DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/ Sci & Tech./B.Voc/NEP/11/2024.

It is hereby inform to all concerned that, the Revised syllabi prepared by the Ad-hoc Board and recommended by the Dean, Faculty of Science & Technology **Academic Council at its meeting held on 05 June, 2024 has accepted the following Revised syllabi of Bachelor of Vocation under the Faculty of Science & Technology as per National Education Policy -2020 run at the University Campus, Dr. Babasaheb Ambedkar Marathwada University as appended herewith.**

Sr.No	Subject Name	Semester
1.	**B.Voc in Industrial Automation**	**I & II**
2.	**B.Voc in Automobile**	**I & II**

This is effective from the Academic Year 2024-25 onwards under the Faculty of Science & Technology.

All concerned are requested to note the contents of the circular and bring notice to the students, teachers and staff for their information and necessary action.

University campus,
Chhatrapati Sambhajinagar-431 004.
Ref. No.SU/B.voc./syllabus./2024-25/1631-39
Date: 02.08.2024

****

Deputy Registrar,
Academic Section.
(Syllabus)

Copy forwarded with compliments to :-

1] The Director,Deen Dayal Upadhyay Kaushal Kendra,
Dr. Babasaheb Ambedkar Marathwada University.

2] **The Director,** University Network & Information Centre, UNIC, with **a request to upload the curriculum along with this Circular on University Website.**

Copy to :-

1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

2] The Section Officer, [B.Voc Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

3] The Programmer, [Computer Unit-1] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

4] The Programmer, [Computer Unit-2] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

5] The In-charge, [E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

Dr. Babasaheb Ambedkar Marathwada University

Chhatrapati Sambhajinagar- 431001

Deen Dayal Upadhyay KAUSHAL Kendra

Three Year
B.VOC. Degree Program

Course Structure

(Revised)

(AS PER NEP-2020)

Subject (Major): INDUSTRIAL AUTOMATION
(Pattern 2024)

Effective from 2024-25

PREFACE

The National Education Policy (NEP) 2020 has introduced significant reforms aimed at transforming the education landscape in India. Here's how NEP 2020 intersects with skill education:

1. **Multidisciplinary Education**: NEP 2020 emphasizes multidisciplinary education, encouraging students to pursue a broad range of subjects and skills. This approach promotes flexibility and enables students to develop diverse skill sets tailored to their interests and career goals.
2. **Holistic Development**: The policy advocates for holistic development, which includes not only academic learning but also social, emotional, and vocational skills. This holistic approach ensures that students are well-rounded individuals equipped to navigate various aspects of life and work.
3. **Vocational Education and Internships**: NEP 2020 places a strong emphasis on vocational education, integrating it into mainstream curriculum from an early age. The policy encourages hands-on learning experiences, internships, and apprenticeships to provide practical skills and real-world exposure to students.
4. **Focus on Critical Thinking and Problem-Solving**: NEP 2020 prioritizes the development of critical thinking, creativity, and problem-solving skills. These skills are essential for innovation and adaptability in a rapidly changing world and are integrated across all levels of education.
5. **Flexible Learning Pathways**: The policy promotes flexible learning pathways, allowing students to choose their own educational trajectories based on their interests, aptitudes, and aspirations. This flexibility enables students to explore diverse skill areas and tailor their education to suit their individual needs.
6. **Teacher Training and Professional Development**: NEP 2020 recognizes the importance of teacher training and professional development in enhancing the quality of education. The policy emphasizes continuous learning for teachers, equipping them with the knowledge and skills necessary to effectively nurture students' talents and abilities.
7. **Digital Education and Technology Integration**: The policy advocates for the integration of digital technology in education to enhance access, equity, and quality. Digital platforms and tools are leveraged to facilitate interactive learning experiences, skill development, and personalized instruction.

By aligning with the principles and objectives of NEP 2020, skill education in India is poised to undergo a transformative shift, fostering innovation, equity, inclusivity, and excellence in education. These contexts have remained as mainframe while developing this curriculum.

The University has adapted Outcome-based education (OBE) since 2017. OBE is widely adopted in educational systems globally due to student centric advantages. OBE provides clear and measurable learning objectives that help students focus and stay motivated. It emphasizes real-world skills, bridging the gap between academia and the workforce. Customized learning paths are possible, accommodating different learning styles and promoting inclusivity. OBE focuses on mastery and competency rather than seat time, encouraging deeper learning and retention of knowledge. Continuous improvement is encouraged through ongoing assessment and feedback. OBE promotes accountability and transparency, allowing stakeholders to monitor progress and evaluate educational programs. It equips students with skills needed for the globalized economy, fostering critical thinking and collaboration. Lifelong learning skills like self-directed learning and adaptability are developed, creating a culture of continuous improvement. Overall, OBE offers a holistic approach to education, emphasizing relevant skills, competencies, and attitudes crucial for success in today's ever-changing world.

The authorities of Dr. Babasaheb Ambedkar Marathwada University, CHHATRAPATI SAMBHAJINAGAR (M.S.), remaining aligned to accreditation standards of National Assessment and Accreditation Council, decided to opt for National Education and Policy and Outcomes Based Education (OBE). As the part of the decision, different meetings, workshops and presentations were held at the campus of university.

This document is the outcome such meetings and workshops held at university level and department level. The detailed document is designed and the existing curriculum of the department has been meticulously analysed from the standpoint of the immediate and long-time requirements of manufacturing and process industries, and transformed in to the framework of NEP with OBE. This is the first step towards the implementation of NEP with OBE in the university departments and affiliated colleges. The document will serve all stakeholders in the effective implementation of the curriculum. The OBE is continuous process for quality enhancement and it will go a long way in order to enhance the competencies and employability of the graduates/Post-graduates of the university departments and affiliated colleges.

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Vocation (B. VOC.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century. At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Vocation (B. VOC.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight. Furthermore, the curriculum is designed to promote experiential learning, research, and hands- on exploration, recognizing the importance of Lab Course engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in Lab Course settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery. Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Vocation (B. VOC.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed. Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Vocation (B. VOC.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world. As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Vocation (B. VOC.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-

makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

In light of aforesaid, Dr. Babasaheb Ambedkar Marathwada University hereby proposes to offer a three years industry embedded Bachelor of Vocation program (B. VOC.) in Industrial Automation. The curriculum design of this program is undertaken with following considerations –

The need for expert human resources in industrial automation is critical for both manufacturing and process industries due to several key factors:

1. **Technical Expertise**: Industrial automation involves complex systems such as Programmable Logic Controllers (PLCs), Supervisory Control and Data Acquisition (SCADA), Distributed Control Systems (DCS), and Industrial Internet of Things (IIoT). Expert human resources possess the technical knowledge and skills required to design, program, integrate, and troubleshoot these systems effectively.
2. **Process Optimization**: In manufacturing and process industries, optimization of production processes is essential for maximizing efficiency, reducing costs, and ensuring product quality. Expertise in industrial automation enables professionals to analyze processes, identify bottlenecks, and implement automation solutions to streamline operations and improve overall performance.
3. **Safety and Compliance**: Industrial automation systems must adhere to strict safety standards and regulatory requirements to protect workers, equipment, and the environment. Expert human resources are needed to assess safety risks, implement safety measures, and ensure compliance with industry regulations to maintain a safe and secure working environment.
4. **Reliability and Maintenance**: Industrial automation systems require regular maintenance to ensure reliable operation and minimize downtime. Expert human resources are responsible for preventive maintenance activities, such as system inspections, software updates, and equipment calibration, to prevent unexpected failures and disruptions in production.
5. **Data Analysis and Decision-Making**: Industrial automation generates vast amounts of data that can be leveraged to gain insights into production processes, identify trends, and make data-driven decisions. Expert human resources with expertise in data analysis and interpretation are essential for extracting valuable insights from automation systems and optimizing performance accordingly.

6. **Integration and Interoperability**: Manufacturing and process industries often utilize a variety of automation technologies and systems that need to seamlessly integrate and communicate with each other. Expert human resources specialize in system integration and interoperability, ensuring that different automation components work together harmoniously to achieve common objectives.

7. **Innovation and Continuous Improvement**: Expert human resources drive innovation and continuous improvement initiatives within manufacturing and process industries by exploring new automation technologies, evaluating their potential applications, and implementing innovative solutions to enhance productivity, quality, and competitiveness.

To summarize, expert human resources play a pivotal role in leveraging industrial automation to optimize processes, ensure safety and compliance, enhance reliability, and drive innovation in both manufacturing and process industries. Their technical expertise, analytical skills, and commitment to excellence are essential for achieving success in highly automated industrial environments.

Structure of

Three Year Bachelor of Vocation (B.VOC)

Subject (Major): INDUSTRIAL AUTOMATION

B.VOC. First Year: 1st Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Lab Course	Theory	Lab Course	
Major (Core) M1 Mandatory	IA/DSC/T/100	Semiconductor Devices	2		2		2+2 = 4
	IA/DSC/P/126	Lab Course based on IA/DSC/T/100		4		2	
Major (Core) M2 Mandatory	IA/DSC/T/101	Digital Electronics	2		2		2+2 = 4
	IA/DSC/P/127	Lab Course based on IA/DSC/T/101		4		2	
Major (Core) M3 Mandatory	IA/DSC/T/102	Basic Industrial Measurements	2		2		2+2 = 4
	IA/DSC/P/128	Lab Course based on IA/DSC/T/102		4		2	
Generic / Open Elective (GE/OE) (Choose any one from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	IA/GE/OE/T/ 100	Introduction to Industrial Manufacturing	2		2		2
SEC (Skill Enhancement Courses) (Choose any one course from IA/SEC/T/100 and IA/SEC/T/101 and its corresponding Lab Course)	IA/SEC/T/100	1) Basic Electrical	1		1		1 + 1 = 2
	IA/SEC/T/101	2) Basic Computing	1		1		
	IA/SEC/P/126	Lab Course based on IA/SEC/T/100		2		1	
	IA/SEC/P/127	Lab Course based on IA/SEC/T/101		2		1	
AEC, VEC, IKS	IA/AEC/T/100	English (Common for all the faculty)	2		2		2+2 =4
	IA/IKS/T/101	Choose any one from pool of courses	2		2		
OJT/ FP/CEP/CC/RP	IA/CC/P/126	Health and Wellness (Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**

IA/GE/OE/T/ 100 = This is a two credit theory Course to be designed for Other Faculty

B.VOC. First Year: 2nd Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Lab Course	Theory	Lab Course	
Major (Core) M1 Mandatory	IA/DSC/T/150	Applied Fluidics - 1	2		2		2+2 = 4
	IA/DSC/P/176	Lab Course based on IA/DSC/T/150		4		2	
Major (Core) M2 Mandatory	IA/DSC/T/151	Applied Fluidics - II	2		2		2+2 = 4
	IA/DSC/P/177	Lab Course based on IA/DSC/T/151		4		2	
Major (Core) M3 Mandatory	IA/DSC/T/152	Discrete State Process Control	2		2		2+2 = 4
	IA/DSC/P/178	Lab Course based on IA/DSC/T/152		4		2	
Generic / Open Elective (GE/OE) (Choose any one from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	IA/GE/OE/T/150	Programmable Logic Controllers	2		2		2
VSC (Vocational Skill Courses) (Choose any one course from IA/VSC/T/150 and IA/VSC/T/151 and its corresponding Lab Course)	IA/VSC/T/150	1) Elements of Control Panel	1		1		1+1 = 2
	IA/VSC/T/151	2) Operational Amplifiers	1		1		
	IA/VSC/P/176	Lab Courses based on IA/VSC/T/150		2		1	
	IA/VSC/P/177	Lab Courses based on IA/VSC/T/151		2		1	
AEC, VEC, IKS	IA/AEC/T/150	Modern Indian Language (MIL-1) (Choose any one from pool of language courses)	2		2		2+2 =4
	IA/AEC/T/151	Constitution of India (Common for all the faculty)	2		2		
OJT/ FP/CEP/CC/RP	IA/CC/P/176	Yoga Education / Sports and Fitness (Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**
Exit Option : Award of UG Certificate in 3 Majors with 44 credits and an additional 4 credits of core NSQF course / Internship OR continue with Major and Minor							

IA/GE/OE/T/150 = This is a two credit theory Course to be designed for Other Faculty

Programme Educational Objectives (PEOs) :

Programme Educational Objectives (PEOs) for the Bachelor of Vocation Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge**: Graduates of the Bachelor of Vocation program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.

2. **Interdisciplinary Proficiency**: Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.

3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.

4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mindset, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.

5. **Global Citizenship and Cultural Sensitivity**: Graduates will possess a global perspective and cultural sensitivity, recognizing the interconnectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Vocation curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

Program Outcomes (PO):

Vocational Education is education that prepares the students for specific trades, crafts andcareers at various levels and scopes. Scope of modern fabric of vocational education builds Human resource from a trade/ craftsmanship, technician or professional position in R & D organizations.

The Program Outcomes are the skills and knowledge which the students have at each exit level/at the time of graduation. These Outcomes are generic and are common to all exit levels mentioned in the programme structure. Graduates of the B.Voc program are expected to -

PO1. Apply broad based fundamental knowledge of the specific skill-based trade for the solution of target skill sector.

PO2. Identify industry domain related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using first principles of domain sectors and technical literature.

PO3. Design / develop solutions for broad based problems in the target skill-based trade to address changing challenges put forward by market demand/ stakeholder

PO4. Design and conduct technology enabled experiments, analyze the resulting data and interpret the same to provide valid conclusions

PO5. Use the techniques, skills and modern tools necessary skill-based trade to practice with clear understanding of limitations.

PO6. Apply broad understanding of ethical and professional skill-based trade practice in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.

PO7. Apply broad understanding of impact of skill-based trade in a global, economic, environmental and societal context.

PO8. Apply ability to develop practical solutions for skill trade problems within positive professional and ethical boundaries.

PO9. Function effectively as a leader and as well as team member in diverse/multidisciplinary environments.

PO10. Communicate effectively in oral and written format addressing specific professional/social demands.

PO11. Demonstrate knowledge and understanding of the first principles of skill trade and apply these to one's own work as a member and leader in a team, to complete project in any environment.

PO12. Recognize the need for and have the ability to acquire advance knowledge for addressing the changing technological demands of the target skill trade.

Program Specific Outcomes (PSO):

Graduates of the B.Voc (Industrial Automation) program are expected to -

1. Apply broad based fundamental knowledge of electronics, electrical, mechatronics fundamentals and Industrial automation specialization for the solution of automated manufacturing and process related problems.

2. Identify industrial automation related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using first principles of electronics, electrical , mechatronics and technical literature.

3. Design and conduct technology enabled experiments, analyze the resulting data and interpret the same to provide valid conclusions.

4. Use the techniques, skills and modern tools necessary for industrial automation practice with clear understanding of limitations.

Eligibility:

10+2 / MCVC/ ITI (two years) with relevant/equivalent trade from any recognized Board/Institution are eligible for registration/ admission to first year (Semester I) of B.Voc Industrial Automation Degree program.

