DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

CHHATRAPATI SAMBHAJINAGAR-431004 (M.S.), INDIA

FACULTY OF SCIENCE AND TECHNOLOGY

Master of Vocation in Industrial Automation

(M. VOC. in Industrial Automation)

(2 Years Industry Embedded P.G. Program)

As Per

National Education Policy-2020

Course Structure and
Outcome based Curriculum

For University Department

Deen Dayal Upadhyay KAUSHAL Kendra

(Department with Academic Autonomy)

Effective from the Academic Year 2024-25

PREAMBLE

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.

Dr. Babasaheb Ambedkar Marathwada University proposes to offer a two years post graduate

programme in Vocation (M. 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.

Course Structure and Curriculum for
Master of Vocation (M. VOC.) in Industrial Automation
Illustrative Course and Credit Distribution Structure for
Two Years Post Graduate Programme with Multiple Entry Exit Options

Year / level	Sem.	Major subject		RM	OJT /FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year 6.0	I	3(4) +2=14	4	4	--	--	22	PG Diploma (after 3 years degree)
	II	3(4) +2=14	4	--	4	--	22	
Cum. Cr. For PG Diploma		28	08	4	4	--	44	
Exit option with Post-graduate Diploma (44 credits) after first year or two semester with completion of courses equivalent to 44 credits								
Second Year 6.5	III	3(4)+2=14	4	---	---	4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3(4)=12	4	---		6	22	
Cum. Cr. For 1 year PG Degree		26	8			10	44	
Cum. Cr. For 2 years PG Degree		54	16	4	4	10	88	
2 Years -4 sem.PG Degree (88 credits) after three year UG Degree or 1 Year -2 sem. PG Degree (44 credits) after four year UG degree								

Note- DSC - is Discipline specific Core courses and are mandatory
Major – Comprising Mandatory – based on core subjects
DSE- Discipline Specific Elective based on specialization
OJT – On-the- Job Training
FP – Field Project (Corresponding to the Major (Specialization) Subject
RP – Research Project (Corresponding to the Major (Specialization) Subject
Internship/Apprenticeship - (Corresponding to the Major (Specialization) Subject

Course and Credit Distribution Structure for
Two Years Post Graduate Programme with Multiple Entry Exit Options
Class: M. VOC. First Year Semester: First Semester Subject: Industrial Automation

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Marks		Total Credits
			TH	PR	TH	PR	MIN	MAX	
Discipline Specific Core Course (DSC) Mandatory	MIAT/MJ/500	Measurement and Transducers	2	--	2	--	20	50	14
	MIAT/MJ/501	Industrial Automation Systems	2	--	2	--	20	50	
	MIAT/MJ/502	Design of Automation Circuits	2	--	2	--	20	50	
	MIAT/MJ/503	Project Management - I	2	--	2	--	20	50	
	MIAP/MJ/504	Practical Based on MIAT/MJ/500T	--	4	--	2	20	50	
	MIAP/MJ/505	Practical Based on MIAT/MJ/501T	--	4	--	2	20	50	
	MIAP/MJ/506	Practical Based on MIAT/MJ/502T	--	4	--	2	20	50	
DSE (Choose any one from pool of Course)	MIAT/DSE/507A	Programmable Logic Controllers	2	--	2	--	20	50	4
	MIAP/DSE/507A	Practical Based on MIAT/DSE/507A	--	4	--	2	20	50	
		OR							
	MIAT/DSE/507B	Microprocessor Fundamentals	2	--	2	--	20	50	
	MIAP/DSE/507B	Practical Based on MIAT/DSE/507BT	--	4	--	2	20	50	
RM	MIAT/RM/508	Research Methodology	4	--	4	--	40	100	4
			14	16	14	8	220	550	22

Course and Credit Distribution Structure for
Two Years Post Graduate Programme with Multiple Entry Exit Options
Class: M. VOC. First Year Semester: Second Semester Subject: Industrial Automation

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Marks		Total Credits
			TH	PR	TH	PR	MIN	MAX	
Discipline Specific Core Course (DSC) Mandatory	MIAT/MJ/550	Robotics for Industrial Automation	2	--	2	--	20	50	14
	MIAT/MJ/551	Embedded Systems	2	--	2	--	20	50	
	MIAT/MJ/552	Manufacturing Systems	2	--	2	--	20	50	
	MIAT/MJ/553	Project Management - II	2	--	2	--	20	50	
	MIAP/MJ/554	Practical Based on MIAT/MJ/550	--	4	--	2	20	50	
	MIAP/MJ/555	Practical Based on MIAT/MJ/551	--	4	--	2	20	50	
	MIAP/MJ/556	Practical Based on MIAT/MJ/552	--	4	--	2	20	50	
DSE (Choose any one from pool of Course)	MIAT/DSE/557A	Industry 4.0	2	--	2	--	20	50	4
	MIAP/DSE/557A	Practical/Case Study Based on MIAT/DSE/557AT	--	4	--	2	20	50	
	OR								
	MIAT/DSE/557B	Computer Integrated Manufacturing	2	--	2	--	20	50	
	MIAP/DSE/557B	Practical/ Case Study Based on MIAT/DSE/557BT	--	4	--	2	20	50	
OJT/FIELD PROJECT	MIA/OJT/FP/558 (Field Project)		4	--	4	--	40	100	4
			14	16	14	8	220	550	22

Course and Credit Distribution Structure for
Two Years Post Graduate Programme with Multiple Entry Exit Options
Class: M. VOC. Second Year Semester: Third Semester Subject: Industrial Automation

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Discipline Specific Core Course (DSC) Mandatory	MIAT/MJ/600	Industrial Measurements	2	--	2	--	14
	MIAT/MJ/601	Fluid Power Systems – I	2	--	2	--	
	MIAT/MJ/602	Fluid Power systems - II	2	--	2	--	
	MIAT/MJ/603	Control Systems for Industrial Automation	2	--	2	--	
	MIAP/MJ/604	Practical Based on MIAT/MJ/600	--	4	--	2	
	MIAP/MJ/605	Practical Based on MIAT/MJ/601	--	4	--	2	
	MIAP/MJ/606	Practical Based on MIAT/MJ/602	--	4	--	2	
DSE (Choose any one from pool of Course)	MIAT/DSE/607A MIAP/DSE/607A	Industrial Communication Practical Based on MIAT/DSE/607A	2	4	2	2	4
	OR						
	MIAT/DSE/607B MIAP/DSE/607B	Operations Management - I Practical/Case Study Based on MIAT/DSE/607B	2	4	2	2	
RP - 1	MIA/RP-1/608	Research Project/Phase – I	--	8	--	4	4
			10	24	10	12	22
OR							
MIA/OJT/FP/609 - I			To be carried out in Relevant Industry				22

Course and Credit Distribution Structure for
Two Years Post Graduate Programme with Multiple Entry Exit Options
Class: M. VOC. Second Year Semester: Fourth Semester Subject: Industrial Automation

