Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	5PS501
Course Name	Digital Protection of Power System
Desired Requisites:	Power system protection

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

Course Objectives	
1	To make students understand digital techniques for realizing various needs of protection.
2	To strengthen the concepts in power system protection.
3	To develop the skills necessary to analyse, design and implement digital protective relays.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO 1	**Interpret** the performance of devices like CT, PT and relays used in digital protection of Power Systems.	Apply
CO 2	**Analyse** the use of digital systems for protection of different parts of power system.	Analyse
CO 3	**Estimate** and Justify settings of relays for protection of different parts of power system.	Evaluate
CO 4	**Design**analog/digital protection scheme for simple electrical systems.	Create

Module	**Module Contents**	**Hours**
I	**Review of Relaying Schemes** Protection schemes for alternator, transformer, bus bar and induction motors. Transmission line protection using over current- time graded and current graded schemes, drawbacks of these schemes, differential & distance schemes, Electromagnetic CT and PT.	6
II	**Comparators** **a. Dual Input Comparator:** Amplitude comparator, phase comparator, duality between amplitude and phase comparators, cosine-type and	4

	sine-type phase comparators, coincidence type phase comparator. **b. Multi Input Comparator:** Amplitude comparator, phase comparator.	
III	**Over Current Relays** Different time-current characteristics of over current relay, Microprocessor/microcontroller based over current relay, Directional over current relay and its implementation using microprocessor/microcontroller based scheme.	8
IV	**Differential Relays** Circulating current differential protection, percentage differential protection of power transformers, effect of magnetizing inrush, effect of over voltage inrush, hardware and software used for digital protection of transformer.	8
V	**Distance Protection Relays** Microprocessor/microcontroller based impedance, reactance and admittance relays, and measurement of R and X. Quadrilateral characteristics. Digital protection scheme based upon fundamental frequency signals, hardware and software design.	8
VI	**Recent Developments in Digital Protection** Digital Relaying techniques based on modern tools of digital signal processing like DFT, Haar Transform, WT etc.	4

Text Books	
1	Badri Ram, D.N. Vishwakarma, "*Power System Protection and Switchgear*", TMH, 2004.
2	Y.G. Paithankar, S.R. Bhide, "*Fundamentals of Power System Protection"*, PHI, 2003.

References	
1	L.P. Singh, "*Digital Protection"*, New Age, Second Edition, 2004.
2	A.G. Phadke, J.S. Thorp, "*Computer Relaying for Power Systems"*, Wiley India, II Edi., 2012

Useful Links	
1	https://nptel.ac.in/courses/108/107/108107167/
2	https://nptel.ac.in/courses/108/105/108105167/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	2					

CO2				3		
CO3			2			
CO4		2				1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High

Each CO of the course must map to at least one PO.

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

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				
Understand				
Apply	10	5	10	25
Analyse	10	5	20	35
Evaluate		10	20	30
Create			10	10
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information	
Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	5PS502
Course Name	Application of Power Electronics to Power systems
Desired Requisites:	Power System Engineering, Power Electronics

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

Course Objectives	
1	To make students understand concept of FACTs envisages the use of power electronics to improve system operation by fast & reliable control.
2	To cover concepts of FACTs including the description, principle of workingand analysis of various FACTs controllers.
3	To strengthen the control of FACTs and system interactions.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO 1	**Explain** necessity, operating principals and benefits of FACTs devices.	Understand
CO 2	**Choose** the suitable FACTs device/controller for particular application.	Apply
CO 3	**Analyze** the characteristics of FACTs Controllers and effect of location of the controller on Power System.	Analyse

Module	**Module Contents**	**Hours**
I	**Introduction** The concept of flexible AC transmission - reactive power control in electrical power transmission lines -uncompensated transmission line – series and shunt compensation. Overview of FACTS devices - Static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified Power Flow controller(UPFC) - Integrated Power Flow Controller(IPFC).	**6**

II	**Static VAR Compensator (SVC) and Applications** Voltage control by SVC – advantages of slope in dynamic characteristics –influence of SVCon system voltage. Applications - enhancement of transientstability – steady state powertransfer – enhancement of power system damping –prevention of voltage instability.	**6**
III	**Thyristor Controlled Series Capacitor (TCSC) and Applications** Operation of the TCSC - different modes of operation – modeling of TCSC – variable reactance model – modeling for stability studies. Applications -improvement of the system stability limit – enhancement of system damping – voltage collapse prevention.	**6**
IV	**Emerging FACTS Controllers I** Static Synchronous Compensator (STATCOM) – operating principle –V-I characteristics	**6**
V	**Emerging FACTS Controllers II** Unified Power Flow Controller (UPFC) – Principle of operation - modes of operation –applications – modeling of UPFC for power flow studies.	**6**
VI	**Co-Ordination of FACTS Controllers** FACTs Controller interactions – SVC–SVC interaction - co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control.	**6**
Text Books		
1	R. Mohan Mathur, Rajiv. K. Varma, "*Thyristor – Based Facts Controllers for Electrical Transmission Systems"*, IEEE press and John Wiley & Sons Inc., 2002	
References		
1	A.T. John, "*Flexible AC Transmission System"*, Institution of Electrical and Electronic Engineers (IEEE), 1999.	
2	NarainG.Hingorani, Laszio. Gyugyl,"*Understanding FACTS Concepts and Technology of Flexible AC Transmission System"*, Standard Publishers, Delhi, 2001.	
Useful Links		
c	https://nptel.ac.in/courses/108/107/108107114/	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			1			
CO2				2		
CO3						2

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

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

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

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*	
AY 2021-22	
Course Information	
Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M.Tech., Sem I
Course Code	5PS560
Course Name	Research Methodology

Desired Requisites:	None

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

Course Objectives	
1	To develop a research orientation among the students and to acquaint them with fundamentals of research methods.
2	To develop understanding of the basic framework of research process and techniques
3	To identify various sources of information for literature review and data collection.
4	To develop an understanding of the ethical dimensions of conducting applied research.
5	To develop understanding about patent process.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Classify** various methods to solve research problem.	Apply
CO2	**Construct** a research problem in respective engineering domain.	Apply
CO3	**Investigate** various data analysis techniques for a research problem.	Analyse
CO4	**Identify** various Intellectual Property Rights procedures	Apply

Module	Module Contents	Hours
I	**Research Fundamentals** What is research, types of research, the process of research, Literature survey and review , Formulation of a research problem.	4
II	**Research Methods** Research design- Meaning, Need and Types , Research Design Process, Measurement and scaling techniques, Data Collection – concept, types and methods, Processing and analysis of data, Design of Experiment	5
III	**Analysis Techniques** Quantitative Techniques, Sampling fundamentals, Testing of hypothesis using various tests like Multivariate analysis, Use of standard statistical software, Data processing, Preliminary data analysis and interpretation, Uni-variate and bi-variate analysis of data, testing of hypotheses.	5
IV	**Research Communication** Writing a conference paper, Journal Paper, Technical report, dissertation/thesis writing. Presentation techniques, software used for report writing such as WORD, Latex etc. Types of journal/conference papers.	4

V	**Intellectual Property Rights** Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	5
VI	**Patents and Patenting Procedures** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs	4

Text Books	
1	C. R. Kothari, Research Methodology, New Age international
2	Deepak Chopra and NeenaSondhi, Research Methodology : Concepts and cases, Vikas Publishing House, New Delhi
References	
1	E. Philip and Derek Pugh, How to get a Ph. D. – a handbook for students and their supervisors, open university press
2	Stuart Melville and Wayne Goddard, Research Methodology: An Introduction for Science & Engineering Students
Useful Links	
1	NPTEL Lectures

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	2		1			
CO2					2	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

There are three components of lab assessment, LA1, LA2 and Lab ESE.

IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation

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

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

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

(For lab Courses)

Bloom's Taxonomy Level	LA1	LA2	Lab ESE	Total
Remember				
Understand				
Apply	15	15	20	**50**
Analyze	15	15	20	**50**
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

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AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	5PS551
Course Name	Activity Based Lab for Digital Protection of Power System
Desired Requisites:	Digital Protection of Power System

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

Course Objectives

1	To develop analytical skills of the student and help to evaluate modern relaying practices.
2	To enable the student to develop protective relaying concepts as well as provide an opportunity for designing relaying hardware and software.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Demonstrate** the operation of electromagnetic & digital relays.	Apply
CO2	**Test** digital relays to verify the operating characteristics.	Analyse & Evaluate
CO3	**Design** hardware and compile programs for simple digital relays, as a group task.	Create

List of Experiments / Lab Activities

Lab activities/performance shall include mini project, presentations, drawings, case study, report writing, site visit, lab experiment, tutorials, assignments, group discussion, programming, and other suitable activities as per nature and requirement of lab course.

Text Books

1	Badri Ram, D.N. Vishwakarma,"*Power System Protection and Switchgear*", TMH, 2004.

References

1	PRDC Relay user manuals
2	MiPower user manuals
3	A.G. Phadke, J.S. Thorp, *"Computer Relaying for Power Systems"*, Wiley India, II Edi., 2012.

Useful Links
https://nptel.ac.in/courses/108/107/108107167/
https://nptel.ac.in/courses/108/105/108105167/

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

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**

Remember				
Understand				
Apply	20	10	10	**40**
Analyse	10	10	10	**30**
Evaluate		10	10	**20**
Create			10	**10**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2020-21

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	5PS552
Course Name	Activity Based Lab for Application of Power Electronics to Power Systems
Desired Requisites:	Power System Engineering , Power Electronics

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

Course Objectives

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

Course Outcomes (CO) with Bloom's Taxonomy Level

CO 1	**Simulation** of various FACTs devices to understand principle and modelling.	Understand
CO 2	**Choose** the suitable FACTs device/controller for particular application.	Apply
CO 3	**Analyse** the characteristics of FACTs Controllers and effect of location of the controller on Power System.	Analyse

List of Experiments / Lab Activities

Lab activities/performance shall include mini project, presentations, drawings, case study, report writing, site visit, lab experiment, tutorials, assignments, group discussion, programming, and other suitable activities as per nature and requirement of lab course

Text Books

1	R. Mohan Mathur, Rajiv. K. Varma, *"Thyristor – Based Facts Controllers for ElectricalTransmission Systems"*, IEEE press and John Wiley & Sons Inc., 2002

References

1	A.T.John, *"Flexible AC Transmission System"*, Institution of Electrical and Electronic Engineers(IEEE), 1999.
2	NarainG.Hingorani, Laszio. Gyugyl, *"Understanding FACTS Concepts and Technology of Flexible AC Transmission System"*, Standard Publishers, Delhi, 2001.
Useful Links	
1	

CO-PO Mapping						
Programme Outcomes (PO)						
	1	2	3	4	5	6
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				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**

Remember				
Understand	10	10	10	**30**
Apply	20	10	10	**40**
Analyse		10	20	**30**
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M. Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	5PS553
Course Name	Presentation and Technical Report Writing
Desired Requisites:	

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

Course Objectives	
1	To provide an opportunity to student to do work independently on a topic.
2	To encourage creative thinking process in technical report writing
3	To enable student for good technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, students will be able to,		
CO 1	Demonstrate the characteristics of technical and business writing.	Apply
CO 2	Produce documents related to technology and writing in the workplace and will have improved their ability to write clearly, concisely, and accurately.	Create
CO 3	Use a variety of materials to produce appropriate visual presentation for documents, such as instructions, descriptions, and research reports.	Evaluate

Course Content

This course introduces students to the discipline of technical communication. Preparation of visuals to supplement text, workplace communication, descriptions of mechanisms, explanations of processes, and writing reports are the major topics included.

This course is designed for students enrolled in technical degree programs for making them industry ready.

Text Books

1	Suitable books based on the contents of the topic.
References	
1	Suitable books based on the contents of the selected topic and research papers from reputed national and international journals and conferences.
Useful Links	
1	As per the need of the topic of report and presentation

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

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**

Remember				
Understand				
Apply	10	10	10	**30**
Analyse				
Evaluate	10	10	10	**30**
Create	10	10	20	**40**
Total Marks	**30**	**30**	**40**	**100**

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(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	5PS554
Course Name	Professional Skills 1
Desired Requisites:	

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

Course Objectives

1	To provide a hands on experience of software in solving complex Electronics engineering problems.
2	To enhance the employability of Electronics engineering student.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Use of the software related to Electronics engineering effectively.	Evaluate
CO2	Develop the solution for Electronics engineering problem using software.	Create
CO3	Explain the process of problem solving using computing tools.	Understand

Course Content

This course is based on computing as a tool to design and analyse the Electronics system. In the modern day work environment, the Electronics engineers should be able to simulate and solve complex problems on computers. The Electronics engineer must be highly computer literate. The engineer with strong fundamentals in Electronics Engineering and computer software proficiency is highly in demand from industry. Employability of the student can be enhanced by providing software training in Electronics engineering.

Text Books

1	Suitable books based on the software selected.
References	
1	Suitable books based on the contents of software selected
Useful Links	
1	As per the need of the software training

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.

IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

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

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	10	10	10	**30**
Apply				
Analyze				
Evaluate	10	10	15	**35**
Create	10	10	15	**35**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	5PS511
Course Name	Professional Elective I: Power Apparatus Modelling
Desired Requisites:	Power System Engineering, A.C. Machines, Power System Analysis and Stability

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

Course Objectives

1	To provide the students the ability to understand the problem of stability of single machine connected to infinite bur and multi machine system.
2	To give the students a sound mathematical approach towards modelling of various approach used in power system.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Construct** models of apparatus in power system.	Apply
CO2	**Analyse** models for stability of power systems.	Analyse
CO3	**Recommend** solutions to the problem of power system stability and control.	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to Power System Stability Problem** Classification of stability, resolution of stability problem by classical method, transient stability of multi-machine system.	6
II	**Modeling of Synchronous machine** Physical description, mathematical description of synchronous machine, dq0 transformation, per unit representation, equivalent circuits for direct and quadrature axis.	6
III	**Excitation System** Elements of excitation system, types of excitation system, necessity of	6

	stabilizing circuits IEEE excitation systems.	
IV	**Prime Movers and Energy supply Systems** Turbines and governing systems, modeling of steam turbines, steam turbine controls, steam turbine off-frequency capability.	6
V	**Dynamic modeling of hydro turbine and governors** Hydraulic turbine transfer function, governors for hydraulic turbines, detailed hydraulic system model, guidelines for modeling hydraulic turbines	6
VI	**Load modeling for stability studies.** Basic load modeling concepts, static load models, dynamic load models, modeling of induction motor, per unit representation, representation in stability studies.	6

Text Books	
1	P. Kundur, *Power System, Stability and Control*, Tata McGraw Hill, New Delhi, 1994.

