6
II	**Energy Audit** Energy audit Definition as per EC-act 2001, Need of Energy Audit, Types of Energy Audit, Energy Audit Reporting Format, Understanding Energy and Costs, Benchmarking, Energy Performance, Energy Audit Instruments, Duties and Responsibilities of Energy Auditor.	6
III	**Energy Action Planning, Monitoring And Targeting** Energy action Planning Steps, Top Management Support, Energy Manager Duties & responsibilities, Evaluating Energy Performance, Energy monitoring & Targeting – Set up, Key Elements, Data & Information Analysis, Relating Energy Consumption & Production, CUSUM Technique, Case Study	7

IV	**Energy Economics** Financial Analysis Techniques – Pay Back Period, Net Present Value, Return on Investment, Internal Rate Of Return, Time Value Of Money, Cash Flow, Risk & Sensitivity analysis.	5
V	**Energy Efficiency in Electrical Utilities** Electricity Billing, Electrical Load Management and Maximum Demand Control, Power Factor Improvement & Benefits, Assessment of Transmission and Distribution Losses, Estimation Of Technical Losses in Distribution System, Commercial Losses, Demand Side Management, Energy Saving Opportunities With Pumps and Fans.	7
VI	**Energy Efficiency in Thermal Utilities** Energy Conservation in Boilers, Steam Turbine, Industrial Heating System, Heat Exchangers, Heat Pumps, Efficiency Improvement, Energy Conservation in Buildings, Climate responsitive Buildings, Thermal load modeling in Building, Zero energy Buildings, Co-generation and Waste heat recovery	6
Text Books		
1	Amlan Chakrabarti, "*Energy Engineering and Management*", PHI, 2011.	
References		
1	Bureau of Energy Efficiency, "*General Aspects of Energy Management & Energy Audit1.1, 1.2 &1.3*", BEE, e-books.	
Useful Links		
1	https://beeindia.gov.in/content/energy-auditors	

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												
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)

Professional Core (Lab) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL491
Course Name	Project 2
Desired Requisites:	-

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	12 Hrs/Week	**LA1**	**LA2**	**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,		
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	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.

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.				

Professional Elective (Theory) Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL431
Course Name	Elective V: Advanced Electrical Machines Design
Desired Requisites:	Electrical Machines

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

Course Objectives

1	Select proper materials based on their properties and selection criterion, IS standards used in electrical machine design.
2	Design commercial Electrical Machine.
3	Apply computer aided optimization techniques for design of electrical machines.

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Analyse** the performance of electrical machines using computer based technique	Analyse
CO2	**Estimate** different parameters required for computer aided design of electrical machines.	Evaluate
CO3	**Design** electrical machines using computer based techniques.	Create

Module	**Module Contents**	**Hours**
I	**Concept of Computer Aided Design** Introduction, Advantages & Limitations of Computer Aided Design, Different. Approaches for computer aided design, Flowchart of electrical machines for overall design of DC machine, transformer, synchronous machines & induction machines, Selection of Optimal Design, Explanation of Lowest Cost and Significance of "Kg/KVA".	4
II	**IS standards used in electrical machine design** Major considerations in Electrical Machine design, Limitations in design, Standard specifications, Electrical Engineering materials standards: High conductivity materials, Insulating materials.	4
III	**Basic Concepts of computer aided Design** Introduction, Specification, Output Coefficient, Importance of Specific Loadings, Electrical Materials, Magnetic Circuit Calculations, General Procedure for Calculation of Amp-Turns, Heating & Cooling, Modes of Heat Dissipation, Standard Rating of Electrical Machines, Ventilation Schemes, Quantity of Cooling Medium, Types of Enclosures, General Design Procedure, Steps to Get Optimal Design.	4

IV	**Computer Aided Design Of Dc Machines** Classification of Armature Windings, Armature Windings for DC Machines, Introduction, Sequential Steps for Design of Each Part and Programming Simultaneously using MATLAB & SciLab, Calculation of different parameters & Design of different parts of DC Machine, 2D FEM open source software-based DC machine part design.	4
V	**Computer Aided Design Of Transformers** Introduction, Sequential Steps for Design of Each Part and Programming Simultaneously (Shell Type Power Transformer, core Type Power. Transformer) using MATLAB & SciLab, Calculation of different parameters & Design of different parts of Transformer, 2D FEM open source software-based Transformer part design.	4
VI	**Computer Aided Design Of Induction Motors** Introduction, Sequential Steps for Design of Each Part and Programming Simultaneously using MATLAB & SciLab, Calculation of different parameters & Design of different parts of Single Phase & Three phase Induction Motor, 2D FEM open source software-based Induction motor part design.	4

Text Books	
1	K.M.Vishnu, *"Computer Aided Design of Electrical Machines"*, B.S. Publications, 2008.
2	R. K. Agarwal, *"Principles of Electrical Machine Design"*, S.K.Kataria & Sons, Fifth Edition 2016, New Delhi.

