# SEM V

# Professional Core (Theory)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL301 |
| **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 |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Power Flow Analysis**<br>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**<br>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. | 6 |
| III | **Fault Analysis: Balanced Fault**<br>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**<br>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**<br>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**<br>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. | 7 |

| **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** | 2 | | | | | | | | | | | | 2 | |
| **CO2** | | 3 | | | | | | | | | | | 2 | |
| **CO3** | | 2 | | | 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.<br>MSE shall be typically on modules 1 to 3.<br>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.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL302 |
| **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 impart knowledge for modeling physical systems. |
| **2** | To analyze physical systems using various time and frequency domain methods. |
| **3** | To enable students for determining the stability of linear systems using different methods. |
| **4** | To introduce the use of state space method for system analysis. |

**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 system transfer function and system characteristics of different Systems. | III | Applying |
| **CO2** | Analyze performance of physical systems using mathematical models. | IV | Analysing |
| **CO3** | Check the stability of linear systems in time and frequency domain. | V | Evaluating |

| Module | Module Contents | Hours |
|---|---|---|
| I | **Analysis of System in Frequency Domain**<br>History of control systems, Laplace transforms review, transfer function of Electrical systems, Mechanical systems, Rotational Systems, Electrical circuit analogs, Transfer function of DC motor | 6 |
| II | **Analysis of System in Time Domain**<br>State space representation, Converting transfer function to state space: Phase Variable Form, State space to transfer function, State Transition Matrix, Solutionof state equation, Controllability, Observability. | 7 |
| III | **Transient Response and Reduction of multiple subsystem**<br>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 | **Steady State Error**<br>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. | 4 |
| V | **Stability Analysis: Routh Criterion and Root Locus**<br>Routh criterion for stability and stability in state space, 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. | 7 |
| VI | **Stability Analysis: Bode Plot and Nyquist Plot , Compensators**<br>Bode plot, Nyquist criterion, 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 | | | | | | | | | | | | |
| **CO2** | | 3 | | | | | | | | | | | | 2 |
| **CO3** | | 3 | | | | | | | | | | | | 2 |

| **Assessment** |
|---|
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>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.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Walchand College of Engineering, Sangli

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**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL303 |
| **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 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** | Apply the signal processing tools and transforms. | III | Applying |
| **CO2** | Apply different techniques for Filter design | III | Applying |
| **CO3** | Explain modern signal processing tools and algorithms. | II | Understanding |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Digital Signals and Systems-** Sampling, transfer function and frequency response, Digital system's response to different inputs. | 6 |
| II | **Discrete Fourier Transform-** DFT, Relation between DFT & Z- Transform, Circular convolution and DFT, FFT Algorithms –DIT-FFT and DIF-FFT, Overlap save algorithm, overlap add algorithm. | 7 |
| 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, frequency sampling methods, quantization and realization. | 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-**<br>Up-sampling and down-sampling time and frequency effects, aliasing and imaging effects, Applications. | 6 |
| | | |
| **Textbooks** | | |
| 1 | John G, Proakis' Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, 2008. | |
| 2 | Sanjeet Mitra, 'Digital Signal Processing', The MIT Press, 2007. | |
| 3 | Venkatramani, Bhaskar, 'Digital Signal Processors', TMH Pub., 2006. | |
| | | |
| **References** | | |
| 1 | Oppenheim and R. W. Schafer, 'Discrete Time Signal Processing' PHI Pub., 2005 | |
| | | |
| **Useful Links** | | |
| 1 | https://nptel.ac.in/ | |

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

| **Assessment** |
|---|
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>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.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Professional Core
# (Lab)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

## Course Information

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL351 |
| **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 provides 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 |

## 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 | | | | | | | | | 2 | |
| **CO2** | | | 2 | | 3 | | | | | | | | 2 | |
| **CO3** | | | 2 | 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.<br>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<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>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<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL352 |
| **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 provide practical knowledge regarding modelling of different physical systems. |
| **2** | To impart skills to evaluate the performance of systems using transient analysis. |
| **3** | To estimate the stability of linear 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** | Solve and analyze physical systems using simulation tools. | III | Applying |
| **CO2** | Assess the stability of systems using frequency domain techniques. | IV | Analyzing |
| **CO3** | Study transient analysis of physical systems. | IV | Analyzing |

**List of Experiments / Lab Activities**

**List of Experiments:**

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.

**Text Books**

| | |
|---|---|
| 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 | | | | | | | | | | | |
| **CO2** | | | | 3 | | | | | | | | | | 2 |
| **CO3** | | | | 3 | | | | | | | | | | 2 |

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

**Assessment**

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

| Assessment | Based on | Conducted by | Typical Schedule | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 8<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>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<br>Marks Submission at the end of Week 19 | 40 |

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

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

## Course Information

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL353 |
| **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** | Apply the signal processing tools and transforms. | III | Applying |
| **CO2** | Apply different techniques for Filter design | III | Applying |
| **CO3** | Explain modern signal processing tools and algorithms. | II | Understanding |

## List of Experiments / Lab Activities/Topics

**List of Lab Activities:** Minimum 10-12 experiments using Matlab and DSP kit with reference to following list-

1. Generation and convolution of DT signals.
2. Digital frequency and aliasing effect in sampling.
3. Frequency response and magnitude, phase plot of system.
4. Response of system to standard test signals.
5. DFT and IDFT computation and magnitude, phase plot.
6. Circular convolution and comparison with linear convolution.
7. IIR filter design.
8. FIR filters design.
9. IIR and FIR filter design using toolbox.
10. Multirate signal processing-up and down sampling and Frequency domain effects.
11. Multirate signal processing- anti- imaging and antialiasing filter.
12. DSP processor- Linear and circular convolution.
13. DSP processor- Difference equation and impulse response.
14. DSP processor- Implementation of filter.