References	
1	K. R. Padiyar, "*Power System Dynamic, Stability & Control"*, B.S. Publication, 2008.
2	Peter W.Sauer, M.A. Pai, "*Power System Dynamics and Stability"*, Person Education Asia, 1998.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
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
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				
Understand				
Apply	10	5	20	35
Analyse	10	10	20	40
Evaluate		5	20	25
Create				
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	5PS512
Course Name	Professional Elective I: DSP Application to Power System
Desired Requisites:	Signals and Systems

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

Course Objectives

1	To provide a mathematical introduction to the theory and applications oforthogonal wavelets and their use in analysing functions and function spaces.
2	It includes a brief survey of Fourier series representation of functions, Fourier transform and the Fast Fourier Transform (FFT) before proceeding to the Haar wavelet system, multi resolution analysis, decomposition and reconstruction of functions, Daubechies wavelet construction, and other wavelet systems.
3	It aims at imparting skills to develop wavelet-based algorithms for applications in the area of Power Systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

CO 1	**Explain** the basic concepts and terminology that are used in theFourier Techniques, wavelets Transforms and Time frequencyanalysis.	Understand
CO 2	**Calculate** filter bank coefficients and **Apply** the concepts of CWT,STFT and DWT for signal analysis.	Apply
CO 3	**Construct** perfect reconstruction wavelet filter banks for a particular application and **justify** why wavelets provide the right tool.	Analyse

Module	**Module Contents**	**Hours**
I	**Fundamentals of Linear Algebra:** Vector spaces, Bases, Orthogonality, Orth normality, Projection, Functions and function Spaces, Orthogonal functions, Orthonormal functions, Orthogonal basis functions.	4

II	**Signal Representation in Fourier Domain** Fourier series, Orthogonality, Orth normality and the method of finding the Fourier coefficients Complex Fourier series, Orthogonality of complex exponential bases, Mathematical preliminaries for continuous and discrete Fourier transform, limitations of Fourier domain signal processing, Review of Nyquist theorem., Review of Z transform, Application of Fourier family transforms in power systems.	6
III	**Discrete Wavelet Transform** **Introduction to Wavelet Transform:** The origins of wavelets, Wavelets and other wavelet like transforms, History of wavelet from Morlet to Daubechies via Mallat, Different communities and family of wavelets, Different families of wavelets within wavelet communities **Discrete wavelet transforms:** Introduction, Haar Scaling Functions and Function Spaces, Translation and Scaling, Orthogonality of Translates, Function Space Vo, Finer Haar ScalingFunctions, Nested Spaces Haar Wavelet Function, Scaled Haar Wavelet Functions, Orthogonality of φ(t) and ψ(t), Normalization of Haar Bases at Different Scales, Standardizingthe Notations, Refinement Relation with Respect to Normalized Bases, Support of a Wavelet System, Triangle Scaling Function, Daubechies Wavelets.	8
IV	**Discrete Wavelet Transform and Relation to Filter Banks** Signal decomposition (Analysis), Relation with filter banks, Frequency response, Signal reconstruction: Synthesis from coarse scale to fine scale, Up sampling and filtering, Perfect reconstruction filters, QMF conditions, Computing initial sj+1 coefficient, Concepts of Multi-Resolution Analysis (MRA) and Multi-rate signal processing, Applications of DWT in power systems.	8
V	**Short Time Fourier Transform(STFT) and Continuous Wavelet Transform(CWT)** **Short Time Fourier Transform:** Signal representation with continuous and discrete STFT, concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's Uncertainty principle and time frequency tiling, why wavelet transform? **Continuous Wavelet Transform:** Wavelet transform-A first level introduction, Continuous time-frequency representation of signals, Properties of wavelets used in continuous wavelet transform, Continuous versus discrete wavelet transform.	6
VI	**Designing Orthogonal Wavelet Systems-A Direct Approach**	

	Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients,Condition-1: Unit area under scaling function, Condition-2: Orth normality of translates of scaling functions, Condition-3: Orth normality of scaling and wavelet functions, Condition-4:Approximation conditions (Smoothness conditions), Designing Daubechies orthogonal wavelet system coefficients, Constraints for Daubechies' 6 tap scaling function.	6
Text Books		
1	K P Soman, Ramachandran, Resmi, "*Insights into wavelets from theory to practice"*, Prentice Hall,New Delhi,	
2	A.N. Akansu and R.A. Haddad, "*Multiresolution signal Decomposition: Transforms, Subbands and Wavelets*", Academic Press, Oranld, Florida, 1992.	
3	John G. Proakis, Dimitris G. Manolakis, "*Digital Signal Processing*", Pearson Prentice Hall,2007.	
References		
1	C. Sidney Burrus, Ramesh A. Gopinath, HaitaoGuo, "*Introduction to Wavelets and WaveletTransform"s,* A Primer PH International Editions, 1998.	
2	Raghuveer M. Rao, Ajit S. Bopardikar, "Wavelet Transforms – *Introduction to Theory andApplication's"*, Addison Wesley Pearson Education Asia, 2000.	
3	IEEE Transaction Papers.	
Useful Links		
1	https://nptel.ac.in/courses/117/101/117101001/	

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

Assessment				
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.				
Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				

Understand	10	10	20	40
Apply	10	5	20	35
Analyse		5	20	25
Evaluate				
Create				
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M. Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	5PS513
Course Name	Professional Elective II: Grid Integration of Renewable Energy
Desired Requisites:	Power Electronics, Renewable Energy

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

Course Objectives

1	To make the students conversant with configurations of renewable energy grid integration.
2	To provide the advance knowledge about voltage-sourced converters & their control.
3	To make the students aware of research avenues in the field of renewable grid integration along with DC micro-grid concepts.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Summarize** two level voltage source converter in various reference frame.	Understand
CO2	**Apply** various voltage source converters and their control.	Apply
CO3	**Analyse** grid synchronization techniques and DC micro-gird.	Analyse

Module	**Module Contents**	**Hours**
I	**Overview of Renewable Energy** Status & trends of renewable energy sources, solar fundamentals, electrical characteristics of PV, stand-alone grid connected PV configurations, wind energy assessment, fixed & variable speed turbines with reduced & full capacity converters.	7
II	**Two level, three phase voltage-sourced converter** Introduction. Two level voltage sourced-converter: structure, principle of operation & power loss. Average model of two level VSC, model in αβ-frame, model & control in dq frame.	6

III	**Three level, three phase, Neutral Point Clamped voltage-sourced converter** Introduction, Three level half bridge NPC, PWM sche e for three level half bridge NPC, switched model & average model for three level half bridge NPC, three level NPC: circuit structure, principle of operation. Three level NPC with impressed dc side voltage.	6
IV	**Grid Imposed frequency VSC system: control in αβ-frame &dq-frame.** Introduction, structure of grid imposed frequency VSC system, real & reactive-power controller, Dynamic model & current mode control for real-/reactive power controller in αβ-frame &dq frame, Phase locked Loop.	6
V	**Grid Synchronization** Grid synchronization techniques for single-phase systems, grid synchronization using the Fourier analysis, grid synchronization using A phase-locked loop, PLL Based on a T/4 transport delay, PLL based on the Hilbert transform.	6
VI	**DC Micro-grid** Introduction, DC micro-grid system overview, Operation and control of DC micro-grids, DC micro-grid system protection, Application of DC micro-grids to future smart grids.	5

Text Books	
1	AmirnaserYazdani and Reza Iravani, *"Voltage-sourced converters in power systems_ modeling, control, and applications"* IEEE Press_John Wiley, 2010.
2	Remus Teodorescu, Marco Liserre, and Pedro Rodriguez, *"Grid Converters for Photovoltaic and Wind Power Systems",* John Wiley & Sons, Ltd, 2011.

References	
1	Antonio Moreno-Munoz, *"Large Scale Grid Integration of Renewable Energy Sources"*, The Institution of Engineering and Technology, 2017.
2	Math J. Bollen andFainan Hassan, *"Integration of Distributed Generation in the Power System"*, IEEE Press, 2011.

