DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

CIRCULAR NO.SU/SYLLABUS/B.VOC./ 20/2020.

It is hereby inform to all concerned that, on recommendation of Ad-hoc Board in Vocational Studies [B.Voc.], the Hon'ble Vice-Chancellor has **accepted the revised curriculum of B. Voc. [Ist Semester] in 1] Industrial Automation and 2] Automobile under the Choice Based Credit and Grading System** in his emergency powers under Section-12[7] of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

This is effective from the Academic Year 2020-21 and Onwards under the Faculty of Science & Technology.

This curriculum is also available on the University website www.bamu.ac.in.

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

University campus,
Aurangabad-431 004.
Ref. No.SU/B.voc./syllabus./2020-21/ 27024-34
Date: 25.01.2021

Deputy Registrar,
Academic Section.

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Copy forwarded with compliments to :-

1] **The Head/Principals, Concerned Department /Colleges, Dr. Babasaheb Ambedkar Marathwada University.**
2] **The Director,** University Network & Information Centre, UNIC, with **a request to upload the curriculum along with this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation, Dr.BAMU, A'bad
2] The Concerned Section Officer, Examination Branch,
3] The Section Officer, [Eligibility Unit],
4] The Programmer [Computer Unit-1] Examinations,
5] The Programmer [Computer Unit-2] Examinations,
6] The In-charge, [E-Suvidha Kendra],
7] The Public Relation Officer,
8] The B.Voc Section,Dr.BAMU,A'bad
9] The Record Keeper,

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY AURANGABAD

COURSE STRUCTURE & CURRICULUM
BACHELOR Of VOCATIONAL

IN

Industrial Automation

I-Semester

Choice Based Credit System

Effective form the Academic Year

2020-2021 & Onwards

Approved

16/1/2021

2020-21

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (MS)

Curriculum Structure

Bachelor of Vocation

(B.Voc; INDUSTRIAL AUTOMATION)

Choice Based Credit System

(Effective from July 2020-21)

2020-21

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (MS)

Curriculum Structure

Bachelor of Vocation

(B.Voc; INDUSTRIAL AUTOMATION)

Choice Based Credit System

(Effective from July 2020-21)

Curriculum for Bachelor in Vocation (B.Voc.)

(Choice Based Credit System)

The Bachelor in Vocation programme is divided into six semesters shaving 180 credits. Each semester has courses categorized under **General Education Components** and **Skill Development Components**.

Preamble:

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad proposes to offer a three-year Bachelor programme in Vocation (B. Voc.) program which are being run University Department and various affiliated colleges. The curriculum design of this program is undertaken in the following framework-

a) Although there has been remarkable progress in all sectors of education in last couple of decades, the less regulated area of the education sector-vocational training—seems to have lost its significance/importance. This has led to the widening gap between the supply and demand for skilled manpower across various industries and R&D organizations. This shortage of skills has translated directly into unemployment among an increasing number of graduates who pass-out every year and are forced to be re-trained in order to become marketable.

   These programme are designed to produce skilled manpower so that wide variety of options in job sectors would be available and it will improve the opportunities for the unemployed youths in the country in both the private and public sectors.

b) According to a study conducted by the Associated Chambers of Commerce and Industry of India (ASSOCHAM), there will be a deficit of 40 million working professionals by the year 2020 and the employers would face the difficulty of filling positions because of the dearth of suitable talent and skilled person.

   These programme aim to provide concrete solution for these problems and would facilitate to improve:

   (i) Quality of training
   (ii) High drop-out rates
   (iii) Linkages with Universities and Industry
   (iv) Inadequacy of resources

c) These programme are intended to offer practical training and skills needed to pursue an occupation straight away. It will provide options to the students to select the courses of their choice which are directly aligned to land a job in a chosen profession or a skilled trade. One of the end results of these programme is to enable an individual to attain self-employment.

d) The curriculum is designed as per IASC and ESSCI Sector Skill Council Qualification packs.

Program Educational Objectives:

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

1. Are equipped with time relevant knowledge of mechatronics and electronics to address multi disciplinary demand of automated manufacturing, and process in modern industries in capacity of productive System Developers and System Integrators.
2. Have a broad-based background 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. Will 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 andcareers at various levels and scopes. Scope of modern fabric of vocational education builds Human resource from a trade/ craftsmanship, technician or professional position in R & D organizations.

