



DEPARTMENT OF ELECTRICAL ENGINEERING  
K. K. Wagh Institute of Engineering Education and Research  
Hirabai Haridas Vidyanagari, Amrut Dham, Panchavati, Nashik-422003

**Vision:**

- To create socially conscious electrical professionals through high-quality education and to establish an electrical engineering research center to meet the requirements of industry and society.

**Mission:**

- To facilitate an adaptive learning environment focusing on fundamental knowledge and human values with an appropriate blend of practical exposure.
- To enable teachers and students to do influential collaborative research on societal and industry demands, enhancing their capacity for lifelong learning.
- To create socially competent, and innovative engineers to contribute effectively toward solving global issues of the 21st Century.

**Dr. R. K. Munje**

**Prof and Head**



### **Programme Educational Objectives (PEO's):**

**PEO1:** Demonstrate expertise in the field of Electrical Engineering and related areas, providing innovative and effective solutions for contemporary problems.

**PEO2:** Establish themselves in the engineering profession as entrepreneurs, higher education aspirants, and researchers, locally and globally.

**PEO3:** Get involved in sustained learning through state-of-the-art technologies, professional development, and self-study for solving societal problems.

**PEO4:** Exhibit leadership and teamwork skills while working in a diverse and interdisciplinary culture to achieve professional and organizational goals.

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## **Program Outcomes:**

At the end of this program, a student will be able to

**PO1:** Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2:** Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3:** Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4:** Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5:** Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6:** The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7:** Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8:** Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9:** Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10:** Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11:** Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12:** Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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## **Program Specific Outcomes**

**PSO 1:** Integrate knowledge in power, control and machines to enhance the sustainability of electrical systems.

**PSO 2:** Provide optimal solutions to real-time electrical engineering problems using modern hardware and software tools.

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**Course Outcomes:**

**SE – Sem I**

**Subject 1: Engineering Mathematics-III (207006)**

At the end of this course, Students will be able to

**CO207006.1:** Describe the architecture and features of various types of the microcontroller.

**CO207006.2:** Illustrate addressing modes and execute programs in assembly language for the microcontroller.

**CO207006.3:** Write programs in C language for microcontroller 8051

**CO207006.4:** Elaborate interrupt structure of 8051 and program to handle interrupt and ADC809

**CO207006.5:** Define the protocol for serial communication and understand the microcontroller development systems

**CO207006.6:** Interface input output devices and measure electrical parameters with 8051 in real time.

**Subject 2: Power Generation Technology (203141)**

At the end of this course, Students will be able to

**CO203141.1:** Identify components and elaborate working principle of conventional power plants.

**CO203141.2:** Recognize the importance and opportunities of renewable energies.

**CO203141.3:** Calculate and control power output of wind solar, and hydro power plant.

**CO203141.4:** Describe process of grid interconnection of distributed generation and requirements

**CO203141.5:** Interpret the environmental and social impact of various generation technologies.



### **Subject 3: Material Science (203142)**

At the end of this course, Students will be able to

**CO203142.1:** Discuss classification, properties and characteristics of different electrical engineering materials.

**CO203142.2:** State various applications of measuring methods for parameters of different classes of electrical engineering materials.

**CO203142.3:** Solve simple problems based on dielectric, magnetic and conducting materials.

**CO203142.4:** Apply knowledge of Nano-technology to electrical engineering.

**CO203142.5:** Execute tests on dielectric, insulating, magnetic, conducting, resistive materials as per IS to decide the quality of the materials.

**CO203142.6:** Create learning resource material ethically to demonstrate self learning leading to lifelong learning skills and usage of ICT/ online technology through collaborative/active learning activities.

### **Subject 4: Analog and Digital Electronics (203143)**

At the end of this course, Students will be able to

**CO203143.1:** Design logical, sequential and combinational digital circuits using K-Map.

**CO203143.2:** Demonstrate different digital memories and programmable logic families.

**CO203143.3:** Apply and analyze applications of OPAMP in open and closed loop condition.

**CO203143.4:** Design uncontrolled rectifier with given specifications

### **Subject 5: Electrical Measurement & Instrumentation (203144)**

At the end of this course, Students will be able to

**CO203144.1:** Define various characteristics and classify measuring instruments along with range extension techniques.

**CO203144.2:** Apply measurement techniques for measurement of resistance, inductance and capacitance.

**CO203144.3:** Demonstrate construction, working principle of electro dynamo type and induction type instruments for measurement of power and energy.