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Discipline Specific Core Course (DSC) Mandatory	MIAT/MJ/650	SCADA and HMI	2	--	2	--	14
	MIAT/MJ/651	Cellular Manufacturing	2	--	2	--	
	MIAT/MJ/652	Python Programming for Automation	2	--	2	--	
	MIAP/MJ/654	Practical Based on MIAT/MJ/650	--	4	--	2	
	MIAP/MJ/655	Practical Based on MIAT/MJ/651	--	4	--	2	
	MIAP/MJ/656	Practical Based on MIAT/MJ/652	--	4	--	2	
DSE (Choose any one from pool of Course)	MIAT/DSE/657A MIAP/DSE/657A	Electric Vehicles Practical Based on MIAT/DSE/657A	2	4	2	2	4
	OR						
	MIAT/DSE/657B MIAP/DSE/657B	Operations Management - II Practical/Case Study Based on MIAT/DSE/608A	2	4	2	2	
RP - 1	MIA/RP-1/658	Research Project/Phase – II	--	8	--	4	4
			10	24	10	12	22
OR							
MIA/OJT/FP/659 - II			To be carried out in Relevant Industry				22

Vision

To Foster an Academic Environment for providing affordable skill based education and training, in alignment to National Standards, under the fundamental aegis of Accessibility, Equity and Inclusion

Mission

- To continue with our responsive standpoint towards changing occupational demands by continuous augmentation of training expertise and infrastructure through industry-academia cooperative ecosystem

- To structure a concrete mechanism to reach closer to student fraternity to ensure inclusion of the truly needed part of society where affordable and quality skill-education defines the pivot for a socio-economic revolution

- To expand training domains to address challenges of multidisciplinary format of employment and entreprenurial opportunities

- To come up with Open Distance Learning (ODL) models to improve accessibility of skill education and facilitate lifelong learning

- To continuously strive for a cohesive academic atmosphere that aids in gaining cognitive skills through enhanced experiential learning and to come up with strategic formative assessment to address outcome challenges at individual level

Program Educational Objectives:

The objectives of M.Voc (Industrial Automation) program are to produce graduates who -

1. Are equipped with time advanced knowledge of mechatronics and electronics to address multi-disciplinary demand of automated manufacturing, and process in modern industries in capacity of productive Senior System Developers, Senior System Integrators and Plant Supervisors.

2. Have an acute knowledge base to practice industrial automation in the areas of robotics, manufacturing, and process control in industry and Government settings meeting the growth expectations of stakeholders.

3. Have an ability to pursue higher studies and succeed in academic and professional Careers.

4. Have the ability to address professional demands individually and as a team member communicating effectively in technical environment using modern tools.

5. Recognize the need for and possess the ability to engage in lifelong learning.

6. Should be sensitive to consequences of their work both ethically and professionally for productive professional career.

Program Outcomes (PO):

Vocational Education is education that prepares the students for specific trades, crafts and career sat various levels and scopes. It trains the students from a trade/ craft, 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 program structure. Graduates of the M.Voc program are expected to -

PO1. Domain knowledge: Apply advanced knowledge of the specific skill based trade for the solution of target skill sector.

PO2. Problem Analysis: 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 Development of solutions: Design / develop solutions for specific critical problems in the target skill based trade to address changing challenges put forward by market demand/ stakeholder

PO4. Conduct Investigation of complex problems: Design and conduct technology enabled experiments, analyze the resulting data and interpret the same to provide valid conclusions

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

PO6. The citizenship and society: Apply sound 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. Environment and sustainability: Apply sound understanding of impact of skill-based trade in a global, economic, environmental and societal context.

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

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

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

PO11. Project management and finance: 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. Life-long learning: Recognize the need for and have the ability to address to the changing technological demands of the target skill trade.

Program Specific Outcomes (PSO):

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

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

2. Identify complex industrial automation related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using advance concepts of electronics, electrical and 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:

Those who have completed B.Voc (Industrial Automation)/ B. Sc with Physics / B. Sc. with Electronics/ B. E./ B. Tech (Electronics/ Electronics and Telecommunication/ Instrumentation/ Electrical/ Mechanical/ Mechatronics/Industrial Automation) from any recognized Board/ Institution are eligible for registration/ admission.

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. There is Full Carry on for M.Voc i.e. irrespective of individual performance in first year; a student should be promoted to Second Year. However, for obtaining M. Voc. Degree, a student will have to complete all semesters successfully within 04 years/ 08 semesters. It also offers multiple exit/entry. Students can exit after completion of one year and can enter into the system (second 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 M. VOC. degree within a period of maximum four years / eight semesters.

Choice Based Credit System (CBCS):

The choice based credit system is going to be adopted by the University. 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 88 credits for the award of two years Master of Vocation (M.VOC) degree

Credit-to-contact hour Mapping:

(a) One Credit would mean equivalent of 15 periods of 60 minutes each 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 be strictly not allowed for appearing the semester examination of each course. Frequent absence from regular lecture/practical course may lead to disqualification from continuous assessment test (CAT) process in respective subject.

Departmental Committee:

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

Results Grievances / Redressal Committee

Grievances / redressal committee will 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:

<u>Evaluation Methods:</u>

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 02 credit 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.

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 (of 02 credits) 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)

This program will adapt Formative assessment/ Continuous Internal Assessments for each 04 credit theory course in following format –

1. **Module-wise Tests – 20 Marks (*04 tests) = 80 marks**
2. **Assignment = 20 Marks**

4. Module-wise Tests 20 Marks (*04 tests) = 80 marks

Module-wise Tests will be conducted in each theory course immediately after completion of teaching with individual module. Such tests will be of 20 marks comprising of Part A and B.

- Part A will be consisting of 05 questions having 02 marks 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 04 questions of 05 marks from module contents, from which students will have to attempt any two questions (10 Marks)

5. Assignment = 20 Marks

This will remain an individual activity and concerned faculty will have to provide assignment/tasks that will lead to incubation of critical and creative thinking ability of students.

A Semester End Examination (SEE) for a certain / all theory courses (of 04 credits) 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 100 marks consisting of Part A, Part B and Part C

- Part A will be consisting of 10 questions having 02 mark each (multiple choice questions / fill in the blanks/ answer in one sentence) as compulsory questions and it should cover entire module syllabus (20 Marks)
- Part B will contain 08 questions of 10 marks each from module contents, from which students will have to attempt any six questions. Contents of each module should contribute towards framing of 02 questions. (60 Marks)
- Part C will contain 04 compulsory short notes of 05 Marks each. Contents of each module should contribute towards framing of 01 question. (20 Marks)

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 final exit.

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 Master 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.
- 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 final exit.

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.

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

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 final exit).

Cumulative Grade Card

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

SYLLABUS FOR SEMESTER - I

M.VOC. Industrial Automation

MIAT/MJ/500: Measurement and Transducers

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 calibration
2. Operational Concepts of signal transduction

Course Outcomes (COs) :

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

1. Relate the foundation elements of measurement science
2. Evaluate transduction concepts in non-electrical domain
3. Evaluate transduction concepts in electrical domain

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	**Measurement, Instrument and Calibration** Concept of measurement, instrument and instrumentation, Classification of transducers, Performance Characteristics (Static & Dynamic), Errors in measurement, Calibration and Standards, Flowsheet Symbols	**10 Hrs**
II	**Mechanical Transducers** Temperature, Pressure, Force, Torque, Liquid Level, Flow (Basic Principle and System Examples), Gyroscope	**10 Hrs**
III	**Electrical Transducers** Passive Electrical Transducers (Resistive, Inductive, Capacitive), Active Electrical Transducers (Thermoelectric, Piezoelectric, Electromechanical, Photo electric, Electrochemical)	**10 Hrs**

Text Books:

- D.V.S. Murty, " Transducers and Instrumentation", Second Edition, Prentice Hall of India, 2010
- D. Patranabis," Principles of Industrial Instrumentation", Second Edition, Tata McGraw Hill Publishing Co. Ltd; 2008

Reference Books:

