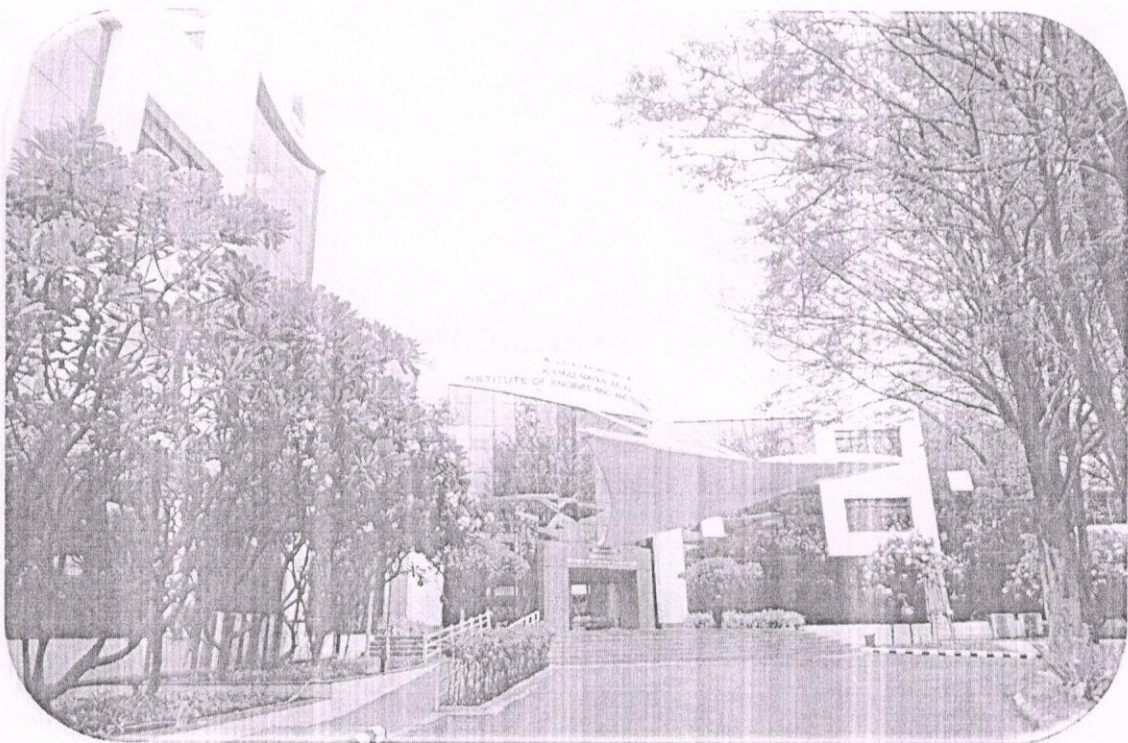




**Vidya Pratishthan's Kamalnayan Bajaj Institute
of Institute of Engineering and Technology,
Baramati**

**Faculty of Science & Technology
Board of Studies
Electrical Engineering**



**B. Tech. Electrical Engineering
(Pattern: 2023)**

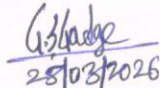
(w.e.f. AY: 2026-27)

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Electrical Engineering
Syllabus: Final Year (B. Tech.) Electrical Engineering
2023 Pattern w.e.f. AY: 2026-2027
SEMESTER-VII

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
IOJT	EL23401PR	Internship/On-job Training	-	24	-	100	-	-	100	-	150	350	-	12	-	12
HSSM	HS23402TH	Entrepreneurship Development	3	-	-	30	-	70	-	-	-	100	3	-	-	4
HSSM	HS23402TU	Entrepreneurship Development	-	-	1	-	-	-	-	-	30	30	-	-	1	
HSSM	HS23403TH	Research Methodology and IPR	3	-	-	30	-	70	-	-	-	100	3	-	-	4
HSSM	HS23403TU	Research Methodology and IPR	-	-	1	-	-	-	30	-	-	30	-	-	1	
AEC	HS23404TH	Public Speaking and Aptitude	1	-	-	40	-	-	-	-	-	40	1	-	-	2
AEC	HS23404TU	Public Speaking and Aptitude	-	-	1	-	-	-	-	-	30	30	-	-	1	
Total			7	24	3	200	0	140	130	0	210	680	7	12	3	22



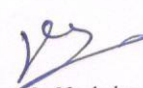
Mrs. S. D. Rokade
Academic Coordinator


28/03/2026

Dr. G. S. Gadge
Head of Department



Dr. S. M. Bhosle
Dean Academics



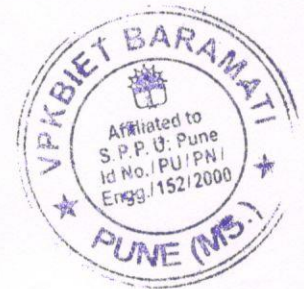
Dr. A. H. Kolekar
Controller of Examination



Dr. S. B. Lande

Principal

Vidya Pratishthan's
Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati
 Vidyanagari, Baramati-413133




Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology
Board of Studies: Electrical Engineering
Syllabus: Final Year (B. Tech.) Electrical Engineering
2023 Pattern w.e.f. AY: 2026-2027

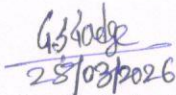
SEMESTER-VIII


Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CA A	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	EL23411TH	Advanced Electrical Drives and Control	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	EL23411PR	Advanced Electrical Drives and Control	-	2	-	-	-	-	-	30	-	30	-	1	-	
PEC	EL23412TH	Programme Elective Course (PLC & SCADA/ PQM)	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PEC	EL23412PR	Programme Elective Course (PLC & SCADA/ PQM)	-	2	-	-	-	-	-	-	30	30	-	1	-	
PEC	EL23413TH	Programme Elective Course (HVE/DCS)	2	-	-	10	-	60	-	-	-	70	2	-	-	3
PEC	EL23413PR	Programme Elective Course (HVE/DCS)	-	2	-	-	-	-	-	-	30	30	-	1	-	
MDM	MD23XXXTH	Multi-disciplinary minor	2	-	-	20	20	50	-	-	-	90	2	-	-	3
MDM	MD23XXXPR	Multi-disciplinary minor	-	2	-	-	-	-	20	-	-	20	-	1	-	
PROJ	EL23414PR	Project	-	8	-	-	-	-	80	-	50	130	-	4	-	4
OE	OE230XXTH	Open Electives	2	-	-	-	-	50	-	-	-	50	2	-	-	2
Total			12	16	0	50	80	280	100	30	110	650	12	8	0	20


List of Program Electives


Code	Program Elective-IV	Code	Program Elective-V
EL23412A	PLC & SCADA	EL23413A	High Voltage Engineering
EL23412B	Power Quality Management	EL23413B	Digital Control System


Mrs. S. D. Rokade
Academic Coordinator

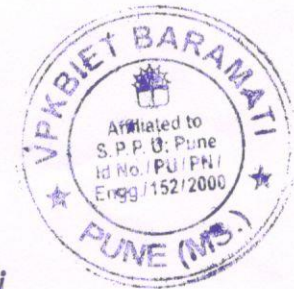

Dr. G. S. Gadge
Head of Department


Dr. S. M. Bhosle
Dean Academics


Dr. A. H. Kolekar
Controller of Examination


Dr. S. B. Lande

Principal
Vidya Pratishthan's
Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati/
Vidyanagari, Baramati-413133



EL23401- Internship/On-job Training

Teaching Scheme: TH: 00 Hrs./Week PR: 24 Hrs./Week	Credits:12	Examination Scheme: CAA:100 Term Work :100 Lab Evaluation: 150 Marks
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Prerequisites:

Students should have successfully completed **Semester VI** of the Engineering program.

Course Objectives:

1. To learn and practice hands-on technical skills.
2. To provide opportunities for acquiring, comprehending, and refining practical technical proficiencies.
3. To gain exposure to professional industrial practices and environments.
4. To understand how real-world factors like cost, society, and management affect a company.
5. To cultivate ethical principles aligned with professional and societal standards.

Course Outcomes:

CO 1. Understand how people in the industry approach and solve problems.

CO 2. Learn how to write clear and effective technical reports.

CO 3. Work effectively and professionally as part of a team.

CO 4. Learn to pick the right tools and technology to solve a given problem.

CO 5. Analyze various career opportunities and decide career goals.

CO 6. Demonstrate abilities of a responsible professional and use ethical practices in day-to-day life.

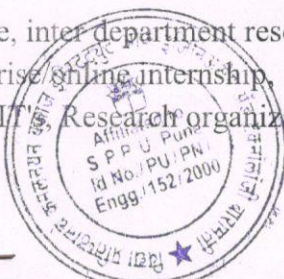
Internship work Identification:

Student may choose to undergo Internship at Industry/Govt. Organizations/NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or Entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry.

Internship work identification process should be initiated in the VI semester in coordination with training and placement cell/ industry institute cell. This will help students to start their internship work on time.

Student can take internship work in the form of the following but not limited to:

1. Working for research project,
2. Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ startups cells of institute,
3. Learning at Departmental Lab/ Institutional workshop,
4. Development of new product/ Business Plan/ registration of start-up,
5. Industry / Government Organization Internship,
6. Internship through Internshala,
7. In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship,
8. Research internship under professors, IISC, IIT, Research organizations,
9. NGOs or Social Internships, rural internship,
10. Participate in open source development.



Duration:

Internship is to be completed after semester 6 and before commencement of semester 8 of at least 14 to 20 weeks; and it is to be assessed and evaluated in semester 7.