**CO203144.4:** Make use of CRO for measurement of voltage, current and frequency.

**CO203144.5:** Classify transducer and apply it for measurement of physical parameters in real time.



**Subject 6: Applications of Mathematics in Electrical Engineering (203150)**

At the end of this course, Students will be able to

**CO203150.1:** Apply fundamentals of mathematics in solving electrical engineering problems.

**CO203150.2:** Analyze complex electrical engineering problems using mathematical techniques.

**CO203150.3:** Implement a program and simulation for problems in electrical engineering.

**CO203150.4:** Demonstrate self lifelong learning skills with applications of mathematics in electrical engineering through software.

**Subject 7: SoftSkill (203151)**

At the end of this course, Students will be able to

**CO203151.1:** Prepare SWOC analysis

**CO203151.2:** Develop a presentation and take part in group discussion.

**CO203151.3:** Discuss & Apply etiquette in the workplace and in society at large.

**CO203151.4:** Recognizing role of team motivation and inspiring others

**CO203151.5:** Demonstrate the techniques for time management and stress management.

**Subject 8: Audit Course- III : Solar Thermal System (203152 (A))**

At the end of this course, Students will be able to

**CO 203152 (A).1:** Differentiate between types of solar Concentrators

**CO 203152 (A).2:** Apply software tool for solar concentrators

**CO 203152 (A).3:** Design different types of Solar collectors and balance of plant



## **SE – Sem II**

### **Subject 1: Power System-I (203145)**

At the end of this course, Students will be able to

**CO203145.1:** Recognize different patterns of load curve and calculate associated different factors with it and tariff.

**CO203145.2:** Draft specifications of electrical equipment in power station.

**CO203145.3:** Design electrical and mechanical aspects in overhead transmission and underground cables.

**CO203145.4:** Evaluate the inductance and capacitance of different transmission line configurations.

**CO203145.5:** Analyse the performance of short and medium transmission lines

### **Subject 2: Electrical Machines-I (203146)**

At the end of this course, Students will be able to

**CO203146.1:** Evaluate performance parameters of transformer with experimentation and demonstrate construction along with specifications as per standards.

**CO203146.2:** Distinguish between various types of transformer connections as per vector groups with application and to perform parallel operation of single/three phase transformers.

**CO203146.3:** Select and draft specifications of DC machines and Induction motors for various applications along with speed control methods.

**CO203146.4:** Justify the need of starters in electrical machines with merits and demerits.

**CO203146.5:** Test and evaluate performance of DC machines and Induction motors as per IS standard.





### **Subject 3: Network Analysis (203147)**

At the end of this course, Students will be able to

**CO203147.1:** Calculate current/voltage in electrical circuits using simplification techniques, Mesh, Nodal analysis and network theorems.

**CO203147.2:** Analyze the response of RLC circuit with electrical supply in transient and steady state.

**CO203147.3:** Apply Laplace transform to analyze behavior of an electrical circuit.

**CO203147.4:** Derive formula and solve numerical of two port network and Design of filters

**CO203147.5:** Apply knowledge of network theory to find transfer function, poles and zeroes location to perform stability analysis and parallel resonance

### **Subject 4: Numerical Methods and Computer Programming (203148)**

At the end of this course, Students will be able to

**CO203148.1:** Demonstrate types of errors in computation and their causes of occurrence.

**CO203148.2:** Calculate root of algebraic and transcendental equations using various methods

**CO203148.3:** Apply numerical methods for various mathematical problems such as interpolation, numerical differentiation, integration and ordinary differential equation.

**CO203148.4:** Solve linear simultaneous equation using direct and indirect method.

**CO203148.5:** Develop algorithms and write computer programs for various numerical methods.

### **Subject 5: Fundamental of Microcontroller and Applications (203149)**

At the end of this course, Students will be able to

**CO203149.1:** Describe the architecture and features of various types of the microcontroller.

**CO203149.2:** Illustrate addressing modes and execute programs in assembly language for the microcontroller.

**CO203149.3:** Write programs in C language for microcontroller 8051

**CO203149.4:** Elaborate interrupt structure of 8051 and program to handle interrupt and ADC809

**CO203149.5:** Define the protocol for serial communication and understand the microcontroller development systems

**CO203149.6:** Interface input output devices and measure electrical parameters with 8051 in real time.



**Subject 6: Project Based Learning (203152)**

At the end of this course, Students will be able to

**CO203152.1:** Identify, formulate, and analyze the simple project problem.

**CO203152.2:** Apply knowledge of mathematics, basic sciences, and electrical engineering fundamentals to develop solutions for the project.