## Textbooks

| | |
|---|---|
| 1 | John G, Proakis' Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, 2008. |
| 2 | Sanjeet Mitra, 'Digital Signal Processing', The MIT Press, 2007. |

| | |
|---|---|
| 3 | Venkatramani, Bhaskar, 'Digital Signal Processors', TMH Pub., 2006. |
| | |
| **References** | |
| 1 | Oppenheim and R. W. Schafer, 'Discrete Time Signal Processing', PHI Pub., 2005 |
| | |
| **Useful Links** | |
| 1 | https://nptel.ac.in/ |

| **CO-PO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 3 | | | | | | | | | | | | | 2 |
| **CO2** | | | 3 | | | | | | | | | | | 2 |
| **CO3** | | | | | 3 | | | | | | | | | 2 |
| The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High<br>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.<br>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<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>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<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem I |
| **Course Code** | 6EL354 |
| **Course Name** | Presentation and Report Writing |
| **Desired Requisites:** | MS-Office |

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

**Course Objectives**

| | |
|---|---|
| **1** | To convey ethical guidelines during technical content preparation and showcasing |
| **2** | To make aware of soft tools for information handling |
| **3** | To provide various relevant benchmark case studies |
| **4** | To share rubric assessing reading, writing and presentation skills |

**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** | Follow ethical guidelines during technical writing and presentations | II | Understanding |
| **CO2** | Choose and practice tools for sharing and linking the information | III | Applying |
| **CO3** | Compare and identify suitable platforms towards practicing write-up and demonstrations | IV | Analysing |
| **CO4** | Discuss within groups to assess his/her own improvement in overall technical expressions | V | Evaluating |
| **CO5** | Create contented reports and meaningful presentations authoring the work | VI | Creating |

**List of Experiments / Lab Activities/Topics**

**List of Sessions:**

**PART - A Technical Report Writing**

1. **Session 1**: Writing technical reports using proper Tense and grammar.
2. **Session 2:** Study of various types of technical Reports
    a. Project report
    b. Conference paper
    c. Journal Paper
    d. Intellectual Property Rights (IPR)
    e. Selection of paper type for possible publication.
3. **Session 3**: Study of technical report Structure - I
    a. Preamble
    b. Abstract
    c. Literature review/survey
    d. Problem statement
    e. Objectives
4. **Session 4**: Study of technical report Structure – II
    a. Methodologies
    b. Results
    c. Discussions
    d. Conclusion
    e. Acknowledgements
5. **Session 5**: Use of Bibliographies/references and proper citations in reports.
6. **Session 6**: Use of Citations, referring style and method of using citations.
7. **Session 7**: Study of Plagiarism
    a. Checking plagiarism
    b. Minimizing plagiarism

**PART - B Presentation**

1. PPT's and Animations
2. Presentation structure, Number of slides and Time management
3. Presentation styles
4. Figures and Tables for data representations

**Part - C Tools and Practices**

1. MS Office, Open Office, Latex, MS Visio, Inkspace etc.
2. End Note; Mendeley, Grammarly, Ginger, 1 Checker, Turnitin etc.

| **Textbooks** | |
|---|---|
| 1 | Kothari C. R, *"Research Methodology"*, 2nd Edition, New Age International, 1990 |
| 2 | Chopra Deepak and Sondhi Neena, *"Research Methodology: Concepts and cases"*,2nd Edition, Vikas Publishing House, New Delhi,2015 |

| **References** | |
|---|---|
| 1 | Melville Stuart and Goddard Wayne, *"Research Methodology: An Introduction For Science & Engineering Students"*, 1st Edition, Kenwyn Juta & Co. Ltd., 1996 |
| 2 | G. Ramamurthy, *"Research Methodology"*, 2nd Edition, Dream Tech Press, New Delhi, 2015 |

| **Useful Links** | |
|---|---|
| 1 | Academic Research & Report Writing<br>https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview |
| 2 | Academic Writing<br>https://onlinecourses.swayam2.ac.in/cec21_ge18/preview |

| | |
|---|---|
| 3 | Qualitative Research Methods and Research Writing<br>https://onlinecourses.nptel.ac.in/noc21_ge12/preview |
| 4 | Effective Writing<br>https://onlinecourses.nptel.ac.in/noc21_hs44/preview |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | | | | | 1 | | 3 | | | | | | |
| **CO2** | | | | | 2 | | | | | | | | 1 | |
| **CO3** | | | | | 1 | | | | | 3 | | | | |
| **CO4** | | | | | | | | | 3 | 2 | | | | |
| The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High<br>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.<br>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<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>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<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Professional Elective 1

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2022-23**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL311 |
| **Course Name** | Professional Elective I: Electromagnetic Field |
| **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 electrostatic and electromagnetic fields. |
| **2** | It familiarizes the students with electrical field and scalar potential, magnetic field and vector potential, Maxwell's equations, Biot-Savart Law, electrostatic boundary conditions, time varying potential. |
| **3** | This course will 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** | **Catch** the concepts of electrostatic and electromagnetic fields. | II | Understanding |
| **CO2** | **Apply** various laws in electromagnetics to identify the nature and strength of electric and magnetic fields. | III | Applying |
| **CO3** | **Test** the boundary value conditions in electromagnetic fields. | IV | Analyzing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Vector Analysis**<br>Vector Algebra, Rectangular Coordinate System, Vector Component, Vector Field, Dot Product, Cross Product, Circular and Cylindrical Coordinate System, Vector Calculus, Del Operator, Gradient of Scalar, Divergence of Vector and Divergence Theorem, Curl of a Vector and Stroke's Theorem, Classification of Vector Fields. | 6 |
| II | **Electrostatic Fields**<br>Coulombs Law and Field Intensity, Electric Fields due to Continuous Charge Distributions, Electric Flux Density, Gauss's Law- Maxwell's Equation, Electric Potential, Relationship between E and V-Maxwell's Equation, Electric Dipole and Flux Lines, Energy Density in Electrostatic Fields. | **7** |
| III | **Electric Fields in Material Space**<br>Properties of Materials, Convection and Conduction Current, Conductors, Polarization in Dielectrics, Dielectric Constant and Strength, Linear , Isotropic and Homogenous Dielectrics, Continuity Equation and Relaxation Time, Boundary Conditions. | **6** |