Exit Options:

The programme allows exit of a student in an intermediate stage, on successful employment. Scopes will be there for further continuation of study. The other wise exit options will be as follows-

Exit Point	*Duration*	*Diploma / Degree to be Offered*
First exit	After 1 yr.	Certificate in Vocation
Second exit	After 2 yrs.	Diploma in Vocation
Third exit	After 3 yrs.	Bachelor in Vocation (B. Voc.)

Admission / Promotion Process:

In response to the advertisement for registration, interested students will have to register themselves. Admission should be done on the basis of performance of students at Common Entrance Test (CET). The CET will be conducted in the month of June every year.
A candidate who has sought admission to Semester – I shall be admitted to Semester – II automatically. A candidate who has passed 75% of the papers at First Year (First and Second Semesters together) examinations shall be allowed to take admissions in third semester.

Similarly, a candidate who has passed 75% of the papers at the Second Year (Third and Fourth Semesters together) examinations shall be allowed to take admission to the Fifth semester. However, if a candidate has not passed the First and Second Semester examinations, he shall not be allowed to take admission to the Fifth Semester. Appearance in the First, Third and Fifth semester is compulsory to get promoted to next semester.

For obtaining B. Voc. Degree, a student will have to complete all semesters successfully within 06 years/12 semesters. It also offers multiple exit/entry. Students can exit after completion of one year and can enter into the system (subsequent year) with 5 years from the date of first time registration.

Dropout students will be allowed to register for respective semester as and when the concerned courses are offered by the department, **HOWEVER HE / SHE SHOULD NOT EXCEED MORE THAN TWICE THE DURATION OF THE COURSE FROM THE DATE OF FIRST REGISTRATION AT PARENT DEPARTMENT / COLLEGE.** The admission of the concern student will be automatically cancelled if he / she fails to complete the B. VOC. degree within a period of maximum six years / twelve semesters.

Choice Based Credit System (CBCS):

The choice-based credit system is going to be adopted. This provides flexibility to make the system more responsive to the changing needs of our students, the professionals and society. It gives greater freedom to students to determine their own pace of study. The credit-based system also facilitates the transfer of credits.

- Students will have to earn 44 credits for the award of one year Certificate in Vocation
- Students will have to earn 88 credits for the award of two year Diploma in Vocation
- Students will have to earn 132 credits for the award of three year Bachelor Degree in Vocation (B. Voc.)

Credit-to-contact hour Mapping:

(a) One Credit would mean equivalent of 15 contact hours for theory lecture.

(b) For lab course/ workshops/internship/field work/project, the credit weightage for equivalent hours shall be 50% that for lectures /workshop.

(c) For self- learning, based on e-content or otherwise, the credit weightage for equivalent hours of study should be 50% or less of that for lectures/workshops.

Attendance:

Students must have 75 % of attendance in each course for appearing examination otherwise he / she will not be strictly allowed for appearing the examination of each course. Frequent absence from regular theory/Laboratory course may lead to disqualification from continuous assessment test (CAT) process in respective subject.

Departmental Committee:

The Departmental Committee (DC) of the Centre will monitor smooth functioning of the program.

Results Grievances / Redressal Committee

Grievances / Redressal committee should be constituted in the department to resolve all grievances relating to the evaluation. The committee shall consist of Head of the department, the concerned teacher of a particular course and senior faculty member of Department of Committee. The decision of Grievances / Redressal committee will have to be approved by Department committee.

Evaluation Methods:

Formative assessment is an efficient method to evaluate students' comprehension, learning needs, and academic progress. It offers immediate feedback, enhanced student engagement, personalized learning, improved learning outcomes, and encourages self-assessment. It reduces test anxiety, facilitates differentiation, enhances instructional practices, supports collaborative learning, fosters continuous improvement, encourages a growth mindset, and builds confidence. Formative assessment also reduces test anxiety by lowering the stakes, ensuring all students receive appropriate challenges and support. It also supports a culture of continuous improvement and fosters a growth mindset among students.

This program will adapt Formative assessment/ Continuous Internal Assessments for each theory course in following format –

1. **Module-wise Tests – 10 Marks (*03 tests) = 30 marks**
2. **Assignment/Mini Project = 10 Marks**
3. **Seminar Presentation = 10 Marks**

1. Module-wise Tests 10 Marks (*03 tests) = 30 marks

Module-wise Tests will be conducted in each theory course immediately after completion of teaching with individual module. Such tests will be of 10 marks comprising of Part A and B.

- Part A will be consisting of 05 questions having 01 mark each (multiple choice questions / fill in the blanks/ answer in one sentence) as compulsory questions and it should cover entire module syllabus (05 Marks)
- Part B will contain 03 questions of 05 marks from module contents, from which students will have to attempt any one.

Every Module-wise Test will be followed by a remedial test. Any student, who has missed to appear for a test can appear for the remedial test. Or if any student wants to improve their performance of main test, will be allowed to appear for remedial test. For all students, who have appeared for main test as well as remedial test, the best performance will be considered for final marks memo preparation.

2. Assignment/Mini Project = 10 Marks

This will remain a group activity and concerned faculty will have to provide assignment/tasks that will lead to incubation of critical and creative thinking ability of students. Depending upon contents of a course, the faculty member may assign a mini project to a group of students as well. However assignment and project will not be given

concurrently.

3. **Seminar Presentation = 10 Marks**

Individual student should deliver a seminar based on topics covered through course contents or topics related to course content. Evaluation of a seminar has to be carried out by course faculty member and an external faculty member.

A Semester End Examination (SEE) for a certain / all theory courses will be conducted only for students who will fall short in obtaining passing marks for respective course through the process of formative assessment. Following will be the pattern of SEE Question Paper –

The Question Paper will be of 50 marks consisting of Part A, Part B and Part C

- Part A will be consisting of 10 questions having 01 mark each (multiple choice questions / fill in the blanks/ answer in one sentence) as compulsory questions and it should cover entire module syllabus (10 Marks)
- Part B will contain 09 questions of 05 marks each from module contents, from which students will have to attempt any seven questions. Contents of each module should contribute towards framing of 03 questions. (35 Marks)
- Part C will contain 03 questions of 05 Marks each, from which students will have to attempt any one question. This question should critically look forward to evaluate critical applied thinking capability of a student. Contents of each module should contribute towards framing of 01 question. (05 Marks)

Semester end practical examination will be conducted at the end of each semester.

Earning Credits:

At the end of every semester, a letter grade will be awarded in each course for which a student had registered. A student's performance will be measured by the number of credits that he/she earned by the weighted Grade Point Average (GPA). The SGPA (Semester Grade Point Average) will be awarded after completion of respective semester and the CGPA (Cumulative Grade Point Average) will be awarded at the respective exit point.

Grading System:

The grading reflects a student-own proficiency in the course. A ten-point rating scale shall be used for the evaluation of the performance of the students to provide letter grade for each course and overall grade for the Bachelor Programme. Grade points are based on the total number of marks obtained by him / her in all heads of the examination of the course. The grade points and their equivalent range of marks are shown in Table-I

Table – I: Ten point grade and grade description

Marks Obtained (%)	Grade Point (GPA/CGPA)	Letter Grade	Description
90-100	9.00- 10	O	Outstanding
80-89	8.00-8.99	A^+	Excellent
70-79	7.00-7.99	A	Very Good
60-69	6.00-6.99	B^+	Good
55-59	5.50-5.99	B	Above Average
50-54	5.00-5.49	C	Average
40-49	4.00-4.99	P	Pass
Below 40	Below 4.0	F	Fail
Absent	Absent	Ab	Absent

- Non-appearance in any examination / assessment shall be treated as the students have secured zero marks in that subject examination / assessment.
- Minimum P grade (4.00 grade points) shall be the limit to clear / pass the **course / subject. A student with F grade will be considered as —failed in the** concerned course and he / she has to clear the course by appearing in the next successive semester examinations. There will be no revaluation or recounting under this system.
- Every student shall be awarded grade points out of maximum 10 points in each subject (based on 10 point scale). Based on the grade points obtained in each subject, Semester
- Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and CGPA will be given at respective exit point.

Computation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)

Grade in each subject / course will be calculated based on the summation of marks obtained in all five modules.

The computation of SGPA and CGPA will be as below

- Semester Grade Point Average (SGPA) is the weighted average points obtained by the students in a semester and will be computed as follows:

$$SGPA = \frac{\text{Sum (Course Credits) X Number of Grade Points in concerned Course Gained by the Student}}{\text{Sum (Course Credits)}}$$

- The SGPA will be mentioned on the grade card at the end of every semester.
- The Cumulative Grade Point Average (CGPA) will be used to describe the overall performance of a student in all semester of the course and will be computed as under.

$$CGPA = \frac{\text{Sum (All six Semester SGPA)}}{\text{Total Number of Semester}}$$

- The SGPA and CGPA shall be rounded off to the second place of decimal.

Grade Card

Results will be declared by the Centre and the grade card (containing the grades obtained by the student along with SGPA) will be issued by the university after completion of every semester. The grade card will be consisting of following details.

- Title of the courses along with code opted by the student. Credits associated with the course.
- Grades and grade points secured by the student.
- Total credits earned by the student in a particular semester. Total credits earned by the students till that semester.
- SGPA of the student.
- CGPA of the student (at respective exit point).

Cumulative Grade Card

The grade card showing details grades secured by the student in each subject in all semesters along with overall CGPA will be issued by the University at respective exit point.

Syllabus for Semester – I

B.VOC Industrial Automation

B.VOC in Industrial Automation – Semester I – Course Structure							
Course Type	**Course Code**	**Course Name**	**Teaching Scheme (Hrs / Week)**		**Credits Assigned**		**Total Credits**
			Theory	**Lab Course**	**Theory**	**Lab Course**	
Major (Core) M1 Mandatory	IA/DSC/T/100	Semiconductor Devices	2		2		2+2 = 4
	IA/DSC/P/126	Lab Course based on IA/DSC/T/100		4		2	
Major (Core) M2 Mandatory	IA/DSC/T/101	Digital Electronics	2		2		2+2 = 4
	IA/DSC/P/127	Lab Course based on IA/DSC/T/101		4		2	
Major (Core) M3 Mandatory	IA/DSC/T/102	Basic Industrial Measurements	2		2		2+2 = 4
	IA/DSC/P/128	Lab Course based on IA/DSC/T/102		4		2	
Generic / Open Elective (GE/OE) (Choose any one from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	IA/GE/OE/T/ 100	Introduction to Industrial Manufacturing	2		2		2
SEC (Skill Enhancement Courses) (Choose any one course from IA/SEC/T/100 and IA/SEC/T/101 and its corresponding Lab Course)	IA/SEC/T/100	1) Basic Electrical	1		1		1 + 1 = 2
	IA/SEC/T/101	2) Basic Computing	1		1		
	IA/SEC/P/126	Lab Course based on IA/SEC/T/100		2		1	
	IA/SEC/P/127	Lab Course based on IA/SEC/T/101		2		1	
AEC, VEC, IKS	IA/AEC/T/100	English (Common for all the faculty)	2		2		2+2 =4
	IA/IKS/T/101	Choose any one from pool of courses	2		2		
OJT/ FP/CEP/CC/RP	IA/CC/P/126	Health and Wellness (Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**

IA/GE/OE/T/ 100 = This is a two credit theory Course to be designed for Other Faculty

Major (Core) Courses

A/DSC/T/100 : Semiconductor Devices

Total Credits : 02 **Total Contact Hours : 30 Hrs**

Maximum Marks : 50

Learning Objectives of the Course: To provide students with-

1. Basic concepts and behavior of semiconductor devices
2. Application concepts of Semiconductor devices

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Discuss basic operation of semiconductor devices used in low power and power electronics domain
2. Explain characteristics of semiconductor devices used in low power and power electronics domain
3. Evaluate role of various Semiconductor Devices in different types applications

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H									H	M	M	
CO2	H	H	H	H									H	M	M	
CO3	H	H	H	H									H	M	M	

Module No.	Course Content	Contact Hours
I	**Semiconductor Basics and Two Terminal Devices** Atomic Structure, Band Theory of Semiconductors, Types of Semiconductors, Formation of Junctions. Diode- Diode Characteristics, Diode Applications, Special Purpose Diodes	10 Hrs
II	**Three Terminal Devices** Bipolar Junction Transistor (BJT)- BJT Biasing, BJT Characteristics, BJT Applications Junction Field Effect Transistor (JFET)- JFET Biasing, JFET Characteristics, JFET Applications Metal-Oxide Semiconductor Field Effect Transistor (MOSFET)- MOSFET Biasing, MOSFET Characteristics, MOSFET Applications	10 Hrs
III	**Power Electronic Devices** Silicon Controlled Rectifier (SCR) – SCR Operation, DC Operational circuit, Turn-on/off, Gate Triggering; DIAC; TRIAC; IGBT; Application of Power electronic devices	10 Hrs

Text Books:

1. Thomas I. Floyd, "Electronic Devices", Seventh Edition, Pearson Education, 2008
2. A. P. Malvino, D. J Bates, " Electronic Principles", Seventh Indian Edition, Mc. Graw Hill, 2007
3. K.L. Rao, C.H. Saibabu,"Theory of Power Electronics", Revised Edition 2009, S.Chand and Company Ltd.2009

Reference Books:

1. V. K. Mehta, Rohit Mehta, " Principles of Electronics", Twelfth Edition, S. Chand Publishers, 2008
2. R. Boylstad, L. Nashelsky, "Electronic Devices and Circuit Theory", Tenth Edition, Pearson, 2009
3. M. D. Singh, K.Khanchandani, " Power Electronics", Second Edition, Mc Graw Hill, 2017

Online Reference:

1. http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html
2. https://nptel.ac.in/courses/122106025

IA/DSC/P/126 : Lab-Course based on IADSC-1

Total Credits : 02 **Total Contact Hours : 60 Hrs**

Maximum Marks : 50

Learning Objectives of the Course:

1 To provide students with operational knowledge of low power and power domain basic semiconductor devices

2 To acquaint students with specific characteristics and limitation of low power and power domain basic semiconductor devices in perspective of developing real life applications

Course Outcomes (COs) :

On completion of this course, students should be able to -

1 Demonstrate operation of basic semiconducting devices

2 Contrast operational characteristics of basic semiconductor devices

3 Implement basic semiconducting devices in operational circuits

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H									H	M	M	
CO2	H	H	H	H									H	M	M	
CO3	H	H	H	H									H	M	M	

At least six experiments have to be performed

1. Study of P-N junction diode characteristics
2. Study of Zener diode application as a voltage regulator
3. Study of Clipper and Clamper circuits
4. Study of rectifiers (half wave, full wave and bridge configuration)
5. Study of BJT Characteristics in CE configuration
6. Study of JFET characteristics
7. Study of MOSFET characteristics
8. Study of BJT and MOSFET as switching device
9. Study of DC characteristics of SCR
10. Study of SCR Firing
11. Study of DIAC characteristics
12. Study of TRIAC Characteristics