Useful Links	
1	http://nptel.ac.in/downloads
2	http://www.nptelvideos.in
3	https://ocw.mit.edu/courses/electrical-engineering

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

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

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

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M.Tech., Sem I
Course Code	5PS514
Course Name	Professional Elective II : Neural Network and fuzzy Application to Power System
Desired Requisites:	Power system

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

Course Objectives

1	To make the student conversant with basic knowledge of Neural Network.
2	To make the student conversant with design and programming knowledge for power systemoperation and control.
3	To make the student conversant with basic knowledge of fuzzy system and fuzzy applications.

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 Neural network and fuzzy knowledge about different neural networks, their architecture and training algorithm to solve power system problems.	Apply
CO3	**Study** the different applications of neural networks and fuzzy logic.	Analyse

Module	**Module Contents**	**Hours**
I	**Introduction to Neural Networks** Introduction, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Historical Developments, Neuron Model, McCulloch and Pitts models of neuron, ANN terminologies, weights, sigmoidal functions, Bias.	6
II	**Essentials of Neural Networks**	6

	Types of Neuron Activation Function, Neural networks architectures, Linearly separable and linearly non separable systems and their examples, Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Hebbian learning rule, Perceptron learning rule etc.	
III	**Feed Forward Neural Networks** Introduction, single layer Perceptron Models, architecture, Limitations of the Perceptron Model, Applications, Back Propagation Network, architecture, Multilayer Feed Forward Neural Networks. Use of ANN MATLAB tools for programming.	6
IV	**Fuzzy Systems** Basic Fuzzy logic theory, history, operation of Fuzzy Logic, Fuzzy relation and extension principle, Fuzzy membership functions and linguistic variables, Mamdani and sugenos models. Use of MATLAB tools of fuzzy logic.	6
V	**Application of Neural Network and fuzzy to power system operation and control problems** Use of MATLAB tools of ANN and fuzzy logic 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 and fuzzy to recent power system protection problems** Use of MATLAB tools of ANN and fuzzy logic for protection applications. Case studies such as fault analysis, fault detection, fault classification, fault location, etc.	6

Text Books	
1	S. N. Sivanandam, "*Introduction to Neural Networks using MATLAB 6*", Tata McGraw hill education, 2006.
2	Hagan, Demuth, Mark Beale, "*Neural Network Design"*, CengageLearing India Private Limited, 2011.

References	
1	Stamatios V. Kartalopoulos, "Understanding neural networks and fuzzy logic basic concepts and applications", Prentice Hall of India (P) Ltd, New Delhi, 2000.
2	J.M. Zurada, "Introduction to artificial neural systems", Jaico Publishers, 1992.
3	Timothy Ross, "Fuzzy Logic with Engineering Applications", Tata McGraw Hill Publication, 1993
4	George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic", PHI Learning Private Limited, 1995.
5	Research Papers.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ge07/preview

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1						1
CO2				3		
CO3				2		

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

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

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., SemI
Course Code	5IC502
Course Name	Constitution of India
Desired Requisites:	

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

Course Objectives	
1	To review and create awareness on various provisions in the constitution of India.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO 1	Explain the premises informing the twin themes of liberty and freedom from a civil rights perspective.	understand
CO 2	Address the growth of Indian opinion regarding modern Indian intellectuals constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism	understand
CO 3	Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution	understand

Module	**Module Contents**	**Hours**
I	History of Making of the Indian Constitution Drafting Committee, (Composition & Working	4
II	**Philosophy of the Indian Constitution :** Preamble, Salient Feature	4
III	**Contours of Constitutional Rights:** Fundamental Rights; Right to Equality; Right to Freedom; Right against Exploitation; Right to Freedom of Religion; Cultural and	5

	Educational Rights; Right to Constitutional Remedies; Directive Principles of State Policy; Fundamental Duties.	
IV	**Organs of Governance:** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	5
V	**Local Administration:** District"s Administration head: Role and Importance,Municipalities: Introduction, Mayor and role of Elected Representative,CEO of Municipal Corporation.Pachayati raj: Introduction, PRI: ZilaPachayat.Elected officials and their roles, CEO ZilaPachayat: Position and role.Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials,Importance of grass root democracy	5
VI	**Election Commission:** Election Commission: Role and Functioning.Chief Election Commissioner and Election Commissioners.State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	5

Text Books	
1	Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
2	M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014
3	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015
References	
1	The Constitution of India, 1950 (Bare Act), Government Publication
Useful Links	
1	https://en.wikipedia.org/wiki/Constituent_Assembly_of_India
2	https://nptel.ac.in/courses/129/106/129106003/
3	https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-lw02/
4	https://eci.gov.in/about/about-eci/the-functions-electoral-system-of-india-r2/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			1			

CO2	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 (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				
Understand	20	20	60	100
Apply				
Analyze				
Evaluate				
Create				
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M. Tech (Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	5PS521
Course Name	Power Quality in Distribution Systems
Desired Requisites:	Power Systems, Power Electronics

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

Course Objectives	
1	To make the students to understand basic knowledge of causes, consequences and solutions of power quality problems that affect the operation of computerized processes and electronic systems.
2	To provide a theoretical background to correctly approach the problem of reactive, harmonic and unbalance compensation.
3	To understand and apply the power theories for compensation problems.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	**State and Explain** the basic concepts of Power Quality disturbances, reactive power compensation, voltage regulation, power definitions and other figures of merit under distorted, operation and modelling of series and shunt compensators.	Remember and Understand
CO2	**Apply** the theory and algorithms to realize reference current generation, reactive power compensation, voltage regulation and harmonic compensation.	Apply
CO3	**Analyse** theories of load compensation, reference generation, figures ofmerits and power definitions, Standards applicable to Power Quality.	Analyse

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

I	**Introduction to Power quality** **Power Quality**: Introduction, State of the Art on Power Quality, Classification of Power Quality Problems, Causes of Power Quality Problems, Effects of Power Quality Problems on Users, Classification of Mitigation Techniques for Power Quality Problems. **Power Quality Standards and Monitoring**: Introduction, State of the Art on Power Quality Standards and Monitoring, Power Quality Terminologies, Power Quality Definitions, Power Quality Standards, Power Quality Monitoring, Numerical Examples.	**6**
II	**Power Definitions in Single Phase and Three phase Circuits** Definitions of various powers, power factor and other figures of merit under balanced, unbalanced and non-sinusoidal conditions applicable to single phase circuits. Definitions of various powers, power factor and other figures of merit under balanced, unbalanced and non-sinusoidal conditions. IEEE 1459 power definitions applicable to three phase circuits	**6**
III	**Theories of Load compensation** Introduction, State of the Art on Passive Shunt and Series Compensators, Classification of Passive Shunt and Series Compensators, Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators, Modelling, Simulation, and Performance of Passive Shunt and Series Compensators, Numerical Examples	**6**
IV	**Active Shunt Compensation** Introduction, State of the Art on DSTATCOMs, Classification of DSTATCOMs, Principle of Operation and Control of DSTATCOMs, Analysis and Design of DSTATCOMs, Modelling, Simulation, and Performance of DSTATCOMs, Numerical Examples.	**6**
V	**Active Series Compensation** Introduction, State of the Art on Active Series Compensators, Classification of Active Series Compensators, Principle of Operation and Control of Active Series Compensators, Analysis and Design of Active Series Compensators, Modelling, Simulation, and Performance of Active Series Compensators, Numerical Examples.	**6**