| | | |
|---|---|---|
| IV | **Electrostatic Boundary-Value Problems**<br>Introduction, Poisson's and Laplace's Equations, Uniqueness Theorem, General Procedures for Solving Poisson's and Laplace's Equations, Resistance and Capacitance, Method of Images. | **7** |
| V | **Magneto Static Fields and Magnetic Forces**<br>Biot- Savart's Law, Ampere's Circuital Law-Maxwell's Equation, Application of Ampere's Law, Magnetic Flux Density-Maxwell's Equation, Maxwell's Equation for Static Fields, Magnetic Scalar and Vector Potentials. Introduction, Forces due to Magnetic Torque and Moment, Magnetic Dipole. | **7** |
| VI | **Maxwell's Equations**<br>Introduction, Faraday's Law, Transformer and Motional ElectromotiveForces, Displacement Current, Maxwell's equations in Final Forms, Time-Varying Potentials, Time Harmonic Fields. | **6** |

| **Textbooks** | |
|---|---|
| 1 | W.H. Hayt, J A Buck, M J Akhtar "Engineering Electromagnetic", McGraw Hill, 8th Edition 2014. |
| 2 | M. Sadiku, "Elements of Electromagnetics", Oxford University Press, 4th Edition 2007. |

| **References** | |
|---|---|
| 1 | Joseph A. Edminster, "Electromagnetics", Tata Mc Graw Hill, 2nd Edition. 2010 |
| 2 | John D. Kraus, "Electromagnetics", Tata Mc Graw Hill, 4th Edition 2006 |
| 3 | Jorden and Balmen, "Electromagnetic Wave and Radiation System" Pearson Publication 2nd Edition 2015. |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/108/106/108106073/ |

**CO-PO Mapping**

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

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL312 |
| **Course Name** | Professional Elective I : Linear Algebra |
| **Desired Requisites:** | Engineering Mathematics I |

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

**Course Objectives**

| | |
|---|---|
| **1** | To become computational proficiency involving procedures in Linear Algebra. |
| **2** | To understand the axiomatic structure of a modern mathematical subject and learn to construct simple proofs. |
| **3** | To solve problems that apply Linear Algebra to Economics and Engineering. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Apply mathematical methods involving arithmetic, algebra, geometry, and graphs to solve problems. | III | Applying |
| **CO2** | Analyze the solution set of a system of linear equations | IV | Analysing |
| **CO3** | Evaluate Engineering problems using the concept of Linear Algebra. | V | Evaluating |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Solving Linear Equations**<br>Vectors, The Idea of Elimination, Elimination Using Matrices, Rules for MatrixOperations, Inverse Matrices, Elimination = Factorization: A = LU, Transposes and Permutations | 4 |
| II | **Vector Spaces and Subspaces**<br>Spaces of Vectors, The Nullspace of A: Solving Ax = 0 and Rx = 0, The Complete Solution to Ax = b, Independence, Basis and Dimension, Dimensions of the Four Subspaces, Orthogonality, Orthogonality of the Four Subspaces. Projections, Least Squares Approximations, Orthonormal Bases and Gram-Schmidt ,The Properties of Determinants, Permutations and Cofactors, Cramer's Rule, Inverses, and Volumes, Review of Eigenvalues and Eigenvectors , Review of Diagonalizing a Matrix , Systems of Differential Equations , Review of Symmetric Matrices, Positive Definite Matrices, , | 7 |
| III | **The Singular Value Decomposition**<br>Image Processing by Linear Algebra, Bases and Matrices in the SVD, Principal Component Analysis (PCA by the SVD), The Geometry of the SVD, Linear Transformations, The Idea of a Linear Transformation , The Matrix of a Linear Transformation, The Search for a Good Basis . | 7 |

| | | |
|---|---|---|
| IV | **Complex Vectors and Matrices**<br>Complex Numbers, Hermitian and Unitary Matrices , The Fast Fourier Transform,. Matrices in Engineering, Markov Matrices, Population, Linear Programming, Fourier Series: Linear Algebra for Functions, Computer Graphics, Linear Algebra for Cryptography**.** | 8 |
| V | **Numerical Linear Algebra**<br>Gaussian Elimination in Practice , Norms and Condition Numbers, IterativeMethods and Preconditioners | 7 |
| VI | **Linear Algebra in Probability & Statistics**<br>Mean, Variance, and Probability, Covariance Matrices and Joint Probabilities, Multivariate Gaussian and Weighted Least Squares | 6 |

| **Textbooks** | |
|---|---|
| 1 | Gilbert Strang, "Linear Algebra and its Applications", Fourth Edition, Cengage Learning, 2005, ISBN: 9788131501726 |
| 2 | David C Lay, "Linear Algebra and its Applications", third Edition, Pearson Education,2002, ISBN: 8177583336 |
| **References** | |
| 1 | Kenneth M Hoffman, "Linear Algebra", Pearson Education, second Edition, 2015, ISBN: 9332550077 |
| 2 | Kuldeep Singh, "Linear Algebra", Oxford University Press, 2013, ISBN: 9780199654444 |
| **Useful Links** | |
| 1 | https://nptel.ac.in/courses/108/104/108104174/ |
| 2 | https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/ |

**CO-PO Mapping**

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

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

**Assessment**

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

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2022-23**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL313 |
| **Course Name** | Professional Elective I: Energy Storage Systems for EV |
| **Desired Requisites:** | Power Electronics |

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

**Course Objectives**

| | |
|---|---|
| **1** | This course 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 fuel cells and supercapacitors. |

