Semester- V
Professional Core Theory Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	7EL301
Course Name	Power System Analysis and Stability
Desired Requisites:	Electrical Transmission and Distribution and A.C. Machines

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

Course Objectives

1	To gain knowledge of load flow analysis and short circuit studies.
2	To provide knowledge about stability problems and dynamic mechanisms in electric power systems.
3	To analyse case studies and real-world examples of power system stability and develop critical thinking skills for problem solving.
4	To help students in preparing for competitive examinations.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Summarize the use of various load flow analysis method and assess the power system under symmetrical fault.	II	Understanding
CO2	Analyse symmetrical components of network and power system under unbalanced fault	IV	Analysing
CO3	Evaluate the power system stability for rotor angle, voltage stability and to solve swing equation	V	Evaluating
CO4	Design the power flow solution, symmetrical component models and fault analysis process and stability strategies for power system scenarios.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Power Flow Analysis** Bus classification, bus admittance matrix, general form of power flow equations, gauss-seidel and newton-raphson methods, comparison of load flow methods, reactive power control and series compensation.	7
II	**Symmetrical Components** Symmetrical components, dr. Fortescue theorem, component synthesis, Component analysis, sequence impedances and sequence networks, sequence Impedances of transmission lines, transformers, and synchronous machines, Construction of sequence network of a power system.	7
III	**Fault Analysis: Balanced Fault** Introduction, classification, severity and occurrence of fault, effect of faults, Balanced three phase fault, transient on transmission line, short circuit capacity, symmetric fault analysis using bus impedance matrix.	6
IV	**Fault Analysis: Unbalanced Fault** Introduction, assumptions, sequence voltages of generator, general procedure For analysis of various faults, analysis of unbalanced faults- SLG, LL and DLG, Short circuit studies of a large power system network.	6

V	**Power System Stability- Revisited and Extended** Basic concepts and definitions, classification of stability including inverter based resources(IBR), power angle curve, an elementary view of transient stability ,swing equation ,m and h constant, equal area criterion and its applications, critical clearing angle, rotor angle stability, voltage stability, factors influencing transient stability.	7
VI	**Case Studies and Real-World Applications for Stability Evaluation** Case studies of power system oscillations and their impact on grid stability, real-world power stability events in power grid with high penetration of inverter based resources (IBR), role of advanced technologies in enhancing grid stability, emerging technologies and trends in power system stability, research challenges and opportunities in this field.	6

Textbooks	
1	I.J. Nagrath and D.P. Kothari, "Power System Analysis", 2nd Edition and TMH Publication 2015.
2	Hadi Saadat, Power System Analysis, TMH, 1st Edition, 2002
3	"Power System Analysis", B.S.R. Murty, B.S. Publications.

References	
1	Glover, Sharma, Overbye Power Systems Analysis and Design, Thompson, 5th Ed., 2012.
2	Stevenson W.D., Elements of Power System Analysis, TMH, 4th Edition, 2014.
3.	Power System Stability and Control" by Prabha Kundur

Useful Links	
1	**NPTEL Courses:** https://nptel.ac.in/
2	**Research Papers IEEE :** https://ieeexplore.ieee.org/
3.	N. Hatziargyriou et al., "Definition and Classification of Power System Stability – Revisited & Extended," in IEEE Transactions on Power Systems, vol. 36, no. 4, pp. 3271-3281, July 2021, doi: 10.1109/TPWRS.2020.3041774.
4	Y. Cheng et al., "Real-World Subsynchronous Oscillation Events in Power Grids With High Penetrations of Inverter-Based Resources," in IEEE Transactions on Power Systems, vol. 38, no. 1, pp. 316-330, Jan. 2023, doi: 10.1109/TPWRS.2022.3161418.

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	Dr. Vijay Mohale
Syllabus Checked By	Mr. S. S. Medhekar

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	7EL302
Course Name	Control System Engineering
Desired Requisites:	Engineering Mathematics III, Signals and Systems, Electrical Circuit Analysis

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

Course Objectives

1	To disseminate information regarding the modeling of physical systems.
2	To furnish students with an analysis of physical systems in both the time and frequency domains.
3	To equip students with the capacity to assess the stability of linear systems.
4	To acquaint students with conventional linear system controllers.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Calculate mathematical representations of physical systems in both time and frequency domains.	III	Applying
CO2	Illustrate physical system's transient and steady-state responses.	III	Applying
CO3	Examine the stability of linear systems in both the time and frequency domains	IV	Analysing
CO4	Analyse the impact of conventional controllers and compensators on linear systems.	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Modeling in the Frequency Domain** History of control systems, Laplace transforms review, transfer function of electrical systems, mechanical systems, rotational systems, electrical circuit analogs, transfer function of dc motor. Case study: - to find transfer function model of each sub-system of antenna azimuth position control system.	6
II	**Modeling in the Time Domain** State space representation, converting transfer function to state space: phase variable form, state space to transfer function, state transition matrix, solution of state equation, controllability, observability. Case study: - to find state space model of each sub-system of antenna azimuth position control system.	7
III	**Transient Response and Reduction of multiple subsystem** Time response, poles, zero and system response, response of first, second and general second order system, system response with additional poles, additional zeros block diagram analysis and design of feedback systems, signal flow graph, mason's rule, signal flow graphs of state equation, similarity transformation.	7

IV	**Stability Analysis and Steady State Error** Routh criterion for stability and stability in state space, steady state error for unity feedback systems, static error constants, and system type, steady state error specifications, steady state error for system with disturbances, non-unity feedback systems, steady state error for systems in state space, PID controllers.	5
V	**Stability Analysis: Root Locus Technique** Sketching the root locus, transient response design via gain adjustment, root locus for positive feedback system, pole sensitivity, lag, lead, lag-lead compensators in root locus domain.	6
VI	**Stability Analysis: Bode Plot and Nyquist Plot** Nyquist criterion, bode plot, determination of stability, gain margin, phase margin via the Nyquist diagram and bode plots. Introduction to compensators, lag, lead, lag-lead compensator in frequency domain.	8