VI	**Unified Power Quality Compensators** Introduction, State of the Art on Unified Power Quality Compensators, Classification of Unified Power Quality Compensators, Principle of Operation and Control of Unified Power Quality Compensators, Analysis and Design of Unified Power Quality Compensators, Modelling, Simulation, and Performance of UPQCs, Numerical Examples.	**6**
Text Books		
1	Dr. Mahesh Kumar, IIT Chennai, "*Power Quality in Distribution Systems"*.	
2	Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "*Power Quality Problems and Mitigation Techniques"*, Wiley, 2015.	
References		
1	Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, "*Electrical Power Systems Quality"*, Mc-Graw Hill, Edition II, 1996.	
2	Angelo Baggini, "*Handbook on Power Quality"*, John Wiley & Sons, New Jersey, USA, 2008	
Useful Links		
1	https://nptel.ac.in/courses/108/106/108106025/	

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

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**

Remember	5	5	10	20
Understand	5	5	10	20
Apply	10	5	20	35
Analyse		5	20	25
Evaluate				
Create				
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M.Tech., Sem II
Course Code	5PS522
Course Name	PLC and Embedded Systems
Desired Requisites:	Instrumentation Techniques, Electrical Measurements, Microcontroller and Applications

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

Course Objectives

1	To exploit the PLC and Embedded Control for industrial automation.
2	To developing programs using ladder logic for industrial automation.
3	To analyse the performance of automation systems employing PLC and Embedded Control.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Interpret** features of PLC and Embedded Control Systems used for Industrial Automation.	Apply
CO2	**Use** ladder logic programming technique for various PLC applications.	Apply
CO3	**Evaluate** the performance of PLC network configurations, PLC functions used for different application	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to PLC** Introduction, Advantages, Disadvantages, Parts of PLC, PLC Input module, PLC Output Module, PLC Architecture, PLC Operation, PLC as a computer, PLC memory and interfacing, Power Supply for PLC	6
II	**PLC programming** Ladder Logic Symbols, Latching and Unlatching of PLC, Programming on/ off inputs to produce on/off outputs, relation of digital gate logic to contact / coil logic, creating ladder diagrams from process control	6

	description.	
III	**PLC Timer and Counter Functions** PLC timer functions, Types of PLC timers, Programming of Non-retentive timers for various applications, Programming of ON timers, OFF timers, PLC counter functions, Programming of UP, DOWN counters, Case studies related to Industrial Automations	6
IV	**PLC Arithmetic, Comparison and Branch functions** PLC Arithmetic functions, PLC comparison functions, Conversion functions, Master control relay functions, PLC jump functions, Jump with return and Jump with No return functions, Programs related to Arithmetic, Comparison and Branch functions	6
V	**Advanced PLC functions** Data move system, Data handling functions, Digital bit functions and applications, Sequencer functions, Analog PLC operations, PID control of continuous process, PID modules & tuning, Typical PID functions	6
VI	**PLC Networking** Networking of PLCs, Levels of Industrial Control, Types of Networking, Network Communications, Cell control by PLC Networks, Factors to consider in selecting a PLC	6

Text Books	
1	John W. Webb, Ronald A. Reis, "*Programmable logic controllers*, principles & applications", PHI publication, Eastern Economic Edition, 1994.
References	
1	John R. Hackworth and Peterson, "*PLC controllers programming methods and applications"*, PHI,2004.
2	Gary dunning, "*Introduction to PLC*, Thomson learning", Edition III, 2006
3	William H. Bolton*," Programmable logic controllers"*, Newnes , Edition VI, 2006.
Useful Links	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
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 (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				
Understand				
Apply	20	10	40	70
Analyse				
Evaluate		10	20	30
Create				
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M. Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	5PS571
Course Name	Activity Based Lab for Power Quality in Distribution Systems
Desired Requisites:	Power Systems, Power Electronics

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

Course Objectives	
1	To educate the students with the practical aspects of Power Quality issues.
2	To develops the critical thinking in solving power quality problems with contemporary Power Quality Theories.
3	To enhance research skills of students to Power Quality issues.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO 1	**Calculate** power components and other figures of merit under distorted conditions.	Apply
CO 2	**Analyse** Power Quality Problems and provide suitable remedy.	Analyse
CO 3	**Evaluate** theories of load compensation, reference generation using suitable simulation tool.	Evaluate

List of Experiments / Lab Activities

Lab activities/Lab performance shall include mini-project, presentations, drawings, case studies, report writing, site visit, lab experiment, tutorials, assignments, group discussion, programming and other suitable activities, as per the nature and requirement of the lab course.

Text Books	
1	Dr. Mahesh Kumar, IIT Chennai, "*Power Quality in Distribution System"*.
2	Bhim Singh, Ambrish Chandra, Kamal Al-Haddad**, "***Power Quality Problems and MitigationTechniques"*, Wiley, 2015.

References	
1	Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, "*Electrical Power Systems Quality"*, Mc-Graw Hill, Edition II, 1996.

2	Angelo Baggini, "*Handbook on Power Quality"*, John Wiley & Sons, New Jersey, USA, 2008
Useful Links	
1	https://nptel.ac.in/courses/108/106/108106025/

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

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				

Understand				
Apply	10	10	10	**30**
Analyse	10	10	20	**40**
Evaluate	10	10	10	**30**
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M.Tech., Sem II
Course Code	5PS572
Course Name	Activity Based Lab for PLC and Embedded Systems
Desired Requisites:	Instrumentation Techniques, Electrical Measurements, Microcontroller and Applications

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

Course Objectives

1	To develop programming skills using PLC for Industrial Automation
2	To introduce the use of PLC for solving real world problems.
3	To use PLC for control applications in electrical engineering

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	**Construct** basic control systems using PLC and SCADA.	Analyse
CO3	**Design** ladder logic programs for various PLC applications.	Create

List of Experiments / Lab Activities

Lab activities/Lab performance shall include mini-project, presentations, drawings, case studies, report writing, site visit, lab experiment, tutorials, assignments, group discussion, programming and other suitable activities, as per the nature and requirement of the lab course.

Text Books

1	John W. Webb, Ronald A. Reis, "*Programmable logic controllers, principles & applications"*, PHI publication, Eastern Economic Edition, 1994.

References

1	John R. Hackworth and Peterson, "*PLC controllers programming methods and applications"*, PHI, 2004.

2	Gary dunning, "*Introduction to PLC"*, Thomson learning, Edition III, 2006
3	William H. Bolton, "*Programmable logic controllers"*, Newnes, Edition VI, 2006.

Useful Links

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
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

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

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

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				

Apply	10	10	10	**30**
Analyse	10	10	10	**30**
Evaluate				
Create	10	10	20	**40**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information						
Programme	M.Tech. (Power System Engineering)					
Class, Semester	First Year M. Tech., Sem II					
Course Code	5PS573					
Course Name	Industrial Project					
Desired Requisites:						
Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**	
Tutorial	-	30	30	40	100	
Practical						
Interaction	2Hr/Week	**Credits: 2**				

Course Objectives	
1	To understand industrial problems.
2	To suggest engineering solutions to the defined problem.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Chose, Formulate** a clear problem.	Apply
CO2	**Select and apply** appropriate engineering methods and tools for solving the problem.	Create
CO3	**Develop** the project and its results following an established project methodology.	Evaluate
CO4	**Present** the project results.	Analyse

List of Experiments / Lab Activities

Industrial Project:

The Industry project will involve the selection of appropriate real time industry problem by understanding the working of particular industry application. Formulate the problem, select design and methodology to find the solution. Construct an electrical system by using appropriate hardware software tools. Each student should conceive, design and develop the idea leading to a project/product. The student should submit a soft bound report at the end of the semester. The final product as a result of Industry project should be demonstrated in phases at the time of examination.

This will help student to understand structured management in industry , sustainable development, with consideration to both scientific and ethical aspects and its presentation with technical report.

