

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

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	
<i>Exit option with Post-graduate Diploma (44 credits) after first year or two semester with completion of courses equivalent to 44 credits</i>								
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

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 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 entrepreneurial 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 at 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:

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 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

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

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.

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

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

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	10 Hrs
	The Industrial Control System; Automation and Process Control; Purpose of Industrial Automation; Industrial Automation Circuits; Computer-Based Industrial Control and Automation	
II	Automation in Manufacturing Industries	10 Hrs
	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.	
III	Automation in Process Industries	10 Hrs
	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.	

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	10 Hrs
	Latch Principle, Principle of Command, Basic Automation Circuit Case Studies; Electrical and Mechanical Latch	
II	Industrial Automation Synthesis – II	10 Hrs
	Automation circuits with sensors, Automation circuit design regulations, Implementation of Automation Circuits; Applications	
III	Logical Design of Automation circuits	10 Hrs
	Introductory concepts, Boolean Logic Components, State Diagrams, Applications	

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	10 Hrs
	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	
II	Arithmetic and Program Control Operations	10 Hrs
	Arithmetic Functions Number Comparison Functions, Jump Functions, Data Handling Functions, SKIP and MASTER CONTROL RELAY Functions	
III	Analog Operations	10 Hrs
	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	

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	10 Hrs
	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.	
II	Instruction Set – I	10 Hrs
	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	

	and Rotate: Shift: left shift, right shift; Rotate: Rotate left, rotate right	
III	Instruction Set II and ALP	10 Hrs
	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	
Text Books:		
<ul style="list-style-type: none"> • 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:		
<ul style="list-style-type: none"> • 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:																
<ol style="list-style-type: none"> 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 –																
<ol style="list-style-type: none"> 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																
<ol style="list-style-type: none"> 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. 																

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	15 Hrs
	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	
II	Literature Review and Hypothesis	15 Hrs
	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	
III	Research Design and Method	15 Hrs
	Characteristics of good research design, Concept of sampling; Types of Research Methods; Experimental method, Case Study method; DOE concepts, Tools for Research	
IV	Presentation of Research Outcome	15 Hrs
	Fundamentals of Data Collection and Analysis; Writing a Research Report; Writing a Research Paper; Ethical Issues; Case Studies	

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/>