**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 operation of various energy storage systems used for Electrical Vehicle applications | II | Understanding |
| **CO2** | **Analyse** the components and working of battery management system, fuel cells and supercapacitors to meet the performance criteria | III | Applying |
| **CO3** | **Investigate** the performance of different power electronic converters used in electric vehicles | IV | Analysing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction to Energy Storage Systems**<br>Introduction and need for storage for EV, Basics of vehicle mechanisms, history of electric vehicles (EV) and hybrid electric vehicles (HEV), need for and Importance of EV and HEV, classification of EV and HEV, Power/Energy supply requirements, traditional energy storage systems, global market and scenario, battery, fuel cell, supercapacitors, compressed air, hydrogen storage, fly-wheels, Comparison of different Energy Storage Systems. | 6 |

| | | |
|---|---|---|
| II | **Batteries**<br>Introduction to Batteries, Batteries Types and Battery Packs, Recent EVs and Battery Chemistries, Basic Battery Operation, Basic Electrochemistry, Lead-Acid Battery, Nickel-Metal Hydride, Lithium-Ion, Lithium-Ion Chemistries Units of Battery Energy Storage, Battery Parameters and Comparisons, Cell Voltage, Specific Energy, Cycle Life, Specific Power, Self-Discharge, Life time and Sizing Considerations, Examples of Battery Sizing, BEV Battery Sizing, PHEV Battery Sizing, Aging. Battery Models, applications of batteries, future developments. | 8 |
| III | **Converters for Batteries**<br>Introduction, Power Conversion–Common and Basic Principles, The Basic Topologies, The Buck or Step-Down Converter, Analysis of Voltage Gain of Buck Converter in CCM, Analysis of Buck Converter in CCM, BCM, DCM, Examples, The Boost or Step-up Converter, Analysis of Voltage Gain of Boost Converter in CCM, Analysis of Boost Converter in CCM, BCM, DCM, Examples, Power Semiconductors, Power Semiconductor Power Loss, Conduction Losses of IGBT and Diode, Examples , Passive Components for Power Converters, Example: Inductor Sizing, Capacitor Sizing, Interleaving, Example: Two-Phase Interleaved Boost Converter. | 7 |
| IV | **Battery Management System**<br>Objectives and functions of the BMS, SOC and DOD, charge controller, sensors in BMS, protection of batteries, CCCV, charging topologies, cell equalization, pulse power capability, dynamic power limits. | 6 |
| V | **Fuel Cells and its Classification**<br>Basic structure and functions of fuel cell, its characteristics and working, fuel cell power conversion, classification of fuel cells, PEM and alkaline fuel cells, molten carbonate fuel cells, phosphoric acid, solid oxide fuel cells. | 6 |
| VI | **Supercapacitors and Hydrogen Storage Systems**<br>Supercapacitor: characteristics, components, schematic, classification, advantages, disadvantages, Hydrogen storage systems: Basics, working and applications. | 6 |
| | | |
| **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 | | | | | | | | | | | | | |
| **CO2** | | 2 | | | | | | | | | | | | 2 |
| **CO3** | | 2 | | | | | | | | | | | | 2 |
| **CO4** | | | | | | | | | | | | | | |
| The strength of mapping is to be written as 1: Low, 2: Medium, 3: High<br>Each CO of the course must map to at least one PO. | | | | | | | | | | | | | | |

| Assessment |
|---|
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>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.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>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) |

# Open Elective - 1

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2022-23**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6OE343 |
| **Course Name** | Open Elective I : Electrical Machine Technology |
| **Desired Requisites:** | Basic Electrical Engineering |

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

**Course Objectives**

| | |
|---|---|
| **1** | To make students understand operation and performance of ac and dc machines. |
| **2** | To make students learn characteristics of ac and dc machines. |
| **3** | To develop skills to choose ratings of ac and dc machines for various 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** | Explain the construction and working principle of A.C. and D.C. Machines. | II | Understanding |
| **CO2** | Examine the various characteristics of A.C. and D.C. machines. | III | Applying |
| **CO3** | Analyze the performance of A.C. and D.C. machines for various applications. | IV | Analysing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **DC Motors**<br>Review of Construction, Working and Types, Back emf, Speed equation, Armature Reaction, Torque equation, Speed torque characteristics, Applications, Power losses in d.c. motors. Need of starter speed control of D.C. shunt and series motor, Thyristor based speed control for D.C. motor. Reversal of rotation, Electric braking of shunt and series motor. | 7 |
| II | **Single Phase Transformer**<br>Construction and type, EMF equation phasor diagram, equivalent circuit, efficiency, losses, regulation, Experimental determination of equivalent circuit parameters and calculation of efficiency and regulation, Introductionto three Phase Transformer, Connection of three Phase Transformer, Applications of Transformers | 6 |
| III | **Three Phase Induction Motor**<br>Construction, Types, Working, Speed equation, Torque equation, Starting torque, Concept of full load torque, torque speed characteristics, Power stages in motor, Induction Generator. | 7 |
| IV | **Three Phase Induction Motor Control**<br>Need of starter, Speed control methods- Pole changing, Voltage control, VFD (V/f) control, Block schematic of electronic VFD control, Rotor resistance speed control, Reversal of rotation. | 6 |

| | | |
|---|---|---|
| V | **Synchronous Machines**<br>Alternator, Construction of Alternator, Synchronous Motor, Equivalent Circuit, Motor on load, Pull-Out Torque, Motor Phasor Diagram, MechanicalPower Developed by Motor, Power Factor of Synchronous Motor, Application of Synchronous Motor, Comparison of Synchronous Motor with Induction Motor. | 6 |
| VI | **Special-Purpose Electric Machines**<br>Stepper motor-Variable-Reluctance Motor, Permanent Magnet Motor, Hybrid Stepper Motor, Servomechanism, D.C. Servomotors, A.C. Servomotors, Switched Reluctance Motor, Permanent Magnet D.C. Motor, Brushless D.C. Motor. Selection and Sizing of Motors based on applications. | 7 |

| | |
|---|---|
| | |
| **Textbooks** | |
| 1 | S. J. Chapman, "Electric Machinery Fundamentals", Tata Mc Graw Hill publication, 4th Edition, 2011, ISBN: 9780071070522 |
| 2 | M. G. Say. "Performance Design of AC Machines", CBS Publishers, 3rd Edition, 2017, ISBN: 9788123910277 |
| | |
| **References** | |
| 1 | SK Bhattacharya, "Electrical Machines", Tata Mc Graw Hill, 3rd Edition, 2010, ISBN: 9789332902855 |
| 2 | J. B. Gupta, "Electrical Machines", SK Kataria and Sons, 2013, ISBN: 9789350140550 |
| | |
| **Useful Links** | |
| 1 | https://nptel.ac.in/courses/108/102/108102146/ |
| 2 | https://nptel.ac.in/courses/108/105/108105155/ |
| 3 | https://nptel.ac.in/courses/108/105/108105131/ |