- J. A. Blackburn,"Modern Instrumentation for Scientists and Engineers", First Edition, Springer Verlag, 2012
- D. Helfrick, W.D. Cooper," Modern Electronic Instrumentation And Measurement Techniques", Third Edition, Prentice Hall of India, 1992
- G. Liptak," Process Measurement and Analysis", Fourth Edition, CRC Press, 2003

Online Reference:

- https://archive.nptel.ac.in/courses/112/107/112107242/
- https://archive.nptel.ac.in/courses/108/105/108105153/

MIAT/MJ/501: Industrial Automation Systems

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Fundamental ideas on automation techniques for manufacturing and process industries
2. Outline of various control techniques employed in manufacturing and process automation

Course Outcomes (COs) :

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

1. Relate the foundation elements of manufacturing automation
2. Relate the foundation elements of process automation operation
3. Get familiar with communication technologies employed in industrial automation

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
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Introductory Concepts** The Industrial Control System; Automation and Process Control; Purpose of Industrial Automation; Industrial Automation Circuits; Computer-Based Industrial Control and Automation	**10 Hrs**
II	**Automation in Manufacturing Industries** Introduction- Automation in production system, Principles and strategies of automation, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms, Analysis of transfer lines without storage, Automated flow lines with storage buffers. Automated Manufacturing Systems-Components, Classification and overview of manufacturing systems, Cellular manufacturing, Flexible manufacturing system (FMS), FMS and its planning and implementation, Automated assembly system – design and types of automated assembly systems, Analysis of multi station and single station assembly machine.	**10 Hrs**
III	**Automation in Process Industries** Introduction to computer based industrial automation- Direct Digital Control (DDC), PLC based Control, Distributed Control System (DCS) and supervisory control and data acquisition (SCADA) based architectures. SCADA for process industries includes understanding of RTUs, Distributed Control System- Local Control Unit (LCU) architecture, LCU Process Interfacing Issues, Block diagram and Overview of different LCU security design approaches, Networking of DCS. Introduction to communication protocols- Profibus, Field bus, HART protocols.	**10 Hrs**

Text Books:

- M.P.Groover,"Automation, Production Systems and Computer Integrated Manufacturing", 5 th Edition, Pearson Education, 2009.
- Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011.

Reference Books:

- Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International, 2013.
- Lukas M.P, " Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
- N. Viswanandham, Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", st Edition, 2009.

Online Reference:

- https://nptel.ac.in/courses/112103174
- https://nptel.ac.in/courses/112104288
- https://nptel.ac.in/courses/112103293

MIAT/MJ/502 : Design of Automation Circuits

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with -

1. Operational sense of automated circuits
2. Step-wise conceptual development of automated circuits for real time operations

Course Outcomes (COs) :

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

1. Identify necessary automation circuit to address a real time application
2. Develop automation circuits following standard regulations
3. Implement postulates of Boolean algebra to develop automation circuits 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
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Industrial Automation Synthesis – I** Latch Principle, Principle of Command, Basic Automation Circuit Case Studies; Electrical and Mechanical Latch	**10 Hrs**
II	**Industrial Automation Synthesis – II** Automation circuits with sensors, Automation circuit design regulations, Implementation of Automation Circuits; Applications	**10 Hrs**
III	**Logical Design of Automation circuits** Introductory concepts, Boolean Logic Components, State Diagrams, Applications	**10 Hrs**

Text Books:

- Stamatios Manesis, George Nikolakopoulos, “Introduction to Industrial Automation”, Taylor and Francis, 2018
- Frank D. Petruzella,”Programmable Logic Controllers”, Fourth Edition, Mc Graw Hill, 2011

Reference Books:

- Raj Kamal,” Digital Systems: Principles and Design”, First Edition, Pearson, 2014
- Charles H. Roth, Jr. Charles Roth.”Fundamentals of Logic Design”, Seventh Edition, Cengage India, 2015

Online Reference:

- https://archive.nptel.ac.in/courses/108/105/108105132/

MIAT/MJ/503 : Project Management - I

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

Hrs Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Basics knowledge of project management, types of organization
2. Understanding of project life cycle, market and demand analysis

Course Outcomes (COs) :

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

1. Recognize essential skill-set for careers in industry and entrepreneurial domain
2. Demonstrate basic traits of manage projects at every strata of profession
3. Undertake a project in the near future and seeking to learn and apply essential project management knowledge and skills.

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				
CO2						H	H	H	H	H	H	H				
CO3						H	H	H	H	H	H	H				

Module No.	Course Content	Contact Hours
I	Introduction of Project Management, Project Success, Types of Structure Organizations, Project Management Office, Stakeholders Management	10 Hrs
II	Types of Projects and Project Life Cycle, Project Life Cycle Phases & Project Appraisal, Methods of Project Selection, Market and Demand Analysis	10 Hrs
III	Financial Analysis, Capital Budgeting Techniques, Risk Management, Stand Alone Risk Analysis, Hillier Model, Simulation Analysis, Product Mix and Plant Capacity Analysis	10 Hrs

Text Books:

- Fundamentals of Quality Control and Improvement by Mitra, Amitava; Wiley India Pvt Ltd, ISBN- 9781118491645

Reference Books:

- The certified six sigma Green Belt Handbook,by Roderick A. Munro and Govindarajan Ramu and Daniel J. Zrymiak,; ASQ Quality Press and Infotech Standards India Pvt. Ltd. , ISBN-978087389891:
- The Certified Six Sigma Black Belt Handbook by T. M. Kubiak and Donald W. Benbow; Pearson Publication, ISBN- 9788131728697

Online Reference:

https://nptel.ac.in/courses/110105167

MIAP/MJ/504 : Practical based on MIAT/MJ/500

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

Maximum Marks : 50

Learning Objectives of the Course:

1. To provide students with practical concept of calibration
2. To equip students with conceptual realization of investigating characteristics of basic transduction platforms

Course Outcomes (COs) :

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

1. Develop basic idea calibration procedure
2. Set up experimental platform to investigate transduction behavior of selected devices
3. Recognize art of field level wiring of transducers

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 five experiments have to be performed

1. Calibration of resistive transducer for measurement of – (i) Linear Displacement and (ii) Angular Displacement
2. Calibration of an Ultrasonic Trans-receiver Unit for Distance Measurement
3. Measurement of level in a tank using capacitive type level probe
4. Calibration of capacitive level transducer
5. Calibration of a variable area flowmeter
6. Study of Thermocouple Characteristics
7. Study of RTD characteristics
8. Study of Temperature Transmitter Characteristics
9. Study of Photoconductive Sensor Characteristics
10. Study of Pressure Transducer Characteristics
11. Characterization of LVDT
12. Design an orifice plate for a typical application
13. Characterization of strain gauge sensor

(Experiments can be performed on Virtual Lab Platform, an MoE, Govt. Of India initiative)

MIAP/MJ/505 : Practical based on MIAT/MJ/501

Total Credits : 02 Total Contact Hours : 60 Hrs Maximum

Marks : 50

Learning Objectives of the Course:

1. To equip students with functional concepts of operational blocks on Industrial Automation systems
2. To introduce students to operational diversity of real time automation challenges

Course Outcomes (COs) :

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

1. Develop basic operational knowledge of automated systems
2. Identify systems requirements for an automated system
3. Develop strategies for logic design with automation components

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 five experiments have to be performed