Guidelines for students

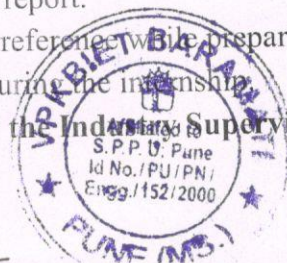
1. All B.Tech students are required to undergo an internship for a minimum duration of **14–16 weeks**. Students must **obtain a Final Year - Bonafide Certificate through the college office**, which is **mandatory** for commencing the internship.
2. Student must submit application form with all documents and Undertaking forms to department IIC Coordinator through mentor
3. Students can take mini projects, assignments, case studies by discussing it with concerned authority from industry and can work on it during internship.
4. All students should compulsorily follow the rules and regulations as laid by industry.
5. Every student should take prior permissions from concerned industrial authority if they want to use any drawings, photographs or any other document from industry.
6. Student should follow all ethical practices and SOP of industry.
7. Students have to take necessary health and safety precautions as laid by the industry.
8. Student should contact his /her academic guide from college on weekly basis to communicate the progress.
9. Each student has to prepare internship report in consultation with the academic guide.

Internship Diary / Internship Workbook

1. Students must maintain a daily diary **in the format prescribed by the college**, documenting observations, tasks performed, information gathered, and any suggestions.
2. The diary should include relevant sketches, drawings, or diagrams based on daily observations.
3. The industry supervisor or section in-charge must **verify and sign the diary every week**.
4. Students must present the diary to the **Faculty Mentor during each industry visit** for verification and ratification.
5. Upon completion of the internship, students must submit the following to the Institute:
 - Student's Daily Diary (as per college format)
 - Internship Report
 - Attendance Record
 - Evaluation Sheet duly signed and stamped by the industry
6. The diary will be evaluated based on **regularity of entries, completeness, and adherence to the prescribed format**.

Internship Report

1. Students must prepare a **comprehensive internship report in the format prescribed by the department**, covering observations, tasks performed, and key learning outcomes.
2. Students may consult the **Industry Supervisor and Faculty Mentor** to obtain specific topics or problem statements to be included in the report.
3. Students should use the **daily diary** as a reference while preparing the report, as it already contains detailed information recorded during the internship.
4. The completed report must be **signed by the Industry Supervisor and Faculty Mentor** before submission to the department.



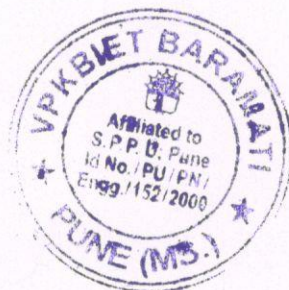
5. The internship report will be evaluated based on the following criteria:
- Originality of content
 - Adequacy and purposefulness of the write-up
 - Organization, formatting, quality of sketches/drawings, writing style, and language
 - Variety and relevance of the learning experiences documented
 - Linkage of practical applications with theoretical concepts learned in coursework

Evaluation Guidelines:

Every student is required to prepare and maintain documentary proofs of the activities done by him/her as internship diary or as workbook. The evaluation of these activities will be done by Department IIC Coordinator / faculty mentor or Industry Supervisor/Appointed External Examiner based on- Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities. Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship.)

Component	Marks
A. Continuous Assessment Activity	100
B. Term-Work (Internship Report)	100
C. Oral Examination / Viva	150
TOTAL	350

1. **Continuous Assessment (100 Marks):** Evaluation includes attendance, discipline, workplace behavior, and the quality of the learning diary or logbook. Mid-semester progress presentations and structured industry supervisor feedback form an integral part of the continuous review process.
2. **Term-Work (150 Marks):** Assessment covers the structure and completeness of the internship report, technical depth, problem-solving ability, and reflection on skills developed. Supporting evidence—drawings, screenshots, certificates, and attendance records—is verified, along with a plagiarism check to ensure originality.
3. **Oral Examination / Viva (150 Marks):** Evaluation focuses on understanding of tasks performed, application of engineering concepts, clarity of communication, industry relevance, and the ability to respond logically during interaction with examiners. Joint assessment by internal and external examiners ensures transparency and fairness.



Internship Evaluation Scheme (Total: 350 Marks)

Component	Marks	Evaluation Basis	Mode of Assessment / Evaluator
A. Continuous Assessment (50 Marks)			
Attendance, Discipline & Professionalism	20	Regularity, punctuality, adherence to workplace culture	Attendance record + Industry Supervisor note
Diary / Logbook	20	Weekly reflection of tasks, learning outcomes, challenges	Logbook review by Faculty Mentor
Mid-Semester Progress Presentation	20	Presentation on tasks performed, tools/technologies learned, contributions	Faculty review (in consultation with Industry Supervisor)
Industry Supervisor Feedback	40	Attitude, initiative, teamwork, professional conduct	Structured feedback form
Subtotal (A)	100		
B. Term-Work (Internship Report)- (100 Marks)			
Internship Report (Structure & Completeness)	20	Cover page, acknowledgement, organization profile, objectives, methodology, tasks, outcomes, conclusion	Faculty Panel Evaluation
Technical Content & Problem Solving	30	Depth of technical work, relevance to discipline, engineering application	Faculty Panel
Skill Development Reflection	20	Technical/professional skills, tools learned, employability skills (NEP focus)	Faculty Panel
Evidence & Annexures	15	Screenshots, codes, drawings, certificates, datasheets, attendance logs	Faculty Panel
Plagiarism / Originality	15	Minimum 80% originality; no copy-paste	Plagiarism check + Faculty review
Subtotal (B)	100		
C. Presentation & Oral Examination / Viva (100 Marks)			
Understanding of Work Done	30	Explanation of tasks performed, process understanding, technical depth	Internal + External Examiners
Application of Knowledge	30	Linkage with curriculum, application of engineering concepts	Viva Panel
Soft Skills & Communication	30	Presentation skills, clarity, professional conduct	Viva Panel
Industry Relevance & Employability	30	Awareness of industry practices, teamwork, adaptability	Viva Panel (Industry input)
Q&A Interaction	30	Logical reasoning and accuracy of responses	Viva Panel
Subtotal (C)	150		
Total A+B+C	350		

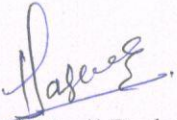


Feedback from internship supervisor

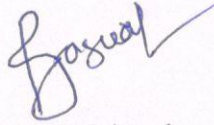
Post internship, faculty coordinator/Mentor should collect feedback about student with recommended parameters include as- Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership

Reference:

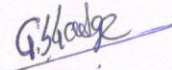
1. <https://internship.aicte-india.org/>
2. Circular No. 29-2024 Internship Cell- BOD Link_15022024.pdf
3. <https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf>



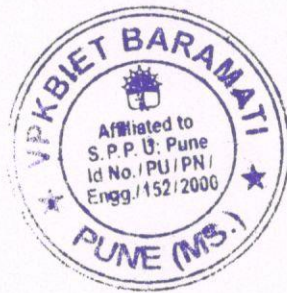
Mr. Shivaji Raskar
PAC Member 1



Ms. Pooja Jaiswal
PAC Member 2



Dr. Gaurav Gadge
PAC Member 3



HS23402: Entrepreneurship Development		
Teaching Scheme: TH: 03 Hrs./Week TUT: 01 Hr./Week	Credits:04	Examination Scheme: Course Activity: 30 Marks End-Semester Exam: 70 Marks Oral Exam: 30 Marks Total: 130 Marks

Course Outcomes

Upon successful completion of this course, the students will be able to:

- CO1:** Understand the fundamentals of entrepreneurship, the entrepreneurial mindset, traits, and the role of entrepreneurs in economic development.
- CO2:** Explain the growth of entrepreneurship in India and analyze the role of institutional support systems and government initiatives.
- CO3:** Apply design thinking principles and innovation strategies in product/service selection and development.
- CO4:** Conduct market and feasibility studies and prepare a comprehensive business plan.
- CO5:** Develop strategies for enterprise management, risk handling, funding acquisition, and incubation support.
- CO6:** Analyze the startup ecosystem and evaluate real-world entrepreneurial case studies.

Course Contents

Unit 1: Introduction to Entrepreneurship

[Hrs]

Introduction to Entrepreneurship, Concept and Definitions of Entrepreneur and Entrepreneurship, Objectives of Entrepreneurship Development, Phases of Entrepreneurship Development, Role of Entrepreneurship in Economic Development, The Entrepreneurial Mindset, Characteristics and Traits of Entrepreneurs, Entrepreneurship Skills

Unit 2: Entrepreneurial Growth in India

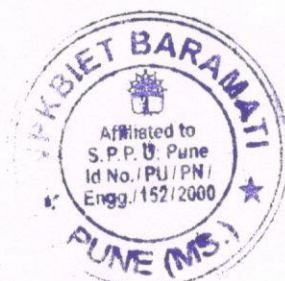
[Hrs]

Sources of Entrepreneurship in India, Entrepreneurial Development Programmes (EDPs): Concept, Need and Phases, Institutions Conducting EDPs in India, Role of Key Institutions: Maharashtra Centre for Entrepreneurship Development, National Institute for Micro, Small and Medium Enterprises, Prime Minister Employment Generation Programme, Directorate of Industries, Khadi and Village Industries Commission

Unit 3: Design Thinking and Product Selection

[Hrs]

Design Thinking, Technology Readiness Levels (TRL), Product/Service Selection Process, Product/Service Life Cycle, New Product/Service Development Process, Mortality Curve, Creativity and Innovation in Product/Service Development and Modification



Unit 4: Market Study and Business Plan Preparation

[Hrs]

Market Study Procedures: Questionnaire Design, Sampling Techniques, Market Survey, Data Analysis. Feasibility Study, Forms of Ownership, Capital and Budgeting, Feasibility Report Preparation and Evaluation Criteria, Business Plan Preparation

Unit 5: Managing Enterprise

[Hrs]

Unique Selling Proposition (USP), Identification and Development of Marketing Plan, Policy Making and Strategic Planning, Risk Management and Calculated Risk-Taking, Angel Investors and Venture Capitalists, Incubation Centers: Role and Procedure

Unit 6: Startup Ecosystem and Case Studies

[Hrs]

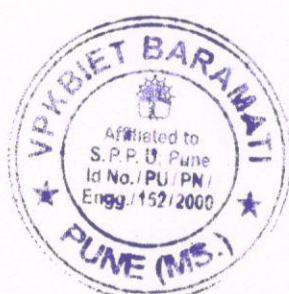
Concept of Startup Ecosystem, Components of Startup Ecosystem, Role of Government, Investors, Incubators, and Accelerators, Case Studies of Successful Startups/Entrepreneurs, Lessons from Startup Success and Failures

Books & Other Resources:**Text Books:**

1. Entrepreneurship Development – Dr. K. Natarajan & Prof. E. Gordon, Himalaya Publishing House.
2. Introduction to Entrepreneurship Development – Abhik Kumar Mukherjee & Shaunak Roy, Oxford University Press.
3. Entrepreneurship Development – Dr. J. Ravi, Manglam Publications.
4. The Dynamics of Entrepreneurial Development and Management – Vasanth Desai, Himalaya Publishing House.