References	
1	A.K.Sawhney – *"A Course in Electrical Machine Design"* 10th Edition, - Dhanpat Rai And sons New Delhi.
2	S.J Salon, *"Finite Element Analysis of Electrical Machines"*, Springer, YesDEE publishers, Indian reprint, 2007.
3	Nicola Bianchi, *"Electrical Machine Analysis using Finite Elements"*, CRC Taylor & Francis, 2005.

Useful Links	
1	https://nptel.ac.in/courses/112104116

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												
CO3			3		2									2
CO4														
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:HighEach 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)

Walchand College of Engineering, Sangli

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AY 2022-23

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem. VIII
Course Code	5EL432
Course Name	Elective V: Intelligent Systems and Its Applications
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 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.	4
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	4
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).	4

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	4
V	Application of Intelligent Systems in Voltage Control, security assessment etc. Study different flow chart of Intelligent system application in Electrical engineering.	4
VI	Application of Intelligent Systems in Schedule Maintenance of Electrical Power Transmission Networks and Intelligent Systems for Demand Forecasting.	4

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 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)

Walchand College of Engineering, Sangli

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AY 2022-23

Course Information

Programme	B. Tech. (Electrical)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL433
Course Name	Elective V: Smart Grid
Desired Requisites:	Power System Engineering, Power Electronics

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

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.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** various concepts associated with smart grid.	Understand
CO2	**Apply** smart grid concept to power system monitoring, communication and protection.	Apply
CO3	**Analyse** tools for smart grid's performance, stability and computational analysis.	Analyse

Module	**Module Contents**	**Hours**
I	**Smart grid architecture** Introduction to smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas regulatory challenges, standards-policies smart-grid activities in India, Smart grid architecture, function of smart grid components, , smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system,	4
II	**Smart grid technologies** Introduction to Smart Meters, advanced metering infrastructure, Automatic Meter Reading(AMR), Outage Management System(OMS),Substation Automation, Feeder Automation, Geographic Information System (GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection.	4

III	**Transmission aspects** Wide area Monitoring Systems (WAMS), PMU and PDCs, PMU placement, smart transmission, System security under smart grid environment, Introduction to Internet of things (IoT)- Applications of IoT in Smart Grid.	4
IV	**Communication aspects** Elements of communication and networking: architectures, standards, Communication technologies, wireless communications, wireline and optical communication, Network architecture- premises network, neighbourhood Area network, wide area network, Network Layer aspects of smart grid communications: TCP/IP networks, Multiprotocol label Switching. Adaptation of power line communication (PLCC), zigbee, GSM, machine to machine communication models for the smart grid.	4
V	**Micro-Grid and Smart Grid** Mini- and micro- grid including the characteristics, components, benefits, Indian scenario and business opportunities. Details of Low voltage DC microgrids , Integration of Variable Energy Resources, Distribution Energy Sources, Renewable Energy Technologies – Microgrids – Storage Technologies –Electric Vehicles and plug – in hybrids, Demand side management of Smart Grid, Environmental impact and Climate Change – Economic Issues	4
VI	**Protection and Security aspects of smart Grid** Basics of digital protection and relays, Advantage of microprocessor technology and its application to protection, subsystem of digital relay, Numerical relays, Protection of substation, transformer, generators and motors. Cyber vulnerabilities into the grid, resilience in a utility's cyber space, Cyber security risk assessment, Static security assessment and contingencies study for the smart grid.	4
Text Books		
1	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "*Smart Grid: Technology and Applications*".	
2	K Uma Rao and Prema V, "Smart Grid- Fundamentals, Design, Technology, Applications, Communications and Security" Wily India Adaptation 2021	
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	A keyhani, M. Marwali, "Smart Power Grids 2011", Springer, 2011	
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
CO1		3												
CO2	1													
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 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)