1. Simulate analog and digital function blocks
2. Study, understand and perform experiments on timers and counters
3. Logic implementation for traffic Control Application
4. Logic implementation for Bottle Filling Application
5. Tune PID controller for heat exchanger using DCS
6. FBD for autoclavable laboratory fermenter
7. Develop graphical user interface for the fermenter plant
8. Study of hardware and software platforms for DCS

(Experiments can be performed on Virtual Lab Platform, an MoE, Govt. Of India initiative)

MIAP/MJ/506 : Practical based on MIAT/MJ/502

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

Maximum Marks : 50

Learning Objectives of the Course:

1. To develop logic building concepts among students to address real time operational challenges
2. To empower students with solid state digital electronic solutions for automation related applications

Course Outcomes (COs) :

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

1. Develop basic operational logic for automated systems
2. Identify fragmental blocks of a complex operation towards developing logic based solutions

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 five experiments have to be performed

1. Study of Basic Latch Operation
2. Study of Industrial Timer for ON DELAY Operation and OFF DELAY Operation
3. Implementation of Motor Start/ Stop and Inversion Circuit
4. Implementation of Star Delta Circuit
5. Washing machine control using basic AND and NOT gates
6. Basics of OR gate and its application in industrial control
7. Basics of NOT gate and its application in an eight bit ones complement circuit
8. Basic NOT gate and its application in fuel level indicator
9. Seat belt warning system using basic AND and NOT gates
10. Basics of AND gate and its application in car wiper control
11. Water level control using basic AND and NOT gates
12. Electronic lock using basic logic gates
13. Universal NAND gate and its application in level monitoring in chemical plant
14. Universal NOR gate and its application in automobile alarm system
15. XOR gate and its application in staircase light control
16. Majority circuit using basic logic gates

(Experiments can be performed on Virtual Lab Platform, an MoE, Govt. Of India initiative)

MIAT/DSE/507A: Programmable Logic Controllers

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Operational concepts of PLC hardware
2. Programming concepts of PLCs for development of real time applications

Course Outcomes (COs) :

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

1. Recognize I/O interfacing in a wired up PLC panel
2. Develop ladder logic for digital I/O operations
3. Illustrate arithmetic and program control operations with PLCs
4. Explain Analog Operations with PLC

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
CO3	H	H	H	H	H								H	H	H	H

Module No.	Course Content	Contact Hours
I	**Introductory Concepts** Introduction to Programmable Logic Controllers; Hardware considerations; Factors to consider in selecting a PLC; Input Devices; Output Actuators; I/O Processing (I/O Address, Signal Conditioning); PLC Programming Basics - General PLC Programming Procedure; Basic I/O Programming; Internal Relays; Creating Ladder Diagram from Process Control Descriptions; PLC Timer and Counter Functions	**10 Hrs**
II	**Arithmetic and Program Control Operations** Arithmetic Functions Number Comparison Functions, Jump Functions, Data Handling Functions, SKIP and MASTER CONTROL RELAY Functions	**10 Hrs**
III	**Analog Operations** Analog PLC Operation; Types of PLC Analog Modules and Systems; PLC Analog Signal Processing; Scaling, PLC Analog Output Applications; PID Control of Continuous Processes – Introduction; PID Principles; Typical Continuous Process Control Curves; PID Modules; PID Tuning; Typical PID Functions; Industry Applications Examples	**10 Hrs**

Text Books:

- J.W. Webb, R. A. Reiss," Programmable Logic Controllers: Principles and Applications", Fifth Edition, Prentice Hall of India, 2013
- W. Bolton," Programmable Logic Controllers", Fourth Edition, Newnes (Elsevier), 2009

Reference Books:

- L. A. Bryan, E. A. Bryan," Programmable Controllers: Theory and Implementation", Second Edition, An Industrial Text Company Publication, 1997

- J. A. Rehg, G. J. Sartori," Programmable Logic Controllers", Second Edition, Pearson,2014
- F. Petruzella," Programmable Logic Controllers", Fifth Edition, Mc Graw Hill Publishing Company,2016
- M. Mitra, S. Sen Gupta," Programmable Logic Controllers and Industrial Automation: An Introduction", Penram International, 2017

Online Reference:

https://archive.nptel.ac.in/courses/108/105/108105088/

MIAP/DSE/507A : Practical based on MIAT/DSE/507A

Total Credits : 02 Total Contact Hours : 60 Hrs Maximum

Marks : 50

Learning Objectives of the Course:

1. To equip students with knowledge of PLC Hardware Interfacing to Field Devices
2. To provide PLC programming skills so that a student can develop on field solutions in digital and analog domain at different complexity level

Course Outcomes (COs) :

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

1. Recognize field level wiring with PLCs
2. Apply programming tools to develop real time applications in digital domain
3. Apply programming tools to develop real time applications in analog domain

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

At least five experiments have to be performed

1. Study of I/O wiring for a PLC installed in a control panel
2. Implementation of Basic Logic Gates in PLC Ladder Diagram (Software and Hardware)
3. Implementation of Derived Logic Gates in PLC Ladder Diagram (Software and Hardware)
4. Implementation of Latching, Interlocking, Set-Reset Coil and Memory Bit (Software and Hardware)
   Selected Problems based on – Sr. No. 2, 3, 4
5. Implementation of Timers in PLC Ladder Diagram (Software and Hardware)
6. Implementation of Counters in PLC Ladder Diagram (Software and Hardware)
   Selected Problems based on – Sr. 5, 6.
7. Implementation of Arithmetic Instructions in PLC Ladder Diagram
8. Implementation of JUMP and LABEL Instruction; use of Subroutine in PLC Ladder Diagram
   Selected Problems based on – Sr. No. 7.8
9. Study of Analog I/O operation in PLC with scaling
10. Tasks with Real Time System Interfacing

MIAT/DSE/507B: Microprocessor Fundamentals

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

Maximum Marks : 50

Learning Objectives of the Course:

1. To make students understand organization and instruction sets 8086 microprocessor
2. To make students able to interface peripheral devices with 8086 microprocessor

Course Outcomes (COs) :

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

1. Illustrate 8086 architecture and architectural support for system development & operating system.
2. Classify the addressing modes and different instruction set of 8086 microprocessor.
3. Develop simple operational program with 8086 microprocessor

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	**Introductory Concepts and Addressing Modes** Introduction : Overview of Microcomputer structure and operation, memory, input / output, CPU, address bus, data bus, control bus, 8086 microprocessor family overview, 8086 internal architecture: execution unit, (flag register, general purpose register, ALU), Bus interface unit, segment register, stack pointer register, pointer and index register, Pin out and pin functions of 8086; **Addressing Modes:** Data addressing modes: Register addressing, Immediate addressing, Direct addressing, register indirect addressing, base plus index addressing, register relative addressing, base relative plus index addressing, Programme memory addressing modes: Direct program memory addressing, relative program memory addressing, indirect program memory addressing; stack memory addressing modes.	**10 Hrs**
II	**Instruction Set – I** Data Movement Instructions: MOV revised: machine language, the opcode, MOD field, register assignments, R/M memory addressing, special addressing, PUSH/POP : PUSH, POP, initializing the stack; Miscellaneous data transfer instructions: XCHG, IN and OUT, Arithmetic and Logic Instructions: Addition, subtraction and comparison: Addition: Register addition, immediate addition, memory to register addition, array addition, increment addition, addition with carry; Subtraction: Register subtraction, immediate subtraction, decrement subtraction, subtraction with barrow; Comparison, Multiplication and division: Multiplication: 8 bit multiplication, 16 bit multiplication; Division: 8 bit division, 16 bit division; Basic Logic Instructions: AND, OR, Ex-OR, TEST, NOT, NEG; Shift	**10 Hrs**

	and Rotate: Shift: left shift, right shift; Rotate: Rotate left, rotate right	
III	**Instruction Set II and ALP** Program Control Instructions: The Jump Group: Unconditional jump: short jump, near jump, far jump, indirect jumps using an index; Conditional Jumps: LOOP, conditional LOOPs; Procedures: CALL, near CALL, far CALL, indirect memory address, RET; Machine Control and Miscellaneous Instructions: Controlling the carry flag bit, wait, HLT, NOP ; Assembly Language Programming: Assembler directives: ASSUME, DB, DD, DQ, DT, DW, END, ENDP, ENDS, EQU, EVEN, EXTRN, GLOBAL, GROUP, INCLUDE, LABEL, LENGTH, NAME, OFFSET, ORG, PROC, PTR, PUBLIC, SEGMENT, SHORT, TYPE Assembly Language Programming Examples	**10 Hrs**