Textbooks	
1	Norman Nise, "Control System Engineering", John Wiley, Sixth Edition, 2011.
2	I.J. Nagrath and M. Gopal, "Control System Engineering", Anshan Publishers, Fifth edition, 2008.
References	
1	M Gopal, "Control System Principle & Design", T.M.H., Fourth Edition, 2012.
2	K Ogata, "Modern Control Engineering", P.H.I., Fourth Edition, 2002.
3	Dorf and Bishop, "Modern Control System", Adison Wesley Longman, Eight Edition, 1998.
Useful Links	
1	https://nptel.ac.in/courses/108/106/108106098/

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	Mr. N.V. Patel
Syllabus Checked By	Dr. Mrs. A. S. Karvekar

Walchand College of Engineering, Sangli

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AY 2025-26

Course Information	
Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	7EL303
Course Name	Digital Signal Processing
Desired Requisites:	Engineering Mathematics –III, Signals and Systems

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

Course Objectives

1	To provide background and fundamental material for the analysis and processing of digital signals and systems.
2	To understand and apply the fast computation of DFT
3	To study the designs and structures of digital (IIR and FIR) filters.
4	To acquaint in multi-rate signal processing techniques and digital signal processors.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain the multirate signal processing and digital signal processors.	II	Understanding
CO2	Use of DFT and the FFT algorithms for processing digital signals	III	Applying
CO3	Examine the IIR and FIR filter response.	IV	Analysing
CO4	Design of digital IIR and FIR filters for different applications.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Digital Signals and Systems** Sampling, transfer function, frequency response and analysis using z-transform, correlation, digital system's response to different inputs.	6
II	**Discrete Fourier Transform** DFT, relation between DFT & Z ¬transform, circular convolution and DFT, FFT algorithms-radix-2 and radix-4 algorithms –DIT-FFT and DIF-FFT, overlap save algorithm, overlap add algorithm.	8
III	**IIR Filter Design** Filter design using impulse invariant technique, bilinear transformation and analog filter approximation (Butterworth) and realization.	7
IV	**FIR Filter Design** FIR Filter design, linear phase property, Fourier series method, windowing method, filter design using window, quantization and realization, applications of IIR and FIR filters.	7
V	**Digital Signal Processors** Introduction, real time signals processing, modifications in structure and architecture, important blocks, programming aspects, applications.	6

VI	**Multirate Signal Processing and Wavelet Transform** Up-sampling and down-sampling time and frequency effects, aliasing and imaging effects, applications, wavelet transform- introduction, continuous and discrete wavelet, applications of wavelet transform.	5
Textbooks		
1	John G, Proakis' Digital Signal Processing ¬Principles, Algorithms and Applications', Pearson Education, 2008	
2	Sanjeet Mitra, 'Digital Signal Processing', TMH Pub., 2006	
3	Oppenheim and R. W. Schafer, 'Discrete Time Signal Processing' PHI Pub., 2005	
References		
1	Venkatramani, Bhaskar, 'Digital Signal Processors, TMH Pub., 2006	
2	Raghuveer Rao, Bopardikar, 'Wavelet Transform', Pearson Education, 2000.	
3	Li Tan,' Digital Signal Processing – Fundamentals and Applications', Elsevier, 2008	
Useful Links		
1	https:// nptel.ac.in/courses/108/101/108101174/	
2	https://nptel.ac.in/courses/117102060	
3		

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	A.B.Patil
Syllabus Checked By	A.N.Inamdar

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AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	7EL304
Course Name	Energy Storage Systems for EV
Desired Requisites:	NIL

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

Course Objectives

1	This course aims to provide the foundation level knowledge of different energy storage systems.
2	The course will enable student to use various energy systems and study various components of battery management system.
3	The course will help the students to examine the power converters for electric vehicles.
4	The course will also help the students to analyse the performance of BESS, fuel cells and super capacitors.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	**Discuss** need and classification of EV, energy storages for EV.	II	Understanding
CO2	**Examine** the operation of various energy storage systems used for Electrical Vehicle applications	II	Understanding
CO3	**Analyse** the components and working of BMS, concept of BESS.	III	Applying
CO4	**Investigate** the performance of different power electronic converters used in electric vehicles	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Introduction to Energy Storage Systems** Basics of vehicle mechanisms, history of electric vehicles (EV), introduction and need of electric vehicles (EV), introduction and need for storage for EV, classification of EV, power/energy supply requirements, traditional energy storage systems, global market and scenario, energy storage system: battery, fuel cell, super capacitors, compressed air, hydrogen storage, fly-wheels, comparison of different energy storage systems.	5
II	**Battery System** Introduction to battery, battery types and battery chemistries, basic battery operation, units of battery energy storage, battery parameters: cell voltage, specific energy, cycle life, specific power, self-discharge, SOC and DOD, life time, aging and sizing considerations, battery models & packs, examples of battery sizing: BEV & PHEV, applications of battery, future developments.	5
III	**Battery Management System & BESS** Objectives and functions of the BMS, sensors in BMS, protection of batteries, CCCV topology, cell equalization, system study for BESS, Solar-plus-storage system architectures & coupling, cabling, earthing and switchgear selection for BESS, BESS container & ventilation arrangement.	4

IV	**Converters for Battery** Introduction, basic topologies, buck or step-down converter, analysis of voltage gain in CCM, analysis of buck converter in CCM, BCM, DCM, examples, boost or step-up converter: analysis of voltage gain in CCM, analysis of boost converter in CCM, BCM, DCM, examples, power semiconductor: power loss & conduction loss, examples, passive components for power converters, example: inductor sizing, capacitor sizing, interleaving, example: two-phase interleaved boost converter.	4
V	**Fuel Cell and Hydrogen Storage System** Basic structure and functions of fuel cell, characteristics and working, fuel cell power conversion, classification of fuel cells, hydrogen storage systems: basics, working and applications.	4
VI	**Super capacitor** Super capacitor: characteristics, components, schematic, classification, advantages, disadvantages.	4

Textbooks	
1	"Electric Powertrain", John G Hayes and G. Abas Gudarazi, First edition, A John Wiley & Sons Ltd. Publication, 2018
2	"Electrical Vehicle Technology Explained", James Larminie and John Lowry, Second edition, A John Wiley & Sons Ltd. Publication, 2012
References	
1	"Renewable and efficient electric power systems ", Masters, Gilbert M., John Wiley & Sons, 2013.
2	"Lithium-ion batteries: fundamentals and performance ", Wakihara, Masataka, and Osamu Yamamoto, eds. John Wiley & Sons, 2008.
Useful Links	
1	https://nptel.ac.in/courses/113105102