IA/DSC/T/101 : Digital Electronics

Total Credits : 02 **Total Contact Hours : 30 Hrs**

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Fundamental concepts of Boolean Electronics
2. Ideas of developing combinational logic circuits

Course Outcomes (COs) :

On completion of this course, students should be able to-

1. Discuss basic operation of Digital Electronics Components
2. Apply laws of Boolean algebra for simplification of digital circuits, conversion of logic expression to circuit diagram and vice versa
3. Correlate operations of fundamental combinational logic circuits

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H									H	H	H	H
CO2	H	H	H	H									H	H	H	H
CO3	H	H	H	H									H	H	H	H

Module No.	Course Content	Contact Hours
I	**Number Systems and Logic Gates** Digital and Analog quantities, Introduction to Logic; Number System- Decimal, Binary, Hexadecimal; Digital Codes; Basic Logic Gates and their IC versions; Universal Logic Gates and their IC versions; Applications	**10 Hrs**
II	**Boolean Algebra** Laws and Rules; De-Morgan'sTheorems; Boolean Analysis of Logic Circuits Simplification using Boolean Algebra; Standard form of Boolean Expressions, K-Map SOP and POS; Applications	**10 Hrs**
III	**Combinational Logic Circuits** Basic Combinational Logic – X-OR, X-NOR, Adder, Encoder, Decoder, Multiplexer, Demultiplexer; Latches; Flip-Flops; Counters	**10 Hrs**

Text Books:

1. Thomas L. Floyd, Digital Fundamental, Tenth Edition, Pearson Education, 2010
2. R. P. Jain, Modern Digital Electronics, Fourth Edition, , Tata Mc. Graw Hill, 2010

Reference Books:

1. John F. Walkerly, Digital Design: Principles and Practices, Fourth Edition, Prentice Hall of India, 2009
2. M. Mano, M. D Ciletti, Digital Design, Fifth Edition, Pearson, 2013

Online Reference:

1. http://www.nptelvideos.in/2012/12/digital-circuits-and-systems.html
2. https://archive.nptel.ac.in/courses/108/105/108105132/

IA/DSC/P/127 : Lab-Course based on IADSC-3

Total Credits : 02 Total Contact Hours : 60 Hrs Maximum

Marks : 50

Learning Objectives of the Course:

1 To provide students with operational knowledge of digital ICS
2 To acquaint students with the designing of combinational logic circuits
3 To implement Boolean Algebra for Logic Applications

Course Outcomes (COs) :

On completion of this course, students should be able to –

1 Demonstrate operation of digital ICs
2 Construct circuits deploying operation of simple and combinational logic circuits
3 Apply laws of Boolean algebra for simplification of digital circuits, conversion of logic expression to circuit diagram and vice versa
4 Deploy digital ICs for sequential logic operations

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H									H	H	H	H
CO2	H	H	H	H									H	H	H	H
CO3	H	H	H	H									H	H	H	H
CO4	H	H	H	H									H	H	H	H

At least six experiments have to be performed

1. Study of basic logic gates and Universal gates
2. Study of universal logic gates using NAND & NOR gates
3. Analysis and Synthesis of boolean expressions using basic logic gates
4. Study of De'Morgans theorem using logic gates
5. Study of discrete component diodes and transistors as logic gates
6. Design and simulation of Decoders, Encoders
7. Design and simulation of Multiplexer and Demultiplexer
8. Study of Flip-Flops
9. Study of Counters
10. Washing machine control using basic AND and NOT gates usig virtual simulator
11. Basics of OR gate and its application in industrial control using virtual simulator
12. Water level control using basic AND and NOT gates using virtual simulator
13. XOR gate and its application in staircase light control using virtual simulator

IA/DSC/T/102 : Basic Industrial Measurements

Total Credits : 02 **Total Contact Hours : 30**

Hrs Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. fundamental concepts of measurement and instrumentation system
2. basic modalities of industrial temperature, pressure, flow and level measurement

Course Outcomes (COs) :

On completion of the course, students should be able to-

1. Describe primary blocks of an Instrumentation System and Qualities of Measurement.
2. Select transducers as per application demand
3. Describe operation of basic transducers employed for industrial process parameter monitoring applications

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Necessity of Industrial Measurements and Discrete Detection Techniques** Industrial Process Overview, Sequential and Continuous Process, Process Control Loop, Instrumentation and Sensors; Industrial Data – Analog, Digital Pneumatic; Smart Sensors; Units and Standards- Basic and Derived Units, Standard Prefixes Discrete Detection of Objects, Displacement Measurement – Proximity Detectors, Photoelectric sensors, Applications of Photoelectric sensor, Selection of Photoelectric sensor. RVDT, LVDT, Ultrasonic Sensors, Photoelectric pick-up sensor (Non-contact type).	**10 Hrs**
II	**Pressure and Temperature Measurement** Pressure Measurement: Parameters of Pressure, Application Considerations; Measuring Instruments- Bourdon Tube, Diaphragm Pressure Sensor, Differential Pressure Sensor, Strain Gauge, Load Cells, Pressure Transducer and Transmitters, Industrial Scales and Weighing Systems Temperature Measurement: Parameters of Temperature, Application Consideration; Measuring Instruments – Thermocouples, RTD, Thermistor, IC solid state temperature sensors; Non-Contact Measurements	**10 Hrs**
III	**Flow and Level Measurement** Flow Measurement: Parameters of Flow, Application Considerations; Flow Calculations; Measuring Instruments Non-Electrical Measurements; Velocity Flow meter, Positive Displacement Flow meter, Mass Flow meter Level Measurement: Parameters of Flow, Application Considerations; Measuring Instruments: Point Contact Level Sensors, Continuous Level Sensors	**10 Hrs**

Text Books:

1. William C. Dunn, "Introduction to Instrumentation, Sensors and Process Control", Artech House Publishers, 2005

2. Thomas E. Kissell, "Industrial Electronics", Third Edition, PHI Learning Pvt. Ltd., 2012
3. Terry Bartlet, " Industrial Electronics" Cengage Learning India Edition, Second Indian Reprint, 2006

Reference Books:

1. H S Kalsi, "Electronic Instrumentation and Measurements", Fourth Edition, Mc Graw Hill, 2019
2. S.K.Singh," Industrial Instrumentation & Control", Third Edition, Tata McGraw Hill Publishing Co. Ltd; 2009
3. D. Patranabis," Principles of Industrial Instrumentation", Second Edition, Tata McGraw Hill Publishing Co. Ltd; 2008

Online Reference:

1. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html

IA/DSC/P/128 : Lab-Course based on IADSC-5

Total Credits : 02 **Total Contact Hours : 60 Hrs**

Maximum Marks : 50

Learning Objectives of the Course:

1. To Provide students with operational knowledge of selected industry grade sensors/ detectors

Course Outcomes (COs) :

On completion of the course, students should be able to –

1. Demonstrate characteristics of different sensors/detectors pertinent to theory course
2. Apply different sensors/detectors (pertinent to theory course for real time applications)

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H

At least six experiments have to be performed

1. Study of proximity sensors
2. Linear Displacement measurement using LVDT
3. Angular Displacement measurement using RVDT
4. Study of Phototransistor
5. Study of photoelectric sensors - retro reflective sensor and through beam sensor
6. Implementation of a photo sensor for switching applications
7. Study of temperature measurement using Resistance Temperature Detector (PT 100)
8. Study of temperature measurement using thermocouple
9. Pressure Measurement using Pressure Transducer
10. Measurement of liquid flow using rotameter
11. Measurement of liquid flow using paddle wheel flowmeter
12. Level measurement using by capacitive/float/conductive probe method

General Elective/ Open Elective Course

IA/GE/OE/T/100 : Introduction to Industrial Manufacturing

Total Credits : 2

Total Contact Hours : 30 Hrs **Maximum Marks : 50**

Learning Objectives of the Course:

To provide overview of the vast world of manufacturing to learners

Course Outcomes (COs) :

On completion of the course, students should be able to-

1. Recognize the outlay of manufacturing operations in industry
2. Correlate elements of manufacturing operation
3. Categorize support systems for industrial manufacturing

Module No.	Course Content	Contact Hours
I	**Introductory Concepts** Introductory Concepts, Production System Facilities, Automation in Production Systems, Manual Interventions in Production Systems, Automation Principle and strategies, Manufacturing operations	**10 Hrs**
II	**Concepts of Automated Manufacturing** Process Industries V/s Discrete Manufacturing Industries, Basic Elements of an Automated System, Levels of Automation, Advanced Automation functions, Industrial Control Systems	**10 Hrs**
III	**Manufacturing Support System** Product Design, Quality Function Deployment, Production Planning and Control Systems, Lean Production and wastes, JIT Concepts, Worker Involvement	**10 Hrs**

Text Books:

Mikell P. Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Fourth Edition, Pearson, 2014

Reference Books:

Michelle Vine, "Manufacturing Technology and Industrial Engineering", First Edition, Willford Press, 2016

Online Reference:

https://archive.nptel.ac.in/courses/112/107/112107292/

Skill Enhancement Courses

IA/SEC/T/100 : Basic Electrical

Total Credits : 01 **Total Contact Hours : 15 Hrs Maximum**

Marks : 25

Learning Objectives of the Course: To provide students with-

1. Fundamental concepts of Single and Three Phase AC
2. Operational Concept of Transformers

Course Outcomes (COs) :

On completion of the course, students should be able to-

1.Describe basic parameters in three phase AC

2.Analyze voltage and current measurements in three phase AC circuits

3.Explain basic transformer operation

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	L								H	H	H	L
CO2	H	H	H	H	L								H	H	H	L
CO3	H	H	H	H	L								H	H	H	L

Module No.	Course Content	Contact Hours
I	**Three Phase Power** Importance of Electric Power Systems, Three Phase Power Systems, Three Phase Power Sources, Three Phase Loads, Per Phase Equivalent Circuits	09 Hrs
II	**Electrical Transformers** Principle of transformer operation, Ideal Transformer, Construction of a Transformer, Transformer on a Load, Losses and Efficiency, Regulation and Polarity test of a Transformer, Voltage Ratio test, Open and Short Circuit test on a Transformer, Load test on a Transformer, Instrument transformers (Current and Potential transformer), Autotransformer	06 Hrs

Text Books:

1. J. R. Cogdell," Foundations of Electric Power", First Edition/Impression, Pearson, 2012
2. B. L. Thereja, A. K. Thereja, " Electrical Technology (Vol 1 and 2), First Multicolour Edition, S. Chand Publishers, 2005

Reference Books:

1. M. E. Schultz, " Grob's Basic Electronics", Thirteenth Edition, Mac. Graw Hill, 2021
2. Terry Bartlet, "Industrial Electronics" – Second Indian Reprint, Cengage Learning India Edition, 2006

Online Reference

1. http://www.nptelvideos.in/2012/11/basic-electrical-technology.html
2. http://www.nptelvideos.in/2012/11/electrical-machines-i.html

IA/SEC/P/126: Lab-Course based on IA/SEC/T/100

Total Credits : 01 **Total Contact Hours : 30 Hrs**

Maximum Marks : 25

Learning Objectives of the Course:

1. To provide students with functional knowledge of Three Phase Electricity and related circuits
2. To Provide students with functional knowledge of transformers

Course Outcomes (COs) :

On completion of the course, students should be able to –

1. Recognize three phase circuits in star and delta configuration
2. Differentiate between balance and unbalanced load
3. Demonstrate relation between voltage and current in three phase circuits
4. Demonstrate operation of a single phase transformer

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	M								H	H	H	M
CO2	H	H	H	H	M								H	H	H	M
CO3	H	H	H	H	M								H	H	H	M
CO4	H	H	H	H	M								H	H	H	M

At least 04 of the enlisted experiments have to be performed

1. Study of three phase low voltage power supply
2. Study of voltage and current in three phase star connected balanced passive load
3. Study of Load (Balanced) Currents in Delta configuration
4. Study of voltage and current in delta connected passive load (Balanced)
5. Study of three phase circuit with balanced load
6. Study of three phase circuit with unbalanced load
7. Study of polarity test in a single phase transformer
8. Study of transformation ratio in a single phase transformer
9. Study of Open Circuit Test in single phase transformer
10. Study of Short Circuit Test in Single phase Transformer

IA/SEC/T/101 : Basic Computing

Total Credits : 01 **Total Contact Hours : 15 Hrs**

Maximum Marks : 25

Learning Objectives of the Course:

1. To introduce students to the world of computers
2. To provide students with basic office management tools in computer

Course Outcomes (COs) :

On completion of the course, students should be able to-

1. Recognize operational parts of computing system
2. Identify building blocks of a digital documentation platform
3. Articulate operational features of spreadsheet
4. Illustrate operational features of a digital presentation platform

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1				H	M					H					H	M
CO2				H	M					H					H	M
CO3				H	M					H					H	M
CO4				H	M					H					H	M

Module No.	Course Content	Contact Hours
I	**Introduction to Computer System and Digital Documentation** Difference between hardware and software, components of Computer, Operating System; Basic operational features of digital documentation (Creation, Opening, Saving, Editing, Formatting, and Closing), Creating an online document using Google Doc	**06 Hrs**
II	**Spreadsheet and Digital Presentation** Basic Operational Features of spreadsheet (Creation, Opening, Saving, Editing, Formatting, Using basic formulae and Closing), Creating an online document using Google Spreadsheet; Basic Operational Features of Digital Presentation (Creation, Opening, Saving, Editing, Formatting of text and images in presentation, Inserting audio and video files in presentation, Modification of themers and Closing), Creating an online presentation using google presentation	**09 Hrs**

Text Books:

1. Basic Computing (Course Code 608); National Institute of Open Schooling; M S Shri Krishna Graphics

Reference Books:

1. N. Srivastava, " Fundamentals of Computer and Information System", Dream Tech Press, 2013
2. Jennifer A. Duffy, Carol M. Cram, " Microsoft Office Word: Illustrated Co: Illustrated Complete
3. Greg Perry, "Sams Teach Yourself Microsoft Office"
4. Greg B. Shelly, Thomas J. Cashman, Jeffrey J. Quasney, "Microsoft Office Excel: Comprehensive Concepts and Techniques
5. David Beskeen, "Microsoft Office Power Point: Illustrated Introductory"

Online Reference

1. https://youtu.be/jzvMjRTmIt8?si=iyb5RHt0HxmuODDr

2. https://youtube.com/playlist?list=PL4Wh1F6PxzzSXRxVCCLo9o2Hus6-6-ql0&si=1HBajPW0-REr9y0j
3. https://youtu.be/yjyWI9wDYNs?si=1T_LiEbc3K5kqqtl

IA/SEC/P/127: Lab-Course based on IA/SEC/T/101

Total Credits : 01 Total Contact Hours : 30 Hrs
Maximum Marks : 25

Learning Objectives of the Course:

1. To introduce students to the world of computers
2. To provide students with basic office management tools in computer

Course Outcomes (COs) :

On completion of the course, students should be able to –

1. Prepare and manage a digital document
2. Prepare and manage a spreadsheet
3. Prepare and manage a digital presentation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1				H	M					H					H	M
CO2				H	M					H					H	M
CO3				H	M					H					H	M