Text Books:

- The Intel Microprocessors, Architecture Programming and interfacing, Barry B Brey ; Sixth Edition ; PHI
- Microprocessors and Interfacing : Programming and Hardware, Douglas V Hall : II Edition ; Tata McGraw-Hill

Reference Books:

- Microcomputer Systems : The 8086 / 8088 Family; Architecture, Programming and Design, Yu-Cheng Liu and Glenn A. Gibson ; PHI
- The 8086/8088 Family:Design, Programming and Interfacing, John Uffenbeck, PHI

Online Reference:

https://archive.nptel.ac.in/courses/108/103/108103157/

MIAP/DSE/507B : Practical based on MIAT/DSE/507B

Total Credits : 02 Total Contact Hours : 60 Hrs Maximum Marks : 50

Learning Objectives of the Course:

1. Students will be able to perform arithmetic operations (addition, subtraction, multiplication, division) and data transfer using the 8086 microprocessor.
2. Students will be

Course Outcomes (COs) :

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

1. Implement arithmetic operations using 8086 microprocessor
2. Implement data manipulation using 8086 assembly language.

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**

At least five experiments have to be performed

1. Implementation of a program to add two 8-bit and 16-bit numbers.
2. Implementation of a program to subtract two 8-bit and 16-bit numbers.
3. Implementation of a program to multiply two 8-bit and 16-bit numbers.
4. Implementation of a program to divide a 16-bit number with an 8-bit number, 32-bit number by a 16-bit.

5. Implementation of a program to find the square of a given data.
6. Implementation of a program to find the square root of a given data.
7. Implementation of a program to calculate the sum of a series of 16-bit numbers
8. Implementation of a program to find largest number from a given array .
9. Implementation of a program to find smallest number from a given array .
10. Implementation of a program to perform factorial operation.

MIAT/RM/508: Research Methodology

Total Credits : 04 **Total Contact Hours : 60 Hrs**

Maximum Marks : 100

Learning Objectives of the Course:

The intent of the course is to make students aware of the details associated with formal research and to help students overcome common misconceptions that may be present in their minds. By going through this course, students are likely to be able to take up research activities in a more systematic and formal manner right from the beginning.

Course Outcomes (COs) :

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

1. Define research and describe the research process and research methods
2. Relate basic aspects of the research process in order to plan and execute a research work
3. Demonstrate a good understanding of how to write a research / technical report

CO –PO – PSO Articulation Matrix

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

Module No.	Course Content	Contact Hours
I	**Perception of Research and Problem Identification** Research – Definition, Characteristics, Function, Objective, Classification; Action Research; Problem – Reflective and Scientific Thinking, Identification of Problem, Sources, Criteria for selection of problem, Definition of Problem, Characteristics of Problem, Evaluation of Problem; Research Proposal Structure	**15 Hrs**
II	**Literature Review and Hypothesis** Literature Review – Need, Objectives, Principles, Procedure, Sources, Functions; Standards of conducting research literature; Reporting; Hypothesis- Contrast of Assumption, Postulate and Hypothesis; Nature, Function, Classification; Characteristics of good hypothesis, Formulating and Testing of Hypothesis, Criteria for Hypothesis evaluation	**15 Hrs**
III	**Research Design and Method** Characteristics of good research design, Concept of sampling; Types of Research Methods; Experimental method, Case Study method; DOE concepts, Tools for Research	**15 Hrs**
IV	**Presentation of Research Outcome** Fundamentals of Data Collection and Analysis; Writing a Research Report; Writing a Research Paper; Ethical Issues; Case Studies	**15 Hrs**

Text Books:

- C.R. Kothari, Gaurav Garg, “Research Methodology” Fourth Edition, New Age International, 2019
- Y. K. Singh,”Fundamental of Research Methodology and Statistics”, Fourth Edition, New Age International, 2006

Reference Books:

- Phyllis G. Supino, Jeffrey S. Borer, “Principles of Research Methodology” Springer Verlag
- John W. Creswell, “Research Design Qualitative, Quantitative. and Mixed Methods Approaches”, SAGE
- Angelika Hofmann, “ Scientific Writing and Communication”, Oxford University Press
- Joshua Schimel, “Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded”, Oxford University Press
- A.Yavuz Oruc, “Handbook of Scientific Proposal Writing”, CRC Press, Taylor & Francis group

Online Reference:

- https://archive.nptel.ac.in/courses/121/106/121106007/
- https://archive.nptel.ac.in/courses/127/106/127106227/

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR-431004 (M.S.), INDIA

FACULTY OF SCIENCE AND TECHNOLOGY

Master of Vocation in Industrial Automation

(M. VOC. in Industrial Automation)

(2 Years Industry Embedded P.G. Program)

As Per

National Education Policy-2020

Course Structure and
Outcome based Curriculum

For University Department

Deen Dayal Upadhyay KAUSHAL Kendra
(Department with Academic Autonomy)

Effective from the Academic Year 2024-25

SYLLABUS FOR SEMESTER - II

M.VOC. Industrial Automation

Course and Credit Distribution Structure
for
Two Years Post Graduate Programme
M. VOC. First Year Semester: Second Semester
Subject: Industrial Automation

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Marks		Total Credits
			TH	PR	TH	PR	MIN	MAX	
Discipline Specific Core Course (DSC) Mandatory	MIAT/MJ/550	Robotics for Industrial Automation	2	--	2	--	20	50	14
	MIAT/MJ/551	Embedded Systems	2	--	2	--	20	50	
	MIAT/MJ/552	Manufacturing Systems	2	--	2	--	20	50	
	MIAT/MJ/553	Project Management - II	2	--	2	--	20	50	
	MIAP/MJ/554	Practical Based on MIAT/MJ/550	--	4	--	2	20	50	
	MIAP/MJ/555	Practical Based on MIAT/MJ/551	--	4	--	2	20	50	
	MIAP/MJ/556	Practical Based on MIAT/MJ/552	--	4	--	2	20	50	
DSE (Choose any one from pool of Course)	MIAT/DSE/557A	Industry 4.0	2	--	2	--	20	50	4
	MIAP/DSE/557A	Practical/Case Study Based on MIAT/DSE/557AT	--	4	--	2	20	50	
	OR								
	MIAT/DSE/557B	Computer Integrated Manufacturing	2	--	2	--	20	50	
	MIAP/DSE/557B	Practical/ Case Study Based on MIAT/DSE/557BT	--	4	--	2	20	50	
OJT/FIELD PROJECT	MIA/OJT/FP/558 (Field Project)		4	--	4	--	40	100	4
			14	16	14	8	220	550	22