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	Mrs. Amaraja A. Dhamangaonkar
Syllabus Checked By	Dr. R. P. Hasabe

Professional Core Laboratory Course

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	7EL351
Course Name	Power System Analysis and Stability Lab
Desired Requisites:	Electrical Transmission and Distribution, AC Machines

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

Course Objectives

1	To cover steady state analysis and fault studies for a power system.
2	To provide hand on skills to simulation of stability studies.
3	To lay the foundation for conducting higher level study in power system

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Simulate various methods of power system analysis.	II	Understanding
CO2	Carry out simulation for symmetrical components of network and analyse the power system under various fault.	III	Applying
CO3	Evaluate the equal Area criterion and swing curve for stability.	V	Evaluating
CO4	Design simulations and analysis for load flow, fault conditions, and power system stability using MATLAB/MiPower/ETAP to evaluate and enhance system performance under various operational scenarios.	VI	Creating

List of Experiments / Lab Activities

List of Experiments:

1. Development of the MATLAB program of bus admittance matrix Ybus.
2. Outline of SIM Power Systems toolbox in MATLAB
3. Analyze load flow using MiPower/MATLAB/ETAP.
4. Simulation of short circuit analysis using MiPower/MATLAB/ETAP.
5. Simulation of transient analysis using MiPower/MATLAB/ETAP.
6. Demonstration of unbalanced Fault using transmission line simulator (TLS)
7. Analyse symmetrical components of 3phase unbalanced system using MATLAB.
8. Development of the program for equal area criteria analysis using MATLAB.
9. Examination of swing curve using power world/ MiPower/MATLAB/ETAP simulation
10. Development of the MATLAB programm to calculate series compensation
11. Outline of MiPower/MATLAB/ETAP for power system analysis and stability.

12. Small signal stability analysis: measurement and analysis of system eigenvalues and damping ratios
13. Determination of critical clearing time for a transient stability event
14. Develop programme for Eigen value analysis of power system stability
15. Analysis of the dynamic response of the power system to disturbances
16. Analysis of power system oscillations in real world application
17. Simulation case studies and real-world applications for stability evaluation
18. Impact of surge impedance loading on high voltage transmission lines

Note: any eight to nine experiments will be conducted during practical

	Text Books
1	I.J. Nagrath and D.P. Kothari, “Power System Analysis”, 2nd Edition and TMH Publication 2015.
	References
1	Glover, Sharma, Overbye Power Systems Analysis and Design, Thompson, 5th Ed., 2012.
2	Hadi Saadat, Power System Analysis, TMH, 1st Edition, 2002.
3	Stevenson W.D., Elements of Power System Analysis, TMH, 4th Edition, 1994.
4	Power System Stability and Control" by Prabha Kundur
	Useful Links
1	**NPTEL Courses:** https://nptel.ac.in/
2	**Research Papers IEEE :** https://ieeexplore.ieee.org/
3	N. Hatziargyriou et al., "Definition and Classification of Power System Stability – Revisited & Extended," in IEEE Transactions on Power Systems, vol. 36, no. 4, pp. 3271-3281, July 2021, doi: 10.1109/TPWRS.2020.3041774.
4	Y. Cheng et al., "Real-World Subsynchronous Oscillation Events in Power Grids With High Penetrations of Inverter-Based Resources," in IEEE Transactions on Power Systems, vol. 38, no. 1, pp. 316-330, Jan. 2023, doi: 10.1109/TPWRS.2022.3161418.

CO-PO Mapping

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

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Syllabus Prepared By	Dr. Vijay Mohale
Syllabus Checked By	Mr. S. S. Medhekar

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AY 2025-26

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	7EL352
Course Name	Control System Engineering Lab
Desired Requisites:	Engineering Mathematics III, Signals and Systems, Electrical Circuit Analysis

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

Course Objectives

1	To inculcate in students the necessary software tools to create mathematical models of physical systems.
2	To cultivate software skills for evaluating system performance concerning stability, transient, and steady-state responses.
3	To assist students in comprehending the impact of feedback on various system parameters of a linear control system using appropriate simulation tools.
4	To familiarize students with various types of controller performance through hardware and software.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Construct mathematical models of linear systems with appropriate software tools.	III	Applying
CO2	Demonstrate the performance of linear system using suitable software tools.	III	Applying
CO3	Investigate the impact of feedback on various system parameters through hardware and software experiments.	IV	Analyzing
CO4	Analyze the performance of controllers on linear systems with both hardware and software tools.	IV	Analyzing

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Construct transfer function using software tools.
2. Analyze the effect of feedback using software and simulation tools.
3. Conversion of transfer functions to state space and vice versa using software tools
4. Calculate the transfer function of electrical, mechanical and rotational systems using MATLAB
5. Calculate the state transition matrix, state and eigen values for Electrical Systems.
6. Evaluate the transient response of first and second order systems.
7. Compute the controllability and observability of physical systems
8. Stability analysis of control system using software tools.
9. Sketch root locus and design compensator using G.U.I. and software tools.
10. Sketch Nyquist, bode diagram and design compensator using G.U.I. and software tools.
11. Design a PID controller for speed control of electric machine.

Textbooks

1	Norman Nise, "Control System Engineering", John Wiley, Sixth Edition, 2011.

2	I.J. Nagrath and M. Gopal, “Control System Engineering”, Anshan Publishers, Fifth edition, 2008.
References	
1	M Gopal, “Control System Principle & Design”, T.M.H., Fourth Edition, 2012.
2	K Ogata, “Modern Control Engineering”, P.H.I., Fourth Edition, 2002.
3	Dorf and Bishop, “Modern Control System”, Adison Wesley Longman, Eight Edition, 1998.
Useful Links	

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

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

Syllabus Prepared By	Mr. N.V. Patel
Syllabus Checked By	Dr. Mrs. A. S. Karvekar

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	7EL353
Course Name	Digital Signal Processing Lab
Desired Requisites:	Engineering Mathematics –III, Signals and Systems