At least 04 of the enlisted experiments have to be performed

1. Study of a computer, peripherals and operating System
2. Exercises with basic features (Pertinent to Theory) of digital documentation
3. Exercises with basic features (Pertinent to Theory) of spreadsheet
4. Exercises with basic features (Pertinent to Theory) of digital presentation
5. Creation and managing a google doc
6. Creation and managing a google spreadsheet
7. Creation and managing a google presentation
8. All students must prepare a summary report on any topic of their syllabus
9. All students must prepare spreadsheet of task assigned by faculty
10. All students must prepare a presentation on any topic of their syllabus

Syllabus for Semester – II

B.VOC Industrial Automation

B.VOC in Industrial Automation – Semester II – Course Structure							
Course Type	**Course Code**	**Course Name**	**Teaching Scheme (Hrs / Week)**		**Credits Assigned**		**Total Credits**
			Theory	**Lab Course**	**Theory**	**Lab Course**	
Major (Core) M1 Mandatory	IA/DSC/T/150	Applied Fluidics - 1	2		2		2+2 = 4
	IA/DSC/P/176	Lab Course based on IA/DSC/T/150		4		2	
Major (Core) M2 Mandatory	IA/DSC/T/151	Applied Fluidics - II	2		2		2+2 = 4
	IA/DSC/P/177	Lab Course based on IA/DSC/T/151		4		2	
Major (Core) M3 Mandatory	IA/DSC/T/152	Discrete State Process Control	2		2		2+2 = 4
	IA/DSC/P/178	Lab Course based on IA/DSC/T/152		4		2	
Generic / Open Elective (GE/OE) (Choose any one from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	IA/GE/OE/T/150	Programmable Logic Controllers	2		2		2
VSC (Vocational Skill Courses) (Choose any one course from IA/VSC/T/150 and IA/VSC/T/151 and its corresponding Lab Course)	IA/VSC/T/150	1) Elements of Control Panel	1		1		1+1 = 2
	IA/VSC/T/151	2) Operational Amplifiers	1		1		
	IA/VSC/P/176	Lab Courses based on IA/VSC/T/150		2		1	
	IA/VSC/P/177	Lab Courses based on IA/VSC/T/151		2		1	
AEC, VEC, IKS	IA/AEC/T/150	Modern Indian Language (MIL-1) (Choose any one from pool of language courses)	2		2		2+2 =4
	IA/AEC/T/151	Constitution of India (Common for all the faculty)	2		2		
OJT/ FP/CEP/CC/RP	IA/CC/P/176	Yoga Education / Sports and Fitness (Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**
Exit Option : Award of UG Certificate in 3 Majors with 44 credits and an additional 4 credits of core NSQF course / Internship OR continue with Major and Minor							

IA/GE/OE/T/150 = This is a two credit theory Course to be designed for Other Faculty

Major (Core) Courses

IA/DSC/T/150 : Applied Fluidics - I

Total Credits : 02

Total Contact Hours : 30 Hrs **Maximum Marks : 50**

Learning Objectives of the Course:

1. To acquaint students with the basic components of hydraulic control
2. To equip students with fundamental tools for basic hydraulic circuit design

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Recognize basic hydraulic elements in a standard circuit
2. Describe operation of basic hydraulic actuators/ control elements
3. Construct circuit diagram for basic hydraulic circuits according to application demand

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Fluid Power fundamentals and Hydraulic pumps** Introduction, Advantages and Disadvantages of fluid power system, Applications; Physical Properties of Hydraulic Fluids; Governing principles in hydraulics- Fluid level, Pascal's Law; Flow of hydraulic fluid- laminar and turbulent, Bernoulli's principle; Reynold's number; Frictional losses in flows through hydraulic systems; Darcey-Weisbach formula; losses in pipe, valve and fittings; Components of a typical Fluid Power System; Types of fluid power system-Hydrostatic and Hydrodynamic; Classification of pumps –PD and NPD pumps; Pumping Theory- PD pumps and parameters; Pumps based on Delivery of oil flow; Gear pumps (Internal Gear Pump, External Gear Pump, Lobe Pump, Gerotor Pump) and Vane pumps, Volumetric Displacement and Theoretical Flow Rate Calculation, Pump Efficiency; ANSI Symbols.	**10 Hrs**
II	**Hydraulic Elements in Design of Circuits - I** Hydraulic cylinders- Basic Operation, Construction, Types - Single and Double Acting Cylinder; Special purpose Cylinder; specification of hydraulic cylinder; cylinder force, velocity and power, cylinder load due to moving weight; Cushioning in Cylinder; ANSI symbols. Basic Circuits with Hydraulic Cylinders; Introduction to Design of Hydraulic Circuits; Control elements and their function; Direction control valve – classification, Pilot operated DCVs; Check valves; ANSI Symbols	**10 Hrs**
III	**Hydraulic Elements in Design of Circuits - II** Pressure Control valves, Direct Acting Relief valve, Pilot operated relief valve, Pressure Reduction valve, Sequence valve, Counterbalance valve; ANSI symbols. ANSI Symbols Flow control valves- Counter- Orifice Principle, Effect of pressure on operation, Effect of flow control valve on relief of system; Throttle valve (with and without pressure compensation),location of flow control valves (Meter in, Meter Out, Bleeder Operation), Ancillary Hydraulic Components- Accumulators-(Types, size, Application Circuits); Filters; Reservoir; Intensifier; Pressure Switch; Manifold; fluid conductors. ANSI Symbols Counterbalance Valve application, pressure sequence valve application, two handed safety circuit, auxiliary power backed circuit using accumulator; Single and Double Acting Cylinder Operation	**10 Hrs**

Text Books:

1. Anthony Esposito, "Fluid Power with Application", Seventh Edition, Pearson Publication, 2009
2. S. Ilango, V. Soundararajan, "Introduction to Hydraulics and Pneumatics", Second Edition, Prentice Hall of India, 2012

Reference Books:

1. S. R. Majumdar," Oil Hydraulic Systems: Principles and Maintenance", First Edition, McGraw Hill, 2017
2. W. Bolton, " Pneumatic and Hydraulic Systems", Second Edition, Butterworth Heinemann, 1998

Online Reference:

https://archive.nptel.ac.in/courses/112/106/112106300/

IA/DSC/P/176 : Lab-Course based on IA/DSC/T/150

Total Credits : 02

Total Contact Hours : 60 Hrs **Maximum Marks : 50**

Learning Objectives of the Course:

1. To introduce students with operational parts of a practical hydraulic circuit
2. To provide operational exposure with hydraulic components towards building of basic circuits

Course Outcomes (COs) :

On completion of this course, students should be able to –

1. Identify basic components of hydraulic circuits
2. Compare applicability of various hydraulic and pneumatic components for dedicated applications
3. Develop basic hydraulic circuits using actuators and valves.

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

At least six experiments have to be performed

1. Study of parts of a hydraulic power pack and pressure relief valve
2. Study of working with Double Acting Cylinder using 4/3 DCV
3. Study of working with Double Acting Cylinder using 4/2 DCV
4. Study of working with Single Acting Cylinder using 3/2 DCV
5. Study of working with hydraulic motor using 4/3 way and 4/2 way DCV
6. Study of Hydraulic Meter-IN circuit
7. Study of Hydraulic Meter-OUT circuit
8. Study of Hydraulic Sequence Valve
9. Study working of Solenoid operated Direction Control Valves
10. Study of accumulator as an emergency power source

IA/DSC/T/151 : Applied Fluidics - II

Total Credits : 02

Total Contact Hours : 30 Hrs **Maximum Marks : 50**

Learning Objectives of the Course:

1. To acquaint students with the basic tools of pneumatic control
2. To equip students with fundamental tools for basic pneumatic circuit design

Course Outcomes (COs) :

On completion of the course, students should be able to –

1. Recognize basic pneumatic elements in a standard circuit
2. Describe operation of basic pneumatic actuators/ control elements
3. Construct circuit diagram for basic pneumatic circuits according to application demand

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Pneumatic System- Concepts, Components and Design Basics** Introduction; Comparison of Pneumatic/Hydraulic/and Electrical System; Air compression system- Types of Compressor, Compressor specifications; Air preparation elements; Arrangement of a complete pneumatic system; compressed air behaviours. Understanding pneumatic components- Pneumatic Actuators, Direction Control Valves. Design of pneumatic circuits- fluid power circuit design; switching valve position; control air/s signal air; Notation/ Numbering of Valves Building of pneumatic circuits; Application of Logic valves-AND, OR; Speed control circuit; Application of time delay valve.	10 Hrs
II	**Design of Pneumatic Circuits** Position sensing in Pneumatic Cylinders, Position Sensing in Pneumatic Cylinders- Signal flow in pneumatic circuits for pressure sensing; Roller lever valve circuits- Notation of roller lever valve and roller lever valve with idle return in pneumatic circuits, Pressure Sensing in Pneumatic Circuits, Pressure Sequence Valve	10 Hrs
III	**Multicylinder Pneumatic Circuits** Two Cylinder Movement, Overlapping of Signals, Displacement Diagrams, Displacement Diagrams of Multicylinder operations, Cascade method of Sequential Circuit Design, Stepper Sequencer or Counter Method of Drawing Pneumatic Circuits	10 Hrs

Text Books:

1. S. Ilango, V. Soundararajan, "Introduction to Hydraulics and Pneumatics", Second Edition, Prentice Hall of India, 2012
2. Anthony Esposito, "Fluid Power with Application", Seventh Edition, Pearson Publication, 2009

Reference Books:

1. S R Majumdar, " Pneumatic Systems (Principal and maintenance)", First Edition, McGraw Hill, 2017
2. Joji P.," Pneumatic Controls", First Edition, Wiley India Edition, 2008

Online Reference:

1. https://archive.nptel.ac.in/courses/112/106/112106300/
2. https://nptel.ac.in/courses/108105088

IA/DSC/P/177 : Lab-Course based on IA/DSC/T/151

Total Credits : 02

Total Contact Hours : 60 Hrs **Maximum Marks : 50**

Learning Objectives of the Course:

1. To introduce students with operational parts of a practical pneumatic circuit
2. To provide operational exposure with pneumatic components towards building of basic circuits

Course Outcomes (COs) :

On completion of this course, students should be able to –

1. Identify basic components of pneumatic circuits.
2. Compare applicability of various pneumatic components for dedicated applications.
3. Design basic pneumatic circuits using actuators and Valves.
4. Design sequential circuits using basic pneumatic components and sensors.
5. Design logic based pneumatic circuits.

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H
CO4	H	H	H	H	H								H	H	H	H
CO5	H	H	H	H	H								H	H	H	H

At least six experiments have to be performed

1. Study of different parts of an air compressor
2. Implementation of a – (i) 3/2 way single air pilot operated DCV and (i) 3/2 way hand lever operated DCV to operate Single Acting Cylinder
3. Implementation of a – (i) 5/2 way double air pilot operated DCV and (i) 5/2 way hand lever operated DCV to operate Double Acting Cylinder
4. Implementation of foot level operated valve and disc rotary valve to operate a DAC.
5. Implementation of a unidirectional flow control valve to control speed of a pneumatic motor
6. Study of 'OR' logic using pneumatic components
7. Study of 'AND' logic using pneumatic components
8. Implementation of solenoid operated direction control valve in pneumatic circuits.
9. Development of Sequential operation in pneumatic circuits using Proximity Sensors
10. Development of Sequential operation in pneumatic circuits using roller lever type DCVs

IA/DSC/T/152 : Discrete State Process Controllers

Total Credits : 02

Total Contact Hours : 30 Hrs **Maximum Marks : 50**

Learning Objectives of the Course:

1. To introduce students to general hardware specifications of Programmable Logic Controllers and I/O devices
2. To develop concepts for creating ladder diagram from process control description
3. To equip students with basic level software tools for application of PLC in real-time operating conditions

Course Outcomes (COs) :

On completion of the course, students should be able to-

1. Recognize Relays and PLCs as building block of Industrial Automation
2. Identify I/O terminals/ connections of a PLC in generic control circuits
3. Develop PLC wiring diagrams and Ladder Diagrams for basic control applications
4. Develop PLC program using Timers and Counters

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H
CO4	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Foundation of Industrial Logics** Industrial Logic overview, Relay Logic, Typical logic circuits, Relay ladder logic, Solid State Relays (SSRs); Programmable Logic Controllers (PLCs)- Parts of a PLC, Principles of Operation, Modifying the Operation, PLC Size and Application; PLC Hardware Components; Logic Fundamentals: The Binary Concept, AND, OR, and NOT Functions, The AND Function, The OR Function, The NOT Function, The Exclusive-OR (XOR) Function, Boolean Algebra, Developing Logic Gate Circuits from Boolean Expressions, Producing the Boolean Equation for a Given Logic Gate Circuit, Hardwired Logic versus Programmed Logic	10 Hrs
II	**PLC Programming Basics and Tools** Programming Basics: Processor Memory Organization (Program Files, Data Files), Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of Operation; Timers: Industrial Timers, Types of Timing Operations, Timer Instructions, On-Delay Timer Instruction, Off-Delay Timer Instruction, Retentive Timer, Cascading Timers; Counters: Counter Instructions, Up-Counter, Down-Counter, Up/Down Counter, Cascading Counters	10 Hrs
III	**Basic I/O Devices, Wiring and Applications** Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors (Proximity Sensor, Magnetic Reed Switch, Light Sensors, Ultrasonic Sensors, Strain/Weight Sensors, Temperature Sensors, Flow Measurement, Velocity and Position Sensors), Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Writing a Ladder Logic Program Directly from a Narrative Description; Program examples	10 Hrs

Text Books:

1. F. Petruzella," Programmable Logic Controllers" Mc Graw Hill Publishing Company
2. W. Bolton," Programmable Logic Controllers", Newnes (Elsevier) ;
3. J. R. Hackworth, F. D. Hackworth Jr., "Programmable Logic Controllers: Programming Methods and Applications-" Pearson India Education

Reference Books:

1. J.W. Webb, R. A. Reiss, " Programmable Logic Controllers: Principles and Applications", Prentice Hall of India

2. L. A. Bryan, E. A. Bryan, "Programmable Controllers: Theory and Implementation" An Industrial Text Company Publication
3. J. A. Rehg, G. J. Sartori," Programmable Logic Controllers", Pearson

Online Reference:

www.instrumentationtools.com

IA/DSC/P/178 : Lab-Course based on IA/DSC/T/152

Total Credits : 02

Total Contact Hours : 60 Hrs **Maximum Marks : 50**

Learning Objectives of the Course:

1. To introduce students to a PLC programming environment
2. To enable students to read wiring of a PLC as per operational requirement
3. To provide students with basic programming tools for real time application development with PLCs

Course Outcomes (COs) :

On completion of the course, students should be able to –

1. Recognize hardware interfacing with Digital I/O devices
2. Develop ladder diagrams as per situational demands (lower to intermediate level complexity)
3. Develop basic real time projects using PLCs