Reference Books:

1. Entrepreneurship – Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, McGraw-Hill.
2. Entrepreneurship Development and Small Business Enterprises – Poornima M. Charanthimath, Pearson Education.
3. Entrepreneurship Development – S. L. Gupta & Arun Mittal, International Book House.
4. Management and Entrepreneurship Development – Sudha G. S., Indus Valley Publication.



HS23403: Research Methodology and IPR		
Teaching Scheme: TH: 03 Hrs./Week TUT: 01 Hr./Week	Credits:04	Examination Scheme: Course Activity: 30 Marks End-Semester Exam: 70 Marks Term Work: 30 Marks Total: 130 Marks

Prerequisites:

Project based learning of all subjects, Fundamental laws and principles of all subjects, Soft and communication skills.

Course Objectives:

1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. It will create consciousness for Intellectual Property Rights and its constituents.
3. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

Course Outcomes

Upon successful completion of this course, the students will be able to:

CO1: Formulate a research problem for engineering and technology domain.

CO2: Analyze the available literature for given research problem and understand different techniques of data collection.

CO3: Investigate the statistical and reliability methods of preliminary data analysis and present the results in graphical form.

CO4: Understand the importance of technical writing and presentation skills.

CO5: Comprehend the various forms of the intellectual property, its relevance and business impact in the changing global business environment.

CO6: Realize the importance of patents, trademark and copyright and follow research ethics.

Course Contents

Unit 1: Introduction

[07 Hrs]

Introduction, Meaning of research, Objectives of research, Types of research, Research approaches, Significance of research, Research methods versus methodology, Research and scientific method, Research process, Criteria of good research, Problems encountered in India for good research, Formulation of research hypotheses, Search for causation, Format for



research proposal, Funding for the proposal, Different funding agencies, Framework for the planning.

Unit 2: Literature Review

[07 Hrs]

Definition of literature and literature survey, Significance of literature survey, Sources of literature, Elements and objectives of literature survey, Styles of literature survey, Strategies of literature survey, Searching the existing literature, Reviewing the selected literature, Writing about the literature reviewed and gap identified, literature analysis, data collection, and interpretation.

Unit 3: Preliminary Data Analysis

[07 Hrs]

Testing of hypothesis- concepts and testing, Review of theory of reliability, Hazard models, System reliability. Data presentation skills, Features of statistical analysis, Histogram, bar charts, Pie charts, 2D & 3D plots, Interpolation & extrapolation techniques, Curve fitting.

Unit 4 Technical Writing and Presentation

[07 Hrs]

Effective technical writing, thesis writing, research proposal writing, research paper writing, Significance of report writing, Different steps in writing report, Layout of the research report, Types of reports, Mechanics of writing a research report, Precautions for writing research reports, Presentation skills, tools for technical writing and presentation. Plagiarism, avoiding plagiarism, Research ethics, Tools for plagiarism checking, technical writing and presentation.

Unit 5: Intellectual Property Rights

[07 Hrs]

Introduction and significance of intellectual property rights, Types of Intellectual Property Rights, Copyright and its significance, Introduction to patents and its filing, Introduction to patent drafting, Best practices in national and international patent filing, Copyrightable work examples.

Unit 6: Patent Rights

[07 Hrs]

Patents and its basics, Patentable items, Designs, Process of filing patent at national and international level, Process of patenting and development, Technological research and patents, innovation, Patent and copyright international intellectual property, Procedure for grants of patents, Need of specifications, Types of patent applications, Provisional and complete specification, Patent specifications and its contents, Trade and copyright.

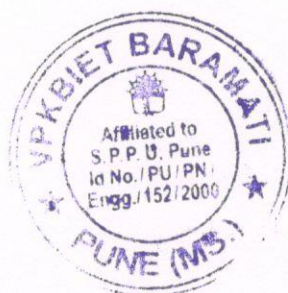
Books & Other Resources:

Text books:

1. Ranjit Kumar (2005), 2nd edition, Research Methodology: A Step by Step Guide for beginners (Pearson Education).
2. C. K. Kothari (2004), 2nd edition, Research Methodology Methods & Techniques (New Age International, New Delhi).
3. T. Ramappa (2016), 2nd edition, Intellectual Property Rights-Law in India (Asia Law House, Hyderabad).

Reference Books:

1. Louis Cohen, Manion, Morrison and Routledge (2017), 8th edition, Research Methods in Education (Taylor & Francis Group- Cambridge University Press India Pvt. Ltd.).



2. John Best and James Kahn (1998), 8th edition, Research in Education (Prentice Hall of India Pvt. Ltd.).
3. Stuart Melville and Wayne Goddard (2001), Research Methodology: An Introduction for Science and Engineering Students. (Juta & Co Ltd.).
4. Benjamine Niebel and Alan Draper (1974), Product Design and Process Engineering, (McGraw Hill International Publishers).
5. Halbert D. J. (2007), 2nd edition, Resisting Intellectual Property (Taylor and Francis Ltd.).
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley (2016), Intellectual Property in New Technological Age (Stanford Public Law Working Paper No. 2780190, Elsevier Publishers).

The term work should consists of following assignments.

1. **Literature Review:** Collect the existing literature on any research idea in engineering/technology and identify the research gap. (Performed in a group of **three or four students**)
2. **Report and Seminar Presentation:** Prepare a research proposal based on the identified research gap, which may serve as a basis for the project work. The report should be checked for plagiarism and language quality (e.g., using Grammarly or equivalent tools), and the idea should be presented. (Performed in a group of **three or four students**)
3. **Blank Format of Research Proposal:** Identify national and international funding agencies and prepare/print the blank format of a research proposal of any one agency, for understanding proposal structuring relevant to research work. (Performed in a group of **three or four students**)
4. **Citation and Referencing Styles:** Write a report on different citation and referencing styles adopted by various publishers, facilitating proper documentation of the research work.
5. **IPR Case Study:** Write a report on a case study of any existing patent/copyright/trademark, providing insight into intellectual property aspects related to project development.
6. **Journal Study:** Collect information on any one peer-reviewed journal and write a report covering abstracting and indexing, H-index, SJR rating, impact factor, aims and scope, and submission guidelines.



HS23404: Public Speaking and Aptitude		
Teaching Scheme: TH: 03 Hrs./Week TUT: 01 Hr./Week	Credits:02 TH: 01 TUT: 01	Examination Scheme: Course Activity: 40 Marks Term Work: 30 Marks Total: 70 Marks

Course Objectives:

1. To develop effective public speaking styles through conversational and communication skills and also enhance speaking skills by focusing on body language and understanding the situational requirements for effective public speaking.
2. To develop students' quantitative, logical and analytical abilities required to solve aptitude-based problems commonly encountered in competitive examinations and also enhance their problem-solving speed, decision-making ability and logical reasoning skills

Course Outcomes

Upon successful completion of this course, the students will be able to:

CO1: Communicate effectively in various public speaking situations and deliver organised and engaging speeches with appropriate body language, voice modulation and confident speech techniques.

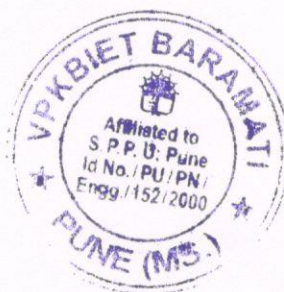
CO2: Apply appropriate quantitative, logical, and reasoning strategies to efficiently solve numerical aptitude, data interpretation, and logical reasoning problems with improved speed and accuracy in placement and competitive examination contexts and apply rapid analytical, logical and decision-making strategies to solve time-bound problems with improved accuracy and efficiency

Course Contents

Unit 1: Essentials and Art of Public Speaking

[6 Hrs.]

Sentence Mastery (Sentence Structure + Subject-Verb Agreement), Verb Tense Control (Past / Present / Future Tenses), Functional Usage (Prepositions + Common Errors & Correct Usage), Verbal & Non-Verbal Communication, Active Listening Skills, Public Speaking & Presentation Skills, Confidence Building, Interpersonal Skills & Relationship Building, Teamwork & Collaboration, Body Language & First Impression, Professional Email, Message & Business Writing, Time Management & Prioritization, Interview Skills & Group Discussion, Workplace Etiquette & Professional Behavior, Emotional Intelligence & Anxiety Control, Stress Management & Work-Life Balance, LinkedIn Profile & Resume Writing, Mock Interviews & Feedback.



Unit 2: Quantitative Aptitude

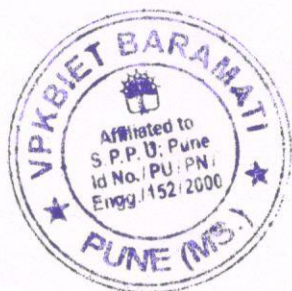
[6 Hrs]

Number System, Percentages, Ratio & Proportion, Profit, Loss & Discount, Averages, Time, Speed & Distance, Time & Work + Pipes, Simple & Compound Interest (Basic), Data Interpretation (DI), Data Sufficiency, Seating Arrangement (Linear & Circular), Blood Relations, Coding–Decoding, Syllogisms, Statement–Assumption / Argument.