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

Course Objectives

1	To develop basic knowledge of DSP systems and signal processing.
2	To develop basic knowledge of FFT and filter design.
3	To enable students to learn different modern signal processing tools.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Simulate different signals and study system analysis.	II	Understanding
CO2	Demonstrate DFT and FFT algorithms, multi rate signal processing techniques using Matlab	III	Applying
CO3	Examine response of FIR and IIR filter.	IV	Analysing
CO4	Design of IIR and FIR filter using MATLAB.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. To study concepts of discrete-time signal, sampling and aliasing.
2. To study the concept of convolution and correlation.
3. Simulation of z-transform analysis using MATLAB.
4. To study the frequency response of system.
5. To study DFT and IDFT algorithm.
6. To study circular convolution and linear filtering using MATLAB.
7. To design IIR Filter using IIM and BLT method.
8. To design IIR filter using Butterworth method.
9. To design IIR filter using FDA Toolbox.
10. FIR filter design and windowing.
11. FIR filter design and windowing using FDA Toolbox
12. To obtain illustration of upsampling and downsampling
13. To obtain illustration of frequency domain effect in upsampling and downsampling.
14. Introduction to DSP processor and CCS simulating environment.
15. DSP processor based simulating examples in signal processing.

Textbooks

1	John G, Proakis' Digital Signal Processing ¬Principles, Algorithms and Applications', Pearson Education, 2008
2	Sanjeet Mitra, 'Digital Signal Processing', TMH Pub., 2006
3	Oppenheim and R. W. Schafer, 'Discrete Time Signal Processing' PHI Pub., 2005

References

1	Venkatramani, Bhaskar, 'Digital Signal Processors, TMH Pub., 2006
2	Raghuveer Rao, Bopardikar, 'Wavelet Transform', Pearson Education, 2000.
3	Li Tan,' Digital Signal Processing – Fundamentals and Applications', Elsevier, 2008
Useful Links	
1	https:// nptel.ac.in/courses/108/101/108101174/
2	https://nptel.ac.in/courses/117102060

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

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

Syllabus Prepared By	Mr. A. B. Patil
Syllabus Checked By	Mr. A. N. Inamdar

Semester- VI
Professional Core Theory Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	7EL321
Course Name	Industrial Drives and Control
Desired Requisites:	DC Machines and Transformer, AC Machines and Power Electronics

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

Course Objectives

The course aims to provide students with a fundamental understanding of the dynamics and control of electric drives. It focuses on strengthening their grasp of control principles applicable to various DC and AC motors through the use of solid-state converters. Additionally, the course covers the essential principles involved in the selection of electric motors and highlights the practical applications of electrical drives in different industrial and engineering scenarios.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Explain the various concepts used in Electric drives.	II	Understanding
CO2	Apply the control techniques for DC drives for speed control.	III	Applying
CO3	Apply the control techniques for AC drives for speed control.	III	Applying
CO4	Analyse the performance of various control techniques used in speed control of electric drives and select a drive for particular application.	IV	Analysing

Module	Module Contents	Hours
I	**Fundamentals of Electric Drives** Types & parts of the Electrical drives, selection criteria of 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** Methods of speed control, starting and braking operation, single phase and three phases 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	4
III	**Induction Motor Drives** Torque equation, speed control methods for three phase squirrel cage induction motor, braking methods, stator voltage control induction motor drive, VSI fed induction motor drive, constant torque (constant E/F and constant V/F), constant HP operation, closed loop speed control block diagram, Stator current control methods fed induction motor drive.	6

IV	**Slip Ring Induction Motor Drives** 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	4
V	**Synchronous Motor Drives and Brushless DC Motor Drives** Torque Equation, 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.	4
VI	**Special Drives** Construction and operating principle of switched reluctance motors, current / voltage control, torque equation, converter circuits, operating modes and applications of switched reluctance motors. Solar panel VI characteristics, solar powered pump, maximum power point tracking and battery-operated vehicles.	4

Textbooks	
1	"Fundamentals of Electrical Drives", G. K. Dubey, Narosa publication, 2nd edition.
References	
1	"Fundamentals of Electrical Drives", NPTEL video lecture series by Prof. Shyama Prasad Das, Department of Electrical Engineering, IIT Kanpur.
2	"Power Electronics - Converter Application", By N. Mohan T.M. Undel and W. P. Robbins, John Wiely and sons.
3	"Electrical Drives - Concept and application", Vedam Subramanyam.
Useful Links	
1	https://nptel.ac.in/courses/108/104/108104140/

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	Seema P Diwan
Syllabus Checked By	Dr. D S More

Walchand College of Engineering, Sangli

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AY 2025-26

Course Information	
Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	7EL322
Course Name	Microcontroller and Applications
Desired Requisites:	Analog and Digital Circuits

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

Course Objectives

1	To develop basic knowledge of microcontrollers and their features.
2	To provide skills for programming microcontroller for applications in electrical engineering.
3	To impart hands-on experience in interfacing microcontrollers with external peripherals
4	To introduce advanced microcontroller families such as ARM, PIC,MSP430 and understand their features and architectures.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Describe the architecture and features of microcontrollers.	II	Understanding
CO2	Develop and debug programs to implement counters, timers, interrupts and other peripherals.	III	Applying
CO3	Construct various applications to interface microcontrollers with electrical and electronics systems.	IV	Analyzing
CO4	Evaluate real-time simulations using microcontrollers for applications in power electronics and automation use-cases	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Microcontroller Basics** Overview of 8051, features, architecture, pin out and pin functions, program memory, data memory, SFRs, PSW, port structure, clock circuit, addressing modes, reset circuits, introduction to IDEs for programming	6
II	**Programming ports and timers** Introduction to embedded C programming, Basic I/O programming , development tools for 8051 programs, programming timers and counters Timer block diagram and function, timer modes, timer and counter programming	7
III	**Interrupts and Serial Communication** Interrupt structure, writing ISR, interrupt, interrupt priorities, programming for external interrupt, programming timer interrupts, serial communication: serial communication modes, RS232 signals of PC, programming through serial communication	6
IV	**Peripheral Interfacing- I** Basics of Arduino microcontrollers, interfacing of microcontrollers to external peripherals and programming, analog to digital converters, interfacing digital and analog sensors, LCD interfacing, stepper motor interfacing, interfacing temperature sensors	7