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

At least six experiments have to be performed

1. Identification of PLC I/O Terminals
2. PLC I/O Wiring with basic I/O devices.
3. Interfacing a PLC with to its programming software, uploading program in PLC
4. Develop ladder expressions for logic gates, hardware implementation (basic gates)
5. Development of ladder expressions for latched contacts, always energized and always de-energized contacts, interlocking
6. Development of ladder expressions for Timer (ON;OFF;PULSE) operation; hardware implementation
7. Development of ladder expression for Counter (Up; Down), hardware and software implementation
8. Development of ladder expression for Water Tank Level Control; hardware implementation
9. Development of ladder expression for Conveyor Control; hardware implementation
10. Development of Ladder Expression for linear bottle filler system; hardware implementation

General Elective/Open Elective Course

IA/GE/OE/T/150 : Programmble Logic Controllers

Total Credits : 02

Total Contact Hours : 30 Hrs **Maximum Marks : 50**

Learning Objectives of the Course:

1. To introduce students to general hardware specifications of Programmable Logic Controllers and I/O devices
2. To develop concepts for creating ladder diagram from process control description
3. To equip students with basic level software tools for application of PLC in real-time operating conditions

Course Outcomes (COs) :

On completion of the course, students should be able to-

1. Recognize Relays and PLCs as building block of Industrial Automation
2. Identify I/O terminals/ connections of a PLC in generic control circuits
3. Develop PLC wiring diagrams and Ladder Diagrams for basic control applications
4. Develop PLC program using Timers and Counters

Module No.	Course Content	Contact Hours
I	**Foundation of Industrial Logics** Industrial Logic overview, Relay Logic, Typical logic circuits, Relay ladder logic, Solid State Relays (SSRs); Programmable Logic Controllers (PLCs)- Parts of a PLC, Principles of Operation, Modifying the Operation, PLC Size and Application; PLC Hardware Components; Logic Fundamentals: The Binary Concept, AND, OR, and NOT Functions, The AND Function, The OR Function, The NOT Function, The Exclusive-OR (XOR) Function, Boolean Algebra, Developing Logic Gate Circuits from Boolean Expressions, Producing the Boolean Equation for a Given Logic Gate Circuit, Hardwired Logic versus Programmed Logic	**10 Hrs**
II	**PLC Programming Basics and Tools** Programming Basics: Processor Memory Organization (Program Files, Data Files), Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of Operation; Timers: Industrial Timers, Types of Timing Operations, Timer Instructions, On-Delay Timer Instruction, Off-Delay Timer Instruction, Retentive Timer, Cascading Timers; Counters: Counter Instructions, Up-Counter, Down-Counter, Up/Down Counter, Cascading Counters	**10 Hrs**
III	**Basic I/O Devices, Wiring and Applications** Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors (Proximity Sensor, Magnetic Reed Switch, Light Sensors, Ultrasonic Sensors, Strain/Weight Sensors, Temperature Sensors, Flow Measurement, Velocity and Position Sensors), Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Writing a Ladder Logic Program Directly from a Narrative Description; Program examples	**10 Hrs**

Text Books:

4. F. Petruzella," Programmable Logic Controllers" Mc Graw Hill Publishing Company
5. W. Bolton," Programmable Logic Controllers", Newnes (Elsevier) ;
6. J. R. Hackworth, F. D. Hackworth Jr., "Programmable Logic Controllers: Programming Methods

and Applications-" Pearson India Education

Reference Books:

4. J.W. Webb, R. A. Reiss, " Programmable Logic Controllers: Principles and Applications", Prentice Hall of India
5. L. A. Bryan, E. A. Bryan, "Programmable Controllers: Theory and Implementation" An Industrial Text Company Publication
6. J. A. Rehg, G. J. Sartori," Programmable Logic Controllers", Pearson

Online Reference:

www.instrumentationtools.com

VSC
(Vocational Skill Courses)
(Choose any one from pool of courses)

IA/VSC/T/150- Elements of Control Panel

Total Credits : 02 | Total Contact Hours : 30 Hrs | Maximum Marks : 50

Learning Objectives of the Course: To provide students with-

1. foundation electrical concepts required for Control Panel Wiring
2. To acquaint students with electrical safety measures while working in AC circuits
3. To provide students with application concepts about different components of Control Panel

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Identify components installed in a control panel and recognize their role in overall operation
2. Apply basic electrical safety measures while working in AC circuits
3. Conceptualize front panel and back panel layout of an MCC with standards

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	M								H	H	H	
CO2	H	H	H	H	M								H	H	H	
CO3	H	H	H	H	M								H	H	H	

Module No.	Course Content	Contact Hours
I	**Foundation Elements** Review of concepts - Current, Voltage and Power, AC & DC; Line, Neutral, and Earth; 1-ph (LN), 3- ph (RYB - N), Star and Delta Connections, Current and Voltage relations in Star and Delta Connections, Relays; Personal Safety-Guidelines; Use of Rubber soled Shoes, Gloves and Goggles, Conductivity of Water, EarthingPit, Earthing Plates & Strips, ESD; Drawings – Types, Wiring Diagram, Elementary Diagram, Single Line Diagram; Symbols	**10 Hrs**
II	**Basic Panel Elements and Cables** Introduction of a typical Control Panel (MCC) – Front Panel and Back End Overview; Power Supply, Busbar, SFUs, MCB, ELCB, RCCB and MPCB, Contactors and Auxiliary Contactors (NO/NC); Push Buttons, NO/NC Elements, Selector/Key Switches, CT and PT, Voltmeter, Ammeter, Energy meter, Multifunction Meter; Terminal Blocks & Din Rails, Plastictrunking, Connector blocks; Indicators, Alarm Annunciators; Timers, Counters. Wire types and preparation - Insulation materials, Conductors, Wire specifications, Standard Wire Gauge, Coaxial and screened wire, Multiway cables, Insulation removal, Forming the wire, Soldering, Crimped joints, Screw clamp terminals; Cable/Wire specification	**10 Hrs**
III	**Control Panel Wiring and Troubleshooting** SLD Preparation (Basic Concepts), Determining BOQ of Components, Checking received material for specifications as per drawing, Creating Channel layout, Selecting the correct Conductor, Testing for Shorts / Continuity, Cutting required lengths, Using Ferrules & Cable lugs, Terminal Tightening Torque,Checking the circuits, Dressing the Cables, Using Cable Glands (Single Compression /Double Compression), Cable forming – Cable forms, Continuous lacing, Breakouts, Spot ties, Laying the wires, Twisted pairs, Cable markers, Connections and Conductor and cable runs, Conductors of different circuits; Earthing the protective bonding circuit Screen connections, System earth terminals; Testing Power Supply, Testing Relays & Contactors, Testing CT/PT, Testing Pushbuttons, Indicating	**10 Hrs**

	Lamps & Selector Switches, Ammeter & Energy meter, Testing Voltmeter, Troubleshooting of Control Panels	

Text Books:

1. A. K. Theraja, B. L. Theraja, "Electrical Technology – (Vol. 1 & 2)"- ; S. Chand Publishers, 2010
2. M. E. Schultz, "Grob's Basic Electronics", Mc Graw Hill Pvt. Ltd., 2012
3. J. Cadick, M. Capeli-Schellpfeffer, A. Winfield, "Electrical Safety Handbook", Mc. Graw Hill, 2014
4. Bob Mercer; Newnes (Elsevier), "Industrial Control Wiring Guide", 2011
5. Wiring Diagram Book- Schneider; Square D,; 1993

Reference Books:

1. Electrical Installation Guide – L. Mischler (Co-Ed), Schneider Electric, 2016
2. Industrial Controls- Answers for Industry – SIEMENS, 2011

Online Reference:

1. https://info.airlinehyd.com/fast-wiring
2. https://www.youtube.com/watch?v=twBJpeJh_Cc&list=PLIn3BHg93SQ_SHJEt9munDqM--YOvOKJV

IA/VSC/P/176 : Lab-Course based on IA/VSC/T/150

Total Credits : 02 Total Contact Hours : 30 Hrs Maximum
Marks : 50

Learning Objectives of the Course:

1 To provide students with operational knowledge of various control panel
2 To acquaint students with specific characteristics and limitation of various elements in perspective of developing control panel

Course Outcomes (COs) :

On completion of this course, students should be able to -

1. Read wiring diagrams
2. Recognize elements in a standard MCC panel
3. Interpret requirements for designing of an MCC panel

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	M								H	H	H	M
CO2	H	H	H	H	M								H	H	H	M
CO3	H	H	H	H	M								H	H	H	M
CO4	H	H	H	H	M								H	H	H	M

At least Four experiments have to be performed

1. Identification of wiring and measurement of series and parallel output
2. Identification Cable Gauges & SWG Sizes for application requirement
3. Study of MCB,ELCB, and determination of ratings as per application requirement
4. Study of MPCB, SFU, Earthing plate wiring and determination of ratings as per application requirement
5. Study of organization of cables in a standard control panel (Colour Code, Ferrules, Lugs, Dressings)
6. Wiring and programming of a standard Industrial Timer with actuators/indicators
7. Wiring and programming of a standard Industrial Counter with IR switch/Proxy sensor
8. Study of contactor and auxiliary contactor with pilot lamps and start/ Stop pushbutton
9. Identification of MCC Elements
10. Testing for Power Supply Shorts / Continuity
11. Wiring of induction motor (1 HP single phase) –
12. Three wire open loop control for motor with overload relay contact and holding contact, and Push button control with two command points
13. Three wire open loop control for motor for set up (Jog) or operation (Run) with start and stop pushbuttons and set up/ run toggle switch
14. Wiring of Ammeters, Voltmeters, Energy Meters/ Multi-Function Meter

IA/VSC/T/151: Operational Amplifiers

Total Credits : 02 Total Contact Hours : 30 Hrs Maximum
Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Fundamental concepts of Operational Amplifiers
2. Ideas of developing various applications of Operational Amplifiers
3. Recognize OP-AMPs for building systems to develop application oriented platforms

Course Outcomes (COs) :

On completion of this course, students should be able to-

1. Discuss basic operation of Operational Amplifiers
2. Apply laws of Boolean algebra for simplification of digital circuits, conversion of logic expression to circuit diagram and vice versa
3. Correlate operations of fundamental combinational logic circuits

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	L								H	H	H	L
CO2	H	H	H	H	L								H	H	H	L
CO3	H	H	H	H	L								H	H	H	L

Module No.	Course Content	Contact Hours
I	**Integrated circuits** An over view of IC design technology, Introduction to wafer cleaning, photolithography, Ion implantation. Classification of IC families and their comparison. Study of data sheets of 741, 301, OP-07 and 324. Op-amp ideal characteristics and op-amp parameters.	**10 Hrs**
II	**OP-amp with positive and negative feedback** Inverting, Non inverting and differential amplifier configuration and their special cases. Summing, scaling, averaging, instrumentation amplifier, integrator and differentiator, V to I and I to V converters.	**10 Hrs**
III	**Oscillator, Comparators and converters** Phase shift oscillator, Wein bridge oscillator, square wave, triangular wave and saw tooth wave generators, Basic comparators, schmitt trigger, D/A converters and A/D converters	**10 Hrs**

Text Books:

1. Ramakant A. Gaikwad, Op-amp and Integrated circuits, Fourth edition, PHI Publication, 2002.
2. Sergio Franco, Design with Op-amp and Analog Integrated circuits, Tata McGraw Hill Edition, New Delhi, 2014
3. Robert F. Coughlin and Frederick F. Driscoll, Operational Amplifiers and Linear Integrated Circuits.2015

Reference Books:

1. L. K. Maheshwari and M.M. S Anand, Analog Electronics, Prentice Hall of India, New Delhi.2000
2. V. Rajaram, Analog Computation and Simulations, Prentice Hall of India, New Delhi.2010

Online Reference:

1. https://archive.nptel.ac.in/courses/108/108/108108114/
2. https://archive.nptel.ac.in/courses/108/108/108108111/
3. https://archive.nptel.ac.in/courses/108/108/108108125/

IA/VSC/P/177 : Lab-Course based on IA/VSC/T/151

Total Credits : 01 Total Contact Hours : 30 Hrs Maximum

Marks : 50

Learning Objectives of the Course:

1 To provide students with operational knowledge of op-amps
2 To acquaint students with the designing of various applications of op-amps
3 To implement various applications based on op-amps

Course Outcomes (COs) :

On completion of this course, students should be able to –

1. Demonstrate operation of op-amps
2. Construct circuits deploying operation of op-amps for various operations like integrator, differentiator etc
3. Deploy op-amps for various applications such as oscillator, comparator and converter.

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	M								H	H	H	M
CO2	H	H	H	H	M								H	H	H	M
CO3	H	H	H	H	M								H	H	H	M

At least four experiments have to be performed

1. Study of basic properties of Operational Amplifier: Inverting and Non-Inverting Amplifiers
2. Study of Summing and Scaling amplifier
3. Study of averaging amplifier
4. Study of Instrumentation amplifier
5. Study of Differentiator and Integrator using Operational Amplifier
6. Study of Log and antilog amplifiers
7. Study of Voltage comparator
8. Study of Wien bridge oscillator using operational amplifier
9. Study of Voltage regulator using operational amplifier to produce output of 12V with maximum load current of 50mA
10. Study of Voltage to current converters
11. Study of Function generator using operational amplifier (sine, triangular & square wave)
12. Study of Astable and monostable multivibrator using IC 555

Reference for Online Practical:

1. https://ae-iitr.vlabs.ac.in/List%20of%20experiments.html
2. https://be-iitkgp.vlabs.ac.in/List%20of%20experiments.html

===XXX===

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

CHHATRAPATI SAMBHAJINAGAR.

NAAC- 'A+' Grade

CIRCULAR NO.SS/ Sci & Tech./ B.Voc /14 /2025.

It is hereby inform to all concerned that, on recommendation of the Dean, Faculty of Science & Technology **Academic Council at its meeting held on 21 July, 2025 has been accepted the revised syllabi of following *Curriculum at UG Level* as per National Education Policy-2020" *1. B.Voc in Industrial Automation, 2. Automobile Division,*** (revised) ***of under*** **the Faculty of Science & Technology run at the Department, Deen Dayal Upadhyay Kaushal Kendra, Dr. Babasaheb Ambedkar Marathwada University as appended herewith.**

This is effective from the Academic Year 2025-26 onwards under the Faculty of Science & Technology.

All concerned are requested to note the contents of the circular and bring notice to the students, teachers and staff for their information and necessary action.