Books & Other Resources:

Text books:

1. King, Dale. *Effective Communication Skills: The Nine-Keys Guidebook for Developing the Art of Persuasion through Public Speaking, Social Intelligence, Verbal Dexterity, Charisma, and Eloquence*, Hamatea Publishing Studio, 2020
2. King, Patrick. *How to Speak Effectively: Master Communication Skills, Public Speaking and Influence | Improve Conversations, Confidence, and Social and Professional Presentations, and Making an Impact on People*, Penguin, 2024
3. Tuhovsky, Tuhovsky. *Communication Skills: A Practical Guide to Improving Your Social Intelligence, Presentation, Persuasion and Public Speaking: 9 (Positive Psychology Coaching)*, Createspace Independent Publishing, 2015
4. Aggarwal. R.S., *Quantitative Aptitude for Competitive Examinations*, S Chand and Company Ltd. 2025.



EL23411 : Advanced Electrical Drives and Control		
Teaching Scheme: TH: 03 Hrs/Week PR: 02 Hrs/Week	Credits:04	Examination Scheme: Course Activity: 10 Marks In-Semester Exam: 30 Marks End-Semester Exam: 60 Marks Practical Exam: 30 Marks

Prerequisite Courses:

Electrical Machines I, Electrical Machines II, Power Electronics

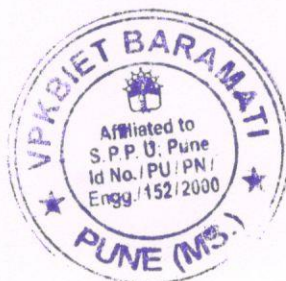
▪ **Course Objectives:**

1. To understand the fundamentals of electrical drives, motor-load dynamics, and multi-quadrant operation.
2. To analyze and evaluate the performance of chopper-fed DC drives for speed control and braking applications.
3. To study different braking methods and advanced control strategies such as vector control for induction motor drives.
4. To understand the construction, operation, and control of BLDC, PMSM, and reluctance motor drives with applications to Electric Vehicles.
5. To comprehend sensor-based control, and control strategies for reliable operation of electrical drives.
6. To evaluate recent trends, industrial applications, and integration of drives with modern power electronic and monitoring systems.

Course Outcomes

On completion of the course, learner will be able to:

- CO1:** Explain motor-load dynamics, speed–torque characteristics, and multi-quadrant operation of electrical drives.
- CO2:** Analyze the performance of chopper-controlled DC drives for starting, speed control, and braking.
- CO3:** Apply different braking methods and vector control strategies for induction motor drives.



CO4: Apply closed-loop control strategies for BLDC and PMSM drives used in Electric Vehicle applications.

CO5: Compare and elaborate the operation of synchronous and reluctance motor drives with their industrial relevance.

CO6: Assess sensor-based, evaluate protection strategies, and recommend appropriate drives for diverse industrial applications.

Course Contents

Unit I: Fundamentals of Electrical Drives (6 Hrs)

Definition and components of electrical drive system, types of electrical drives (DC and AC), selection of drive parameters, industrial applications of drives, motor-load dynamics, speed–torque conventions and multi-quadrant operation, equivalent values of drive parameters, load torque components, nature and classification of load, constant power operation of a drive, steady-state stability of drives.

Unit II: DC Motor Drives (7 Hrs)

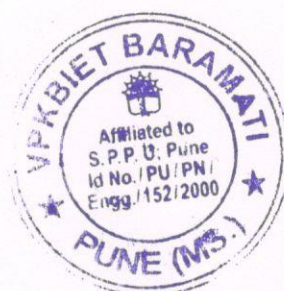
Chopper-controlled drives for separately excited and series DC motor operations, closed-loop speed control of DC motors below and above base speed, starting, speed control and braking operations of DC drives, applications and relevance of DC drives in modern industry.

Unit III: Induction Motor Drives (7 Hrs)

Methods of braking: regenerative braking, dynamic braking, plugging with numerical examples, voltage source inverter (VSI) control and steady-state analysis, current source inverter (CSI) control – open and closed loop, regenerative braking and multi-quadrant operation of induction drives, principle and block diagram of vector control of induction motor, failure modes and protection of induction motor drives.

Unit IV: BLDC Drives (6 Hrs)

Construction and working (block diagram) for motoring and regenerative braking, speed–torque characteristics, closed-loop control of BLDC drives (PI controller), vector control of BLDC drives, applications in electric vehicles (descriptive treatment).



Unit V: Synchronous Motor drives**(7 Hrs)**

Part A: PMSM Drive: Construction and working (block diagram) for motoring and regenerative braking, speed–torque characteristics, closed-loop control of PMSM drives (PI controller), vector control of PMSM drives.

Part B: Synchronous Reluctance Motor: Introduction and working principle, applications of synchronous reluctance motor in electric vehicles (descriptive treatment).

Unit VI: Control, Sensors and Recent Industrial Applications**(7 Hrs)**

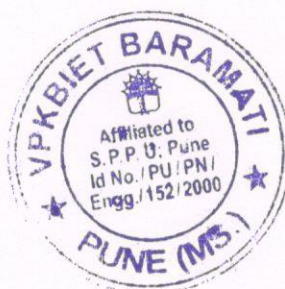
Role of sensors in electrical drives: types such as encoders, Hall-effect sensors, current and voltage sensors, temperature sensors, sensor-based control for speed, position and torque regulation, IoT-based monitoring and smart drives, specific requirement and choice of drives for machine tools, textile mills, steel rolling mills, sugar mills, traction, cranes and hoists.

Books & Other Resources:**Text Books:**

1. G. K. Dubey, “Fundamentals of Electric Drives”, 2nd Edition, Narosa Publishing House
2. N. K. De, P. K. Sen, “Electric Drives”, Prentice Hall of India Eastern Economy Edition
3. S. K. Pillai, “Analysis of Thyristor Power Conditioned Motors”, University Press
4. G.K. Dubey, “Power Semiconductor controlled drives”, PHI publication
5. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education

Reference Books:

1. R. Krishnan, “Electric Motor Drives – Modeling Analysis and Control”, PHI India
2. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education
3. V. Subrahmanyam, “Electric Drives: Concepts and Application”, Tata Mc-Graw Hill (An imprint of Elsevier)
4. M.D. Singh and Khanchandani “Power Electronics”, Tata Mc-Graw Hill
5. Austin Huges, “Electrical motor and drives: Fundamental, types and applications”, Heinemann Newnes, London
6. Tyagi MATLAB for engineers oxford (Indian Edition)
7. Malcolm Barnes, “Practical Variable Speed Drives and Power Electronics”, Elsevier Newnes Publications



Guidelines for Laboratory - Term Work Assessment:

1. The distribution of weightage of term work marks should be informed to students before the start of the semester.
2. Term work assessment should be on a continuous basis. At frequent intervals students are expected to inform about their progress/lagging.

Guidelines for Laboratory Conduction:

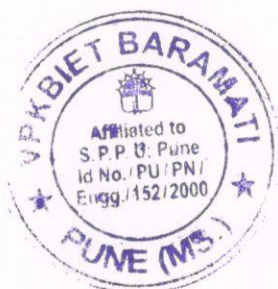
1. DO's and DON'TS, along with precautions, are needed to be displayed at prominent locations in the laboratory.
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Guidelines for Students Lab Journal:

1. The Student's Lab Journal should contain following related to every experiment –
2. Theory related to the experiment.
3. Apparatus with their detailed specifications.
4. Connection diagram /circuit diagram.
5. Observation table/ simulation waveforms.
6. Sample calculations for one/two readings.
7. Result table.
8. Graph and Conclusions.
9. There should be continuous assessment for the TW.
10. Assessment must be based on understanding of theory, attentiveness during practical, understanding Session, how efficiently the student is able to make connections and get the results, and timely submission of journals.

LIST OF PRACTICALS (Any 08 to be performed by the student)

1. To perform electrical braking of D.C. Shunt motor (Rheostatic, Plugging).
2. To perform Speed control characteristics of single phase fully converter fed separately excited D.C. motor
3. To observe VSI fed 3 phase Induction motor (using V/f control PWM inverter) speed control characteristics.



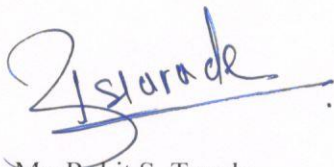
4. To observe chopper fed D.C. series/separately motor speed control characteristics.
5. To perform electrical braking of 3 phases Induction Motor (DC Dynamic Braking, Plugging, Regenerative Braking).
6. To perform speed control characteristics of 3-ph fully converter fed separately excited D.C. motor.
7. To perform simulation of Induction motor vector control.
8. To study of constant torque and constant power characteristic of Induction motors.
9. To study of speed control of BLDC / PMSM drive.
10. To perform simulation of closed loop control of BLDC / PMSM drive.
11. To perform simulation of vector control of PMSM/BLDC motor
12. To perform simulation of synchronous reluctance motor

NOTE: The list of experiments is not limited to the above, but a course coordinator may design a few new experiments based on recent technologies/trends in the relevant Engineering Domain. However, the course coordinator needs to get approval by the Program Assessment Committee and Chairman BOS/HOD well in time.

Course Activity (Any one of the following)

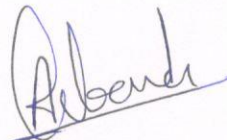
For the assessment of course activity students must complete at least ONE activity out of the following:

1. Design of electric vehicle drivetrain system using MATLAB.
2. Case study on selection of appropriate drive for electric vehicle.