V	**Peripheral Interfacing- II** DC motor interfacing, interfacing current an voltage sensors, PWM programming using microcontrollers, use of Arduino in power electronics applications, relay interfacing, programming examples	7
VI	**Introduction to Advanced microcontrollers** Concept of hardware-in-loop simulation, Use of Matlab/Simulink for real-time simulations using microcontrollers, introduction to DSP microcontrollers and architectures, overview and features	6

Textbooks	
1	Muhammad Mazidi, Janice Mazidi and Rolin McKinlay, 'The 8051 Microcontroller and Embedded systems using Assembly and C', Pearson Education, 2nd Edition, 2007
2	Kenneth Ayala ,'8051 Architecture, Programming and Applications', 3rd Edition, 2007
3	Massimo Banzi and Michael Shiloh, Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform, Shroff/Maker Media; 3rd edition, 2014

References	
1	Subrata Ghoshal, 'Embedded Systems and Robots- Projects using the 8051 Microcontroller', Cengage Learning, 1st Edition, 2009
2	Michael Margolis, 'Arduino Cookbook', Shroff/ O'Reilly,2nd Edition, 2012
3	Andrew N. Sloss, 'Arm System Developer's Guide: Designing and Optimizing System Software', Elsevier Publication, 2005
4	Texas Instruments MSP 430 microcontroller: Guide and Datasheets

Useful Links	
1	https://nptel.ac.in/courses/106/108/106108100/
2	https://nptel.ac.in/courses/117/104/117104072/
3	https://nptel.ac.in/courses/108/102/108102045/

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	Dr. S. S. Karvekar
Syllabus Checked By	Ms. N. B. Jagtap

Walchand College of Engineering, Sangli

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AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	7EL323
Course Name	Power System Protection
Desired Requisites:	Power System Engineering

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

Course Objectives

1	To teach need for power system protection and basic principles of circuit breakers and relays.
2	To discuss protection of feeders, transmission lines, transformers, generators and their implementation using electromagnetic & microprocessor based relays.
3	To discuss causes of over voltages in power system and protection against these over voltages.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	**Describe** basic principles & working of circuit breakers & fuses	II	Understanding
CO2	**Classify** the requirements of protection for different parts of a power system	III	Applying
CO3	**Analyze** the performance of various protection devices	IV	Analyzing
CO4	Analyze various schemes for protection and select appropriate scheme.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Over Current Relays** Need of protection, classification and brief explanation of various types of relays, electromagnetic relays, over current relays, differential relays, directional relays, drawbacks of over current schemes, distance relays	6
II	**Arc Interruption Process** Voltage - current characteristics of arc, principles of DC and AC arc interruption, high resistance and current zero interruption, arc voltage, transient Re-striking Voltage (TRV), recovery voltage, RRRV	6
III	**Circuit Breakers & Fuses** Classification of circuit breakers, brief study of construction and working of sir break and air blast CB, SF6 and vacuum CB, HVDC breakers, ratings of CB, Fuses	4
IV	**Protection of Transformer Generator and Bus Bar** Circulating current differential protection, percentage differential protection of power transformers, through fault stability, effect of magnetizing inrush, effect of over voltage inrush, buchholz relay.	4
V	**Protection of Transmission Line** Over current protection of transmission lines, distance relay protection of transmission lines, effect of arc resistance, and power swing on relay operation, carrier aided protection of transmission line.	4

VI	**Protection of Generator and Bus Bar** Differential protection of generator, stator and rotor protection schemes of generator, loss of excitation, bus bar protection.	4

Textbooks	
1	S.S. Rao, *"Switchgear & Protection"*, Khanna Pub., XI edition, 2005.
2	B.Ram & Vishwakarma, *"Power System Protection & Switchgear*", TMH Pub., III edition, 2008.
References	
1	Oza, Nair, Mehta & Makwana*," Power System Protection & Switchgear",* MGH pub., 2011.
2	C.R. Mason, *"Art & Science of Protective Relaying",* GE e-book.
3	Y.G. Paithankar & S.R. Bhide, *"Fundamentals of Power System Protection",* PHI pub., I edition, 2004.
Useful Links	
1	https://nptel.ac.in/courses/108/101/108101039/

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	S. L. Shaikh
Syllabus Checked By	A. A. Dhamangaokar

Professional Core Laboratory Courses

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	7EL371
Course Name	Industrial Drives and Control Lab
Desired Requisites:	DC Machines and Transformer, AC Machines and Power Electronics

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

Course Objectives

The primary objective is to impart comprehensive knowledge on the performance of fundamental control practices associated with AC and DC machines, including starting, reversing, braking, and plugging, particularly through the application of solid-state converters. Additionally, the aim is to develop the necessary skills for utilizing computer-based analysis tools to evaluate the major classes of electrical machines. This includes understanding their physical principles of operation and assessing their suitability for various practical applications.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Demonstrate basic experiments on DC and AC drives	III	Applying
CO2	Apply the concepts of DC and AC drives to construct and implement hardware and simulation models for analysing their performance under various operating conditions.	III	Applying
CO3	Analyse the performance of electrical drives using hardware circuits and simulations	IV	Analysing
CO4	Evaluate the effectiveness of drive systems under various operating conditions.	V	Evaluating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Analyze the performance of chopper fed D. C. drive for closed – loop speed control (simulation).
2. Demonstrate operation and application of single-phase full wave, half controlled converter for open loop speed control of D. C. shunt motor. (Hardware).
3. Demonstrate operation and application of single-phase full wave, full controlled converter for open loop speed control of D. C. shunt motor. (Hardware).
4. Analyze the performance of converter fed D. C. drive for closed loop speed control. (Simulation).
5. Study the operation of two quadrant single phase converter fed 5 HP DC drive (Simulation).
6. Study the four-quadrant operation of 5 HP DC motor using single phase converter. (Simulation).
7. Assess the performance of rotor resistance control method for speed control of Slip – Ring Induction motor. (Simulation)
8. Demonstrate speed control of induction motor using V/f method. (Hardware)
9. Analyze the operation of induction motor drive with Six – step VSI control (Simulation).
10. Demonstrate the operation of brushless DC motor drive with software Simulation. (Simulation)
11. Simulate Stator Voltage Control based Speed Control of Induction Motor (Proteus Simulation)
12. Simulate maximum power point (MPP) tracking of solar panels (Proteus Simulation)
13. Simulation of speed control of AC and DC drives (Simulation)
14. Demonstrate operation and application of single-phase full wave, full controlled converter for open loop speed control of D. C. shunt motor. (Simulation).