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

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

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

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

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

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

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

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

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

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

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

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

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

Program Specific Outcomes (PSO):

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

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

2. Identify complex industrial automation related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using first principles 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 clear understanding of limitations.

Exit Options:

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

Exit Point	*Duration*	*Diploma / Degree to be Offered*
First exit	After 6 months	Certificate in Vocation
Second exit	After 1 yr.	Diploma in Vocation (D. Voc.)
Third exit	After 2 yrs.	Advanced Diploma in Vocation (Adv. D. Voc.)
Fourth exit	After 3 yrs.	Bachelor in Vocation (B. Voc.)

Eligibility:

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

Admission / Promotion Process:

Admission process will be as per University rules.

A candidate who has sought admission to Semester – I shall be admitted to Semester – II automatically. A candidate who has passed 75% of the papers at First Year (First and Second Semesters together) examinations shall be allowed to take admissions in third semester. Similarly, a candidate who has passed 75% of the papers at the Second Year (Third and Fourth Semesters together) examinations shall be allowed to take admission to the Fifth semester.

However, if a candidate has not passed the First and Second Semester examinations, he shall not be allowed to take admission to the Fifth Semester. Appearance in the First, Third and Fifth semester is compulsory to get promoted to next semester.

Choice Based Credit System (CBCS):

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

- Students will have to earn 30 credits for the award of Six Month Certificate in Vocation
- Students will have to earn 60 credits for the award of one year Diploma in Vocation (D. Voc.)
- Students will have to earn 120 credits for the award of two year Advance Diploma in Vocation (Adv. D. Voc.)
- Students will have to earn 180 credits for the award of three year Bachelor Degree in Vocation (B. Voc.)

Credit-to-contact hour Mapping:

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

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

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

Attendance:

Students must have 75 % of attendance in each course for appearing examination otherwise he / she will not be strictly allowed for appearing the examination of each course.

Departmental Committee:

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

Results Grievances / Redressal Committee

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

Evaluation Methods:

The assessment will be based on 20: 80 ratio of continuous internal assessment (CIA) and semester end examination (SEE). Performance will be decided after combining performance in CIA and SEE. In case of failure in SEE in particular course(s), exam will be conducted in immediate subsequent semester.

Continuous Internal Assessment (CIA):

For 4 credit courses-

There will be 20 marks for Continuous Internal Assessment. Two internal tests (of 20 marks each) will be conducted, after completion of 40% and 80% of the curriculum respectively.

Average performance of the two tests will be considered for final marks-memo preparation. The setting of question papers and the assessment will be done by concerned teacher.

Semester End Examination (SEE):

The semester end theory examination for each theory course of 4 credits will be of 80 marks. Therefore, the total marks shall be 100 for 4 credit theory course (80 marks semester end exam + 20 marks CIA).

Pattern of semester end question paper will be as below:

For 4 credit courses-

- The semester end examination of theory course will have two parts (20+60 = 80 Marks)
- Part A will be consisting of 10 questions having 2 marks each (multiple choice questions / fill in the blanks/ answer in one sentence) as compulsory questions and it should cover entire course syllabus (20 Marks)
- Part B will contain 05 questions of 12 marks each with equal weightage on every module. Each of these questions will have two options, from which students will have to attempt any one.
- 20 to 30% weightage can be given to problems/ numerical (wherever applicable) wherein use of non-programmable scientific calculator may be allowed.
- Number of sub questions (with allotment of marks) in a question may be decided by the examiner.

Regarding practical examinations

During each semester, student must perform at least fifteen experiments from laboratory course. Semester end practical examination will be conducted at the end of each semester.

Earning Credits:

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

Grading System:

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

Table – I : Ten point grade and grade description

Marks Obtained (%)	Grade Point	Letter Grade	Description
90-100	9.00- 10	O	Outstanding
80-89	8.00-8.99	A++	Exceptional
70-79	7.00-7.99	A	Excellent
60-69	6.00-6.99	A	Very Good
55-59	5.50-5.99	B	Good
50-54	5.00-5.49	B	Fair
45-49	4.50-4.99	C++	Average (Above)
41-44	4.1-4.49	C	Average
40	4.0	P	Pass
< 40	0.0	F	Fail (Unsatisfactory)
	0.0	AB	Absent

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

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

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

The computation of SGPA and CGPA will be as below

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

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

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

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

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

Grade Card

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

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

Cumulative Grade Card

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

Course Structure for Bachelor of Vocation (B. Voc) Industrial Automation
Deen Dayal Upadhyay KAUSHAL Kendra
WEF Academic year 2020-21