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Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL434
Course Name	Elective VI: EHVAC
Desired Requisites:	Electrical Transmission and Distribution, Power system

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		
CO1	**Understand** various aspects of EHVAC line and power frequency over voltages in EHVAC line	Understanding
CO2	**Evaluate** line and ground parameters associate with EHVAC line	Evaluating
CO3	**Explain** lightning strokes and protection against lightning.	Analyzing

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.	5
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.	6
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.	6
Text Books		
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	2												1	
CO2	2	1											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 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)

Walchand College of Engineering, Sangli

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AY 2022-23

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year Year B. Tech., Sem VIII
Course Code	5EL435
Course Name	Elective VI: Introduction to Embedded System
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.

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
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 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)

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Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL436
Course Name	Elective VI : Solar and Wind Power Generation
Desired Requisites:	Power System Engineering, Power Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1/LA1**	**T2/LA2**	**ESE**	**Total**
Tutorial	-	20	20	60	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,

CO1	**Discuss** importance, potential and harnessing technologies for various renewable energy sources.	Understanding
CO2	**Apply** various technologies to harness the power from renewable energy sources	Apply
CO3	**Analyse /study** various modern technologies to harness the renewable energy and energy storage systems.	Analyse

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.	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.	6
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	6
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.	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.	6

Text Books	
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	2	1												
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 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)

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Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL437
Course Name	Elective VII - Neural Network and Applications with software
Desired Requisites:	Software Packages

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

Course Objectives

1	Imparting basic knowledge of neural network.
2	To make the student conversant with design and programming knowledge of neural network.
3	It intends to analyze the performance of different applications employing neural network algorithm.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** the basic knowledge of neural network.	Understanding
CO2	**Apply** the knowledge about different neural networks, their architecture and training algorithm for various applications.	Applying
CO3	**Study and analyse** the different applications of neural networks.	Analyzing

Module	**Module Contents**	**Hours**
I	**Fundamentals of Neural Networks:** Introduction, Need for Neural Networks, Structure and working of biological Neural Network, Artificial model for Neuron, Neural network architectures, Perceptron learning rule, Introduction to different NN learning algorithms, Training and testing of ANN	6
II	**Basic MATLAB programming for NN:** To calculate output of simple neuron for different activation functions, Classification of linearly separable data using perceptron, Design of AND,OR and NOT gate using neural networks etc.	6
III	**Introduction to ANN MATLAB toolbox:** Study of Neuron model and architectures using NN toolbox, Creating a custom Neural Network, Commands in Neural Network Toolbox, Neural Network Graphical User Interface Toolbox etc.	6

IV	**Use of ANN MATLAB tools for programing:** Neural network design steps, Function approximation, Pattern recognition, Clustering of data, Development of the simulation for steepest descent algorithm, LMS algorithm, back propagation-momentum algorithm, simulation for variable learning rate etc.	6
V	**Application of Neural Network to power system operation and control problems:** Use of MATLAB tools of ANN for power system applications. Case studies such as load fore-casting, optimal power flow, control applications in FACTS devices etc.	6
VI	**Application of Neural Network to recent power system protection problems:** Use of MATLAB tools of ANN for protection applications. Case studies such as fault analysis, fault detection, fault classification, fault location etc.	6

Text Books	
1	S. N. Sivanandan, "*Introduction to Neural Networks using MATLAB 6*", Tata McGraw hill education, 2006.
2	Hagan, Demuth, Mark Beale, "*Neural Network Design*", Cengage Learning India Private Limited, 2011.
References	
1	J.M. Zurada, "*Introduction to artificial neural systems*", Jaico Publishers, 1992.
2	Simon Haykin, "*Neural Network*", Pearson Publications, 2005.
3	Mark Hudson Beale, Martin T. Hagan, Howard B. Demuth, "*MATLAB Neural Network Toolbox™ 7 User's Guide*".
Useful Links	
1	https://nptel.ac.in/courses/117/105/117105084/

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											
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)

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Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL438
Course Name	Elective VII : Process Control
Desired Requisites:	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	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 behavior 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
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 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)

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Course Information					
Programme	B.Tech. (Electrical Engineering)				
Class, Semester	Final Year B. Tech., Sem VIII				
Course Code	5EL439				
Course Name	Elective VII : FACTS				
Desired Requisites:	Power System Engineering, 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 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.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Explain** necessity, operating principles and benefits of various FACTs devices.	Understanding
CO2	**Choose** the suitable FACTs device/controller for a particular application.	Applying
CO3	**Analyze** the functioning and control of various FACTs Controllers	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	6
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	6

	of Compensator Requirements, Methods of Controllable Var Generation, Variable Impedance Type Static Var 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 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	6
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)	6