Textbooks	
1	"Fundamentals of Electrical Drives", G. K. Dubey, Narosa publication, 2nd edition.

References	
1	"Electrical Drives - Concept and application" Vedam Subramanyam.
2	"Power Electronics - Converter application" By N. Mohan T.M. Undeland and W. P. Robbins, John Wiley and sons
3	"Modern Power Electronics and AC drives" by B. K. Bose, Prentice Hall of India Pvt. India

Useful Links	
1	https://nptel.ac.in/courses/108/104/108104140/

CO-PO Mapping

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

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30

Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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

Walchand College of Engineering, Sangli

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AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	7EL372
Course Name	Microcontroller and Applications Lab
Desired Requisites:	Analog and Digital Circuits Lab

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

Course Objectives

1	To develop the necessary skills required for programming 8051 and Arduino microcontroller to implement real world applications.
2	To enable students to understand and apply Embedded C programming techniques for implementing basic input/output operations, port programming, and timer/counter functionalities
3	To understand the practical problems in electrical systems and implement programs for same.
4	To introduce various programming software's and implement microcontroller based applications.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	**Use** simulation tools to analyze microcontroller based systems.	III	Applying
CO2	**Apply** programming techniques to implement counters, timers, interrupts and other peripherals.	III	Applying
CO3	**Evaluate** programming techniques to interface microcontrollers with electrical and electronics systems.	V	Evaluating
CO4	**Create** programs for electrical applications using microcontrollers.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Demonstration of different development boards and introduction to IDE: Keil/Arduino IDE, deploying and executing the programs
2. Demonstrate the flashing of GPIO ports using delay routine.
3. Implementation of 8-bit up/down counters using microcontroller.
4. Devise a running light scheme using GPIO pins of microcontroller.
5. Demonstrate the process of serial communication using 8051 and Arduino microcontroller
6. Construct a C program using 8051 to generate pulses using various timer modes
7. Execute programs to demonstrate interrupts for 8051.
8. Construct a C program to interface LCD with Arduino.
9. Design an Arduino based relay control for single phase ac loads.
10. Construct a C program to interface stepper motor with Arduino.
11. Construct a temperature control system using Arduino
12. Demonstration of hardware-in-loop simulation using Arduino and MATLAB /Simulink

Textbooks

1	Muhammad Mazidi, Janice Mazidi and Rolin McKinlay, "*The 8051 Microcontroller and Embedded systems using Assembly and C"*, Pearson Education, 2nd Edition, 2007

2	Kenneth Ayala , "*8051 Architecture, Programming and Applications"*, 3rd Edition, 2007
3	Massimo Banzi and Michael Shiloh, Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform, Shroff/Maker Media; 3rd edition, 2014
References	
1	Subrata Ghoshal, "*Embedded Systems and Robots- Projects using the 8051 Microcontroller"*, Cengage Learning, 1st Edition, 2009
2	Michael Margolis, "*Arduino Cookbook"*, Shroff/ O'Reilly,2nd Edition,2012
Useful Links	
1	https://nptel.ac.in/courses/106/108/106108100/
2	https://nptel.ac.in/courses/117/104/117104072/
3	https://nptel.ac.in/courses/108/102/108102045/
4	https://www.arduino.cc/

CO-PO Mapping

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

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Syllabus Prepared By	Dr .S. S. Karvekar
Syllabus Checked By	Ms. N. B. Jagtap

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	7EL373
Course Name	Power System Protection Lab
Desired Requisites:	Power System Engineering

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

Course Objectives

1	To develop hands on skills to test and verify protective relay operation, used in power system protection
2	To demonstrate electromagnetic and digital relays to illustrate their operating characteristics
3	To experience to use power system analysis software for developing protection schemes for simple electrical systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	**Demonstrate** the working of over current, earth fault relays and plot the I-V characteristics	III	Applying
CO2	**Execute** experimental study of a numerical relay.	III	Applying
CO3	**Execute** experimental study on virtual labs	III	Applying
CO4	**Design** a scheme for over current relay co-ordination using simulation software / hardware.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Experiments:

1. Arrange the set-up & perform an experiment to verify the current-time characteristics of over current relay.
2. Arrange the set-up & perform an experiment to verify the current-time characteristics of a shaded pole type earth fault relay.
3. Arrange the set-up & perform an experiment to demonstrate the operation & use of directional over current relay.
4. Assemble a circuit to obtain & verify various Current-Time curves for Digital over Current Relay.
5. Demonstrate the application of quadrilateral distance relay for detection of fault on transmission lines.
6. Conduct a simulation study to develop relay co-ordination scheme of over current relays for a simple radial feeder system.
7. Conduct an experiment to illustrate the over current relay co-ordination on the transmission line simulator.
8. Conduct a simulation study to explain the circuit breaker operation under fault condition.
9. Arrange the set-up & perform an experiment to demonstrate the operation & use of earth fault relay.
10. Arrange the set-up & perform an experiment to demonstrate the operation & use of numerical relay.
11. Arrange the set-up & perform an experiment to demonstrate the operation & use of miniature circuit breaker.

1	S.S. Rao, *"Switchgear & Protection",* Khanna Pub., XI edition, 2005
2	B.Ram and Vishwakarma, *"Power System Protection & Switchgear",* TMH Pub., III edition, 2008.
References	
1	Oza, Nair, Mehta and Makwana, *"Power System Protection and Switchgear"*, MGH pub., 2011.
2	C.R. Mason, *"Art and Science of Protective Relaying",* GE e-book.
3	Y.G. Paithankar and S.R. Bhide, *"Fundamentals of Power System Protection",* PHI pub., I edition, 2004.
Useful Links	
1	https://nptel.ac.in/courses/108/101/108101039/

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

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

Syllabus Prepared By	Mrs. S. L. Shaikh
Syllabus Checked By	Mrs. A. A. Dhamangaokar

Program Elective - 1

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information	
Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	7EL331
Course Name	Professional Elective 1: Electromagnetic Fields
Desired Requisites:	Electrical Circuits, DC Machines, and Transformers

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

Course Objectives	
1	This course develops foundational concepts in electromagnetic fields.
2	It familiarizes the students with the working principles of electrical devices, sensors, and actuators using principles of electromagnetics.
3	Exposure to the theory and procedure of a numerical technique, finite element method, will be given to solve simple two-dimensional problems associated with electrical machines and equipment.
4	This course will help students prepare for competitive examinations (e.g., GATE).