**CO-PO Mapping**

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

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)

# SEM VI

# Professional Core (Theory)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL321 |
| **Course Name** | Power System Protection |
| **Desired Requisites:** | Power System Engineering |

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

**Course Objectives**

| | |
|---|---|
| **1** | 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 and select proper CB/fuse for a particular application. | II | Understanding |
| **CO2** | **Classify** the requirements of protection for different parts of a power system and select proper relay scheme. | III | Applying |
| **CO3** | **Analyse** the performance of various protection devices and discuss digital relaying techniques. | IV | Analysing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Over Current Relays**<br>Need of protection, Brief theory and construction of electromagnetic relays. Different time current characteristics of over current relay, Directional relay, Microprocessor based over current relay, Directional over current relay, drawbacks of over current schemes. | 7 |
| II | **Arc Interruption Process**<br>Voltage - current characteristics of arc, Principles of DC and AC arc interruption, high resistance and current zero interruption, arc voltage, Transient Restriking Voltage (TRV), Recovery voltage, RRRV, current chopping, resistance switching, capacitive current interruption | 6 |

| | | |
|---|---|---|
| III | **Circuit Breakers & Fuses**<br>Classification of circuit breakers, brief study of construction and working of Air break and Air Blast CB, SF6 and Vacuum CB, HVDC breakers, ratings of CB and testing of CB, Fuse –Rewirable and HRC fuse, fuse characteristics, application and selection of fuse | 6 |
| IV | **Protection of Transformer, Generator and Bus Bar**<br>Circulating current differential protection, percentage differential protection of power transformers, through fault stability, effect of magnetizing inrush, effect of over voltage inrush ,Buchholz relay, Differential protection of generator, stator and rotor protection schemes of generator, loss of excitation, prime mover failure protection, bus bar protection. | 7 |
| V | **Protection of Transmission Line**<br>Principles of distance relays, Effect of arc resistance, and power swing on relay operation, Microprocessor based impedance, reactance and admittance relays, Quadrilateral characteristics, carrier aided protection of transmission line. Protection Against Over Voltages. | 7 |
| VI | **Recent Developments in Protection**<br>Introduction to numerical/digital relay techniques. New numerical /digital relaying algorithms, introduction of various transform techniques - Discrete Fourier Transform, Haar Transform etc. | 6 |
| | | |
| **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** | 2 | | | | | | | | | | | | | |
| **CO2** | | 3 | | | | | | | | | | | | |
| **CO3** | | | 3 | | | | | | | | | | | |
| The strength of mapping is to be written as 1: Low, 2: Medium, 3: High<br>Each CO of the course must map to at least one PO. | | | | | | | | | | | | | | |

| Assessment |
| --- |
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>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.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2022-23**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL322 |
| **Course Name** | Industrial Drives and Control |
| **Desired Requisites:** | DC Machines and Transformer, AC Machines and Power Electronics |

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

**Course Objectives**

| | |
|---|---|
| **1** | To make students understand concept of fundamental knowledge in dynamics and control of Electric Drives. |
| **2** | To strengthen control principles of various DC and AC motors using solid state converters. |
| **3** | To cover principles of selection of Electric Motors and highlights the applications of Electrical Drives. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | **Explain** the various concepts used in Electric drives. | II | Understanding |
| **CO2** | **Apply** the control techniques for Electric drives for speed control. | III | Applying |
| **CO3** | **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**<br>Types & parts of the Electrical drives, Selection criteria of drives, motor rating, selection based on duty cycle, selection of converter rating, 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. | 7 |
| II | **DC Motor Drives**<br>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, converter fed DC series motor drive, chopper control of DC shunt and series motor drives, four quadrant operation of chopper fed DC shunt motor drive. | 7 |

| | | |
|---|---|---|
| III | **Induction Motor Drives**<br>Torque equation, Speed control methods for three phase 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, speed torque characteristics of CSI fed drive, closed loop speed control block diagram, comparison of CSI fed and VSI fed induction motor drive. | 7 |
| IV | **Slip Ring Induction Motor Drives**<br>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, cyclo - converter in rotor circuit. | 6 |
| V | **Synchronous Motor Drives and Brushless DC Motor Drives**<br>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. | 6 |
| VI | **Special Drives**<br>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. | 6 |

| | |
|---|---|
| | |
| **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** | | | 2 | | | | | | | | | | | 2 |
| **CO3** | | | 2 | | | | | | | | | | | 2 |
| **CO4** | | | | | | | | | | | | | | |
| The strength of mapping is to be written as 1: Low, 2: Medium, 3: High<br>Each CO of the course must map to at least one PO. | | | | | | | | | | | | | | |

| Assessment |
| --- |
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>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.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL323 |
| **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 enable students to interface and program different peripherals to microcontrollers. |

**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 architecture and features of microcontrollers. | II | Understanding |
| **CO2** | Apply programming techniques to implement counters, timers, interrupts and other peripherals. | III | Applying |
| **CO3** | Implement the applications related to interface microcontroller with electrical and electronics systems. | III | Applying |
| **CO4** | Construct a microcontroller based application. | III | Applying |

| Module | Module Contents | Hours |
|---|---|---|
| I | **Microcontroller Basics**<br>Overview of 8051, features, Architecture, Pin out and pin functions, program memory, data memory, SFR area, PSW, Code memory space, (Internal/External), Port structure, clock circuit, Addressing Modes | 6 |
| II | **Programming ports and timers**<br>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 0, 1, 2 and their Applications, Timer and Counter Programming | 7 |
| III | **Interrupts and Serial Communication**<br>Interrupt structure, Writing ISR, interrupt, Interrupt priorities, Programming for external interrupt. Programming timer interrupts.<br>Serial Communication: Serial communication modes, RS232 signals of PC, Programming through Serial communication | 6 |
| IV | **Peripheral Interfacing- I**<br>Interfacing of microcontrollers to external peripherals and programming, LCD interfacing, Interfacing of Analog to Digital Converters and Digital to Analog Converters, Stepper motor interfacing | 7 |

| | | |
|---|---|---|
| V | **Peripheral Interfacing- II**<br>DC motor interfacing, PWM programming using microcontrollers, Use of Arduino in Power Electronics Applications, Interfacing Temperature Sensors, Relay Interfacing, concept of hardware-in-loop simulation, programming examples | 7 |
| VI | **Introduction to Advanced microcontrollers**<br>Introduction to ARM and PIC processors of MSP 430 microcontroller, 16 bit Micro-controllers, overview, features, architecture, addressing modes, Low power operation feature of MSP 430 | 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 | Mazidi, RolinMc Kinlay and Danny Causey, 'PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education, 2007 |
| 4 | Andrew N. Sloss, 'Arm System Developer's Guide: Designing and Optimizing System Software', Elsevier Publication, 2005 |
| 5 | 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 | | | | | | | | | | | |
| **CO2** | | | | | 3 | | | | | | | | | |
| **CO3** | | | | | 3 | | | | | | | | | |
| **CO4** | | | 3 | | | | | | | | | | | 2 |