MIAT/MJ/550: Robotics for Industrial Automation

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Fundamental concepts of industrial robots
2. Operational framework of robots in industrial automation

Course Outcomes (COs) :

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

1. Explain foundational concepts on industrial robots and its peripherals
2. Analyze robot motion in world space
3. Evaluate application domains of industrial robots

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	H
CO2	H	H	H		H			M					H	H	H	H
CO3	H	H	H		H			M					H	H	H	H

Module No.	Course Content	Contact Hours
I	**Fundamental Concepts** Robotics in industrial automation framework, Definition and laws of robotics, Robot systems and anatomy, Robot classifications, Robot Control Systems, Programming methods, Specifications of industrial robots	**10 Hrs**
II	**Mathematical Foundation** Manipulator Kinematics – Forward and Inverse (2, 3 and 4 DOF manipulators), Homogenous Transformation, Kinematic Equations using homogenous transformation, Inverse Kinematics, Manipulator Path Control	**10 Hrs**
III	**Application Considerations** Approach for implementing robots, Quantitative techniques for economic performance, Safety considerations, Application case studies	**10 Hrs**

Text Books:

- S. R. Deb, S. Deb 'Robotics Technology and Flexible Automation', Second Edition, McGraw Hill (India) Private Limited, 2016
- M. P. Groover, M. Weiss, R. N. Nagel. N. G. Odrey, A. Dutta, 'Industrial Robotics-Technology, Programming and Applications' , Second Edition, Tata McGraw Hill Publishing Co. Ltd; 2012

Reference Books:

- R. K. Mittal, I. J. Nagrath, 'Robotics and Control' , 23rd Reprint, McGraw Hill Education (India) Private Limited, 2013
- S. K. Saha, 'Introduction to Robotics', Third Edition, McGraw Hill Education (India) Private Limited, 2024

- R. K. Rajput,' Robotics and Industrial Automation', Second Edition, S. Chand and Company Pvt. Ltd., 2016
- A. K. Gupta, S. K. Arora, J. R. Westcott, ' Industrial Automation and Robotics', First Edition, Mercury Learning and Information, 2017

Online Reference:

- https://archive.nptel.ac.in/courses/112/105/112105249/
- https://nptel.ac.in/courses/107106090

MIAP/MJ/554: Practical Based on MIAT/MJ/550

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Primary Exposure to design and control of robot motions
2. Operational ideas concerning positions, velocity and acceleration synthesis of basic robotic motions

Course Outcomes (COs) :

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

1. Relate geometric relation between input and output motion parameters of industrial robots
2. Recognize formation of transformation matrix
3. Verify robot position for a particular set of joint solution and joint angles
4. Develop basic program for operational motion of an industrial robot in base coordinate system

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 five experiments have to be performed

1. Study of Quick Return Mechanism.
2. Study of Forward Kinematics of a Six axis Industrial Robot and Formation of Transformation Matrix
3. Study of Forward Kinematics of a Six axis Industrial Robot and Formation of Transformation Matrix
4. Performance of Offline Robot Teaching using VAL Programming for basic jogging
5. Study of a heavy payload industrial robot to identify geometric relationship between input and output motion parameters
6. Program a six axis industrial for pick and place operation of object on same plane
7. Program a six axis industrial for pick and place operation of object on orthogonal plane

(Experiments can be performed on Virtual Lab Platform, an MoE, Govt. Of India initiative)

https://mr-iitkgp.vlabs.ac.in/List%20of%20experiments.html

MIAT/MJ/551: EMBEDDED SYSTEMS

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Fundamental concepts of ARM Controller
2. Operational framework of Embedded Systems

Course Outcomes (COs):

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

1. Explain foundational concepts on ARM design philosophy
2. Study ARM instruction set.
3. Analyze Embedded system hardware and software.

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	**Fundamental Concepts of ARM processor**	**10 Hrs**
	ARM processor and its features , ARM architecture , Risc design philosophy, ARM design, ARM bus technology, AMBA Bus technology , Embedded system software	
II	**ARM Instruction set**	**10 Hrs**
	Fundamentals of ARM Instructions ,Data types, Conditional Execution, Barrel shifter with example, Classification of instructions ,Data processing Instructions, Multiply Instructions, Zero Instruction, Swap instruction, Branch Instruction, Load and Store Instruction, Multiple register , Software Interrupt Instruction.	
III	**Application and Thumb and ARM programming**	**10 Hrs**
	ARM Applications , Introduction to Thumb, Difference between ARM and Thumb, Register usage in Thumb, Structure of ARM assembly module.	

TextBooks:

- Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things by Peter Marwedel | 25 January 2021 | 4th Edition
- E. A. Lee and S. A. Seshia,. Introduction to Embedded Systems - A Cyber-Physical Systems Approach,. Second Edition, MIT Press, 2017

Reference Books:

- ARM Controller by A.P.Godse Technical publications
- Fundamentals of System-on-Chip Design on *Arm* Cortex-M *Microcontrollers* · Modern System-on-Chip Design on *Arm* · Beginner's Guide to Designing Embedded Systems ...

- A.N. Sloss, D. Symes and C. Wright, "ARM System Developer's Guide: Design and Optimizing System Software", Morgan Kaufman Publishers, 2004.

Online Reference: http://www.ietf.org/rfc/ien/ien137.txt**.**

- https://archive.nptel.ac.in/courses//
- https://nptel.ac.in/courses/107106090

MIAP/MJ/555: Practical Based on MIAT/MJ/551

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

Maximum Marks: 50

Learning Objectives of the Course:

To provide students with-

1. Primary Exposure to understand ARM
2. Introduce the outline architecture of ARM controller including basics

Course Outcomes (COs):

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

1. Students should be able to understand the main features of the ARM based Embedded System development environment.
2. After studying this course, students will be able to: Understand the instruction set of 32-bit microcontroller ARM Cortex M3, and the.
3. software tool required for programming in Assembly and C language.
4. Develop assembly language programs using ARM Cortex M3 for different 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 five experiments have to be performed

1. Study of structure of an assembly language program.
2. Study assembly directives to allocate memory in the data section.
3. Introduce the idea that ARM is a Load-Store Architecture and data has to be moved to registers before any operations can be performed on them.
4. Program to find square of number (1 to 10) using lookup table.
5. Program for, if there is a constant whose size is greater than 16 bits
6. Program for Converting a complex expression into an assembly program evaluating that expression
7. Program for Translating if-then-else statements into assembly
8. Program for Writing loops in assembly
9. Study of IDE and ARM development board usage & program execution.