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain the fundamental principles of electromagnetic fields.	II	Understanding
CO2	Apply the fundamentals to understand the working principles of electrical machines and equipment.	III	Applying
CO3	Understand how the Finite Element Method (FEM) can be used to analyze and estimate performance parameters of electrical machines and equipment.	IV	Analyzing
CO4	Consolidate the learning by solving practical issues and problems encountered in electrical engineering by analytical formulae and FEM through assignments and simulations.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Vector Analysis** Scalars and vectors, addition and subtraction of vectors, dot product, cross product, coordinate systems (Cartesian, cylindrical, and spherical), del operator, gradient of a scalar field, divergence of a vector field, divergence theorem, curl of a vector field, Stoker's theorem, Laplacian of a scalar.	6
II	**Electrostatics** Coulomb's law and electric field intensity, comparison of electrostatic force with other fundamental forces of nature, electric flux density, Gauss's law and its applications, electric potential, electric dipole, energy density, conductors and dielectrics in electrostatic fields, polarization in dielectrics, dielectric constant, boundary conditions, electrical field and capacitance calculations using analytical techniques. Applications: Capacitive fuel-level sensors, inkjet printers, design of a multi-dielectric insulation system, cathode ray oscilloscope, Faraday's cage for earthing and safety in HV laboratories, electrostatic actuators, charge distribution and electric stress equalization in condenser bushings, parasitic capacitances (of windings, PCB layouts, etc.) and their estimation.	7

III	**Steady Electric Current and Magnetostatic Fields** Steady electric current, conduction and convection currents, continuity equation and relaxation time, magnetic flux density and magnetic field intensity, Biot-Savart's law, ampere's circuital law, current densities (line, surface, and volume), magnetic scalar and vector potentials, Poisson's equation in magneto-statics, magnetic energy density, analytical calculation of inductances of solenoids and toroid's, Maxwell's equations for static EM fields, analogy between electric and magnetic fields. Applications: Magnetic Resonance Imaging (MRI), magnetic storage devices, Nuclear Magnetic Resonance (NMR), magneto-resistive sensors.	6
IV	**Magnetic Forces and Materials** Lorentz force equation, magnetic torque and moment, magnetic dipole, magnetization in materials, classification of magnetic materials, B-H characteristics of ferromagnetic materials and permanent magnets, magnetic boundary conditions, magnetic circuits, and reluctances. Applications: magnetic levitation, forces and torques in electrical machines, hall effect sensors, loudspeakers, electromagnets for industrial lifting, electromagnetic pumps, magnetic actuators and relays, magnetic bearings.	7
V	**Maxwell's Equations** Faraday's law, transformer and motional EMF, displacement current, Lorentz gauge, pointing vector and theorem, diffusion equation, theory of eddy currents, skin and proximity effects, dimensioning of conductors at high frequencies, variation of inductances and resistances with frequency. Applications: working principles of transformers and AC machines, induction heating, wireless charging for EVs, electromagnetic railguns, electromagnetic shielding using Faraday's cage.	7
VI	**Finite Element Method and Applications** Introduction and principles of numerical techniques, procedure of Finite Element Method, solution of Laplace's equation in electrostatics, solution of Poisson's equation in magneto-statics, solution of diffusion equation in case of time varying fields. Tutorials of FEM analysis of electrical machines/ equipment using commercial or freeware software: calculation of inter-turn capacitances, estimation of maximum electric stress in insulation, calculation of self and mutual inductances between coils, computation of leakage inductances of transformers and slot leakage inductances in rotating machines, determination of torque-speed characteristics of induction motors, analysis of eddy currents (calculation of AC resistance of a current carrying conductor and analysis of eddy currents in a metallic plate in vicinity of a time-varying current source).	6
Textbooks		
1	M.N.O. Sadiku and S.V. Kulkarni, *Principles of Electromagnetics*, Sixth Edition, Oxford University Press, India, 2015 (Asian adaptation of 'M.N.O. Sadiku, *Elements of Electromagnetics*, Sixth International Edition, Oxford University Press').	
2	W.H. Hayt, J.A. Buck, and M.J. Akhtar, *Engineering Electromagnetic*s, McGraw-Hill, 8th Edition, 2014.	
3	A. Pramanik, *Electromagnetism: Theory and Applications*, PHI Learning, 2008.	
References		
1	J. A. Edminster, *Electromagnetics*, Tata McGraw-Hill, 2nd Edition. 2010.	
2	John D. Kraus and D. A. Fleisch, *Electromagnetics with Applications*, McGraw-Hill, 5th Edition, 1999.	
3	N. Ida, *Engineering Electromagnetics*, Springer, 2015.	
Useful Links		

1	https://nptel.ac.in/courses/108101167- Prof. S.V. Kulkarni, Electrical Equipment and Machines: Finite Element Analysis, IIT Bombay.
2	https://www.youtube.com/playlist?list=PLUdYlQf0_sSsfcNOPSNPQKHDhSjTJATPu – Lectures 1 to 24 by Walter Lewin, MIT Physics II: Electricity and Magnetism 8.02x.
3	https://www.ee.iitb.ac.in/course/~vel/ - Virtual Electromagnetics Laboratory, Electrical Engineering Dept, IIT Bombay.