**CO203152.3:** Learn to work in teams, and to plan and carry out different tasks that are required during a project.

**CO203152.4:** Understand their own and their team-mate's strengths and skills.

**CO203152.5:** Draw information from a variety of sources and be able to filter and summarize the relevant points.

**CO203152.6:** Communicate to different audiences in oral, visual, and written forms.

**Subject 7: Audit Course-IV :Solar Photovoltaic Systems (203153(A))**

At the end of this course, Students will be able to

**CO203153(A).1:** Design of Solar PV system for small and large installations

**CO203153(A).2:** Handle software tools for Solar PV systems

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**TE – Sem I**

**Subject 1: Industrial and Technology Management (303141)**

At the end of this course, Students will be able to

**CO303141.1:** Differentiate between different types of business organizations and discuss the fundamentals of economics and management.

**CO303141.2:** Explain the importance of technology management and quality management

**CO303141.3:** Explain the importance of IPR and role of Human Resource Management.

**CO303141.4:** Understand the importance of Quality and its significance

**CO303141.5:** Describe the characteristics of marketing & its types and overview of financial Management.

**CO303141.6:** Discuss the qualities of a good leader and road map to Entrepreneurship.

**Subject 2: Power Electronics (303142)**

At the end of this course, Students will be able to

**CO303142.1:** Fundamentals of power electronic devices and characteristics.

**CO303142.2:** The concepts and operating principles of power electronics circuits.

**CO303142.3:** Design procedures and techniques of power electronics systems.

**Subject 3: Electrical Machines-II (303143)**

At the end of this course, Students will be able to

**CO303143.1:** Understand construction, working principle of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.

**CO303143.2:** Appreciate characteristics of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.

**CO303143.3:** Select an appropriate machines for applications in Power System, industrial sector, household and Military Engineering applications.



**CO303143.4:** Test machines to evaluate the performance through experimentation.

**Subject 4: Electrical Installation Design and Condition Based Maintenance (303144)**

At the end of this course, Students will be able to

**CO303144.1:** Classify different types of distribution supply system and determine economics of distribution system. compare and classify various substations, bus-bars and Earthing systems.

**CO303144.2:** Demonstrate the importance and necessity of maintenance.

**CO303144.3:** Analyse and test different condition monitoring methods.

**CO303144.4:** Carry out estimation and costing of internal wiring for residential and commercial installations.

**CO303144.5:** Apply electrical safety procedures.

**Subject 5: Advanced Microcontroller and Embedded System (303145A)**

At the end of this course, Students will be able to

**CO303145A.1:** Explain architecture of PIC18F458 microcontroller, its instructions and addressing modes.

**CO303145A.2:** Use Ports and timers for peripheral interfacing and delay generation.

**CO303145A.3:** Interface special and generate events using CCP module.

**CO303145A.4:** Effectively use interrupt structure in internal and External interrupt mode.

**CO303145A.5 :** Effectively use ADC for parameter measurement and also understand LCD interfacing.

**CO303145A.6 :** Use Serial Communication and various serial communication protocols.

**Subject 6: Digital Signal Processing (303145B)**

At the end of this course, Students will be able to

**CO303145B.1:** Construct frequency response of LTI system using Fourier Transform.

**CO303145B.2:** Apply concepts of DSP in applications of electrical engineering

**CO303145B.3:** Analyse discrete time signals and systems

**CO303145B.4:** Design and realize IIR and FIR filters.



**Subject 7: Seminar (303146)**

At the end of this course, Students will be able to

**CO303146.1:** Relate with the current technologies and innovations in Electrical engineering.

**CO303146.2:** Improve presentation and documentation skill

**CO303146.3:** Apply theoretical knowledge to actual industrial applications and research activity.

**CO303146.4:** Communicate effectively

**Subject 8: Audit Course V: Energy Storage System (303147A)**

At the end of this course, Students will be able to

**CO303147.1:** Explain and differentiate various types of energy storage for suitable applications

**CO303147.2:** Understand battery recycling techniques



**TE – Sem II**

**Subject 1: Power System-II (303148)**

At the end of this course, Students will be able to

**CO303148.1:** Model and analyze short, medium and long transmission line with and without compensation

**CO303148.2:** Solve problems involving modelling, design and performance evaluation of HVDC and EHVAC power transmission lines

**CO303148.3:** Calculate per unit values and develop Y bus for solution of power flow equations in power transmission networks.