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

| Assessment |
| --- |
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>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.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem V |
| **Course Code** | 6EL324 |
| **Course Name** | 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 create awareness in the students about energy conservation and its importance. |
| **2** | To develop skills for energy auditing and energy management in industrial environment |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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** | **Calculate** the financial analysis for energy economics. | III | Applying |
| **CO3** | **Analyse** Energy Efficiency in Electrical and Thermal Utilities | IV | Analysing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Energy Conservation and Management**<br>Energy Conservation and its importance, Energy strategy for future, Energy Conservation Act2001 and its features, Energy Pricing, Energy Sector Reforms, Energy And Environment, Energy Security, Objectives and Principles of Energy Management. | 7 |
| II | **Energy Audit**<br>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. | 7 |
| III | **Energy Action Planning, Monitoring And Targeting**<br>Energy action Planning Steps, Top Management Support, Energy Manager Duties & responsibilities, Evaluating Energy Performance, Energy monitoring & Targeting – Set up, Key Elements, Data & Information Analysis, Relating Energy Consumption & Production, CUSUM Technique, Case Study | 7 |
| IV | **Energy Economics**<br>Financial Analysis Techniques – Pay Back Period, Net Present Value, Return on Investment, Internal Rate Of Return, Time Value Of Money, Cash Flow, Risk & Sensitivity analysis. | 6 |

| | | |
|---|---|---|
| V | **Energy Efficiency in Electrical Utilities**<br>Electricity Billing, Electrical Load Management and Maximum Demand Control, Power Factor Improvement & Benefits, Assessment of Transmission and Distribution Losses, Estimation Of Technical Losses in Distribution System, Commercial Losses, Demand Side Management, Energy Saving Opportunities With Pumps and Fans. | 7 |
| VI | **Energy Efficiency in Thermal Utilities**<br>Energy Conservation in Boilers, Steam Turbine, Industrial Heating System, Heat Exchangers, Heat Pumps, Efficiency Improvement, Energy Conservation in Buildings, Climate responsive Buildings, Thermal load modelling in Building | 5 |
| | | |
| **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. | |
| | | |
| **Useful Links** | | |
| 1 | https://beeindia.gov.in/content/energy-auditors | |

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

| **Assessment** |
|---|
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>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.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Professional Core (Lab)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL371 |
| **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-t characteristics | III | Applying |
| **CO2** | **Execute** experimental study of a microcontroller based relays. | III | Applying |
| **CO3** | **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 a shaded pole type 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.

| | |
|---|---|
| | |
| **Textbooks** | |
| 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** | 1 | | | | | | | | | | | | | |
| **CO2** | 3 | 3 | | | | | | | | | | | | |
| **CO3** | | 2 | | | | | | | | | | | | |
| The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High<br>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.<br>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<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>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<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2022-23**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL372 |
| **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**

| | |
|---|---|
| **1** | To impart knowledge on performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using solid state converters. |
| **2** | To develop the skills for the use of computer-based analysis tools to review the major classes of machines and their physical basis for operation and suitability for a particular operation |
| **3** | |
| **4** | |

**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** experiments on basics of DC and AC drives. | III | Applying |
| **CO2** | **Analyze** the performance of drives using hardware circuits and simulation. | IV | Analysing |
| **CO3** | **Evaluate** performance of drives using hardware circuits and simulation**.** | VI | Evaluating |

**List of Experiments / Lab Activities/Topics**

**List of Lab Activities:**

1. Verify Speed – Torque characteristics of chopper fed D. C. series motor. (Hardware)
2. Analyze the performance of chopper fed D. C. drive for closed – loop speed control (simulation).
3. Demonstrate operation and application of single-phase full wave, half controlled converter for open loop speed control of D. C. shunt motor. (Hardware).
4. Demonstrate operation and application of single-phase full wave, full controlled converter for open loop speed control of D. C. shunt motor. (Hardware).
5. Analyze the performance of converter fed D. C. drive for closed loop speed control. (Simulation).
6. Study the operation of two quadrant single phase converter fed 5 HP DC drive (Simulation).
7. Study the four-quadrant operation of 5 HP DC motor using single phase converter. (Simulation).
8. Study the operation of four quadrant chopper fed DC drive (simulation).
9. Assess the performance of rotor resistance control method for speed control of Slip – Ring Induction motor. (Simulation)
10. Demonstrate speed control of Induction motor using V/f method. (Hardware)
11. Analyze the operation of Induction motor drive with Six – step VSI control (Simulation).
12. Demonstrate the operation of brushless DC motor drive with software Simulation. (Simulation)
13. Demonstrate speed control of Induction motor using Kramer speed control method. (Hardware)

| | |
|---|---|
| **Textbooks** | |
| 1 | *"Fundamentals of Electrical Drives", G. K. Dubey, Narosa publication, 2nd edition.* |
| | |
| **References** | |
| 1 | "Modern Power Electronics and AC drives" by B. K. Bose, Prentice Hall of India Pvt. India |
| 2 | "*Power Electronics - Converter application*" By N. Mohan T.M. Undeland and W. P. Robbins, John Wiley 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 | | | | | | | | | | | | |
| **CO2** | | 2 | | | | | | | | | | | | 2 |
| **CO3** | | | 2 | | | | | | | | | | | 2 |
| **CO4** | | | | | | | | | | | | | | |