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	Dr. V. P. Mohale
Syllabus Checked By	Mr. A. N. Inamdar

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B. Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	7EL332
Course Name	Professional Elective 1: Energy Audit and Management
Desired Requisites:	Nil

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

Course Objectives

1	To develop skills for energy auditing and energy management in industrial environment
2	To create awareness in the students about energy conservation and its importance.
3	To study energy efficiency in electrical utilities
4	To study energy management in Smart grid

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	**Explain** energy conservation, its importance and necessity of Energy audit.	II	Understanding
CO2	**Describe** the methods and different instruments used for energy audit	II	Understanding
CO3	**Calculate** the financial analysis for energy economics	III	Applying
CO4	**Analyse** energy performance in electrical System	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Energy Conservation and Management** Energy Conservation and its importance, Energy strategy for future, Energy Conservation Act 2001 and its features, energy pricing, energy sector reforms, energy and environment, energy security, objectives and principles of energy management.	6
II	**Energy Audit** Energy audit definition as per EC-act 2001, need of energy audit, types of energy audit, energy audit reporting format, understanding energy and costs, benchmarking, energy performance, energy audit instruments, duties and responsibilities of energy auditor and case studies	7
III	**Energy Action Planning, Monitoring And Targeting** Energy action planning steps, top management support, energy manager duties & responsibilities, evaluating energy performance, energy monitoring & targeting – set up, key elements, CUSUM technique,	7
IV	**Energy Economics** Financial analysis techniques – payback period, net present value, return on investment, internal rate of return, time value of money, cash flow, risk & sensitivity analysis.	6

V	**Energy Efficiency in Electrical Utilities** Electricity billing, electrical load management and maximum demand control, power factor improvement & benefits, assessment of transmission and distribution losses, estimation of technical losses in distribution system, commercial losses, energy saving opportunities with pumps and fans.	7
VI	**Energy management in Smart Grid** Conventional power systems and smart grid, definition of smart grid, need for smart grid, smart grid architecture, advanced distributed generations for renewable energy	6
Textbooks		
1	Amlan Chakrabarti, "Energy Engineering and Management", PHI, 2011	
References		
1	Bureau of Energy Efficiency, "General Aspects of Energy Management & Energy Audit1.1, 1.2 &1.3", BEE, e-books.	
2	A. Mahaboob Subahani, G. R. Kanagachidambaresan, M. Kathiresh, Integration of Renewable Energy Sources with Smart Grid, Willey, 2021	
Useful Links		
1	https://beeindia.gov.in/content/energy-auditors	

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	Mr. M. S. Mahagaonkar
Syllabus Checked By	Dr. Vijay P. Mohale

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information	
Programme	B.Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	7EL333
Course Name	Program Elective 1: Nonlinear and Digital Control System
Desired Requisites:	Control System Engineering

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

Course Objectives

1	To enable students to recognize diverse attributes of nonlinear systems.
2	To cultivate students' abilities in the analysis of nonlinear systems.
3	To familiarize students with the modeling and analysis of digital control systems.
4	To impart to students the principles of digital controller design.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Examine the characteristics of the nonlinear system with a range of fundamental and widely employed tools.	IV	Analysing
CO2	Calculate mathematical representations of digital control systems in both time and frequency domains.	III	Applying
CO3	Analyze the transient and steady-state responses, as well as the stability, of a discrete-time control system**.**	IV	Analyzing
CO4	Assess the design of a controller for a discrete-time control system.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Nonlinear System** Properties of nonlinear system, multiple equilibrium states, chaos, sensitive to input amplitude, limit cycle, bifurcation, jump phenomenon, common physical nonlinearities, dead zone, saturation, hysteresis, backlash, classification of nonlinearities	5
II	**Analysis of Nonlinear System** Linearization, phase plane analysis, classification of equilibrium states, node, focus, saddle point, centre, prediction of limit cycle using phase Plane, limit cycle theorem, lyapunov stability for non-linear and linear systems.	7
III	**Digital Control System** Review of Z transforms, Z transform method for solving difference equation, impulse sampling and data hold, pulse transfer function, sampling theorem, mapping between S plane and Z plane, stability analysis, transient and steady state analysis.	7
IV	**Design of Digital Control System** Construction of root locus, design based on root locus, P, PI, PD, PID controllers, lead, lag, lead-lag compensators, frequency response analysis, bode diagram.	8

V	**State Space Analysis of Digital Control System** State space representation of digital system, controllable canonical form, observable canonical form, diagonal form, Jordan form, solving state Space equations, state transition matrix, properties of state transition matrix, pulse transfer function matrix, discretization of continuous time state space equation.	6
VI	**State Space Design of Digital Control System** Controllability, controller design in state space, design via pole placement for controller design, Ackermann's formula for controller design, observability, observer design, design via pole placement for observer design, Ackermann's formula for observer design, deadbeat design, design for deadbeat response	6

Textbooks	
1	K. Ogata, "Discrete Time Control Systems", Second Edition, Pearson Education, 2005, ISBN: 9788120327603
2	C.L. Phillips, J.M. Parr, "Feedback Control Systems", Fifth Edition, Pearson Education,2013, ISBN: 9789332507609
References	
1	I.J. Nagrath, M.Gopal "Control Systems Engineering", New Age International, Sixth Edition, 2018, ISBN: 9789386070111
2	B.C. Kuo, "Digital Control Systems", Oxford University Press, Second Edition, 2012, ISBN: 9780198083542
Useful Links	
1	https://nptel.ac.in/courses/108/106/108106162/
2	https://nptel.ac.in/courses/108/102/108102113/

CO-PO Mapping

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

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

Assessment

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

Syllabus Prepared By	Mr. N.V. Patel
Syllabus Checked By	Dr. Mrs. A. S. Karvekar

VESC Laboratory Course

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B.Tech. (Electrical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	7VSEL371
Course Name	Mini-Project
Desired Requisites:	-

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

Course Objectives

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

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	**Understand** the basics concepts used in Mini Project.	III	Understanding
CO2	**Analyse** and infer the reference literature critically and efficiently.	IV	Analysing
CO3	**Construct** the model of the project.	VI	Creating
CO4	**Evaluate** the performance of the project.	V	Evaluating
CO5	**Write and Present** the report of the project.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Visit to a local industry or search for the study of problems of industry.
2. Prepare the problem based hardware Mini project.
3. Evaluate the performance of project.
4. Prepare a report on the same.

Note :

Student will have to perform a group project based on above points which will be evaluated as In Semester Examination (LA1, LA2 and Lab ESE).

Textbooks

References

Useful Links

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						3			1					
CO2		3							3				2	2
CO3	1		3								2			
CO4				2	3		2					2		
CO5								2	3	3				
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.														

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

Syllabus Prepared By	Dr. Mrs. A. S. Karvekar
Syllabus Checked By	Mrs. A. A. Dhamangaonkar