**CO303148.4:** Calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings.

**Subject 2: Computer Aided Design of Electrical Machines (303149)**

At the end of this course, Students will be able to

**CO303149.1:** Summarize temperature rise, methods of cooling of transformer and consider IS 2026 in transformer design.

**CO303149.2:** Design the overall dimensions of the transformer.

**CO303149.3:** Analyze the performance parameters of transformer.

**CO303149.4:** Design overall dimensions of three phase Induction motor

**CO303149.5:** Analyze the performance parameters of three phase Induction motor.

**CO303149.6:** Implement and develop computer aided design of transformer and induction motor.



### **Subject 3: Control System Engineering (303150)**

At the end of this course, Students will be able to

**CO-303150.1:** Obtain transfer function of Electrical and Mechanical system using differential equations and develop analogy between Electrical and Mechanical systems (Un)

**CO-303150.2:** Determine time response of systems for a given input and evaluate performance of first and second order systems based on time domain specifications (Ap/An)

**CO-303150.3:** Analyze stability of the system using routh Hurwitz Criteria, root locus, Bode plot and Nyquist plot. (An)

**CO-303150.4:** Design of P, PI and PID controllers by various techniques and obtain mathematical models of different control system components. (Cr)

### **Subject 4: Elective-II Electric Mobility (303151B)**

At the end of this course, Students will be able to

**CO303151B.1:** Analyze the concepts of Hybrid and Electric vehicles.

**CO303151B.2:** Describe the different types of energy storage systems

**CO303151B.3:** Comprehend the knowledge of the battery charging and management systems.

**CO303151B.4:** Classify the different mode of operation for hybrid vehicle.

**CO303151B.5:** Apply the different Charging standards used for electric vehicles.

**CO303151B.6:** Differentiate between Vehicle to home & Vehicle to grid concepts.



**Subject 5: Internship (303152)**

At the end of this course, Students will be able to

**CO303152.1:** Understand the working culture and environment of the Industry and get familiar with various departments and practices in the industry.

**CO303152.2:** Operate various meters, measuring instruments, tools used in industry efficiently and develop technical competence.

**CO303152.3:** Apply internship learning in other course completions and final year project management, i.e. topic finalization, project planning, hardware development, result interpretations, report writing, etc.

**CO303152.4:** Create a professional network and learn about ethical, safety measures, and legal practices.

**CO303152.5:** Appreciate the responsibility of a professional towards society and the environment.

**CO303152.6:** Identify career goals and personal aspirations

**Subject 6: Audit Course VI Audit Course VI: Project Management (303153B)**

At the end of this course, Students will be able to

**CO303153B.1:** Elaborate importance of project management and its process

**CO303153B.2:** Learn about the role of high performance teams and leadership in project management.

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## **BE – Sem I**

### **Subject 1: Power System Operation & Control (403141)**

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

**CO203149.1:** Summarize angle, voltage and frequency stability in the power system control

**CO203149.2:** Illustrate various ways of interchange of power between interconnected utilities (AP).

**CO203149.3:** Analyze stability and optimal load dispatch using different techniques (AN).

**CO203149.4:** Select appropriate FACTS devices for stable operation of the system (EV).

**CO203149.5:** Evaluate the stability of the system and suggest the methods to improve it (EV).

### **Subject 2: Advanced Control System (403142)**

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

**CO403142.1:** Explain compensation networks, common nonlinearities, the concept of state, sampling and reconstruction, and concepts of advanced controls (Understanding)