(Experiments can be performed on Virtual Lab Platform, an MoE, Govt. Of India initiative)

https://cse11-iiith.vlabs.ac.in/exp/arm1/objective.html

MIAT/MJ/552: Manufacturing System

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Basic aspects of production system
2. Knowledge of management issues that must be addressed in implementation of manufacturing systems
3. Various mathematical models of production performance and manufacturing

Course Outcomes (COs) :

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

1. Explain basic dimensions of modern production systems
2. Describe mathematical models of production performance and manufacturing costs
3. Discuss classification scheme of Manufacturing Systems

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	**Production systems**	**10 Hrs**
	Production systems, automation in production systems, automation principle and strategies, manufacturing industries and products, manufacturing operations, production facilities	
II	**Mathematical models of Production performance**	**10 Hrs**
	Mathematical models of Production performance: production rate, production capacity, utilization and availability, manufacturing lead time, work in process, manufacturing costs	
III	**Manufacturing systems**	**10 Hrs**
	Components of manufacturing systems: production machines, material handling systems, computer handling system, human resources; Classification Scheme for Manufacturing Systems: types of operations performed, number of workstations, system layout, automation and manning levels, part or product variety; Overview of classification scheme: single station cells, multi-station systems with fixed routing, multi-station systems with variable routing	

Text Books:

- Mikell P Groover, 'Automated Production Systems, and computer integrated manufacturing', Third Edition, Pearson Education, Inc. 2016, ISBN-978-93-325-4981-4

- Kapil Gupta, 'Advanced Manufacturing Technologies- Modern Machining, Advanced Joining, Sustainable Manufacturing', Springer. 2017, ISBN 9783319560984; 9783319560991
- Tien-chien Chang, Richard A Wysk, Hsu-Pin Wang, 'Computer aided manufacturing", Third Edition, Pearson Education, Inc. 2019 ISBN: 978-81-317-2164-3
- A.Alavudeen, N. Venkateshwaran 'Computer aided manufacturing', PHI Learning Private Limited, 2008. ISBN: 978-81-203-3345-1

Reference Books:

- K.K. Shivanand, M.M.Benal,V.Koti, 'Flexible Manufacturing System', New age Publishers, ISBN-10 : 8122418708, ISBN-13 : 978-8122418705
- Mikell P Groover, 'Fundamentals of Modern Manufacturing: Materials, processes and systems', Fifth Edition, Wiley. 2012, ISBN-978-11-183-9367-3
- Er. R. K. Rajput 'Robotics and Industrial Automation', S. Chand and Company, 2016, ISBN: 978-81-219-2997-4
- P.N.Rao, N.K.Tewari, T.K.Kundra 'Computer aided manufacturing', Tata McGraw Hill Education Pvt. Ltd, 2017, ISBN-13: 978-0-07-463103-4 and ISBN-10:0-07-463103-9
- S. Kant Vajpayee, ' Principles of Computer-Integrated Manufacturing', PHI Learning Private Limited, 2015, ISBN-978-81-203-1476-4

Online Reference:

- https://nptel.ac.in/courses/112107077/
- https://nptel.ac.in/courses/112104028/3
- https://nptel.ac.in/courses/112107078/

MIAP/MJ/556: Practical Based on MIAT/MJ/552

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Primary Exposure to manufacturing processes
2. Operational ideas of manufacturing systems

Course Outcomes (COs) :

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

1. Recognize advance manufacturing processes
2. Verify mathematical models with respect to local industries

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 five experiments have to be performed

(Student has to perform any five experiments from sr.no. 1 to 7 OR students have to perform Experiment no 08 only by visiting the industry in person and calculate all mathematical models as per Theory course as advised by the faculty)

1. Study of stereolithography (SLA) process
2. Study of Fused Deposition Modelling (FDM) Process
3. Study of Selective Laser Sintering (Non-Metal) Process
4. Study of Selective Laser Sintering (Metal) Process
5. Study of Laminated object manufacturing Process
6. Study of Project Investment using Internal Rate of Return (IRR) method
7. Study of Project Investment using Net Present Value (NPV) and PI method
8. Study the Mathematical models with respect to Local industry

(Experiments can be performed on Virtual Lab Platform, an MoE, Govt. Of India initiative)
(Expt. 1 to 5 from https://3dp-dei.vlabs.ac.in/List%20of%20experiments.html)
(Expt. 6 to 7 from http://vlabs.iitkgp.ac.in/gs/index.html)

MIAT/MJ/553 : Project Management - II

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Basics knowledge of crashing project, risk management
2. Understanding of outsourcing negotiation

Course Outcomes (COs) :

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

1. Holistic view of project management covering among others project risk and quality management, procurement and contract management
2. Developing leadership skills and managing PM team, project performance evaluation, project audit and closure.

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**				
CO2						**H**	**H**	**H**	**H**	**H**	**H**	**H**				
CO3						**H**	**H**	**H**	**H**	**H**	**H**	**H**				

Module No.	Course Content	Contact Hours
I	**Reducing Project Duration and Managing Risks**	**10 Hrs**
	Reducing Project duration - Crashing project activities to speed up a project Project Risk Management - Identification, quantification, and mitigation of risks	
II	**Outsourcing, Negotiation, and Procurement in Projects**	**10 Hrs**
	Project Outsourcing, Negotiation, and Managing inter-organizational Relations Project Procurement and Contract Management	
III	**Project Evaluation, Performance, and Closure**	**10 Hrs**
	Project Evaluation, Project progress and Performance Management Project Closure, and Project Oversight	

Text Books:

- Fundamentals of Quality Control and Improvement by Mitra, Amitava; Wiley India Pvt Ltd, ISBN- 9781118491645
- Project Management (A Strategic Managerial Approach) by Meredith ISBN: 0471073237

Reference Books:

- The certified six sigma Green Belt Handbook,by Roderick A. Munro and Govindarajan Ramu and Daniel J. Zrymiak,; ASQ Quality Press and Infotech Standards India Pvt. Ltd. , ISBN-978087389891:
- The Certified Six Sigma Black Belt Handbook by T. M. Kubiak and Donald W. Benbow; Pearson Publication, ISBN- 9788131728697

Online Reference:

- https://nptel.ac.in/courses/110105167

MIAT/DSC/557: Industry 4.0

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

Maximum Marks: 50

Learning Objectives of the Course:

To provide students with-

1. basic idea in Industry 4.0.
2. good depth of knowledge of designing Industrial 4.0 Systems for various application.
3. design and analysis of Industry 4.0 systems for Energy and smart vehicular application

Course Outcomes(COs):

On completion of the course, student will be able to

1. Understand the basic concepts of Industry 4.0 and the other related fields.
2. Understand cyber physical system and the emerging applications.
3. Analyze the different energy storage systems

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 INDUSTRY 4.0**	**10Hrs**
	Introduction, Historical Context, General framework, Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development, Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances	
II	**Industry 4.0 and Technologies & Design Principles**	**10Hrs**
	Network Operator Requirements, IoT Platform Design Specification – Requirements, Process, Domain Model, Service, IoT Level, Function, Operational view, Device and Component Integration, Application development. File Handling, Python Packages for IoT, IoT Physical Servers – Cloud Storage Models, Communication APIs	
III	**Communication, Smart Applications**	**10Hrs**
	Protocols – MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, MQTT broker, Message types, Quality of Service (QoS), Application; OPC UA – History, Specification, Client, Server, Programming with – Free and open-source software, Propriety software; Augmented Reality; Understanding Smart	

	Appliances -Smart Operation-Smart Monitoring-Smart Energy; Savings-Smart Maintenance, Case study-Smart Cars, Self-Driving Cars, Introducing Google's Self-Driving Car, Intellectual Property Rights	

TextBooks:

- Jean-Claude André, —Industry 4.0‖, Wiley- ISTE, July 2019, ISBN: 781786304827,2019
- Diego Galar Pascual, Pasquale Daponte, Uday Kumar, —Handbook of Industry 4.0 and SMART Systems‖ Taylor and Francis,2020
- Miller M, —The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world‖, Pearson Education, 2015, ISBN: 9780134021300.

Reference Books:

- Pengwei Du and Ning Lu, —Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs ‖, Academic Press, 2018, Reprint edition, ISBN-13:978-0128100714
- Hossam A. Gabbar, —Smart Energy Grid Engineering‖, Academic Press, 2017, ISBN 978-0-12-805343-0.