Sr. No.	Name of the Course		Contact Hours Per Week			Evaluation Scheme		Total Marks	Credit
			L	T	P	CIA	SEE		
SEMESTER – I									
General Academic Component									
1	IAVOC101	Linguistic Proficiency (English)	3	1	0	20	80	100	4
2	IAVOC 102	Analog and Digital Electronics	3	1	0	20	80	100	4
3	IAVOC 103	Electrical and Mechanical Systems	3	1	0	20	80	100	4
Skill Development Component									
4	IAVOC 104	Industrial Instrumentation	3	1	0	20	80	100	4
5	IAVOC 105	Lab Course-I	-	-	8	-	100	100	4
6	IAVOC 106	Laboratory Project-I	-	-	-	-	200	200	10
TOTAL								700	30
SEMESTER – II									
General Academic Component									
1	IAVOC201	Industrial Safety Practices	3	1	0	20	80	100	4
2	IAVOC202	PLC Fundamentals	3	1	0	20	80	100	4
3	IAVOC203	Control Panel and Wiring	3	1	0	20	80	100	4
Skill Development Component									
4	IAVOC204	Hydraulics and Pneumatics	3	1	0	20	80	100	4
5	IAVOC205	Lab Course-II	-	-	8	-	100	100	4
6	IAVOC206	Laboratory Project-II	-	-	-	-	200	200	10
							TOTAL	700	30
SEMESTER – III									
General Academic Component									
1	IAVOC301	Energy and Environment	3	1	0	20	80	100	4
2	IAVOC302	Embedded Systems	3	1	0	20	80	100	4
Elective -I (Any one among IAVOC303A and IAVOC303B)									
3A	IAVOC303A	Electrical Drives	3	1	0	20	80	100	4
3B	IAVOC303A	PC based Instrumentation	3	1	0	20	80	100	4
Skill Development Component									
Elective -II (Any one among IAVOC304A and IAVOC304B)									
4A	IAVOC304A	Process Control Fundamental	3	1	0	20	80	100	4
4B	IAVOC304B	Building Automation	3	1	0	20	80	100	4
5	IAVOC305	Lab Course-III	-	-	8	-	100	100	4
6	IAVOC306	Laboratory Project-III	-	-	-	-	200	200	10
							TOTAL	700	30

Sr. No.	Name of the Course		Contact Hours Per Week			Evaluation Scheme		Total Marks	Credit
			L	T	P	CIA	SEE		
SEMESTER – IV									
General Academic Component									
1	IAVOC401	Entrepreneurship Development	3	1	0	20	80	100	4
2	IAVOC 402	Internet of Things	3	1	0	20	80	100	4
Elective -I (Any one among IAVOC403A and IAVOC403B)									
3A	IAVOC 403B	Robotics	3	1	0	20	80	100	4
3B	IAVOC 403B	Embedded Robotics	3	1	0	20	80	100	4
Skill Development Component									
Elective -II (Any one among IAVOC404A and IAVOC404B)									
4A	IAVOC 404A	Networking Essential	3	1	0	20	80	100	4
4B	IAVOC 404B	Manufacturing Technology	3	1	0	20	80	100	4
5	IAVOC 405	Lab Course-IV	-	-	8	-	100	100	4
6	IAVOC 406	Laboratory Project-IV	-	-	-	-	200	200	10
							TOTAL	700	30
SEMESTER – V									
1	Industrial On-Job Training-I							700	30
							TOTAL	700	30
SEMESTER – VI									
1	Industrial On-Job Training-II							700	30
							TOTAL	700	30
Total Credits of Semester I to VI= 180									

Total Credits (Three Years) : 180 Credits
Total Marks: 4200

Glossary and Notes:

CIA: Continuous Internal Assessment

SEE: Semester End Examination

L: Theory Lecture **T:** Tutorial

P: Practical/ Hands-on

IAVOC: Industrial Automation Vocational

NAAC Reaccredited Grade A
CGPA – 3.22; 2019

Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad (MS)

Deen Dayal Upadhyay KAUSHAL Kendra

Syllabus

Bachelor of Vocation

INDUSTRIAL AUTOMATION

Semester I

PATTERN 2020

DIRECTOR, DDU KAUSHAL KENDRA
DIRECTOR.DDUKK@BAMU.AC.IN

General Academic Components

Industrial Automation

Semester - I

IAVOC-101: Linguistic Proficiency (English)
(4 Credits: 100 Marks)