University campus,
Chhatrapati Sambhajinagar-431004.
Ref. No. S S/Sci & Tech/B.Voc./2025-26/
Date: 01/ 08/ 2025 1436-38

****

Deputy Registrar,
Syllabus Section

Copy forwarded and Information to necessary action:-

1] **The Director, Department, of, Deen Dayal Upadhyay Kaushal Kendra, Dr. Babasaheb Ambedkar Marathwada University.**

2] **The Director, Board of Examination & Evaluation,**

3] **The Director,** University Network & Information Centre, UNIC, with a **request to upload this circular on University Website.**
Dr. Babasaheb Ambedkar Marathwada University **Chhatrapati Sambhajinagar.**

Dr. Babasaheb Ambedkar Marathwada University

Chhatrapati Sambhajinagar- 431001

Deen Dayal Upadhyay KAUSHAL Kendra

Three Year
B.VOC. Degree Program

Course Structure Sem III- IV & Syllabus Sem III

(Revised)

(AS PER NEP-2020)

Subject (Major): INDUSTRIAL AUTOMATION

(Pattern 2024)

Effective from 2025-26

1/7/2025

Course Structure for Semester – III & IV

B.VOC Industrial Automation

Course Structure for Semester III of Bachelor of Vocation Major (Industrial Automation)							
Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Lab Course	Theory	Lab Course	
Major (Core) M7 Mandatory	IA/DSC/T/200	Embedded Systems	2		2		2+2=4
	IA /DSC/P/226	Embedded Systems Lab		4		2	
Major (Core) M8 Mandatory	IA/DSC/T/201	Process Control	2		2		2+2=4
	IA /DSC/P/227	Process Control Lab		4		2	
Minor Course **It is from Different Discipline from same faculty**	**To be chosen from Other Discipline of same faculty**		2		2		2+2=4
			2		2		
Generic / Open Elective (GE/OE) (Choose any one from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	**It should be chosen compulsorily from the faculty other than that of Major**		2		2		2
VSC (Vocational Skill Courses) (Choose any one from pool of courses)	IA / VSC/T/200	Industrial AC Motors	1		1		1+1=2
	IA / VSC /T/201	Variable Frequency Drives	1		1		
	IA / VSC /P/226	Industrial AC Motors Lab		2		1	
	IA / VSC /P/227	Variable Frequency Drives Lab		2		1	
AEC, VEC, IKS	IA /AEC/T/200	English- 2 (Common for all the faculty)	2		2		2+2 =4
	IA /VEC/T/201	Environmental Studies	2		2		
OJT/ FP/CEP/CC/RP	IA/CC/P/226	Cultural Activity/ NSS, NCC (Common for all Faculty)		4		2	2
							22

Minor Courses for Other Discipline offered by DDUKK (Industrial Automation): (2 Credits Each)
1) IA/MN/T/200 : Semiconductor Devices 2) IA/MN/T/201: Basic Industrial Measurements
Generic / Open Elective offered for Other Faculty by DDUKK (Industrial Automation): (2 Credits)
IA/GE/OE/T/200: Embedded System

Course Structure for Semester IV of Bachelor of Vocation Major (Industrial Automation)							
Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Lab Course	Theory	Lab Course	
Major (Core) M9 Mandatory	IA/DSC/T/250	Fundamentals of Flexible Manufacturing Systems	2		2		2+2=4
	IA /DSC/P/276	Fundamentals of Flexible Manufacturing Systems Lab		4		2	
Major (Core) M10 Mandatory	IA/DSC/T/251	Fundamental of Industrial Robotics	2		2		2+2=4
	IA /DSC/P/277	Fundamental of Industrial Robotics		4		2	
Minor Course **It is from Different Discipline from same faculty**	**To be chosen from Other Discipline of same faculty**		2		2		2+2=4
			2		2		
Generic / Open Elective (GE/OE) (Choose any one from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	**It should be chosen compulsorily from the faculty other than that of Major**		2		2		2
SEC (Skill Enhancement Courses) (Choose any one from pool of courses)	IA /SEC/T/250	IOT	1		1		1+1= 2
	IA /SEC/T/251	SCADA	1		1		
	IA /SEC/P/276	IOT Lab		2		1	
	IA /SEC/P/277	SCADA LAB		2		1	
AEC, VEC, IKS	IA /AEC/T/250	Modern Indian Language (MIL – 2)	2		2		2+2 =4
	IA /FP/P/276	Field Project	2		2		
OJT/ FP/CEP/CC/RP	IA/CC/P/277	(Fine/ Applied/ Visual/ Performing Arts)				2	2
							22

Minor Courses for Other Discipline offered by DDUKK (Industrial Automation): (2 Credits Each)
1) IA/MN/T/250 : Applied Fluidics 2) IA/MN/T/251: Discrete State Process Control
Generic / Open Elective offered for Other Faculty by DDUKK (Industrial Automation): (2 Credits)
IA/GE/OE/T/250: Fundamental of Industrial Robotics

Syllabus for Semester – III

B.VOC Industrial Automation

Major (Core)
Mandatory

IA/DSC/T/200: Embedded Systems

Total Credits : 02

Total Contact Hours : 30 Hrs | Maximum Marks : 50

Learning Objectives of the Course:

1. To provide students foundational knowledge of Embedded C Programming
2. To Provide students with functional knowledge with Arduino Uno
3. To provide students with basic idea of prototyping

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Apply concepts to embedded C to develop programs in Arduino IDE
2. Develop prototypes with Arduino UNO

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Introduction to Arduino and Programming Environment** Introduction - What is Arduino, Introduction to Arduino family, Arduino Shields; Creating an Arduino Programming Environment – Exploring microcontroller Internals, Moving beyond machine codes, Creating Arduino programs, Installing the Arduino IDE, Overview of Arduino IDE, Exploring IDE – Menus, Toolbar, Message Area and Console Window, Setting Up Arduino IDE, Using Serial Monitor; Building a Basic Arduino sketch, Interfacing Concept with Electronic Circuits	10 Hrs
II	**Hydraulic Elements in Design of Circuits - I** Basics of C - Working with variables, Operators, Exploring Arduino functions; Structured Commands – if Statement, Grouping multiple statements, else Statements, else if Statements, Comparison conditions, Creating compound conditions, Negating a Condition check, Switch Statement; Programming Loops – Understanding Loops, while Loops, do-while loops, for Loops, Using arrays in Loops, Using multiple variables, Nesting Loops, Controlling Loops; Development of Sketches	08 Hrs
III	**Real World Interfacing** Concept of Library, Using standard libraries; Digital Interfaces – Digital overview, Working with Digital inputs and outputs; Analog Devices – Analog overview, Analog Input, Modifying input result, Using input mapping, Changing reference voltage, Analog output; Analog output dependent on digital and analog input; Overview of the spectrum of sensors and actuators compatible with Arduino family of microcontrollers. Interfacing of Sensors; Interfacing of actuators; Interfacing with LCD; Development of Sketches	12 Hrs

Text Books:

[1] R. Blum, Sams Teach Yourself Arduino Programming in 24 Hours, 1st ed. Pearson Education, 2015. ISBN: 9789332552432.

[2] S. O. F. Towaha, Learning C for Arduino, 1st ed. Packt Publishing, 2017. ISBN: 9781787120099.

Reference Books:

[1] M. McRoberts, Beginning Arduino, 2nd ed., Apress, 2013. ISBN: 9781430232407.
[2] S. Monk, Programming Arduino: Getting Started with Sketches, 2nd ed., McGraw-Hill Education, 2016. ISBN: 9781259641633.
[3] M. Margolis, Arduino Cookbook, 2nd ed., O'Reilly Media, 2011. ISBN: 9781449313876.
[4] J. Blum, Exploring Arduino: Tools and Techniques for Engineering Wizardry, 1st ed., Wiley, 2013. ISBN: 9781118549360.

Online Reference:

https://spoken-tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English

IA /DSC/P/226: Embedded Systems Lab

Total Credits : 02

Total Contact Hours : 60 Hrs **Maximum Marks : 50**

Learning Objectives of the Course:

1. To introduce students with Arduino IDE
2. To provide operational exposure with sensors and actuators compatible to Arduino Uno

Course Outcomes (COs):

On completion of this course, students should be able to –

1. Identify sensors and actuators (compatible to Arduino UNO) for target applications
2. Develop basic sketches for working with sensors and actuators compatible to Arduino uno
3. Develop simple prototypes for real life applications

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

At least six experiments have to be performed

1. Installation of Arduino IDE and getting Arduino Uno connected to IDE
2. LED interfacing to Arduino Uno: Blinking, Slow glowing/dimming of LED
3. Interfacing of potentiometer to Arduino Uno and printing of voltage developed across potentiometer in serial monitor
4. Interfacing of LM 35 to Arduino Uno and printing of temperature in serial monitor
5. Interfacing of LCD to Arduino Uno: temperature reading from LM35
6. Interfacing of LCD and temperature + humidity sensor to Arduino Uno
7. Interfacing of a flow sensor to Arduino Uno and printing of flow in serial monitor
8. Development of a distance monitor using Arduino Uno and Ultrasonic transmitter/receiver
9. Interfacing a DC motor to Arduino Uno: Using toggle switches to Start/Stop and Direction Control of Motor, Using Potentiometer to control speed of motor
10. Interfacing a DC motor to Arduino Uno (speed and direction of rotation control)
11. Interfacing DC servo motor to Arduino Uno
12. Interfacing stepper motor to Arduino Uno (using transistor/ MOSFET)

IA/DSC/T/201: Process Control

Total Credits : 02 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course: To provide students with-

1. Fundamental traits, definitions and expressions of industrial process control
2. Application concepts of discrete, continuous and composite controller

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Discuss basic operation of controllers in different modes of operation and basic control loop characteristics
2. Explain basic characteristics industrial process and process control .
3. Evaluate role of sensors, final control elements and controllers in industrial process control

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H									H	M	M	
CO2	H	H	H	H									H	M	M	
CO3	H	H	H	H									H	M	M	

Module No.	Course Content	Contact Hours
I	**Introduction to Industrial Process Control** Overview of Process Control, Role of Automation, Current trends in Automated Process Control; Fundamentals: Process Definition, Process Control Principles, Servomechanism, Discrete-State Control System, Block Diagram of Process Control, Evaluation of a typical control system, Analog and Digital Processing, Analog data Representations, Pneumatic and Current Signal	10 Hrs
II	**Process-control elements and Discrete Process Control** Basic Definitions of common terms and expressions used to describe process-control elements Overview of sensors and final control elements, Process Control Drawings: P&ID symbols, Discrete state process control: Overview, System characteristics,	10 Hrs
III	**Controller Principles** Process characteristics, Control system parameters, Open loop control, Closed loop control, Control System Parameters, Discontinuous Controller Modes: Two position control, Multi-position control, Continuous and Composite Controller Modes: Proportional, Integral and Derivative Control, PI, PD and PID control	10 Hrs

Text Books:

1. Process Control Instrumentation Technology- C. D. Johnson; PHI Learning PVT LTD, 2005; ISBN-10 : 0131194577 ISBN-13 : 978-0131194571
2. Industrial Control Electronics (Devices, Systems, Applications): T. Bartelt; Delmar Cengage Learning, 2005; ISBN-10 : 1401862926 ISBN-13 : 978-1401862923

Reference Books:

1. Fundamentals of Industrial Instrumentation and Process Control: W. Dunn; Mc-Graw Hill, 2005; ISBN-10 : 0071457356 ISBN-13 : 978-0071457354
2. Process Control: A Practical Approach: M. King, Wiley, 2011; ISBN-13: 978-0470975879 ISBN-10: 9780470975879
3. Practical Process Control: A. M. Seal, Elsevier Butterworth-Heinemann, 1998; ISBN: 9780340705902,

9780080539393

Online Reference:

1. https://nptel.ac.in/courses/103/103/103103037/
2. https://nptel.ac.in/courses/103/105/103105064/

IA /DSC/P/227 Process Control Lab

Total Credits : 02 **Total Contact Hours : 60 Hrs**

Maximum Marks : 50

Learning Objectives of the Course:

1 To provide students with operational knowledge of process control elements

2 To acquaint students with specific characteristics and limitation of process control elements in perspective of developing real life applications

Course Outcomes (COs) :

On completion of this course, students should be able to -

1 Demonstrate operation of Controllers

2 Contrast operational characteristics of valves and transmitters

3 Implement basic process control circuits

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H									H	M	M	
CO2	H	H	H	H									H	M	M	
CO3	H	H	H	H									H	M	M	

At least six experiments have to be performed

1. Study of I/P converter
2. Study of P/I converter
3. Study of open and closed loop system
4. Study of basic blocks of an analogue PID controller
5. Study of basic ON/OFF controller
6. Study of proportional, integrator and derivative controller (independent action)
7. Study of controller in composite modes (PI, PD, PID)
8. Study of PID controller operation
9. Study of Temperature / Level Transmitter
10. Study of Flow / Pressure Transmitter
11. Study of installed and inherent characteristics of Equal Percent Plug
12. Study of installed and inherent characteristic of Linear Plug
13. Study of Quick Opening valve characteristic
14. Study of Industrial PID Controller
15. Study of Temperature controller

Minor Course
in
Industrial Automation

Offered by DDUKK
(Industrial Automation
Division)

IA/MN/T/200 : Semiconductor Devices

Total Credits : 02 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course: To provide students with-

1. Basic concepts and behavior of semiconductor devices
2. Application concepts of Semiconductor devices

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Discuss basic operation of semiconductor devices used in low power and power electronics domain
2. Explain characteristics of semiconductor devices used in low power and power electronics domain . 3. Evaluate role of various Semiconductor Devices in different types applications

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H									H	M	M	
CO2	H	H	H	H									H	M	M	
CO3	H	H	H	H									H	M	M	

Module No.	Course Content	Contact Hours
I	**Semiconductor Basics and Two Terminal Devices** Atomic Structure, Band Theory of Semiconductors, Types of Semiconductors, Formation of Junctions. Diode- Diode Characteristics, Diode Applications, Special Purpose Diodes	10 Hrs
II	**Three Terminal Devices** Bipolar Junction Transistor (BJT)- BJT Biasing, BJT Characteristics, BJT Applications Junction Field Effect Transistor (JFET)- JFET Biasing, JFET Characteristics, JFET Applications Metal-Oxide Semiconductor Field Effect Transistor (MOSFET)- MOSFET Biasing, MOSFET Characteristics, MOSFET Applications	10 Hrs
III	**Power Electronic Devices** Silicon Controlled Rectifier (SCR) – SCR Operation, DC Operational circuit, Turn-on/off, Gate Triggering; DIAC; TRIAC; IGBT; Application of Power electronic devices	10 Hrs

Text Books:

1. Thomas l. Floyd, "Electronic Devices", Seventh Edition, Pearson Education, 2008
2. A. P. Malvino, D. J Bates, " Electronic Principles", Seventh Indian Edition, Mc. Graw Hill, 2007
3. K.L. Rao, C.H. Saibabu,"Theory of Power Electronics", Revised Edition 2009, S.Chand and Company Ltd. 2009

Reference Books:

1. V. K. Mehta, Rohit Mehta, " Principles of Electronics", Twelfth Edition, S. Chand Publishers, 2008
2. R. Boylstad, L. Nashelsky, "Electronic Devices and Circuit Theory", Tenth Edition, Pearson, 2009
3. M. D. Singh, K.Khanchandani, " Power Electronics", Second Edition, Mc Graw Hill, 2017

Online Reference:

1. http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html
2. https://nptel.ac.in/courses/122106025

IA/MN/T/201: Basic Industrial Measurements

Total Credits : 02 | Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. fundamental concepts of measurement and instrumentation system
2. basic modalities of industrial temperature, pressure, flow and level measurement