Online Reference:

- http://www.mqtt.org
- https://opcfoundation.org/about/opc-technologies/opc-ua/
- https://www.profibus.com/pi-organization/about-pi/organization-communitu/
- https://www.ethercat.org/default.htm

MIAP/DSE/557A: Practical/Case Study Based on MIAT/DSE/557AT

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Impart knowledge of smart manufacturing for industry 4.0 for making student innovative.
2. Understand could-computing IoT platform for Smart Manufacturing.
3. Understand machine learning to make smart factories.
4. Understand application of hardware, communication protocol, IOT platform, machine
5. learn to implement IoT for smart manufacturing for the need of Industry 4.0.

Course Outcomes(COs):

On completion of the course, student will be able to

1. Introduce concept of Industry 4.0 for Smart Manufacturing.
2. Understand use various hardware used in Smart Manufacturing.
3. Understand need of various communication protocols. hardware and software, IoT Layers
4. and their relative importance.

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

Student has to perform either practical or case study

Practical Based on MIAT/DSE/557AT
At least five experiments have to be performed

1. Python Programming (Any three practical's/ Programs)
2. Arduino Programming, Integration of Sensors and Actuators with Arduino,
3. Raspberry Pi, Implementation of IoT with Raspberry Pi
4. Creation of Things Speak Account
5. Actuator Controlling Through Cloud
6. Dht11sensor Data To Cloud
7. Iot Based Air Pollution Control System
8. Tds Sensor Interfacing With Arduino
9. Actuator Controllingby Mobile Using Arduino

(Experiments can be performed on Virtual Lab Platform, an MoE, Govt. Of India initiative)

EXP 1- https://python-iitk.vlabs.ac.in/
EXP 2- https://ggnindia.dronacharya.info/CSE-IOT-CS/Downloads/Labmanuals/Sensors-and-Actuators-28072023.pdf
EXP 3 - https://ai.thestempedia.com/example/thinkspeak-send-data-to-cloud-dht-sensor/
EXP 5 to 9 - https://vemu.org/uploads/lecture_notes/28_12_2022_411037496.pdf

Case Study Based on MIAT/DSE/557A

Student has to make a case study on MIAT/DSE/557A in consultation with the concerned faculty.

MIAT/DSE/557B: Computer Integrated Manufacturing

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Basic traits of Computer Integrated Manufacturing
2. Introductory concepts of computer graphics and computer geometric modelling
3. Fundamental concepts of NC and CNC machines
4. Diversified spectrum of Computer Aided Manufacturing

Course Outcomes (COs) :

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

1. Recognize the diversified role of computers in modern manufacturing fabric
2. Describe basic traits of computer-based design related to manufacturing industries
3. Explain NC and CNC machines
4. Discuss different horizon of computer aided modern 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			M					H	H	H	H
CO2	H	H	H		H			M					H	H	H	H
CO3	H	H	H		H			M					H	H	H	H

Module No.	Course Content	Contact Hours
I	**Introduction to Computer Integrated Manufacturing (CIM)**	**10 Hrs**
	Introduction to CIM, Data flow in CIM, CIM wheel, Processes involved in CIM, Necessity of CIM, Advantages, CIM integration, Applications of CIM, Challenges, Subsystems in CIM, Present industry scenario	
II	**Computers and Manufacturing System**	**10 Hrs**
	Computers in manufacturing industries – Concepts of Industry 4.0, Artificial Intelligence, Machine learning, Deep learning, Digital learning, Smart manufacturing, IOT, Cloud based manufacturing; Future Prospects; Computer Graphics – Concept of design, Coordinate systems	
III	**Computer Aided Manufacturing**	**10 Hrs**
	Introduction to group technology, Benefits, Part Family, Coding systems, Limitations of GT; Process planning details, Stages of computer aided process planning stages; CAD/CAM integration; Advance manufacturing planning; Flexible Manufacturing System – Introduction, FMC/FMS components, FMS applications consideration;	

Text Books:

- Mikell P Groover, 'Automated Production Systems, and computer integrated manufacturing', Third Edition, Pearson Education, Inc. 2016, ISBN-978-93-325-4981-4
- Kapil Gupta, 'Advanced Manufacturing Technologies- Modern Machining, Advanced Joining, Sustainable Manufacturing', Springer. 2017, ISBN 9783319560984; 9783319560991

Reference Books:

- Tien-chien Chang, Richard A Wysk, Hsu-Pin Wang, 'Computer aided manufacturing', Third Edition, Pearson Education, Inc.; ISBN: 978-81-317-2164-3
- A.Alavudeen, N. Venkateshwaran 'Computer aided manufacturing', PHI Learning Private Limited, 2008. ISBN: 978-81-203-3345-1
- K.K. Shivanand, M.M.Benal, V.Koti, 'Flexible Manufacturing System', New age Publishers; ISBN-13 : 978-8122418705
- S. Kant Vajpayee, ' Principles of Computer-Integrated Manufacturing', PHI Learning Private Limited, 2015, ISBN-978-81-203-1476-4

Online Reference:

- Lectures of Professor J. Ramkumar (Department of Mechanical Engineering, IIT, Kanpur) on 'Computer Integrated Manufacturing' available with NPTEL ; https://nptel.ac.in/courses/112/104/112104289/

MIAP/DSE/557B: Practical/ Case study Based on MIAT/DSE/557B

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

Maximum Marks : 50

Learning Objectives of the Course:

To provide students with-

1. Primary Exposure to Computer Integrated Manufacturing
2. Operational ideas of CIM

Course Outcomes (COs) :

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

1. Recognize advance manufacturing processes
2. Verify mathematical models with respect to local industries

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

Student has to perform either practical or case study

Practical Based on MIAT/DSE/557B
At least five experiments have to be performed

1. Simulation of Pre-processing in Additive manufacturing
1. Simulation of Post-processing in Additive manufacturing

2. Study of 3D Printer Machine
3. To study Digital fabrication and project development
4. Digital Fabrication of flexible circuit board
5. Programming and operation of a Robot manipulator
6. Programming and operation of CNC Miling Machine
7. Machine vision-based quality control
8. Remote Monitoring and Operation of a Computer Integrated Manufacturing System
9. Modeling and Simulation of Computer Integrated Manufacturing System

(Experiments can be performed on Virtual Lab Platform, an MoE, Govt. Of India initiative)
(Expt. 1 to 5 from https://3dp-dei.vlabs.ac.in/List%20of%20experiments.html)
(Expt. 6 to 9 from http://vlabs.iitkgp.ac.in/cim/index.html#)

Case study Based on MIAT/DSE/557B

Student has to make a case study on MIAT/DSE/557B in consultation with the concerned faculty.

MIA/OJT/FP/558 (Field Project)

Total Credits : 4 **Total Contact Hours : 120 Hrs**
Maximum Marks : 100

Students have to identify an industry-relevant problem in the field of industrial automation, develop a detailed project proposal, and work on its practical implementation in an industrial environment. They must apply theoretical concepts to real-world scenarios, utilizing tools such as PLCs, SCADA, IoT, and robotics to design, analyze, and optimize automation systems. The project involves data collection, system integration, troubleshooting, and performance evaluation. Students are required to manage resources, adhere to timelines, and collaborate effectively while maintaining professional and ethical standards. The course culminates in a comprehensive technical report and a final presentation to academic and industry evaluators, showcasing their findings, innovations, and practical expertise in automation.