Learning Objectives

To provide students with-

1. Fundamental grammatical tools for sentence formation
2. Basic Concepts of Tense
3. Basic tools for effective verbal and written communication in English language

Course Outcomes

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

1. Apply grammatical tools to formulate correct sentences in English.
2. Apply concept of tenses to formulate correct sentences in English.
3. Formulate different types of dialogues, expression of ideas/information in English
4. Compose applications, reports, requests, responses, summary and comprehensions in English

Course Contents

Unit 1: Functional Grammar Elements **(09 Hrs)**

Recapitulation of Grammar – Noun, Verb (Classifications), Infinitive and Gerunds, Auxiliaries and Modals, Passivity, Conditionals, Concord, Articles, Conjunction, Prepositions, Pronouns, Adverbs; Active and Passive Voice; Question Tag

Unit 2: Tenses **(09 Hrs)**

Present Tense, Past Tense, Future Tense (all four types to be included in each)

Unit 3: Sentence Formation **(09 Hrs)**

Types of Sentences – Simple, Complex, Compound; Phrases; Clauses; Synthesis of Sentences; Transformation of Sentences; Direct and Indirect Speech

Unit 4: Basic Verbal Communications **(09 Hrs)**

Introducing yourself (The communicator); Introducing people to others; Giving personal information; Getting attention and interrupting; Giving instructions and seeking

clarifications; Making requests and responding to requests

Unit 5: Basic Writing Skill **(09 Hrs)**

Writing Notices; Drafting Agendas; Writing minutes; Note taking; Writing applications for various jobs, referring to the ads.; Writing summary; Writing advertisements

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. High School Grammar and Composition; Wren and Martin; Fifteenth Edition; Blackie Elt Books; India; ISBN- 978-81-219-0009-6
2. Synergy: Communication in English and Study Skills; Board of Ed.; 2008; Orient Blackswan; India; ISBN- 978-81-250-3577-0
3. Business Communicator – V.K. Jain, O. P. Biyani, S. Chand, New Delhi.

Suggested Reading:

1. Macmillan Foundation English – R. K. Dwivedi, A. Kumar: Macmillan India Ltd. 2001
2. The Art of Powerful Communication – Dinesh K. Vohra, Are Maria Publications, Pune

IAVOC-102: Analog and Digital Electronics

(4 Credits: 100 Marks)

Learning Objectives

To provide students with-

1. Basic concepts of electronics components, semiconductor devices and power supply design
2. Application concepts of above components
3. Fundamental concepts of Boolean Electronics
4. Ideas of developing combinational logic circuits

Course Outcomes

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

1. Discuss basic operation of Analog and Digital Electronics Components viz. resistors, capacitors diodes, transistors, FETs and digital ICs.
2. Explain role of various components in different types of DC voltage regulated power supplies
3. Demonstrate inter-conversions between number systems, operation of simple and combinational logic gates
4. Apply laws of Boolean algebra for simplification of digital circuits, conversion of logic expression to circuit diagram and vice versa
5. Describe operations of fundamental combinational logic circuits

Course Contents

Unit 1: Electronic Components, Diodes, Transistors **(09 Hrs)**

Basic Electronic Components – Resistor, Capacitors and Inductors (Basic construction, types and standard coding)
Semiconductor Devices – Concept of Semiconductors, P-N Junction Diode operation, Diode applications (Rectifiers, Clippers, Clampers and Voltage Multipliers), Special Purpose Diodes;
Bipolar Junction Transistor (BJT) – basic structure and operation, Characteristics and parameters, Transistor as amplifier and switch; Transistor biasing- Concept of DC operating Point, Voltage Divider Bias

Unit 2: BJT Amplifiers and Field Effect Transistors **(09 Hrs)**

BJT amplifiers- Amplifier Operation, CE amplifier operation, Comparative figure of merit with other amplifier modes, Multistage amplifiers (RC Coupling)

Field Effect Transistors - Junction Field Effect Transistors (JFETs) – Basic Construction and Operation, JFET Characteristics and parameters; Metal Oxide Semiconductor Field Effect Transistors (JFETs) - Basic Construction and Operation, MOSFET Characteristics and parameters;