Mr. Rohit S. Tarade

PAC member 1



Mr. A. V. Golande

PAC member 2



Mrs. J. S. Kulkarni

PAC member 3



EL23412A: PLC & SCADA		
Teaching Scheme: TH: 03 Hrs/Week PR: 02 Hrs/Week	Credits:04	Examination Scheme: Course Activity: 10 Marks In-Semester Exam: 30 Marks End-Semester Exam: 60 Marks Oral: 30 Marks

Prerequisite Courses:

Logic gates operations, Boolean algebra, Relay logic

Course Objectives:

1. To understand the fundamentals of automation and systems used in the industry, such as PLC.
2. To understand and apply the knowledge of interfacing of PLC with I/O devices.
3. To provide knowledge needed for PLC programming and operating.
4. To apply the knowledge of programming to advanced PLC applications.
5. To understand the architecture of SCADA and study various critical applications.
6. To understand SCADA Protocols and introduce the concept of Distributed Control Systems

Course Outcomes

On completion of the course, learner will be able to:

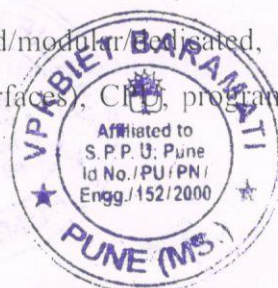
- CO-1:** Explain the working of a PLC with the help of a block diagram and its role in automation.
- CO-2:** Classify input and output interfacing devices with PLC.
- CO-3:** Design PLC based application by proper selection criteria, developing GUI and ladder program.
- CO-4:** Execute, debug, and test the programs developed for digital and analog operations.
- CO-5:** Explain the architecture of SCADA and its importance in critical infrastructure.
- CO-6:** Elaborate the SCADA protocols and digital control systems, along with their architecture for automation.

Course Contents

Unit 01: Introduction to PLC

(07 Hrs)

Role of automation in Industries, benefits of automation, Necessity of PLC, History and evolution of PLC, Definition as per NEEMA (National Electrical Engineering Manufacturers' Association), types – fixed/modular/dedicated, Overall PLC system, PLC Input and output modules (along with Interfaces), CLP, programmers and monitors, power



various PLCs manufactured by Allen Bradley, Siemens, ABB, Mitsubishi, GE, Fanuc and Schneider.

Unit 02: Interfacing of PLC with I/O devices

(06 Hrs)

Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, Output analog devices, Sensors-temperature, pressure, flow, level, Actuators, Encoders-Incremental, Absolute, Transducers, Limit switches, proximity sensors, Control Elements- Mechanical, Electrical, Fluid valves.

Unit 03: Programming of PLC

(06 Hrs)

Programming languages for PLC, Ladder diagram fundamentals, Rules for proper construction of ladder diagram, Timer and Counter- types along with timing diagrams, Reset instruction, latch instruction, MCR (master control relay) and control zones, developing ladder logic for Sequencing of motors, ON OFF Tank level control, ON OFF temperature control, elevator, bottle filling plant, car parking, traffic light controller.

Unit 04: Advance function and Applications of PLC

(07 Hrs)

Analog PLC operation and PLC analog signal processing, PID principles, typical continuous process control curves, simple closed loop systems, closed loop systems using Proportional, Integral and Derivative (PID), PID modules, PID tuning, tuning methods including the "Adjust and observe" method.AC Motor Controls: AC Motor Starter, AC Motor Overload Protection, DC Motor Controller, Variable Speed (Variable Frequency) AC Motor Drive. PLC Applications in developing systems- Tank level controller using analog signals, temperature controller using RTD, speed control of electric motor.

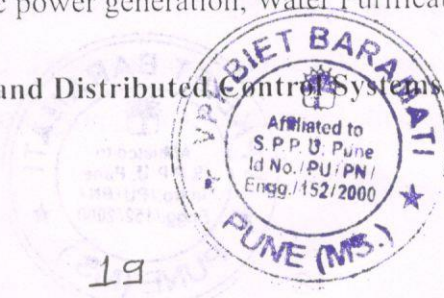
Unit 05: SCADA Systems

(06Hrs)

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system architecture, important definitions HMI, MTU, RTU, communication, Desirable properties of the SCADA system, advantages, disadvantages, and applications of SCADA.SCADA generations (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, functions and features of SCADA systems, Petroleum Refining Process, Conventional electric power generation, Water Purification System, Chemical Plant.

Unit 06: SCADA Protocols and Distributed Control Systems

(07Hrs)



Open systems interconnection (OSI) Model, TCP/IP protocol, Modbus model, DNP3 protocol, IEC 60870-5-101 (IEC101), Control and Information Protocol (CIP), EtherNet/IP, Flexible Function Block process (FFB), Process Field bus (Profibus).

Distributed Control System: Introduction to DCS- its working & operation, Architecture, Features, Advantages & Applications of DCS, Comparison between DCS & PLC.

Books & Other Resources:

Text Books:

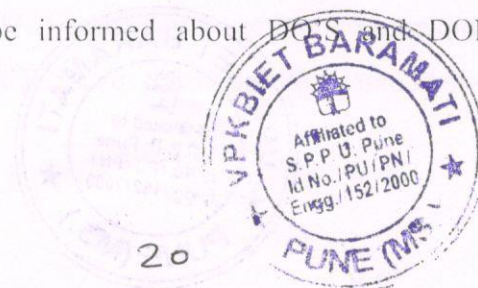
1. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning, New Delhi, 5th Edition
2. John R. Hackworth, Frederick D., Hackworth Jr., "Programmable Logic Controllers Programming Methods and Applications", PHI Publishers.
3. Ronald L. Kurtz, "Securing SCADA Systems," Wiley Publishing.
4. Stuart A. Boyer, "SCADA supervisory control and data acquisition", ISA, 4th Revised edition.
5. Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 2nd Edition.
6. Curtis Johnson, "Process Control Instrumentation Technology," Prentice-Hall of India.

Reference Books:

1. Gordan Clark, Deem Reynders, "Practical Modern SCADA Protocols," ELSEVIER
2. Batten G. L., "Programmable Controllers," McGraw Hill Inc., Second Edition
3. BE Electrical (2019 Course) 13
4. Bennett Stuart, "Real Time Computer Control," Prentice Hall, 1988
5. Krishna Kant, "Computer Based Industrial Control," PHI
6. P. K. Srivstava, "Programmable Logic Controllers with Applications," BPB Publications
7. Distributed Computer Control systems in Industrial Automation, D Popovic & Vijay Bhatkar

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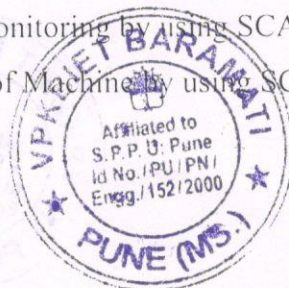
Guidelines for Students Lab Journal:

The Student's Lab Journal should contain following related to every experiment –

1. Theory related to the experiment.
2. Apparatus with their detailed specifications.
3. Connection diagram /circuit diagram.
4. Observation table/ simulation waveforms.
5. Sample calculations for one/two readings.
6. Result table.
7. Graph and Conclusions.
8. There should be continuous assessment for the TW.
9. Assessment must be based on understanding of theory, attentiveness during practical, understanding Session, how efficiently the student is able to make connections and get the results, and timely submission of journals.

List of Practical (Minimum 10 experiments should be conducted. 5 experiments should be on PLC and 5 experiments should be on SCADA.)

1. To identify various parts of the given PLC and front panel status indicators.
2. To develop/execute a ladder program to test the START STOP logic using two inputs and one output. Verify functions of Logic gates.
3. To develop/execute ladder program for sequential control of DC motor.
4. To develop/execute ladder program for interfacing of Encoder with PLC.
5. To develop/execute ladder program for DOL starter and star delta starter operation by using PLC.
6. To develop/execute ladder program for Traffic light control system.
7. To develop/execute ladder program for temperature ON-OFF control.
8. To develop/execute ladder program for tank water level control.
9. To develop program on PLC interfaced with SCADA and status read/command transfer operation.
10. To develop program on parameter reading of PLC in SCADA.
11. To develop program on alarm annunciation using SCADA.
12. To develop program on Reporting and Trending in the SCADA system.
13. To develop program on tank level control by using SCADA.
14. To develop program on temperature monitoring by using SCADA.
15. To develop program on speed control of Machine by using SCADA.



Industrial Visit (if any): Visit to automation industry.

Note :

The list of experiments is not limited to the above, but a course coordinator may design a few new experiments based on recent technologies/trends in the relevant Engineering Domain. However, the course coordinator needs to get approval by the Program Assessment Committee and Chairman BOS/HOD well in time.

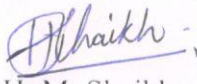
Course Activity (Any one of the following):

1. Poster presentation
2. Simulation using PLC/SCADA applications



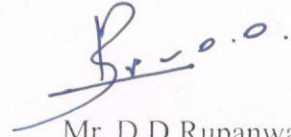
Mrs. S. D. Rokade

PAC Member 1



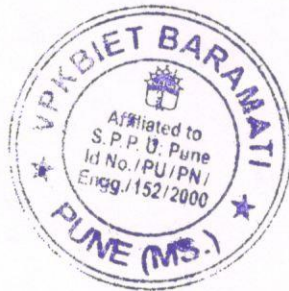
Dr. H. M. Shaikh

PAC Member 2



Mr. D.D Rupanwar

PAC Member 3



EL23412B: Power Quality Management		
Teaching Scheme: TH: 03 Hrs/Week PR: 02 Hrs/Week	Credits:04	Examination Scheme: Course Activity: 10 Marks In-Semester Exam: 30 Marks End-Semester Exam: 60 Marks Oral Exam: 30 Marks

Prerequisite Courses:

Fundamentals of Power Systems, Electrical Machines and Power Electronics

Companion Course, if any: Laboratory Practical

Course Objectives:

1. To explain the fundamentals of power quality issues
2. To describe voltage flicker and mitigation of it
3. To analyze the effect of power system events on voltage sag and its characteristics
4. To identify the sources of harmonics and harmonics produced
5. To select proper method for harmonic mitigation along with methods of power quality monitoring.
6. To assess and monitor power quality using appropriate instruments, standards, and indices.