Text Books	
1	To be used based on selected project

References	
1	Industry 4.0 : fourth Industrial Revolution guide to Industry 4.0

Useful Links	
1	-

CO-PO Mapping						
Programme Outcomes (PO)						
	1	2	3	4	5	6
CO1	3	2				
CO2				2		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				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance	Lab Course Faculty	During Week 7 to Week 12	30

			Marks Submission at the end of Week 12	
Lab ESE	Lab activities, attendance	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.				

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	**LA1**	**LA2**	**ESE**	**Total**
Remember				
Understand				
Apply	30	10	5	**45**
Analyse		10	5	**15**
Evaluate		10	10	**20**
Create			20	**20**
Total	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	5PS574
Course Name	Professional Skills 2
Desired Requisites:	

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

Course Objectives	
1	To provide a hands on experience of software in solving complex Electrical Engineering problems.
2	To enhance the employability of Electrical Engineering student.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, students will be able to,		
CO1	**Use** of the software related to Electrical Engineering effectively.	Evaluate
CO2	**Develop** the solution for Electrical Engineering problem using software.	Create
CO3	**Explain** the process of problem-solving using computing tools.	Understand

Course Content

This course is based on computing as a tool to design and analyse the Electrical Engineering system. In the modern day work environment, the Electrical Engineer should be able to simulate and solve complex problems on computers. The Electrical Engineer must be highly computer literate. The engineer with strong fundamentals and computer software proficiency is highly in demand from industry. Employability of the student can be enhanced by providing software training.

Text Books	
1	Suitable books based on the software selected.

References

1	Suitable books based on the contents of software selected
Useful Links	
1	As per the need of the software training

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

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

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	10	10	10	**30**
Apply				
Analyse				
Evaluate	10	10	15	**35**
Create	10	10	15	**35**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M. Tech (Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	5PS523
Course Name	Professional Elective III: Power System Dynamics
Desired Requisites:	Power Apparatus Modelling

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

Course Objectives	
1	To introduce the concept of small signal and transient stability analysis of power systems.
2	To provide solutions to SSR problem and voltage stability problem.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Distinguish** various categories of system stability.	Understand
CO2	**Analyse** models, use analytical tools to decide upon the stability of various types.	Analyse
CO3	**Recommend** various methods to improve various type of stabilities of power system.	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to small signal stability of power system** Small Signal Stability analysis of single machine connected to infinite bus. Step by step model development of single machine connected to infinite bus.	4
II	**Improvement of small signal stability** Power system stabilizer, Simulation of Power System Dynamic response using power systemstabilizer in the small signal stability model of single machine connected to infinite bus.	6

	III	**Large scale power systems** Dynamic equalization of large scale system systems. Step by step reduction of large scale model to a smaller model for analysis purpose.	6
	IV	**Transient stability analysis** Introduction to Direct method of transient stability analysis by roller ball analogy. Development of model using energy concept, and analysis of model for transient stability.	4
	V	**Sub synchronous resonance** Introduction to Sub-Synchronous oscillation & sub-synchronous resonance. Effect of series compensation of transmission line. Induction generator effect, stability of hydro turbines.	4
	VI	**Voltage stability** Reactive power compensation and Voltage stability. Development of model of power system for voltage stability. Sensitivity analysis and QV modal analysis for voltage stability. Methodsof improving stability.	4

	Text Books	
	1	P. Kundur*," Power System, Stability and Control"*, Tata McGraw Hill, New Delhi, 1994.
	References	
	1	K. R. Padiyar*, "Power System Dynamic, Stability & Control"*, B.S. Publication, 2008.
	Useful Links	
	1	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
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
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				
Understand	10	10	20	**40**
Apply				
Analyse	10	10	20	**40**
Evaluate			20	**20**
Create				
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M. Tech. (Power System Engineering)
Class, Semester	First Year M.Tech., Sem II
Course Code	5PS524
Course Name	Professional Elective III: EHVAC
Desired Requisites:	Power System

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

Course Objectives	
1	To understand parameters of EHVAC line.
2	To develop a skill to design and analyse EHVAC line.
3	To develop a skill to understand power frequency over voltages developed in EHVAC line.
4	To develop a skill to understand insulation coordination based on lightening.

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO 1	**Outline** parameters of EHVAC line and develop skills to design and analyse EHVAC line.	Understand
CO 2	**Examine** power frequency over voltages developed in EHVAC line.	Apply
CO 3	**Explain** insulation coordination based on lightening.	Analyse

Module	**Module Contents**	**Hours**
I	**Introduction, Calculation of Line and Ground Parameters, Voltage Gradients of Conductor and Corona Effects.** **a**. Introduction: Engineering aspects and growth of EHVAC transmission line trends and preliminaries, power transferability, transient stability limit and surge impedance loading. **b**. Calculation of Line and Ground Parameters: Resistance, power loss, temperature rise, properties of bundled conductors, inductances, and	6

	capacitances, calculation of sequence inductance and capacitance line parameters of modes of propagations, resistance and inductance of ground return. **c**. Voltage Gradients of Conductor: Charge potential relations for multi-conductor lines, surface voltage gradients on conductors, distribution of voltage gradient on sub conductors of bundle. **d**. Corona Effects: I2R 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.	
II	**Theory of Traveling Waves and Standing Waves** Waves at power frequency, differential equations and solutions for general case, standing waves and natural frequencies , open ended line; double exponential response, response to sinusoidal excitation, line energization with trapped charge voltage, reflection and refraction of traveling waves.	6
III	**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 andtheir characteristics.	4
IV	**Over Voltage in EHV Systems Covered by Switching Operations** Over voltages their types, recovery voltage and circuit breaker, Ferro resonance over voltagescalculation of switching surges single phase equivalents.	4
V	**Power Frequency Voltage Control and Over Voltages** Generalized constants, charging current, power circle diagram and its use, voltage control shuntand series compensation, sub synchronous resonance in series capacitor compensated lines andstatic reactive compensating systems.	4
VI	**Insulation Coordination** Insulation coordination, Insulation levels, voltage withstand levels of protected equipment's andinsulation coordination based on lightning, Design of EHVAC lines.	4
Text Books		
1	Rakosh Das Begamudre, "*EHVAC Transmission Engineering*", Wiley Eastern Limited, 3rd Edition2008.	

References	
1	TwianGonen, "*EHVAC and HVDC Transmission System Engineering – Analysis and Design*"JohnWiley and Sons 1988.
2	EHV –AC and HVDC Transmission Engineering &Practice : S.V. Rao
3	TwianGonen, *"Electric Power Transmission System Engineering-Analysis and Design*", John Wileyand Sons 1988.
Useful Links	
1	NPTEL Lectures

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	3					
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
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				

Understand	10	10	20	**40**
Apply	10	10	20	**40**
Analyse			20	**20**
Evaluate				
Create				
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M. Tech.(Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	5PS525
Course Name	Professional Elective IV: Computer Aided Power System Analysis
Desired Requisites:	Power System

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

Course Objectives

1	To makes the students conversant with different power system analysis methods.
2	To provide basic knowledge of formation of Ybus methods.
3	To provide different power system computer analysis methods using computer.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** various methods of analysing shunt and series faults.	Understand
CO2	**Apply** the Network Topology knowledge for power system analysis.	Apply
CO3	**Study** Power flow analysis and economic dispatch of generation.	Analyse

Module	**Module Contents**	**Hours**
I	**Analytical Simplifications** Three Component method, Two-Component method, sequence network connections for different faults, Analysis of unsymmetrical shunt and series faults using three-component (symmetrical component method) and two-Component method.	4
II	**Network Topology** Introduction, Elementary graph theory, Connected graph, tree, co-tree, basic cutsets, basic loops, Incidence matrices, Element-node, Bus incidence, Tree-branch path, Basic cutset, augmented cut-set, Basic loop and Augmented loop, Primitive network, Impedance form and Admittance form.	4