Unit 3: Power Supply Basics **(09 Hrs)**

Power supply building blocks, Rectifier, need of rectifier, Types of Rectifier, Filter and their types, Mathematical treatment of different types of rectifiers (Peak Voltage, Average Voltage, Peak Inverse Voltage, Ripple Factor), Zener Diode as voltage regulator, Basic Transistorized Series and Shunt Regulators, IC based voltage regulator such as IC 78XX and IC 79 XX, Adjustable voltage regulator using LM-317; Design Considerations and Application; Concept of Switch mode power supplies

Unit 4: Basic Digital Electronics **(09 Hrs)**

Introductory Concepts – Digital and Analog Quantities, Binary digits, Logic levels and digital waveforms, basic logic operations

Number System, Operations and Code – Decimal, Binary, Octal, Hexadecimal Number Systems and their conversion; 1's and 2's complements of Binary Numbers; Binary addition, subtractions;

Logic Gates – Basic logic gates – AND, OR, NOT; Basic Circuit, Symbol, Truth table, Universal Gates & their truth table, EX-OR and EX-NOR gates, Digital Integrated Circuits

Boolean Algebra – Basic Laws, De Morgan's Theorem, Conversion of Boolean expression to logic diagram and truth table, Boolean analysis of logic circuits, Simplification Techniques-Karnaugh map

Unit 5: Combinational Logic **(09 Hrs)**

Combination of Logic Analysis: Converting a Boolean Expression to a Logic Diagram, converting a Truth Table to a Boolean Expression, Converting a logic diagram to a truth table, AND-OR logic, Minterm, OR-AND logic, Maxterm, EX-OR gate, EX-NOR Gate, NAND and NOR gate, Universal Property of NAND and NOR gate

Functions of Combinational Logic: Adders, Comparators, Decoders, Encoders, Multiplexer, Demultiplexer, Parity Generators

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. Electronic Devices- Thomas I. Floyd; Pearson Education, Seventh Edition, 2008, Indian Subcontinent adaptation
2. Electronic Principles- A. P. Malvino, D. J Bates; Mc. Graw Hill (India Pvt. Ltd), Seventh Indian Edition, 2007, New Delhi

   Digital Fundamental- Thomas L. Floyd; Pearson Education, Tenth Edition, 2010, Uni Indian Subcontinent adaptation
3. Modern Digital Electronics- R. P. Jain; Fourth Edition,2010, Tata Mc. Graw Hill, New Delhi

Suggested Reading:

1. Principles of Electronics- V. K. Mehta, Rohit Mehta; S. Chand Publishers, Twelfth Edition, 2008, New Delhi
2. Semiconductor Electronics – A. K. Sharma; New Age International publishers, 2001 Reprint, New Delhi
3. Electronic Devices and Circuit Theory – R. Boylstad, L. Nashelsky, Pearson, Tenth Edition, 2009, Indian Subcontinent Adaptation
4. Digital Design: Principles and Practices- John F. Walkerly; Fourth Edition, Second Impression, 2009, Prentice Hall of India, New Delhi
5. Digital Design- M. Mano, M. D Ciletti; Fifth Edition, 2013, Pearson, Indian Subcontinent adaptation

Web:

1. http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html
2. http://www.nptelvideos.in/2012/12/digital-circuits-and-systems.html

IAVOC-103: Electrical and Mechanical Systems

(4 Credits: 100 Marks)

Learning Objectives

To provide students with-

1. Fundamental concepts of Single and Three Phase AC
2. Operational Concept of Transformers, DC motors and AC motors
3. Introductory concepts of mechanical power transmission

Course Outcomes

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

1. Describe basic elements and parameters in AC
2. Recognize Interconnections in three phase AC circuits
3. Discuss basic transformer operation
4. Illustrate basic construction and operation of AC and DC motors and select requisite motor for application specific demand
5. Explain terminologies and operational concepts of belt, rope, chain, gears, cam and follower drives and evaluate related advantages and disadvantages.