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<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>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<br>Marks Submission at the end of Week 19 | 40 |

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

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL373 |
| **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: #** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To develop the necessary skills required for programming 8051 and Arduino microcontroller implement real world applications. |
| **2** | To understand the practical problems in electrical systems and implement programs for same. |
| **3** | To introduce various programming softwares 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** | **Execute** programs to interface microcontrollers with electrical and electronics systems. | III | Applying |
| **CO4** | **Construct** programs for electrical applications using microcontrollers. | III | Applying |

**List of Experiments / Lab Activities/Topics**

**List of Lab Activities:**

1. Introduction to different Development Boards, Keil/Arduino IDE, Using Keil/Arduino IDE to assemble a program, Hex file format, Downloading and running the program
2. Demonstrate the flashing of GPIO ports of using delay.
3. Implement a 8-bit up and down counter 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. Devise a 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 |
| 3 | Mazidi, RolinMc Kinlay and Danny Causey, "*PIC Microcontroller and Embedded Systems using Assembly and C for PIC18*", Pearson Education. |
| | |
| **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 | | | | | | | | | | | |
| **CO2** | | | | | 3 | | | | | | | | | |
| **CO3** | | | | | 3 | | | | | | | | | |
| **CO4** | | | 3 | | | | | | | | | | | |
| The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High<br>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.<br>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<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>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<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL341 |
| **Course Name** | Mini-Project-3 |
| **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 | | | | | |
| **CO3** | 1 | | 3 | | | | | | | | | | | |
| **CO4** | | | | 2 | 3 | | | | | | | | | |
| **CO5** | | | | | | | | | 3 | | | | | |
| The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High<br>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.<br>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<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>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<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Professional Elective-2

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2022-23**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B.Tech., Sem VI |
| **Course Code** | 6EL331 |
| **Course Name** | Professional Elective II: ANN and Fuzzy Control |
| **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 make students understand operation and performance of ac and dc machines. |
| **2** | To make students learn characteristics of ac and dc machines. |
| **3** | To develop skills to choose ratings of ac and dc machines for various 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** | Explain the architecture and features of neural networks | II | Understanding |
| **CO2** | Explain programming techniques to implement neural networks | III | Understanding |
| **CO3** | Implement the applications related to electrical and electronics | IV | Applying |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Neural Networks and Architecture**<br>Fundamentals of Neural Networks: What is Neural Network, Model of Artificial Neuron, Learning rules and various activation functions, Single layer Feed-forward networks, Perceptron learning, MLP structures. | 7 |
| II | **Back propagation Networks**<br>Delta and LMS rules, Back propagation Networks, Architecture of Back-propagation (BPN) Networks, Back-propagation Learning, Variation of Standard Back propagation algorithms. | 7 |
| III | **Unsupervised networks**<br>Associative Memory: Auto correlators, Heterocorrelators, Multiple Training Encoding Strategy, Exponential BAM, and Associative Memory for Real coded pattern pairs, Applications | 7 |
| IV | **Adaptive Resonance Networks**<br>Adaptive Resonance Theory: Cluster Structure, Vector Quantization, Classical ART Network, Simplified ART Architecture, ART1 and ART2 Architecture and algorithms, Applications, Sensitivities of ordering of data. | 6 |
| V | **Radial and Convolution Networks**<br>Convolution networks, pooling, working and design, Radial basis function network, working | 6 |
| VI | **Application to Electrical**<br>Control system design with neural network- controller design, tuning and learning, Power system applications, Load forecasting and fault analysis | 6 |

| | |
|---|---|
| **Textbooks** | |
| 1 | Simon Haykin, “Neural Network”, Pearson Publications, 2005. |
| 2 | Bishop, C. M., “Neural Networks for Pattern Recognition”, Oxford University Press. 1995. |
| 3 | S.Rajasekaran and G.A. Vijayalakshmi Pai., “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI publications,2012. |
| | |
| **References** | |
| 1 | Chin Teng Lin, C. S. George Lee , “Neuro-Fuzzy Systems” , PHI.pub. 2007. |
| | |
| **Useful Links** | |
| 1 | https://onlinecourses.nptel.ac.in/noc21_ge07/preview |

**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 | |

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)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL332 |
| **Course Name** | Professional Elective II: 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 make students identify various characteristics of nonlinear systems. |
| **2** | To develop skills for analyzing nonlinear systems. |
| **3** | To make students familiar with digital control 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** | Construct mathematical models of digital control system. | III | Applying |
| **CO2** | Analyze the nonlinear systems using various basic and commonly used tools. | IV | Analysing |
| **CO3** | Calculate the compensators and controllers for digital control system. | V | Evaluating |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Nonlinear System**<br>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**<br>Linearization, Phase Plane Analysis, Classification of Equilibrium States, Node,Focus, Saddle Point, Centre, Prediction of Limit Cycle using Phase Plane, Describing Function Method, Lyapunov Stability for Non-linear and Linear Systems. | 7 |
| III | **Digital Control System**<br>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 SteadyState Analysis. | 7 |
| IV | **Design of Digital Control System**<br>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**<br>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 SpaceEquation. | 6 |
| VI | **State Space Design of Digital Control System**<br>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,<br>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** | 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 MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL333 |
| **Course Name** | Professional Elective III: Introduction to Electric Vehicle |
| **Desired Requisites:** | Electrical Machines, Power Electronics |

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

| **Course Objectives** | |
|---|---|
| **1** | To develop basic knowledge related to architecture of Electric Vehicles |
| **2** | To provide knowledge related to design aspects and dynamics of Electric vehicles |
| **3** | The course aims at enabling students to understand the motor specifications and charging standards for Electric vehicles. |