Course Outcomes:

On completion of the course, learner will be able to:

CO-1: Explain the fundamentals of power quality issues

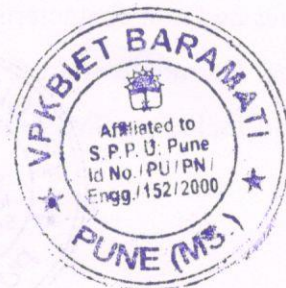
CO-2: Describe voltage flicker and mitigation of it

CO-3: Analyze the effect of power system events on voltage sag and its characteristics.

CO-4: Identify the sources of harmonics and harmonics produced

CO-5: Select proper method for harmonic mitigation along with methods of power quality monitoring.

CO-6: Assess and monitor power quality using appropriate instruments, standards, and indices.



Course Contents

Unit I: Basics of Power Quality (07 Hrs)

Importance of power quality, terms and definitions of power quality as per IEEE std. 1159-2019 such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers and transients. Symptoms of poor power quality. Definitions and terminology of grounding. Purpose of groundings. Good grounding practices and problems due to poor grounding, grounding and power quality, recommended grounding practices for noise and power quality control.

Unit II: RMS Voltage variations, Flickers and Transient Over-Voltages (06 Hrs)

RMS voltage variations in power system, Principles of voltage regulation. Basic power flow and voltage drop, Various devices used for voltage regulation and impact of reactive power management, Various causes of voltage flicker and their effects, Short term and long term flickers, Ferro-resonance Various means to reduce flickers, Flicker meter and monitoring, Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages.

Unit III: Voltage Sag, Swell and Interruption (06 Hrs)

Definitions of voltage sag and interruptions. Voltage sags versus interruptions. Economic impact of voltage sag, Voltage sag characteristics, Voltage sag assessment. Influence of fault level on voltage sag, Phase angle jumps, Types of sags (Type 1 to type 7), Areas of vulnerability, Voltage sag limits for computer equipment, CBEMA, ITIC, SEMI F 42 curves, Measurement of voltage sag half cycle RMS, one cycle RMS methods, Representation of the results of voltage sags analysis, Voltage sag indices, Mitigation measures for voltage sags, such as UPS, DVR, SMEs, CVT etc., utility solutions and end user solutions.

Unit IV: Harmonics-I (07 Hrs)

Definition of harmonics, inter-harmonics, sub-harmonics, Causes and effects of harmonics, Voltage versus current distortion, Overview of Fourier analysis, Harmonic indices and other indices for assessing impacts of harmonics, A.C. quantities under non-sinusoidal conditions, Triplen harmonics characteristics and non characteristics harmonics, Power assessment under waveform distortion conditions, Harmonic sources and harmonic generation from lighting loads, Computer and allied load including SMPS, household equipment, Office automation



devices, Utility equipment like transformer, synchronous machines and FACTS devices. Industrial equipment – induction machines, AC and DC drives, Arc Furnaces.

Unit V: Harmonics-II

(07 Hrs)

Harmonics resonances - series and parallel resonances, Consequences of harmonic resonance, Principles for controlling harmonics, Reducing harmonic currents in loads, K-rated transformer, Harmonic study procedure, Computer tools for harmonic analysis, Locating sources of harmonics, Modifying the system frequency response, Harmonic filtering, IEEE 1531 standard for key design criteria for filters, Passive filters, Notch filter, Tuned filters, Broadband filters and active filters, IEEE Standard 519-2014 for Harmonic control.

Unit VI: Power Quality Monitoring & Assessment

(06 Hrs)

Need of power quality monitoring and approaches followed in power quality monitoring, Power quality monitoring objectives and requirements, Initial site survey, Power quality instrumentation, Power quality analyser specification requirement as per EN50160 Standard, Selection of power quality equipment for cost effective power quality monitoring, Selection of power quality monitors, selection of monitoring location and period, Selection of transducers. Harmonic monitoring, Transient monitoring, event recording and flicker monitoring. Power Quality assessment, Power quality indices and standards for assessment disturbances, waveform distortion.

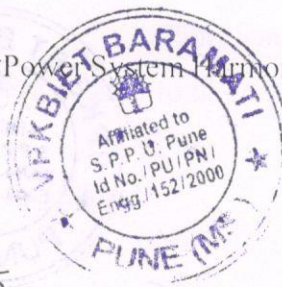
Books & Other Resources:

Text Books:

1. R. C. Dugan, Mark F. McGranaghan, Surya Santoso, and H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw-Hill Publication.
2. C.Sankaran, "Power Quality", CRC Press.
3. M. H. J. Bollen, "Understanding Power Quality Problems, Voltage Sag and Interruptions", New York: IEEE Press, 2000, Series on Power Engineering.
4. Arrillaga, M. R. Watson, and S. Chan, "Power System Quality Assessment," John Wiley and Sons.

Reference Books:

1. Enriques Acha, Manuel Madrigal, "Power System Harmonics: Computer Modeling and



- Analysis," John Wiley and Sons Ltd.
2. Ewald F. Fuchs, Mohammad A. S. Masoum, "Power Quality in Power Systems and Electrical Machines," Elsevier Publication.
 3. Arrillaga, M. R. Watson, "Power System Harmonics", John Wiley and Sons.
 4. G. J. Heydt, "Electric Power Quality", Stars in Circle Publications.
 5. EN50160 and IEEE 1100, 1346, 519, and 1159 standards.

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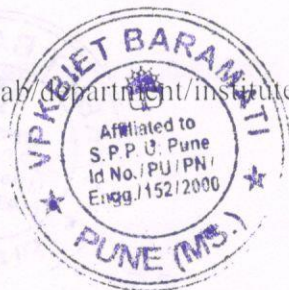
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6. Result table.
7. Graph and Conclusions.
8. There should be continuous assessment.
9. Assessment must be based on understanding of theory, attentiveness during practical, understanding Session, how efficiently the student is able to make connections and get the results, and timely submission of journals.

LIST OF PRACTICALS (Any 08 to be performed by the student)

1. To study the power quality analyzer and measurement of various power quality parameters.
2. To measure harmonic distortion of various non-linear loads.
3. To perform harmonic analysis of SMPS based Equipment such as UPS/AC/DC drive.
4. To analyze harmonic compliance of institute as per IEEE 519-2014 standard and sizing of hybrid (Active + detuned filter).
5. To conduct power quality audit of lab/department/institute.



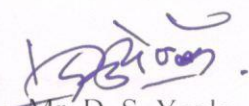
6. To perform harmonic analysis of transformer for various conditions (no load, inrush, full load etc.)
7. To analyze harmonic analysis of UPS/DC Drive/AC Drive.
8. To analyze the performance of induction motor/transformer operated with sinusoidal supply and under distorted supply conditions supplied by 3 phase inverter.
9. To measure voltage sag magnitude and duration by using digital storage oscilloscope/power quality analyzer.
10. To design of 7% detuned Passive Filter.
11. To simulate the study of transient and/or flicker measurement.
12. To simulate the studies of harmonic generation sources such as VFD/SVC/STATCOM /FACTS devices and harmonic measurement (THD) by using professional software like MATLAB.
13. To analyze harmonic load flow using professional software such as ETAP/PSCAD/ATP.

Note:

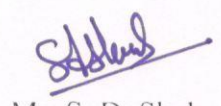
The list of experiments is not limited to the above, but a course coordinator may design a few new experiments based on recent technologies/trends in the relevant Engineering Domain. However, the course coordinator needs to get approval by the Program Assessment Committee and Chairman BOS/HOD well in time.

Course Activity (Any one of the following):

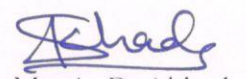
1. Power point presentation/Chart Preparation on various PQ issues
2. Power quality audit of any lab/residential/commercial building


Mr. D. S. Yeole

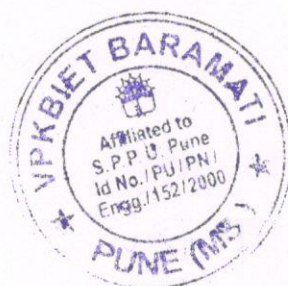
PAC Member 1


Mr. S. D. Shelar

PAC Member 2


Mr. A. B. Akhade

PAC Member 3



EL23413A: High Voltage Engineering		
Teaching Scheme: TH: 02 Hrs/Week PR: 02 Hrs/Week	Credits: 03	Examination Scheme: Course Activity: 10 Marks End-Semester Exam: 60 Marks Oral Exam: 30 Marks

Prerequisite Courses:

Basic Electrical Engineering, Power System Engineering, Electrical Machines.

Course Objectives:

1. To understand the Breakdown mechanism in a Dielectric medium.
2. To study lightning overvoltage and travelling waves
3. To comprehend the generation methods of high voltage and current
4. To learn measurement methods of high voltage and current

Course Outcomes:

On completion of the course, the learner will be able to:

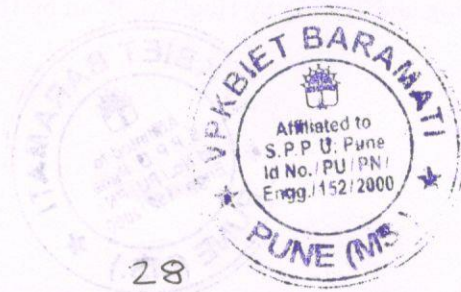
- CO-1:** Explain the breakdown mechanisms in dielectric media.
- CO-2:** Analyze lightning overvoltage and traveling waves and their impact on power systems.
- CO-3:** Discuss the methods of generation of high voltage and high currents.
- CO-4:** Illustrate and summarize various techniques for the measurement of high voltage and high current.

Course Contents

Unit 1: Breakdown (B.D.) mechanism in Di-electric (06 Hrs)

B.D. in Gas insulation: Ionization process; Townsend's criterion for Breakdown, B.D. in electro-negative gases, Time-lag for B.D., Streamer theory, Paschen's law, B.D. in non-uniform field, Post B.D. phenomenon and applications, Practical considerations in using gases for insulation purposes.