Course Contents

Unit 1: A.C. Fundamentals **(09 Hrs)**

AC fundamentals: Generation of Alternating Voltages and Currents, Equations of the Alternating Voltages and Currents, Alternate Method for the Equations of Alternating Voltages and currents, Simple Waveforms, Complex Waveforms, Cycle, Time-Period, Frequency, Amplitude, Different Forms of E.M.F. Equation, Phase, Phase Difference, Root Mean Square (R.M.S.) Value; A.C. through Resistance, Inductance and Capacitance (individual); A.C. through Resistance and Inductance, Power Factor, Active and Reactive Components of Circuit Current—Active, Reactive and Apparent Power, Concept of resonance

Unit 2: Polyphase AC and Transformers **(09 Hrs)**

Generation of Polyphase Voltages, Phase Sequence, Phases Sequence At Load, Numbering of Phases, Phase Reversal, Interconnection of Three Phases, Star or Wye (Y) Connection, Values of Phase Currents, Voltages and Currents in Y-Connection, Delta (D) or Mesh Connection, Balanced Y/D and D/Y Conversions, Star and Delta Connected Lighting Loads, Single Phasing, Power Factor Improvement, Power Correction Equipment; Unbalanced Loads

Principle of transformer operation, Ideal Transformer, Construction of a Transformer, Transformer on a Load, Losses and Efficiency, Regulation and Polarity test of a Transformer, Voltage Ratio test, Open and Short Circuit test on a Transformer, Load test on a Transformer, Instrument transformers (Current and Potential transformer), Autotransformer

Unit 3: DC Motors and Three Phase AC Motors **(09 Hrs)**

DC Motors: Basic Motor Principle, Significance of Back emf, Voltage equation of a motor, Conditions of maximum power, Reversal of Rotation of DC Motor, Torque, Armature Torque, Shaft Torque; Characteristics of Series and Shunt Motor; Applications

AC Motors: Classification, General Principle of Induction Motor, Construction (Squirrel Cage), Production of Rotating Field, Three Phase supply, Principle of Operation of Three phase, Rotation of Rotor, Reversing the rotation of three phase induction motor, Slip, Frequency of Rotor Current, Starting Torque, Condition for maximum starting torque, effect of change in supply voltage on starting torque; effect of change in supply voltage and supply frequency on torque and speed; Torque/ Speed Curve, Current/ Speed curve, Torque/ Speed Characteristic under load, plugging of an induction motor; Connecting Motor for Torque speed and horsepower conditions; Motor Data Plate; Basic Troubleshooting of Three phase Motor

Unit 4: Single Phase Motors and Kinematic Links **(09 Hrs)**

Single phase induction motor, Types of Single-phase motors, Double field revolving theory, self-starting of single-phase induction motor, Types of capacitor start motors, Capacitor start and run motor

Introduction to Kinematic links, types, structure, Kinematic pairs, classification, types of constrained motion, Kinematic chain, Types of joints in a kinematic chain

Unit 5: Mechanical Power Transmission **(09 Hrs)**

Belt, Rope and Chain Drives: Introduction to belt drive, Selection of a belt drive, Types of beltdrives and belts, belt materials, types of flat belt drives, velocity ratio in belt drive, Slip of belt, creep of belt, Power transmission by a belt drive, Centrifugal tension in a belt drive, ; V-belt drive, Advantages and disadvantages of V-belt over flat belt; Rope drive, Types, Advantages and disadvantages of a rope drive; Chain drives, advantages and disadvantages of a chain drive, terminologies in a typical chain drive

Gear, Gear Trains and Cam Introduction to toothed wheels, Advantages and disadvantages of gear drive, Classification, Terminologies in gears, Helical gears, Spiral Gears; Introduction to gear trains, types of gear trains (simple Compound, Reverted, epicyclic) Introduction to cams, classification of cams and followers, terms used in radial cam.

Unit 6: Tutorial (15 Hrs)

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. Electrical Technology (Vol 1 and 2)- B.L.Thereja, A. K. Thereja; S. Chand Publishers; First multicolour edition, 2005; New Delhi
2. **Grob's** Basic Electronics- M.E. Schultz; Mc.Graw Hill Pvt. Ltd., Special Indian Edition (Tenth)2007, New Delhi
3. Electrical Machines-M.V. Deshpande; PHI Learning PVT LTD, Second Printing, 2013, Delhi
4. R. S. Khurmi, J. K. Gupta – Theory of Machines, S. Chand Publishing, ISBN -81-219- 2524-X
5. Rattan – Theory of Machines, Tata McGraw Hill Education Pvt. Ltd., ISBN- 00-701- 4477-X

Suggested Readings:

1. Electric Machines- D.P.Kothari, I.J.Nagrath; Mc.Graw Hill Pvt. Ltd., Special Indian Edition (Twelfth) 2015, New Delhi
2. Industrial Electronics – Terry Bartlet; Cengage Learning India Edition, Second Indian Reprint, 2006, New Delhi
3. T. Bevan - Theory of Machines, B S Publishers and Distributors Pvt. Ltd., ISBN – 81- 239-0874-1