Course Outcomes (COs) :

On completion of the course, students should be able to-

1. Describe primary blocks of an Instrumentation System and Qualities of Measurement.
2. Select transducers as per application demand
3. Describe operation of basic transducers employed for industrial process parameter monitoring applications

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Necessity of Industrial Measurements and Discrete Detection Techniques** Industrial Process Overview, Sequential and Continuous Process, Process Control Loop, Instrumentation and Sensors; Industrial Data – Analog, Digital Pneumatic; Smart Sensors; Units and Standards- Basic and Derived Units, Standard Prefixes Discrete Detection of Objects, Displacement Measurement – Proximity Detectors, Photoelectric sensors, Applications of Photoelectric sensor, Selection of Photoelectric sensor. RVDT, LVDT, Ultrasonic Sensors, Photoelectric pick-up sensor (Non-contact type).	10 Hrs
II	**Pressure and Temperature Measurement** Pressure Measurement: Parameters of Pressure, Application Considerations; Measuring Instruments- Bourdon Tube, Diaphragm Pressure Sensor, Differential Pressure Sensor, Strain Gauge, Load Cells, Pressure Transducer and Transmitters, Industrial Scales and Weighing Systems Temperature Measurement: Parameters of Temperature, Application Consideration; Measuring Instruments – Thermocouples, RTD, Thermistor, IC solid state temperature sensors; Non-Contact Measurements	10 Hrs
III	**Flow and Level Measurement** Flow Measurement: Parameters of Flow, Application Considerations; Flow Calculations; Measuring Instruments Non-Electrical Measurements; Velocity Flow meter, Positive Displacement Flow meter, Mass Flow meter Level Measurement: Parameters of Flow, Application Considerations; Measuring Instruments: Point Contact Level Sensors, Continuous Level Sensors	10 Hrs

Text Books:

1. William C. Dunn, "Introduction to Instrumentation, Sensors and Process Control", Artech House Publishers, 2005
2. Thomas E. Kissell, "Industrial Electronics", Third Edition, PHI Learning Pvt. Ltd., 2012
3. Terry Bartlet, " Industrial Electronics" Cengage Learning India Edition, Second Indian Reprint, 2006

Reference Books:

1. H S Kalsi, "Electronic Instrumentation and Measurements", Fourth Edition, Mc Graw Hill, 2019
2. S.K.Singh," Industrial Instrumentation & Control", Third Edition, Tata McGraw Hill Publishing Co.

Ltd; 2009
3. D. Patranabis," Principles of Industrial Instrumentation", Second Edition, Tata McGraw Hill Publishing Co. Ltd; 2008

Online Reference:

1. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html

Generic / Open Elective (GE/OE) Offered by DDUKK (Industrial Automation Division)

IA/GE/OE/T/200: Embedded Systems

Total Credits : 02

Total Contact Hours : 30 Hrs Maximum Marks : 50

Learning Objectives of the Course:

4. To provide students foundational knowledge of Embedded C Programming
5. To Provide students with functional knowledge with Arduino Uno
6. To provide students with basic idea of prototyping

Course Outcomes (COs) :

On completion of the course, students should be able to -

3. Apply concepts to embedded C to develop programs in Arduino IDE
4. Develop prototypes with Arduino UNO

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Introduction to Arduino and Programming Environment** Introduction - What is Arduino, Introduction to Arduino family, Arduino Shields; Creating an Arduino Programming Environment – Exploring microcontroller Internals, Moving beyond machine codes, Creating Arduino programs, Installing the Arduino IDE, Overview of Arduino IDE, Exploring IDE – Menus, Toolbar, Message Area and Console Window, Setting Up Arduino IDE, Using Serial Monitor; Building a Basic Arduino sketch, Interfacing Concept with Electronic Circuits	10 Hrs
II	**Hydraulic Elements in Design of Circuits - I** Basics of C - Working with variables, Operators, Exploring Arduino functions; Structured Commands – if Statement, Grouping multiple statements, else Statements, else if Statements, Comparison conditions, Creating compound conditions, Negating a Condition check, Switch Statement; Programming Loops – Understanding Loops, while Loops, do-while loops, for Loops, Using arrays in Loops, Using multiple variables, Nesting Loops, Controlling Loops; Development of Sketches	08 Hrs
III	**Real World Interfacing** Concept of Library, Using standard libraries; Digital Interfaces – Digital overview, Working with Digital inputs and outputs; Analog Devices – Analog overview, Analog Input, Modifying input result, Using input mapping, Changing reference voltage, Analog output; Analog output dependent on digital and analog input; Overview of the spectrum of sensors and actuators compatible with Arduino family of microcontrollers. Interfacing of Sensors; Interfacing of actuators; Interfacing with LCD; Development of Sketches	12 Hrs

Text Books:

[1] R. Blum, Sams Teach Yourself Arduino Programming in 24 Hours, 1st ed. Pearson Education, 2015. ISBN: 9789332552432.

[2] S. O. F. Towaha, Learning C for Arduino, 1st ed. Packt Publishing, 2017. ISBN: 9781787120099.

Reference Books: [1] M. McRoberts, Beginning Arduino, 2nd ed., Apress, 2013. ISBN: 9781430232407. [2] S. Monk, Programming Arduino: Getting Started with Sketches, 2nd ed., McGraw-Hill Education, 2016. ISBN: 9781259641633. [3] M. Margolis, Arduino Cookbook, 2nd ed., O'Reilly Media, 2011. ISBN: 9781449313876. [4] J. Blum, Exploring Arduino: Tools and Techniques for Engineering Wizardry, 1st ed., Wiley, 2013. ISBN: 9781118549360.
Online Reference: https://spoken-tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English

Vocational Skill Courses (VSC)

IA/VSC/T/200: Industrial AC Motors

Total Credits : 01

Total Contact Hours : 15 Hrs | Maximum Marks : 25

Learning Objectives of the Course:

1. 1. To provide students with fundamental knowledge in dynamics and control of electric motors.
2. 2. To equip students with basic wiring knowledge of standard industrial ac motors.

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Discuss different modes of Induction motor speed control
2. Accomplish wiring and working with a standard industrial ac motors

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	L								H	H	H	L
CO2	H	H	H	H	L								H	H	H	L
CO3	H	H	H	H	L								H	H	H	L

Module No.	Course Content	Contact Hours
I	**Fundamentals of Induction Motor Drives and Control Techniques** Induction Motor Drives, Basic operation of three phase induction motor, operation with nonsinusoidal supply, Stator current of Induction motor with non-sinusoidal supply, operation of Induction motor with Unbalanced Voltage Supply, Single Phasing of Induction Motor, Braking of Induction Motor, Dynamic Braking (Ac and DC) Speed control of induction motor using stator voltage regulator, Variable Voltage/Variable Frequency Control of Induction Motor, Open Loop V/F Control, Slip Speed Control of Induction Motor, Constant Volt/ Hz Control of Induction Motor, Closed Loop Volt/ Hz Control of Induction Motor with Slip Speed Regulation, Multi Quadrant Operation of Induction Motor Drive	09 Hrs
II	**Industrial Applications of Electrical Drives and Automation** Steel Mills, Cement Mills, Textile Mills, Sugar Mills, Electric Traction, Machine Tools	06 Hrs

Text Books:

1. A First Course On Electrical Drives (SECOND EDITION)S. K. Pillai; 2001;; New Age International PVT LTD ; New Delhi (India), ISBN- 81-224-0166-X

2. Electrical Drives; N. K. DEP. K. SEN; Prentice Hall of India Private Limited; New Delhi (India), ISBN-978-81-203-1492-4

Reference Books:

1. Fundamentals of Electrical Drives (SECOND EDITION) Gopal K Dubey; 2001;; Narosa Publishing House; New Delhi (India)

2. Fundamentals of Electrical Drives; Veltman André, PulleDuco W.J., de Doncker R.W.; Springer Netherlands

Online Reference:

1. https://nptel.ac.in/courses/108/104/108104140/
2. https://www.nptel.ac.in/courses/108102046/

IA / VSC /P/226: Industrial AC Motors Lab

Total Credits : 01

Total Contact Hours : 30 Hrs

Maximum Marks : 25

Learning Objectives of the Course:

1. To develop hands-on skills in connecting and operating three-phase induction motors using various starters and understanding their internal components.
2. To enable students to measure and analyze performance characteristics, such as speed-torque and slip, of induction motors through practical experiments.

Course Outcomes (COs):

On completion of this course, students should be able to –

1. Connect, start, and operate three-phase induction motors using DOL, star-delta, and auto-transformer starters, and reverse their direction of rotation.
2. Analyze and measure speed-torque characteristics and slip of single-phase and three-phase induction motors through experimental setups

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

At least four experiments have to be performed

1. Identify components and terminals of a three-phase induction motor.
2. Connect an automatic star-delta starter with three contactors.
3. Operate a three-phase induction motor using DOL, star-delta, and auto-transformer starters.
4. Operate and analyze performance of a slip-ring induction motor with rotor resistance starter.
5. Study speed-torque characteristics of a single-phase capacitor-start induction motor.
6. Measure slip in a squirrel cage three-phase induction motor.
7. Study speed-torque characteristics of a squirrel cage three-phase induction motor.
8. Determine transformer equivalent circuit using open-circuit and short-circuit tests.
9. Perform maintenance, servicing, and troubleshooting of AC motor starters.

IA/ VSC /T/201: Variable Frequency Drives

Total Credits : 01

Total Contact Hours : 15 Hrs Maximum Marks : 25

Learning Objectives of the Course:

1. To enable students towards recognition/identification for need of appropriate drives for different applications.
2. To equip students with basic wiring and programming knowledge of standard industrial VFD.

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Discuss need of appropriate drives for different applications
2. Accomplish wiring and basic programming with a standard industrial VFD

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	L								H	H	H	L
CO2	H	H	H	H	L								H	H	H	L
CO3	H	H	H	H	L								H	H	H	L

Module No.	Course Content	Contact Hours
I	**Fundamentals of Drives:** AC Motor Drive Fundamentals , Variable-Frequency Drives (VFD), Volts per Hertz Drive, Flux Vector Drive	05 Hrs
II	**Industrial Applications of Electrical Drives and Automation** VFD Fundamentals, Pulse width modulation, carrier frequency, fundamental frequency, control modes for speed and torque; Cold test to check the healthiness of VFD; Connection of cables to the power terminals, Continuity test with the help of as per drawings. Drive installation and programming (Based on standard Allen Bradley/Siemens/Mitsubishi/ABB/Delta VFD) : common wiring connection, equipment/components used in typical VFD panel, parameters and programming, menu navigation and LCD display, common parameters, braking method; basic troubleshooting in VFD- over temperature fault, over current fault, over voltage fault.	10 Hrs

Text Books:

1. Variable Frequency Drives: Installation and Troubleshooting – Gary D. Anderson; ISBN- 978-15-027-7089-9

2. Electrical Drives; N. K. DEP. K. SEN; Prentice Hall of India Private Limited; New Delhi (India), ISBN-978-81-203-1492-4

Reference Books:

1. Fundamentals of Industrial Drives; B. N. Sarkar; Prentice Hall of India Private Limited; New Delhi (India)
2. Industrial Electronics: Circuits, Instrument and Control Technique Terry Bartlet; 2006; (INDIA EDITION); Cengage Learning India PVT LTD; Delhi (India)

Online Reference:

1. https://nptel.ac.in/courses/108108077/35
2. https://nptel.ac.in/courses/108104011/2
3. https://youtube.com/playlist?list=PLRLTfp5JUl6SRefy1tSAtYkC8fDP9uk8B&si=mgyQniBh6qHwddPA

IA / VSC/P/227: Variable Frequency Drives Lab

Total Credits : 01

Total Contact Hours : 30 Hrs | Maximum Marks : 25

Learning Objectives of the Course:

1. To acquire practical skills in installing, wiring, and configuring a variable frequency drive (VFD) for motor control applications.
2. To develop the ability to operate and troubleshoot a VFD using digital keypads, external terminals, and various control modes.

Course Outcomes (COs):

On completion of this course, students should be able to –

1. Install, wire, and configure a variable frequency drive (VFD) by setting motor parameters and performing a trial run using digital keypad controls.
2. Operate and control motor speed using VFD through keypad potentiometer, external terminals, and NPN/PNP 2-wire/3-wire configurations.

CO-PO-PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

At least four experiments have to be performed

1. Reading Motor Nameplate and Specifications
2. Installation of Variable Frequency Drive (VFD)
3. Power and Control Wiring for VFD
4. Operation of VFD Using Digital Keypad
5. Resetting VFD to Factory Default Settings
6. Configuration of Motor-Related Parameters in VFD
7. Trial Run of VFD Using Digital Keypad Controls
8. Speed Control of Motor Using Keypad Potentiometer
9. Operation of VFD Using External Terminals
10. NPN/PNP 2-Wire and 3-Wire Control Modes
11. Controlling Motor Speed with VFD

IA/DSC/T/250 : Fundamentals of Flexible Manufacturing System

Total Credits : 02 **Total Contact Hours : 30 Hrs**
Maximum Marks : 50

Learning Objectives of the Course:

To provide students with:

1. Basic understanding of manufacturing concepts, processes, and materials.
2. Knowledge of components and classification of manufacturing systems.
3. Understanding of FMS and CIM concepts, layouts, and applications.
4. Awareness of automation principles, safety practices, and modern manufacturing innovations.

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Describe key manufacturing processes, production systems, and safety measures.
2. Identify major components and classifications of manufacturing systems.
3. Explain the structure, operation, and benefits of FMS.
4. Analyze automation strategies and evaluate flexibility and technological improvements in manufacturing.

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H
CO4	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	Foundations of Manufacturing and Production Systems Introduction to Manufacturing, Materials in Manufacturing, Manufacturing Processes, Production Systems, Manufacturing Economics, Basic Safety measures; Manufacturing Processes; Production systems, automation in production systems, automation principle and strategies, manufacturing industries and products, manufacturing operations, production facilities;	10 Hrs
II	Components and Classification of Manufacturing Systems Components of manufacturing systems: production machines, material handling systems, computer handling system, human resources; Classification Scheme for Manufacturing Systems	10 Hrs
III	Flexible Manufacturing Systems (FMS) and Computer-Integrated Manufacturing (CIM) Introduction and definition of FMS; Basic components of FMS; Types of FMS and FMS layouts; Factors influencing FMS layouts; Benefits of flexibility; Objectives and aims of FMS; Advantages and disadvantages of FMS implementation; Industrial applications of FMS; Equipment required for FMS and their functions; Innovations advancing manufacturing;	10 Hrs

Text Books:

1. Mikell P Groover, 'Automated Production Systems, and computer integrated manufacturing', Third Edition, Pearson Education, Inc. 2016, ISBN-978-93-325-4981-4.
2. Fundamentals of Modern Manufacturing - Materials, Processes, and Systems: Mikell P.Groover; Wiley; ISBN: 9781118231463

Reference Books:

1. Mikell P Groover, 'Fundamentals of Modern Manufacturing: Materials, processes and systems', Fifth Edition, Wiley. 2012, ISBN-978-11-183-9367-3
2. K.K. Shivanand, M.M.Benal,V.Koti, 'Flexible Manufacturing System', New age Publishers, ISBN-10 : 8122418708, ISBN-13 : 978-8122418705
3. S. Kant Vajpayee, ' Principles of Computer-Integrated Manufacturing', PHI Learning Private Limited, 2015, ISBN-978-81-203-1476-4

Online Reference:

1. https://nptel.ac.in/courses/110105155
2. https://nptel.ac.in/courses/110106044
3. https://nptel.ac.in/courses/112104289

IADSCP276: Fundamentals of Flexible Manufacturing Systems Lab

Total Credits : 02 **Total Contact Hours : 60 Hrs**

Maximum Marks : 50

Learning Objectives of the Course:

1. To provide students hands-on experience with flexible color-sorting and material-sorting stations.
2. To train students in operating linear transport stations for controlled movement of parts.
3. To enable students to perform multi-parameter sorting (shape, material, color) at varying difficulty levels.