B.D. in Liquid dielectrics: Conduction and B.D. in pure and commercial liquids, Intrinsic, electromechanical & thermal B.D., **B.D. in Vacuum insulation, B.D. of Solid dielectrics.**



Unit 2: Lightning over voltages and traveling waves**(06 Hrs)**

Lightning: Mechanism of lightning, Types of strokes, Parameters and characteristics of lightning strokes, Protection of lines by ground wires, Protection by lightning arresters (L.A.), Gap type and Gapless L.A., Selection of L.A. ratings, Surge-absorbers and their types,

Traveling waves: Classification of line attenuation and distortion of traveling waves, reflection and transmission of waves, and behavior of rectangular waves at transition points.

Unit 3: Generation of high voltage and current**(07 Hrs)**

Generation of high D.C voltage by Rectifiers, Voltage Doubler and Multiplier circuits (Derivations of expression not required), Electrostatic Machines, **Generation of high AC voltage** by Cascade Transformers, Resonant Transformers, **Generation of high frequency AC high voltage**, **Generation of impulse voltage:** Standard impulse wave shapes, analyses of model and commercial impulse generation circuits, wave shape control Marx circuit, tripping and control of impulse generation, generation of switching surges, **Generation of impulse current.**

Unit 4: Measurement of high voltage and current**(07 Hrs)**

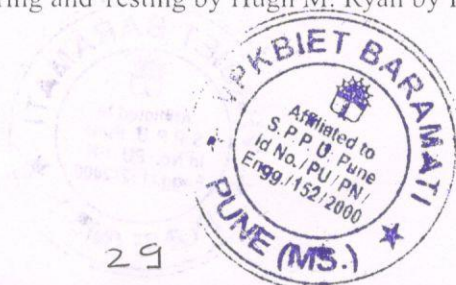
Measurement of high AC and DC voltage by Micro ammeter, Generating Voltmeter, Resistance and Capacitance Potential divider, Series impedance voltmeter, CVT, Magnetic type potential transformers, Electrostatic voltmeter. Peak reading AC voltmeter, Sphere gap arrangement, **Measurement of impulse voltage** by potential dividers and peak reading voltmeters, **Measurement of High AC and DC currents**, **Measurement of high frequency and impulse current** by resistive shunt (Bifilar strip shunt only).

Books & Other Resources:**Text Books:**

1. High Voltage Engineering by M. S. Naidu and V. Kamaraju by TMG 5th Edition.
2. High Voltage Engineering by C. L. Wadhwa, New Age International Publisher.
3. An Introduction to High Voltage Engineering by Subir Ray by PHI.
4. Fundamentals of High Voltage Engineering by Ravindra Arora by Dhanpat Rai Publications.
5. High Voltage Engineering Theory and Practice by R. Arora, Wolfgang Mosch, by New Age International Publishers.

Reference Books:

1. High Voltage Engineering: Fundamentals John Kuffel, Peter Kuffel.
2. High Voltage Engineering and Testing by Hugh M. Ryan by IET (Institution of Engineering and Technology).



3. High Voltage Insulation Engineering by Ravindra Arora by New Age International Publishers.
4. Dielectric Phenomena in High Voltage Engineering by F. W. Peek Jr. by McGraw-Hill.

Guidelines for Laboratory Conduction:

1. DO's and DON'TS, along with precautions, are needed to be displayed at prominent locations in the laboratory.
2. Students should be informed about DO'S and DON'T and precautions before performing.

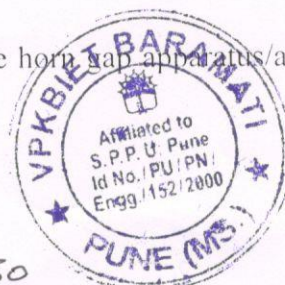
Guidelines for Students' Lab Journal:

The Student's Lab Journal should contain the following related to every experiment –

1. Theory related to the experiment.
2. Apparatus with its detailed specifications.
3. Connection diagram/circuit diagram.
4. Observation table/ simulation waveforms.
5. Sample calculations for one/two readings.
6. Result table.
7. Graph and Conclusions.
8. There should be continuous assessment.
9. Assessment must be based on understanding of theory, attentiveness during practical, understanding Session, how efficiently the student is able to make connections and get the results, and timely submission of journals.

LIST OF PRACTICALS (Any 08 to be performed by the student)

1. To study about layout/earthing/safety of HV installation /lab.
2. To find the constants of the breakdown equation for transformer oil.
3. To measure of unknown high a.c. voltage using a sphere-gap assembly.
4. To obtain the breakdown strength of composite insulation systems, and observe the effect of parameters like the number of layers, the thickness of layers.
5. To find out the breakdown of air in uniform and non-uniform fields and compare them.
6. To obtain audible and visible corona inception and extinction voltage under a non-uniform field.
7. To perform an experiment on the horn gap apparatus/arrester and understand the arc



quenching phenomenon.

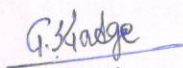
8. To observe the development of tracks and/or trees on insulation systems.
9. To study the effect of the barrier on the breakdown voltage of air/ transformer oil.
10. To perform various HV insulation tests on cables as per IS.
11. To perform a parametric analysis of the Impulse current generator using Virtual Laboratory.
12. To simulate lightning and switching impulse voltage generation using any simulation software.

Note :

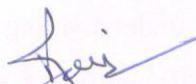
The list of experiments is not limited to the above, but a course coordinator may design a few new experiments based on recent technologies/trends in the relevant Engineering Domain. However, the course coordinator needs to get approval from the Program Assessment Committee and Chairman BOS/HOD well in time.

Course Activity (Any one of the following):

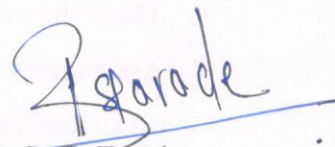
1. Draw the layout of the HVE lab using any simulation software.
2. Perform any TWO experiments on the virtual lab.



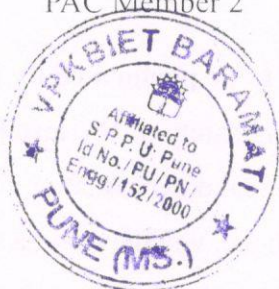
Dr. G. S. Gadge
PAC Member 1



Mrs. P. N. Jaiswal
PAC Member 2



Mr. R. S. Tarade
PAC Member 3



EL23413B: Digital Control System		
Teaching Scheme: TH: 02 Hrs/Week PR: 02 Hrs/Week	Credits:03	Examination Scheme: Course Activity: 10 Marks End-Semester Exam: 60 Marks Oral: 30 Marks

Prerequisite Courses:

Control System Engineering, Engineering Mathematics.

Course Objectives:

1. To introduce fundamentals of digital control and its advantages over conventional analog control systems.
2. To familiarize students with mathematical modeling of discrete-time systems using difference equations, z-transform, and state-space representation.
3. To analyze the stability and performance of digital control systems using methods such as bode, frequency response, and state-space analysis.
4. To design digital controllers and compensators (e.g., PID, lead, lag, deadbeat controllers) for practical control applications.

Course Outcomes

On completion of the course, learner will be able to

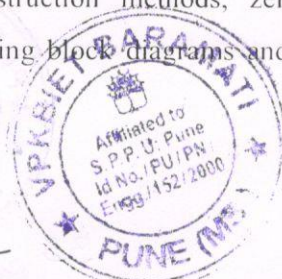
- CO-1:** Explain the fundamentals of digital control systems, sampling, and data reconstruction.
- CO-2:** Apply z-transform techniques and state-space methods to model discrete-time systems.
- CO-3:** Evaluate the stability and performance of digital control systems using bode, nyquist, and frequency response in z-domain.
- CO-4:** Design digital controllers and compensators (PID, lead, lag, deadbeat) for various applications

Course Contents

Unit I: Introduction to Digital Control Systems

(07 Hrs)

Introduction to signals and systems. Need and advantages of digital control over analog control, Sampling process and choice of sampling period, Applications of sampling theorem, aliasing effects, Data reconstruction methods, zero-order hold (ZOH), Modelling of digital control systems using block diagrams and difference equations,



Discretization of continuous-time systems.

Unit II: Discrete-Time System Analysis

(06 Hrs)

Applications of Z-transform and inverse Z-transform (for stability analysis), Pulse transfer function derivation and properties, Relationship between continuous and discrete transfer functions, Discrete-time state-space representation, Controllability and observability in discrete domain, Solution of difference equations (homogeneous, non-homogeneous), Time-domain response of discrete-time systems.

Unit III: Stability Analysis

(07 Hrs)

Stability concepts in z-domain, Mapping between s-plane and z-plane, Jury's stability criterion, Bilinear transformation and Routh stability, Routh-Hurwitz criterion via bilinear transformation, Effect of sampling time on stability, Relative stability and transient response analysis, frequency response of digital control system, Linear quadratic regulator (LQR) concept, Nyquist criterion in discrete domain, Verification of stability analysis using some digital tool.

Unit IV: Digital Controller Design

(06 Hrs)

Digital PID controllers (design and tuning methods), Design using pole placement in z-domain, State feedback and observers, Realization of Digital Controllers, Deadbeat response design and its key characteristics, Implementation issues (computational delay, word length, round-off errors).

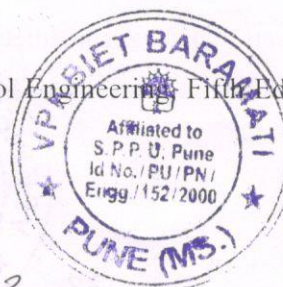
Books & Other Resources:

Text Books:

1. K. Ogata – Discrete-Time Control Systems, Second Edition, PHI Pvt. Ltd. 2006
2. M. Gopal – Digital Control and State Variable Methods, Tata McGraw-Hill.
3. I. J. Nagarath, M. Gopal, Control System Engineering, Fourth Edition, New Age International (P) Limited, Publishers
4. A. Nagoor Kani, Advanced Control Theory, Third Edition, CBS Publishers and Distributes, 2020.