Web:

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

Skill Development Components

Industrial Automation

Semester - I

IAVOC-104: Industrial Instrumentation

(4 Credits: 100 Marks)

Learning Objectives

To provide students with-

1. fundamental concepts of measurement and instrumentation system
2. basic modalities of industrial displacement/speed measurement
3. basic modalities of industrial temperature measurement
4. basic modalities of industrial flow and level measurement
5. basic modalities of industrial pressure measurement

Course Outcomes

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

1. Describe primary blocks of an Instrumentation System and Qualities of Measurement.
2. Classify physical measurement backgrounds.
3. Select transducers as per application demand.
4. Identity terminals of industry grade transducers.
5. Describe operation of basic transducers employed for industrial process parameter monitoring applications

Course Contents

Unit 1: Basics of Measurement and Electrical Measurements **(09 Hrs)**

Instrumentation System- Block diagram, Function of each block, Need of Instrumentation system.

Sensors and Transducers- Introduction, Needs, Classification, Selection criteria, Primary sensing elements.

Qualities of Measurements- Introduction, Performance Characteristics: Static and Dynamic Characteristics, Concept of error

Basic Electric Measurement devices- Ammeter: DC Ammeter, Multi range Ammeter, Voltmeter, Multi Range Voltmeter; Loading, Calibration of Instruments. Multimeter: Multimeter operating instructions. Oscilloscope: Introduction, Basic principle, Block diagram of Oscilloscope, Simple CRO.

Unit 2: Displacement/ Detection, Speed Measurement **(09 Hrs)**

Resistance Transducers, Variable inductance type transducers, Proximity Detectors, Hall Effect Sensor, Photoelectric sensors, Applications of Photoelectric sensor, Selection of Photoelectric sensor. Ultrasonic Sensors.
Photoelectric pick-up & Proximity sensor (Non-contact type). Rotary and translational encoders

Unit 3: Temperature Measurement **(09 Hrs)**

Temperature: Definition and units, Different temperature scales & their conversions; Classification of temperature measuring transducers: Gas Filled thermometer, Bimetallic thermometer, Thermistors, RTD – (PT-100) , 2 wire systems (circuit diagram only), Thermocouple – Seeback & Peltier effect, Types J, K, R , S, T(Based on material, temperature ranges)

Unit 4: Flow and Level Measurement **(09 Hrs)**

Flow measurement - Flow: Definition, Types of Flow – Laminar, turbulent, Reynolds number

Classification of flow measuring transducers: Variable head flow meter- Venturimeter, orifice plate meter, Variable area flow meter – Rota meter, Electromagnetic Flow meter, Ultrasonic flow meter- Doppler Type, Solid flow measurement, Flow measurement

Level Measurement - Classification of level measurement methods: Float type – linear & rotary potentiometer (Contact type), Capacitive type (Contact type), Ultrasonic type (Non-contact type) Radiation type (Non-contact type), RADAR type (Non-contact type).

Unit 5: Pressure Measurement and Special Purpose sensors **(09 Hrs)**

Pressure measurement - Pressure: Definition, Types - Absolute, Gauge, Atmospheric, Vacuum(Definition, Units), Classification of Pressure measuring devices; Non elastic pressure transducer: U tube, Inclined Tube, Well type manometer; Elastic pressure transducer: Bourdon Tube, Bellows, Diaphragm, Capsule; Strain Gauge: Working principle, construction, piezo resistance co-efficient; Types of strain gauge: bonded, unbounded, semiconductor; Strain gauge measurement: Wheatstone bridge measurement; Electronic pressure transducers: Bourdon tube with LVDT Diaphragm with Strain gauge

Special purpose commercial sensor modules

Unit 6: Tutorial **(15 Hrs)**

References:

Text:

1. Electronics Instrumentation – H. S. Kalsi; Second Edition, 2004, Tata McGraw Hill Publishing Co. Ltd; N. Delhi
2. Instrumentation and Control - D. Patranabis; Publishing PHI Learning Private Limited, New Delhi
3. Industrial Electronics – Terry Bartlet; Cengage Learning India Edition, Second Indian Reprint, 2006, New Delhi

Suggested Readings:

1. Electrical and Electronic Measurements and Instrumentation - A.K.Sawhney; Dhanpat Rai & Sons.
2. Industrial Instrumentation & Control - S.K.Singh; Tata McGraw Hill Publishing Co. Ltd; 2006, Second Edition, New Delhi
3. Principles of Industrial Instrumentation - D. Patranabis; Tata McGraw Hill Publishing Co. Ltd; Third Edition, 1995, New Delhi
4. Mechatronics- M.D.Singh, B.Joshi; First Edition, 2006,Prentice Hall of India, New Delhi

Web:

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

IAVOC 105: Laboratory Coursework – 1
(4 Credits: 100Marks)

There are three sections in laboratory course work corresponding to theory courses taught in the semester. Students have to perform at least 05 experiments from each section.