III	**Network Matrices** Introduction, formation of Ybus by method of Inspection, method of Singular Transformation, Step by Step building algorithm for formation of Ybus. Formation of Bus Impedance Matrix, Modification of Zbus for addition of a branch, addition of link, removal of an element.	6
IV	**Network Fault and Contingency Calculations** Fault calculations using Zbus, fault calculations using the Ybus table of factors, Contingency analysis for Power systems. Using the Ybus table of factors for contingencies. Analysis of Unsymmetrical faults using Bus Impedance Matrix.	6
V	**Power flow analysis** Formulation of the problem and power flow equations. Application of numerical techniques to solve load flow problems using bus admittance matrix and bus impedance matrix in the bus – frame of reference such as Gauss, Gauss – Seidel, Newton – Raphson methods, Decoupled load flow methods etc.	4
VI	**Optimal Dispatch of generation** Performance Curves, economic dispatch of generation without and with transmission-line losses, Iterative technique, approximate penalty factor, Derivation of transmission loss formula, Calculation of loss-coefficient using Ybus and sparse matrix techniques.	4

Text Books	
1	Pual M. Anderson, "*Analysis of faulted system*", The Iowa state university press/ AMES, 1973.
2	K. Uma Rao, "*Computer Techniques and Models in Power systems*", I. K. International Publishing house Pvt. Ltd. New Delhi, 2007.

References	
1	I. J. Nagrath and D. P. Kothari,*"Power System Engineering*", Tata Mc-Graw Hill Publishing Co., 1994.
2	Hadi Sadat, *"Power system analysis*", 1st edition, Tata Mc-Graw Hill publishing company ltd., 2002.
3	George L. Kusic, "*Computer Aided Power System Analysis*", PHI, 2003.
4	Research Papers.

Useful Links	
1	http://nptel.ac.in/downloads.
2	http://www.nptelvideos.in
3	https://ocw.mit.edu/courses/electrical-engineering.

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

Assessment
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				
Understand	10		20	**30**
Apply	10	10	20	**40**
Analyse		10	20	**30**
Evaluate				
Create				
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	5PS526
Course Name	Professional Elective IV: HV Engineering
Desired Requisites:	Power System

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

Course Objectives	
1	To understand the breakdown mechanisms in gaseous, liquid and solid insulation
2	To understand methods of generation and measurement of high voltage, impulse voltage and impulse current.
3	To lay a foundation for higher studies in high voltage engineering

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO 1	**Summarize** breakdown mechanisms in gaseous, liquid and solid insulations.	Understand
CO 2	**Analyse** the HV generation equipment and their application.	Analyse
CO 3	**Design and construct** a simple HV gadget/ model.	Create

Module	**Module Contents**	**Hours**
I	**Breakdown In Gaseous Medium** Townsend mechanism of breakdown in gases, streamer (kanal) mechanism of breakdown in gases, derivation of breakdown criterion for Townsend and streamer mechanisms. Panchen's law for breakdown voltage in gases, effect of pressure and gap distance on breakdown voltage.	4
II	**Breakdown In Liquid and Solid Insulation**	4

	Comparison of pure and commercial liquids for insulation, breakdown in pure liquids, effect of hydrostatic pressure on breakdown strength. Breakdown in commercial liquids - suspended particle theory, cavitation and bubble theory, thermal breakdown, stressed oil volume theory. Types of breakdown mechanisms in solids - intrinsic, electromechanical, treeing and tracking, thermal breakdown, electrochemical, breakdown due to internal discharges. Breakdown in composite dielectrics, applications of solid dielectrics like paper, mica, glass and ceramics.	
III	**Generation Of High Voltages** Generation of high D.C. voltages by rectifiers, voltage doubler and multiplier circuits, electrostatic machines - Van de Graaff generator, electrostatic generator. Generation of high A.C. voltages by cascade transformer set, resonant transformer, Tesla coil for generation of high frequency A.C. voltage.	4
IV	**Generation Of Impulse Voltage and Current** Standard impulse wave shape, analysis of model and commercial impulse generation circuits, wave shape control, Marx circuit, tripping and control of impulse generation. Generation of switching surges, generation of impulse current.	6
V	**Measurement Of High Voltage and Current** Peak voltage measurement by Chubb - Fortescue method, spark gaps, sphere gap, uniform field gap, rod gap, electrostatic voltmeter, measurement of high voltage by an ammeter in series with high impedance, use of rectifier and voltage divider. Measurement of high A.C., D.C. and impulse currents by resistive shunts- Hall generator, current transformer with electro-optical signal converter, squirrel-cage shunt, Rogowski coil.	6
VI	**High Voltage Testing and Partial Discharges** High voltage testing of - insulators, bushings, circuit breakers, cables, transformers, lightning arrestors and power capacitors. Phenomenon of partial discharges (PD), internal and surface discharges, effects of PD, equivalent circuit of PD phenomenon, measurement of apparent charge. PD detection - straight detection method, wide band and narrow band detection circuits. Bridge detection method, calibration of PD detectors.	4
Text Books		
1	E. Kuffel& W.S. Zaengl, *„ ”High Voltage Engineering Fundamentals"*Pergamon Press, 1992	
2	M.S. Naidu & V. Kamaraju*“High Voltage Engineering"*, 4th Edition Tata Mc-Graw	

	Hill, 2011
References	
1	C.L. Wadhwa, „*"High Voltage Engineering"* New Age, 2007.
2	E. Kuffel& Abdullah *, "High Voltage Engineering",* 1 st Edition, PPO, 1981
Useful Links	
1	https://nptel.ac.in/courses/108/104/108104048/

CO-PO Mapping						
Programme Outcomes (PO)						
	1	2	3	4	5	6
CO1			2			
CO2				3		
CO3	2	2				

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High

Each CO of the course must map to at least one PO.

Assessment
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				
Understand	10	10	20	**40**
Apply				
Analyse	10	10	20	**40**
Evaluate				
Create			20	**20**
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	5PS575
Course Name	Activity Based Elective Lab : Computer Aided Power System Analysis lab
Desired Requisites:	Power System

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

Course Objectives

1	To make the students conversant with different recent techniques for power system analysis methods.
2	To provide basic knowledge of formation of Ybus methods using programming languages
3	To provide different computer solution for large interconnected power system networks.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** the different computer analysis methods of power system faults.	Understand
CO2	**Apply** the Network Topology knowledge for power system analysis.	Apply
CO3	**Study** MATLAB programming for Power flow analysis and economic dispatch of generation.	Analyse

List of Experiments / Lab Activities

Lab activities/Lab performance shall include mini-project, presentations, drawings, case studies, report writing, site visit, lab experiment, tutorials, assignments, group discussion, programming and other suitable activities, as per the nature and requirement of the lab course.

Text Books

1	Pual M. Anderson, "*Analysis of faulted system*", The Iowa state university press/ AMES, 1973.
	K. Uma Rao, "*Computer Techniques and Models in Power systems*", I. K. International Publishing house Pvt. Ltd. New Delhi, 2007.

References	
1	I. J. Nagrath and D. P. Kothari,*"Power System Engineering*", Tata Mc-Graw Hill Publishing Co., 1994.
2	Hadi Sadat, *"Power system analysis*", 1st edition, Tata Mc-Graw Hill publishing company ltd., 2002.
3	George L. Kusic, "*Computer Aided Power System Analysis*", PHI, 2003.
Useful Links	
1	http://www.nptelvideos.in

CO-PO Mapping						
Programme Outcomes (PO)						
	1	2	3	4	5	6
CO1				2		
CO2						3
CO3				1		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High

Each CO of the course must map to at least one PO.