Reference Books:

1. Katsuhiko Ogata, Modern Control Engineering, Fifth Edition, Prentice-Hall, 2010



2. Karl J. Åström, Björn Wittenmark, Adaptive Control, Second Edition, Dover Publications, Inc. New York
3. Jean-Jacques E. Slotine, Jean-Jacques E. Slotine, Weiping Li, Applied Nonlinear Control, Prentice Hall, 1991.

Guidelines for Laboratory Conduction:

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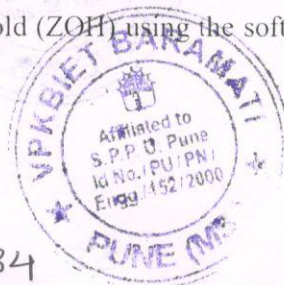
Guidelines for Students Lab Journal:

The Student's Lab Journal should contain following related to every experiment –

1. Theory related to the experiment.
2. Apparatus with their detailed specifications.
3. Connection diagram/circuit diagram.
4. Observation table/ simulation waveforms.
5. Sample calculations for one/two readings.
6. Result table.
7. Graph and Conclusions.
8. There should be continuous assessment.
9. Assessment must be based on understanding of theory, attentiveness during practical, understanding Session, how efficiently the student is able to make connections and get the results, and timely submission of journals.

List of Practical (Any 08 to be performed by the student)

1. To converting a continuous-time system to a discrete-time system and checking the response using the software.
2. To effect of sampling and verification of sampling theorem using the software.
3. To software programming for determination of controllability and observability of a given system.
4. To software programming to design system by pole placement through state feedback.
5. To simulation of a full-order observer-based state feedback control system using the software.
6. To simulation of Zero-Order Hold (ZOH) using the software.



7. To obtain the pulse transfer function of a given plant and verify using simulation using the software.
8. To solution of Linear Difference Equations using Software.
9. To design and Simulation of Digital PID Controller for a given plant using the software.
10. To design a deadbeat controller for a given system and validate the step response using the software.
11. To implement observer-based feedback for partial state availability using the software.
12. To design, implement, and analyze a digital control system for a given plant using software tools.

Industrial Visit (if any): Visit to process control industry (Ex: pharmaceutical or chemical).

Note:

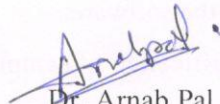
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Course Activity (Any one of the following):

1. Seminar on Advanced Topics in Digital Control
2. Mini-Project / Case Study on Digital Controller Design



Dr. H. M. Shaikh
PAC Member 1



Dr. Arnab Pal
PAC Member 2



Mrs. S. D. Rokade
PAC Member 3



EL23414: Project		
Teaching Scheme: PR: 08 Hrs./Week	Credits: 04	Examination Scheme: Term work: 80 Marks Oral Exam: 50 Marks

Prerequisites:

Community Engagement Project, Internship, Laboratory works, Skill Development, Audit Course, Industrial Visits.

Course Objectives:

The objectives of this course are to:

1. To provide students with the opportunity to design and develop a complete system or subsystem in their area of interest, enabling them to acquire specialized skills.
2. To gain practical experience in transforming a novel idea or technique into a functional model or prototype by applying multi-disciplinary knowledge.
3. To cultivate the ability among students to work independently on a chosen topic, problem, or experimentation, and to develop independent thinking skills for drawing meaningful conclusions within the curriculum timeframe under faculty guidance.
4. To foster creative thinking and build confidence by planning, executing, and completing the project through systematic observations, discussions, and informed decision-making.

Course Outcomes

On completion of the course, learner will be able to

CO1: Implement systems approach for problem-solving and design.

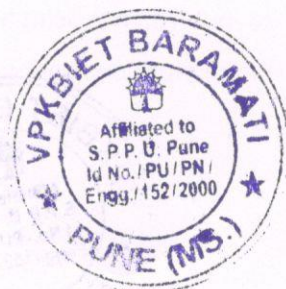
CO2: Create and conceptualize a novel idea/technique into a product or prototype.

CO3: Analyze and integrate knowledge in a multi-disciplinary environment.

CO4: Collaborate effectively in a team and document all aspects of design work.

CO5: Employ project management techniques for effective implementation.

CO6: Evaluate and demonstrate the final product in terms of functionality, designability, and manufacturability.



Guidelines for Project Execution:**At the end of the VI Semester**

1. A group of 4 students shall be formed.
2. Students will interact with guides for scope and outline of the project.
3. A maximum of two groups will be given to a guide.
4. Guide and Project groups will be finalized at the end of sixth semester so that project work can be started at the start of Seventh semester.

During the VII Semester

1. Project topic Identification and Literature review is expected to be done during the VII semester.
2. Project Topic Identification Presentation is to be taken at the end of the VII semester, in which student groups will present their problem statement along with literature review related to the topic.
3. Students can prepare and submit a review paper to a reputed journal/conference based on the literature review completed.
4. Project activities in VII semester are to be executed in conjunction with the other courses Research Methodology (Termwork) and/or Internship.

During the VIII Semester

1. Project work/Fabrication/Experimentation is expected to be done in the Project Lab/Industry.
2. Projects must be executed in association with industrial experts/facilities.
3. Progress of project work is monitored regularly on weekly project slots/project day.
4. Regular interval presentations are to be arranged to review and assess the work.
5. Project work is monitored and continuous assessment is done by guides and authorities.

Term Work:

1. In Project, one topic approval presentation and two reviews shall be taken.
2. Review I shall be based on the approximate end of fabrication / design validation etc. in front of an expert panel from the department.
3. Review II shall be based on the complete project work in front of an expert panel from the department.
4. Students shall be encouraged to publish a research paper/patent/technical note. Their credential shall be considered while term work evaluation.



- The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.
- Recommended performance measure parameters may Include-Problem definition and scope of the project, Literature Survey, Appropriate Engineering approach used, Exhaustive and Rational Requirement Analysis.
- Comprehensive Implementation - Design, modeling, documentation, Usability, Optimization considerations (Time, Resources, Costing), Thorough Testing, Project Presentation and Demonstration (ease of use and usability), Social and environment aspects.
- The term work under project submitted by students shall include project diary; project diary to be maintained by a group and countersigned by the guide (weekly). The contents of work diary shall reflect the efforts taken by project group for;
 - a. Searching suitable project work
 - b. Brief report preferably on journals/research or conference papers/books or literature surveyed to select and bring up the project.
 - c. Brief report of feasibility studies carried to implement the conclusion.
 - d. Rough Sketches/ Design Calculations
 - e. Synopsis
- The group should submit the synopsis in the following form.
 - i. Title of Project
 - ii. Names of Students
 - iii. Name of Guide
 - iv. Relevance/Literature review
 - v. Present Theory and Practices
 - vi. Proposed work
 - vii. Expenditure
 - viii. References
- The synopsis shall be signed by each student in the group, approved by the guide (along with external guide in case of sponsored projects) and endorsed by the Head of the Department.
- Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.



Examination Scheme

1. Examination committee shall consist of Internal Examiner and External Examiner. (External Examiner shall be a competent Industry/Research/Laboratory/Academic person.)

2. Soft copies of the project shall be shared with the examination committee well in advance

- During examination Internal examiner (preferably the guide) and External examiners jointly, evaluate the project work.

- During the process of monitoring and continuous assessment & evaluation the individual and team performance is to be measured.

- The project term work shall be evaluated on the basis of reviews.

- The final presentation shall be taken in front of external examiner and to be evaluated for 50 marks

- **Project Report:**

1. The report shall be both side print hard bound. A hardbound report shall be made after examination and examiner and guide's expected correction, before that report must be loosely bound.

2. Plagiarism check is must, and certificate shall be attached in the report.

3. A group activity shall be presented in report.

4. Two report copies shall be submitted in the department, one for Department and one for project guide.

5. For standardization of the project reports the following format shall be strictly followed.

Page size: Trimmed A4

Top Margin: 1"

Bottom Margin: 1.32"

Left Margin: 1.5"

Right Margin: 1"

Para Text: Times New Roman 12-point font

Line Spacing: 1.15 Lines

Page Numbers: Right aligned at footer. Font 12 point Times New Roman

Headings: Times New Roman, 14 Points, Boldface 10.

Certificate

1. All students shall attach a standard format of Certificate as described by the department.

2. Certificates shall be awarded to project groups and not individual students of the group.

3. Certificates shall have signatures of Project Guide, External Examiner, HoD and Principal.

Index of Report

1. Title Sheet

2. Certificate (Institution)

3. Certificate (Company, if sponsored by company)

4. Acknowledgement

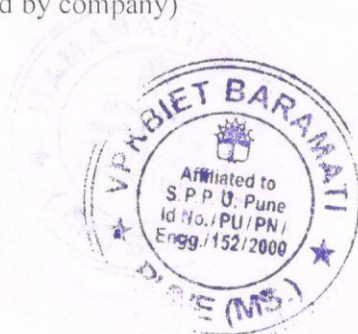
5. Abstract of the Project

6. List of Figures

7. List of Photographs / Plates

8. List of Tables

9. Table of Contents



10. Introduction
11. Literature Survey / Theory
12. Design / Experimentation / Fabrication / Production / Actual work carried out for the same
13. Observation Results
14. Discussion on Result and Conclusion
15. References format - IEEE
16. Publications and Achievements
17. Student and Guide details. (A common photograph with project)

Web References:

1. SWAYAM-NPTEL Course.
2. MOOCs' Courses.



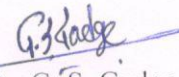
Mr. D. S. Yeole

PAC Member 1



Dr. H. M. Shaikh

PAC Member 2



Dr. G. S. Gadge

PAC Member 3