Course Outcomes (COs) :

On completion of this course, students should be able to –

1. Identify and operate key components of a flexible color-sorting station.
2. Perform linear transport operations for organized part handling.
3. Sort products based on shape, material, and color, including combined complex sorting tasks.

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	**H**	**H**	**H**	**H**									**H**	**M**	**M**	
CO2	**H**	**H**	**H**	**H**									**H**	**M**	**M**	
CO3	**H**	**H**	**H**	**H**									**H**	**M**	**M**	

At least six experiments have to be performed

1. Study of different parts of a flexible color sorting station
2. Experiment with retrieval of modular workpieces from cartridge assembly
3. Experiment with linear transport station
4. Sorting of finished products on basis of their shape/ contour.
5. Sorting of finished products on basis of their material of construction
6. Sorting of finished products on basis of their colour
7. Experiments with combining 2 to 6 at different difficulty levels
8. Logic implementation for Bottle Filling Application
9. Study with Linear transport and material station (Linear movement of Object and sequential/batch wise placing)
10. Study pick and place Robot on Rotating station.
11. Programming of Robot as in for pick and place operation
12. Study of Cartesian robot customized for AS/RS.
13. Programming of a Cartesian robot for AS Operation.
14. Programming of a Cartesian robot for Retrieval Operation.
15. Study of Virtual Simulation Software's for FMS.

Virtual Simulation Software like FlexSim, Visual Components etc can be used for experimentation purpose and experiments can be performed

IA/DSC/T/251 : Fundamentals of Industrial Robotics

Total Credits : 02 **Total Contact Hours : 30 Hrs**

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with:

1. Basic knowledge of industrial manipulators and work-cell components.
2. Understanding of coordinate frames and simple kinematics for positioning.
3. Familiarity with robot programming principles and teach pendant operation.
4. Awareness of safety measures and industrial applications of robots.

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Describe basic attributes of industrial manipulators.
2. Apply coordinate transformations and basic forward kinematics to determine the end-effector position.
3. Demonstrate understanding of robot programming and safe operation.
4. Identify key industrial applications and perform basic preventive maintenance checks.

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H
CO4	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Introduction to Robotics and Robot Anatomy** Evolution and Classification of Robots; Industrial Manipulator Components; Joints, Links, DOF, Work Cell and Work Volume; Sensors and Actuators – overview; Safety protocols while operating manipulators; Applications overview.	**10 Hrs**
II	**Robot Kinematics and Coordinate Systems** Robot Coordinate Frames; Homogeneous Transformations; Simple 2–3 DOF Forward Kinematics; Inverse Kinematics Concept (qualitative); Specifications of Robots; Basic Robot Motions and Path Concept.	**10 Hrs**
III	**Robot Programming and Industrial Applications** Teach Pendant Operation, Motion Commands, Speed Control, Wait/Loop Functions; Safety Interlocks; Maintenance Practices; Industrial Use Cases – Pick & Place, Welding, Assembly; Case Discussions.	**10 Hrs**

Text Books:

1. M.P. Groover, M. Weiss, R. N. Nagel, N. G. Odrey, 'Industrial Robotics: Technology. Programming and Applications', Second Edition; Tata McGraw Hill Education, 2012
2. S. K. Saha, 'Introduction to Robotics', Third Edition;Tata McGraw Hill Education, 2024

Reference Books:

1. R. K.Mittal, I. J. Nagrath,' Robotics and Control', First Indian Edition; Tata McGraw Hill Education, 2012
2. M. R. Miller & R. Miller,' Robots and Robotics: Principles, Systems, and Industrial Applications' First Edition; McGraw Hill Education, 2017
3. K. M. Lynch & F. C. Park,' Modern Robotics: Mechanics, Planning, and Control' First Edition; Cambridge University Press, 2017.

Online Reference:

1. https://nptel.ac.in/courses/122106025
2. ABB RobotStudio: https://new.abb.com/products/robotics/robotstudio/downloads
3. https://robodk.com/

IA/DSC/P/277: Fundamentals of Industrial Robotics Lab

Total Credits : 02 **Total Contact Hours : 60 Hrs**

Maximum Marks : 50

Learning Objectives of the Course:

1. To provide students with an understanding of the fundamentals of position, speed, and servo control in robotics.
2. Operating and programming industrial six-axis articulated robots safely for basic operations.
3. Performing simple automated motion programs.

Course Outcomes (COs) :

On completion of this course, students should be able to –

1. Demonstrate position and speed control of DC, stepper, and servo systems.
2. Operate a six-axis industrial robot safely using teach pendant and coordinate modes.
3. Develop and execute robot programs for joint, linear, and circular motion paths.

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H									H	M	M	
CO2	H	H	H	H									H	M	M	
CO3	H	H	H	H									H	M	M	

At least six experiments have to be performed

1. Study of position control for different angular position commands.
2. Study of effect of forward gain on position control performance.
3. Study of speed and load characteristics of a DC motor in open-loop and closed-loop configuration.
4. Study of operation and control of a stepper motor.
5. Study and programming of an AC servo motor for controlled operation.
6. Familiarization with teach pendant of an industrial six-axis articulated robot.
7. Zeroing and jogging of industrial six-axis articulated robot (Axis and World Coordinate Modes).
8. Programming of robot for Joint and Linear motion.
9. Programming of robot for Circular motion and Tool Centre Point (TCP) calibration.
10. Programming of robot I/O channels and execution of a simple sequence task.

Mini Project (Mandatory):

Title: Development of a Robotic Pick-and-Place System (Physical or Simulated)

Objective: To integrate motion, I/O, and safety knowledge by designing a small automation task using either an actual industrial robot/ miniature servo platform/a simulation environment such as ABB RobotStudio, RoboDK, Fanuc ROBOGUIDE, or CoppeliaSim.

Expected Deliverables: Project report, Demonstration of motion and logic

IA/SEC/T/250 : Internet Of Things

Total Credits : 01 **Total Contact Hours : 15 Hrs**

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with:

1.To introduce students with building blocks of Internet of Things (IoT) and their characteristics.

2. To provide students with basic knowledge of connectivity technologies employed across IOT domain

3. To acquaint students with basic traits of IOT based system design

Course Outcomes (COs) :

On completion of the course, students should be able to -

1.Describe the basic connectivity technologies in IOT

2. Compare physical and logical design of IOT, IOT model specifications

3. Explain role of IOT in industry, agriculture and other sectors

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Foundation of IOT** Origin of terminology, IOT market share, evolution of connected devices, modern day IOT applications, baseline technologies. IOT resulting in address crunch, connectivity terminologies, IOT network configurations; Sensors- features, classes, types, Sensorial Deviations; Actuators- types-hydraulic, pneumatic, thermal, electrical and mechanical; Basics of IOT networking: IoT Components, IoT Interdependencies	05 Hrs
II	**Connectivity Technologies** 6LoWPANs, RPL routings, RFID, MQTT, SMQTT, CoAP, XMPP, AMQP; Communication Protocols: IEEE 802. 15.4, Zigbee, 6LoWPAN, Wireless HART, Z-Wave, ISA 100, Bluetooth, NFC, RFID	05 Hrs
III	**IOT Platforms and Design Methodology** Purpose and requirement specification, process specification, domain model specification, information model specification, service specification, IoT level specification, functional view specification, operational view specification, device and component integration, application developments; Case studies	05 Hrs

Text Books:

1. A. Bahga, V. Madisetti, *Internet of Things: A Hands-On Approach*, 1st Edition, Universities Press, 2014.
2. M. Milenkovic, *Internet of Things: Concepts and System Design*, 1st Edition, Springer, 2020.

Reference Books:

1. D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, J. Henry, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases*, 1st Edition, Cisco Press, 2017.

2. S. Ziegler, R. Radócz, A. Q. Rodriguez, S. N. M. Garcia (Eds.), *Springer Handbook of Internet of Things*, 1st Edition, Springer, 2023.

3. M. Alam, K. A. Shakil, S. Khan (Eds.), *Internet of Things: Concepts and Applications*, 1st Edition, Springer, 2020.

Online Reference:

1. https://nptel.ac.in/courses/106105166

IA/SEC/P/276: Internet of Things Lab

Total Credits : 01 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

1. To provide students with an understanding of the fundamentals of IOT.
2. Operating and programming industrial IOT basic operations with ESP8266.

Course Outcomes (COs) :

On completion of this course, students should be able to –

1. Configure and program IoT boards (NodeMCU/ESP32) for basic input–output operations.
2. Interface sensors and actuators using Arduino IDE and perform real-time data acquisition.
3. Implement IoT communication using MQTT and cloud dashboards for real-time data publishing and monitoring.

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H										H	M	M	
CO2	H	H	H										H	M	M	
CO3	H	H	H										H	M	M	

At least six experiments have to be performed.

1.Study of NodeMCU / ESP32 Development Board Pin configuration,Power supply,GPIO, ADC, PWM

2.Installation and Setup of Arduino IDE Library installation, Board manager setup

3.Blink LED using IoT Board (NodeMCU/ESP32): Digital output control

4.Interface Temperature Sensor (LM35/DHT11/DHT22): Displaying temperature & humidity on Serial Monitor

5.Interfacing LDR Sensor for Light Measurement: ADC reading and LED control

6.Interfacing Ultrasonic Sensor (HC-SR04),Distance measurement

7.Interfacing Gas Sensor (MQ-2/MQ-135),Smoke / pollution detection

8.Interfacing Relay Module for AC/DC Load Control using IoT board

9.Interfacing DC Motor or Servo Motor: PWM speed control (DC) / angle control (Servo)

10.Interfacing Buzzer for Alert Notification

11.MQTT-based IOT experiment using MQTT Dashboard ,Publishing sensor data

12.IOT Virtual Labs: https://iot-amrt.vlabs.ac.in/List%20of%20experiments.html

IA/SEC/T/251 : SCADA

Total Credits : 01 **Total Contact Hours : 15 Hrs**
Maximum Marks : 50

Learning Objectives of the Course:

To provide students with:

1. fundamentals and evolution of SCADA systems and their industrial role.
2. introductory explanation of SCADA hardware, software, and communication architectures.
3. Concepts of SCADA protocols, LAN integration, and application case studies.

Course Outcomes (COs) :

On completion of the course, students should be able to -

1. Explain the evolution, structure, and essential components of SCADA systems.
2. Describe SCADA communication principles, hardware configuration, and data flow.
3. Illustrate the functions of SCADA software, protocols, and typical industry applications.

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H								H	H	H	H
CO2	H	H	H	H	H								H	H	H	H
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Introduction to SCADA Systems** Definition, Purpose and Evolution of SCADA; Concept of Telemetry and Data Acquisition; Hierarchical Structure and Components — Field Devices, RTUs, Master Stations; Comparison: SCADA vs DCS vs PLC; Smart Instruments and IEDs; Benefits of SCADA in Automation.	**05 Hrs**
II	**SCADA Hardware, Communication and Protocols** SCADA Architecture; RTU and Master Station Design; Communication Media (Landlines, Modem, Fiber, Radio, Ethernet); LAN and Internet-based SCADA; Overview of Communication Protocols — Modbus, DNP3, IEC 60870-5, CSMA/CD; Noise, Interference and Shielding Concepts.	**05 Hrs**
III	**SCADA Software, Human–Machine Interface and Applications** SCADA Software Components — I/O Server, Database, Alarm & Trend System, Reporting; HMI Design, Alarming and Display Concepts; Data Acquisition Cycle and Redundancy; Case Studies — Power Distribution, Process Industries, and Water Systems; Web-based and IoT-enabled SCADA Trends.	**05 Hrs**

Text Books:

1. David Bailey & Edwin Wright, Practical SCADA for Industry, First Edition, Elsevier / IDC Technologies, 2003.
2. Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, Fourth Edition, ISA / Toaz Publications, 2023.

Reference Books:

1. Gordon Clarke & Deon Reynders, 'Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems', First Edition, Newnes / Elsevier, 2004.
2. Frank Lamb, Industrial Automation: Hands-On Approach, McGraw-Hill Education, First Edition, 2013.

Online Reference:

1. Ignition, Siemens, and Schneider Electric SCADA Documentation.
2. https://nptel.ac.in/courses/108106022

IA/SEC/P/277- SCADA LAB

Total Credits : 01 Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

1. To provide students hands-on experience with SCADA installation, setup and configuration.
2. To provide students with first-hand experience on interfacing of SCADA to PLCs/devices, create tags, monitor/control data.
3. To equip students with basic concepts of designing HMI screens, create alarms/trends/reports, and interface I/O.

Course Outcomes (COs) :

On completion of this course, students should be able to –

1. Install and configure standard SCADA and link with PLCs/devices.
2. Create tags, HMI screens, I/O channels and real-time monitoring using Ignition.
3. Implement alarms, trends, and data logging in SCADA environment.

CO –PO – PSO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H									H	M	M	
CO2	H	H	H	H									H	M	M	
CO3	H	H	H	H									H	M	M	

At least six experiments have to be performed

1. Installation of Ignition SCADA, setup project workspace.
2. Connection of Ignition to a PLC (e.g., Siemens S7-1200 or Micrologix) and tag creation.
3. Create HMI screens: start/stop controls, status indicators, analog value display.
4. Configure alarms and event handling in Ignition SCADA.
5. Configure trend logging and historical data display.
6. Configure report generation and dashboard export.
7. Interface SCADA with digital I/O channels: read/write from PLC.
8. Interface SCADA with analog I/O and display values with graphics.
9. Develop data analytics: simple dashboards, graphs, KPI indicators in Ignition.
10. Simulated industrial control scenario: conveyor sort system or water tank system — integrate PLC, SCADA screens, alarms, I/O and logging.

Mini Project (Mandatory):

Title: Design and Implement a SCADA Monitoring & Control System for a Simulated Process
Objective: Integrate PLC (real or simulated) with Ignition SCADA; create tags, HMI screens, alarms/trends, I/O control, logging & dashboard; document the implementation and present a demo.
Deliverables: Project report, SCADA project file/screenshots, demo session.