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

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

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	5PS576
Course Name	Activity Based Elective Lab : HV Engineering lab
Desired Requisites:	Power System

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

Course Objectives

1	To understand the breakdown mechanisms in gaseous, liquid and solid insulation
2	To understand methods of generation and measurement of high voltage, impulse voltage and impulse current.
3	To lay a foundation for higher studies in high voltage engineering

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Summarize** breakdown mechanisms in gaseous, liquid and solid insulations.	Understand
CO2	**Understand** the basic generation and measurement of High voltage and High current for testing purposes	Understand
CO3	**Analyse** the HV generation equipment and their application.	Analyse

List of Experiments / Lab Activities

Lab activities/Lab performance shall include mini-project, presentations, drawings, case studies, report writing, site visit, lab experiment, tutorials, assignments, group discussion, programming and other suitable activities, as per the nature and requirement of the lab course.

Text Books

1	E. Kuffel& W.S. Zaengl, *„"High Voltage Engineering Fundamentals"* Pergamon Press, 1992
2	M.S. Naidu & V. Kamaraju *"High Voltage Engineering"*, 4th Edition Tata Mc-Graw Hill, 2011

References	
1	I. J. Nagrath and D. P. Kothari,*"Power System Engineering*", Tata Mc-Graw Hill Publishing Co., 1994.
2	Hadi Sadat, *"Power system analysis*", 1st edition, Tata Mc-Graw Hill publishing company ltd., 2002.
3	George L. Kusic, "*Computer Aided Power System Analysis*", PHI, 2003.
Useful Links	
1	

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

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	20	20	20	**60**
Apply				
Analyse	10	10	20	**40**
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	M.Tech. (Power System Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	5OE106
Course Name	Open Elective I: Control Techniques for Electrical Drives
Desired Requisites:	

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

Course Objectives

1	To provide the latest knowledge in the field of electrical drives.
2	To provide sufficient knowledge in the area of advanced control techniques for induction motor and synchronous machines.
3	To make the student aware of the research in the field of electrical drives.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** various concept used in AC and DC drives.	Understand
CO2	**Apply** control techniques to AC and DC drives.	Apply
CO3	**Analyze** control techniques for AC and DC drives.	Analyse
CO4	**Evaluate** various control schemes of AC and DC drives.	Evaluate

Module	**Module Contents**	**Hours**
I	**Basics of drives** Types & parts of the Electrical drives, fundamental torque equation, speed torques characteristics DC motor & Induction motor, multi quadrant operation of the drive, classification of mechanical load torques, steady state stability of the drive, constant torque and constant HP operation of the drive, closed loop speed control.	4
II	**DC motor drives**	5

	Methods of speed control, starting and breaking operation, single phase and three phase full controlled and half controlled converter fed DC drives, Multi quadrant operation of separately excited DC shunt motor, dual converter fed DC drives, circulating and non – circulating mode of operation, chopper control of DC shunt motor drives, four quadrant operation of chopper fed DC shunt motor drive.	
III	**Induction motor drives** Speed control methods for three phase induction motor, VSI fed induction motor drive, constant torque (constant E/F and constant V/F), constant HP operation, closed loop speed control block diagram., CSI fed induction motor drive, speed torque characteristics of CSI fed drive, closed loop speed control block diagram, comparison of CSI fed and VSI fed induction motor drive, Stator voltage control. Chopper controlled resistance in rotor circuit, slip power recovery using converter cascade in rotor circuit, sub synchronous and super synchronous speed control, Kramer speed control.	5
IV	**Modeling of Induction Motor and PWM Techniques** abc – dq transformation, transformation from stationary reference frame to synchronously rotating reference frame and vice versa. Equivalent circuits of induction motor in dynamic dq stationary and synchronously rotating reference frame. Permanent magnet synchronous machine dq equivalent circuits. The three phase six step bridge inverter, three phase PWM inverter, PWM techniques such as sinusoidal PWM, hysteresis band current control PWM.	5
V	**Vector Control and Direct Torque Control of Induction Motor** Vector control of induction motor, DC drive analogy, equivalent circuit, phasor diagram. Direct rotor flux oriented vector control and indirect rotor flux oriented vector control, stator flux oriented vector control.Torque equation of IM in terms of stator and rotor flux, direct torque and flux control method (DTC) and self-commissioning of the drive.	5
VI	**Synchronous motor and SRM Drives** VSI fed synchronous motor drives, true synchronous and self-control mode, open loop and closed loop speed control of Permanent magnet synchronous machine, brushless DC motor drives. Switched reluctance motor drives, torque equation, converter circuits, operating modes and applications. Solar panel VI characteristics, solar powered pump, maximum power point tracking and battery operated vehicles.	4

Text Books	
1	G. K. Dubey, *"Fundamentals of Electrical Drives*", Narosa publication, 2nd edition, 2002.
2	B. K. Bose, "*Modern Power Electronics and AC drives*", Prentice Hall of India Pvt. India, 1986.

References	
1	Peter Vas, "*Vector Control of AC machines*", Clarendon Press Oxford, 1999.
2	Ned Mohan, "*Advanced Electrical drives – Analysis, control and modeling using Simulink*", John Wiley and sons, 2001.
3	P. S. Bhimra, "*Power Electronics*", 2nd edition, Khanna Publishers.

Useful Links	
1	NPTEL video lectures on Electrical Drives

CO-PO Mapping

Programme Outcomes (PO)

	1	2	3	4	5	6
CO1				1		
CO2				1		
CO3			1	2		
CO4			1	3		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High

Each CO of the course must map to at least one PO.

Assessment

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level				
Bloom's Taxonomy Level	**T1**	**T2**	**ESE**	**Total**
Remember				
Understand	10		10	20
Apply	10	10	20	40
Analyse		10	20	30
Evaluate			10	10
Create				
Total	**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*						
AY 2021-22						
Course Information						
Programme	M.Tech. (Power System Engineering)					
Class, Semester	First Year M. Tech., Sem II					
Course Code	5IC501					
Course Name	Value Education					
Desired Requisites:						
Teaching Scheme	**Examination Scheme (Marks)**					
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**	
Tutorial	-	20	20	60	100	
Practical	-					
Interaction	-	**Credits: 0**				
Course Objectives						
1	To impart knowledge on value of education and self-development.					
2	To imbibe good values in students.					
3	To highlight importance of character.					
Course Outcomes (CO) with Bloom's Taxonomy Level						
At the end of the course, students will be able to,						
CO1	**Explain** value of education and self- development.				Understand	
CO2	**Summarize** importance of good character, and Behaviour development.				Evaluate	
Module	**Module Contents**				**Hours**	
I	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles, Value judgments.				6	
II	Importance of cultivation of values, Sense of duty. Devotion, Self-reliance, confidence, Concentration. Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline.				6	

III	Personality and Behaviour Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature	7
IV	Character and Competence –Holy books vs. Blind faith, Self-management and Good health, science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control. Honesty, Studying effectively	7
Text Books		
1	Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi	
References		
1	-	
Useful Links		
1	https://nimsuniversity.org/wp-content/uploads/2018/02/Value-Education-Human-Rights-and-Legislative-Procedures.pdf	
2	http://cbseacademic.nic.in/web_material/ValueEdu/Value%20Education%20Kits.pdf	
3	https://www.verywellmind.com/personality-development-2795425	
4	https://trudreadz.com/2019/09/10/blind-faith-in-religion-destroys-our-ability-to-critically-think-for-ourselves/	

CO-PO Mapping

Programme Outcomes (PO)						
	1	2	3	4	5	6
CO1	2				1	2
CO2	1		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 (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3,4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

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