	Basic Operating Principles and Characteristics , Control Structure	
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		
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			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 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)

Professional Elective (Lab) Courses

Walchand College of Engineering, Sangli

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AY 2022-23

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL471
Course Name	Elective V Lab: Advanced Electrical Machines Design Lab
Desired Requisites:	Electrical Machine

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

Course Objectives

1	To make the students conversant with techniques of computer based design of electrical machines.
2	To understand different parameters required for computer based design of electrical machine
3	To prepare computer based design of electrical machines

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Understand** different computer based techniques of electrical machine design	Understand
CO2	**Apply** different computer based techniques to design electrical machines.	Apply
CO3	**Create** software-based design of electrical machines	Create

List of Experiments / Lab Activities

1. Study of Flowcharts of electrical machines for overall design.
2. Prepare a flow chart and computer program for optimum design of a small transformer with given specifications and constraints.
3. Prepare a flow chart and computer program for optimum design of a DC motor to be used for industrial applications with given specifications and constraints.
4. Use of open source FEM software for 2D design.
5. Find leakage inductance of transformer using FEM software.
6. Design progressive double layer lap winding of DC Machine using MATLAB/SciLab.
7. Design stator of DC Machine using MATLAB/SciLab.
8. Design of core type Transformer using MATLAB/SciLab.
9. Design of shell type Transformer using MATLAB/SciLab.
10. Design of Single Phase Induction Motor using MATLAB/SciLab.
11. Design of Three Phase Induction Motor using MATLAB/SciLab.

Text Books

1	K.M.Vishnu, *"Computer Aided Design of Electrical Machines"*, B.S. Publications, 2008.

2	R. K. Agarwal, *"Principles of Electrical Machine Design"*, S.K.Kataria & Sons, Fifth Edition 2016, New Delhi.

References	
1	A.K.Sawhney – *"A Course in Electrical Machine Design"* 10th Edition, - Dhanpat Rai And sons New Delhi.
2	S.J Salon, *"Finite Element Analysis of Electrical Machines"*, Springer, YesDEE publishers, Indian reprint, 2007.
3	Nicola Bianchi, *"Electrical Machine Analysis using Finite Elements"*, CRC Taylor & Francis, 2005.

Useful Links	
1	https://nptel.ac.in/courses/112104116

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:HighEach 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.(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.

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Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL472
Course Name	Elective-V Lab: Intelligent Systems and Its Applications Lab
Desired Requisites:	NIL

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

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.

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	CrinaGrosan, 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
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.(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.				

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	B. Tech. (Electrical)
Class, Semester	Final Year B. Tech., Sem VIII
Course Code	5EL473
Course Name	Elective V Lab: SMART Grid Lab
Desired Requisites:	Power System Engineering, Power Electronics

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

Course Objectives	
1	To understand the components and features of Smart Grid
2	To develop the skills of simulation and analysis of smart grid systems

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**Understand** different components and working of smart grid	Understanding
CO2	**Apply** different protection and control schemes in smart grid	Applying
CO3	**Analyse** the performance of microgrid and smart grid	Analysing

List of Experiments / Lab Activities

List of Experiments: (Any Eight Experiments)

1. Study different components of smart grid.
2. Study and measure certain parameters of power quality in laboratory with and without power quality improvement devices.
3. Study of Demand side management in smart Grid
4. Relay coordination in smart grid protection scheme for Radial Circuit Topology
5. Relay coordination in smart grid protection scheme for Bidirectional Circuit Topology
6. Study and testing of islanding protection in microgrids
7. Simulation of decentralized DC microgrid systems.
8. Simulation of Voltage and frequency control of a load connected inverter
9. Simulation of decentralized inverter based AC microgrid with *P-f* and *Q-V* droop control
10. Design of Smart Grid and Practical Smart Grid Case Study

Text Books

1	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "*Smart Grid: Technology and Applications*".
2	G. M. Masters, "*Renewable and Efficient Electric Power Systems"*, John Wiley & Sons Inc., 2004.

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.

Useful Links	
1	http://www.nptelvideos.in/2012/12/digital-communication.html
2	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**	
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CO1	2													
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