**CO403142.2:** Determine transfer function from state model (Applying)

**CO403142.3:** Test controllability and observability properties of the system (Evaluating)

**CO403142.4:** Design compensators, state feedback controls, and observers for the system (Creating)

### **Subject 3: PLC and SCADA (403143A)**

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

**CO403143A.1:** Understand the generic architecture and constituent components of a Programmable Logic Controller.

**CO403143A.2 :** Develop a software program using modern engineering tools and technique for PLC and SCADA.

**CO403143A.3 :** Classify input and output interfacing devices with PLC and SCADA.

**CO403143A.4:** Execute, debug and test the programs developed for digital and analog operations.

**CO403143A.5:** Apply knowledge gained about PLCs and SCADA systems to real-life industrial applications.



#### **Subject 4: Power Quality Management (403143B)**

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

**CO403143B.1:** Identify various power quality issues and explain their causes .

**CO403143B.2:** Use the IEEE standards to carry out power quality monitoring for the chosen parameters.

**CO403143B.3:** Analyze power quality parameters and Evaluate impact on equipment

**CO403143B.4:** Select cost effective mitigation technique for the power quality problem

#### **Subject 5: Electric and Hybrid Vehicle (403144B)**

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

**CO403144B.1:** Analyze the Life Cycle Assessment of Li-ion battery

**CO403144B.2:** Describe the different types of Li-ion charging methods

**CO403144B.3:** Comprehend the knowledge of drivetrain hybridization

**CO403144B.4:** Evaluate EV motor sizing

**CO403144B.5:** Classify Battery Recycling methods

#### **Subject 6: Project Stage-I (403145)**

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

**CO403145.1:** Define the project problem statement and identify the scope of the project.

**CO403145.2:** Search the appropriate research papers, standards and e-resources and write a literature survey.

**CO403145.3:** Identify tools, techniques, methods, concepts, measuring devices, and instruments required for the project to define the methodology of the project.

**CO403145.4:** Justify the selection of electrical, electronic and mechanical components for the project prototyping

**CO403145.5:** Simulate or develop a system for software or hardware verification.

**CO403145.6:** Write a project report with proper interpretation of results.



**Subject 7: MOOCs (403146)**

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

**CO403146.1:** Enables the students to directly engage and learn from the best faculty in the country in order to strengthen the fundamentals.

**CO403146.2:** Explore new areas of interest in a relevant field.

**CO403146.3:** Enable self learning initiative in learners..

**CO403146.4:** Develop critical thinking to solve complex problems in engineering, science and humanities.

**CO403146.5:** Improve communication skills by interacting with peers and course teachers.

**Subject 8: Audit Course- VII Engineering Economics-I (403147B)**

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

**CO403147B.1:** Discuss concepts related to business and its impact on enterprise.

**CO403147B.2:** Illustrate time value of money in economic analysis



## **BE – Sem II**

### **Subject 1: Switchgear and Protection (403148)**

At the end of this course, Students will be able to

**CO203148.1:** List the many power system anomalies and the different types of circuit breakers that are employed.

**CO203148.2:** Determine the various power system protection zones and schemes

**CO203148.3:** Differentiate various relays, such as distance relays and relays with different protection strategies.

**CO203148.4:** Describe how static relays, numerical relays, and recent developments function.

**CO203148.5:** Compile a list of the protection protocols for transmission lines, feeders, motors, transformers, and generators.

### **Subject 2: Advanced Electrical Drives and Control (403149)**

At the end of this course, Students will be able to

**CO403149.1:** Explain motor-load dynamics and multi quadrant operation of a drive

**CO403149.2:** Analyze modes of operation of DC drive and BLDC drives

**CO403149.3:** Analyze modes of operation of AC drive using conventional and modern controls

**CO403149.4:** Demonstrate and verify operations of drives for different applications

### **Subject 3: Elective-III Smart Grid (403150C)**

At the end of this course, Students will be able to

**CO403150C.1:** Apply the knowledge to differentiate between Conventional and Smart Grid

**CO403150C.2:** Describe importance of Supercapacitors

**CO403150C.3:** Identify the need of Smart metering.

**CO403150C.4:** Apply the communication technology in smart grid.

**CO403150C.5:** Comprehend the issues of micro grid.



**Subject 4: EHVAC Transmission (403151A)**

At the end of this course, Students will be able to

**CO403151A.1:** Highlight need for EHV ac transmission.

**CO403151A.2:** Calculate line and ground parameters.

**CO403151A.3 :** Enlist problems encountered in EHV transmission.

**CO403151A.4:** Describe the effect of electric and magnetic fields on human beings.

**Subject 5: Elective-IV Illumination Engineering (403151B)**

At the end of this course, Students will be able to

**CO403151B.1:** Define and reproduce various terms in illumination.

**CO403151B.2:** Identify various parameters for illumination system design.

**CO403151B.3:** Design indoor and outdoor lighting systems.

**CO403151B.4:** Enlist state of the art illumination systems.

**Subject 6: Project stage II (403152)**

At the end of this course, Students will be able to

**CO403152.1:** Work in a team and ensure satisfactory completion of the project in all respects.

**CO403152.2:** Handle different tools to complete the given task and to acquire specified knowledge in area of interest

**CO403152.3:** Provide solution to the current issues faced by the society

**CO403152.4:** Practice moral and ethical values while completing the given task.

**CO403152.5:** Communicate effectively findings in verbal and written forms.

**Subject 7: Audit Course VIII Engineering Economics-II (403153B)**

At the end of this course, Students will be able to

**CO 403153B.1:** Apply various techniques for evaluation of engineering projects.

**CO 403153B.2:** Assess cash flow under risk with varying parameters.

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