**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 architecture and features of Electric Vehicles | II | Understanding |
| **CO2** | Interpret the topologies and various design considerations for Electric vehicles | II | Understanding |
| **CO3** | Calculate the vehicle dynamics for Electric propulsion systems | III | Applying |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction to Electric Vehicles**<br>Background of Electric Vehicles, Electric Vehicle System, Components of Electric Vehicles, Advantages of Electric Vehicles, Efficiency, Pollution Comparison with conventional vehicles, Fundamentals of Electric Vehicles | 6 |
| II | **Types of Electric Vehicles and Architecture of EVs**<br>Concept of Electric, Hybrid and Plug-in Electric Vehicles, Typical configuration of Hybrid Electric Vehicle, Topologies of HEVs: Series, Parallel and Series-Parallel Configuration, Topologies of Plug-in Hybrid Electric Vehicles, Fuel Cell Electric Vehicles, Solar Powered Electric Vehicles | 7 |
| III | **Design Considerations for Electric Vehicles**<br>Introduction to EV design fundamentals, Aerodynamic Consideration, Rolling resistance, Transmission efficiency, Consideration of vehicle mass, Basics of Electric vehicle chassis and body design, general issues in Electric vehicle design | 6 |

| | | |
|---|---|---|
| IV | **Vehicle Dynamics**<br>Roadway fundamentals, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion power: Force velocity characteristics, Vehicle gradability, Velocity and Acceleration: Velocity Profile, Distance traversed, tractive power, Energy Required, Propulsion System Design for EV systems | 7 |
| V | **EV Drive systems**<br>Types of motors used in EV, Requirements of EV drive systems, Series Hybrid Electric Drive Train - Operation Patterns, Control Strategies, Parallel Hybrid Electric Drive Train – Operation Pattern, Control Strategies | 7 |
| VI | **Electric Vehicle Chargers and Charging Standards**<br>EV charging: requirements and Classification, Charging standards for Electric vehicles, Introduction to AC and DC chargers for EV systems, Working of Electric Vehicle Supply Equipment (EVSE), Fast Chargers for EV systems, ARAI Testing standards for Electric Vehicles | 6 |

| **Textbooks** | |
|---|---|
| 1 | Iqbal Husain ,‘ Electric and Hybrid Vehicles: Design Fundamentals ’, CRC Press, 2003 |
| 2 | James Larminie, John Lowry, “ Electric Vehicle Technology Explained”, Wiley , 2nd edition, 2012 |

| **References** | |
|---|---|
| 1 | Sheldon Williamson, ‘ Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles ’, Springer-Verlag, 2012 |
| 2 | M. Ehsani, Y. Gao, S. Gay and A. Emadi , Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press, 2005. |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/108/103/108103009/ |
| 2 | https://nptel.ac.in/courses/108/102/108102121/ |
| 3 | https://nptel.ac.in/courses/108/106/108106170/ |

**CO-PO Mapping**

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

The strength of mapping is to be written as 1: 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)

# Open Elective 2

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2022-23**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6OE350 |
| **Course Name** | Open Elective 2: Industrial Automation |
| **Desired Requisites:** | Basic Electrical Engineering, Basic Mechanical Engineering |

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

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

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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 working of various types of measuring instruments, controllers and actuators for implementation in industrial automation. | II | Understanding |
| **CO2** | **Identify** the use of various actuators in industrial automation | III | Applying |
| **CO3** | **Apply** the knowledge of PLC and SCADA for Industrial Automation. | III | Applying |
| **CO4** | **Explore** the use of variable speed drives for Industrial Automation. | III | Applying |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Measurement of Various Process Parameters**<br>Measurement of quantities such as temperature, pressure, force, displacement, speed, flow, level, humidity, pH etc., signal conditioning, estimation of errorsand calibration. | 6 |
| II | **Process Control and Various Controllers**<br>Introduction to process control, PID controller and tuning, various control configurations such as cascade control, feed forward control, split range control, ratio control, override control and selective control. | 6 |
| III | **Actuators**<br>Introduction to various actuators such as flow control valves, Hydraulic andpneumatic, servo motors, symbols and characteristics. | 6 |
| IV | **PLC**<br>Introduction to sequence control and relay ladder logic, basic PLC system, I/O modules, scan cycle, programming of timers, counters and I/O programming. | 7 |

| | | |
|---|---|---|
| V | **SCADA for Industrial Automation**<br>Components of SCADA systems, functions, classification of SCADA, networking and communication protocols. | 7 |
| VI | **Variable Speed Drives**<br>Role of variable speed drives in automation, DC drives, AC drives and synchronous motor drives applications of variable speed drives. | 7 |

| | |
|---|---|
| | |
| **Textbooks** | |
| 1 | John W. Webb, Ronald A. Reis "Programmable logic controllers, principles & applications" by PHI publication, Eastern Economic Edition. |
| 2 | C. D. Johnson, "Process control & instrumentation techniques".Pearson Education |
| | |
| **References** | |
| 1 | George Stephanopoulos, "Chemical Process Control - An introduction to Theory and Practice", Prentice-Hall of India, 1st Edition 1984. |
| 2 | "Fundamentals of Electrical Drives", G. K. Dubey, Narosa publication, 2nd edition. |
| | |
| **Useful Links** | |
| 1 | https://nptel.ac.in/courses/108105063 |
| 2 | https://archive.nptel.ac.in/courses/108/106/108106022/ |

**CO-PO Mapping**

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

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

**Assessment**

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

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Electrical Engineering) |
| **Class, Semester** | Third Year B. Tech., Sem VI |
| **Course Code** | 6EL375 |
| **Course Name** | Humanities 2- Project Management (Universal values, ethics) |
| **Desired Requisites:** | B.Tech. (Electrical Engineering) |

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

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

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Grasp and perceive the project activities with respect to resources required and the constraint for feasibility or completion within time | II | Understanding |
| **CO2** | Estimate and prepare budget for project completion, Understand commercial management | IV | Analyzing |
| **CO3** | Figure out and schedule the project and assess for controlling critical path networks | V | Evaluating |

**List of Experiments / Lab Activities/Topics**

**List of Topics(Applicable for Interaction mode ):**

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

**Textbooks**

| | |
|---|---|
| 1 | Dennis Lock , "Project Management", Gower Publishing Limited, 2013 |
| 2 | Samuel J. Mantel, Jr., Jack R. Meredith, Scott M. Shafer, Margaret M. Sutton, "Project Management in Practice", John Wiley & Sons, Inc., 2011 |

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

**CO-PO Mapping**

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

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

**Assessment**

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<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>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<br>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.