Section I: Experiments based on Analog and Digital Electronics

Section Outcome

On completion of this section experiments, students should be able to -

1 Demonstrate operation of diodes, transistors, various digital ICs, etc.
2 Construct circuits deploying operation of simple and combinational logic gates
3 Apply laws of Boolean algebra for simplification of digital circuits, conversion of logic expression to circuit diagram and vice versa
4 Design basic circuits using analog and/or digital electronic components for simple applications that include (but not limited to) power supply, water level control etc

List of Experiments:

1. Capacitor Charging and Discharging
2. Study of P-N junction diode characteristics.
3. Study of characteristics of CE configuration of transistor.
4. Study of transistor as small signal amplifier (CE configuration) and Switching Device.
5. Study of Clipper and Clamper circuits
6. Study of Zener diode characteristics and its application as a voltage regulator.
7. Study of rectifiers (half wave, full wave, bridge rectifier)
8. Study of JFET characteristics
9. Study of MOSFET characteristics
10. Study of Zener diode as voltage regulator
11. Study of Voltage regulator IC-78XX & IC-79Xx
12. Study of adjustable voltage regulator using IC-317
13. Study of digital logic gates and De'Morgans theorem using logic gates
14. Study of discreet components (diodes and transistors) as logic gates
15. Study of universal logic gates NAND & NOR gates
16. Study of MUX /DEMUX

Section II: Experiments based on Electrical and Mechanical Systems

Section Outcomes

On completion of this section experiments, students should be able to-

1. Verify working of single-phase transformer
2. Explain working of AC induction motor and DC shunt/series motor
3. Demonstrate working of simple power transfer mechanisms

List of Experiments:

1. Study of Single Phase Transformer
2. Study of series R-L-C Resonance
3. Study of Parallel R-L-C Resonance
4. Study of three phase circuits with balanced load
5. Study of three phase circuit with unbalanced load
6. Study and verify Characteristics of DC Shunt Motor
7. Study and verify Characteristics of DC Series Motor
8. Study of characteristics of single-Phase Induction motor
9. Study of characteristics of three phase squirrel cage motor
10. Study of voltages and currents with 3 phase induction motor in star configuration
11. Study of voltages and currents with 3 phase induction motor in delta configuration
12. Study of different types of constrained motions
13. Study of different belt and chain drives
14. Study of different gears
15. Study of Simple and Compound gear train
16. Study of different cam and follower arrangements

Section III: Experiments based on Industrial Instrumentation

Section Outcomes

On completion of this section experiments, students should be able to-

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

List of Experiments:

1. Study of proximity sensors and Hall effect switch
2. Displacement measurement using LVDT
3. Determination of distance using ultrasonic transmitter/ receiver
4. Study of photoelectric sensors – photovoltaic cell, photoconductive cell

5. Study of photoelectric sensors – PIN photodiode, Phototransistor
6. Study of photoelectric sensors - retroreflective sensor and through beam sensor
7. Implementation of a photosensor for switching applications
8. Study of temperature measurement using Resistance Temperature Detector (PT 100)
9. Study of temperature measurement using thermocouple
10. Pressure Measurement using Bourdon tube
11. Study of flow of liquid using orifice meter and rotameter
12. Study of flow of liquid using venturi meter and paddle wheel flowmeter
13. Level measurement using by capacitive/float/conductive probe method
14. Measure speed of motor using non contact type photo electric / Inductive pick up/Tachogenerator
15. Temperature and humidity determination using DHT11 sensor

IAVOC 105: Laboratory Project-I
(10 credits – 200 marks)

The semester end Laboratory Project will act as primary mechanism of the Institute to provide students with an opportunity to gain on hand experience through effective, efficient, and practical application of what they have studied through the semester.

Course Outcomes:

On completion of this course, students should gain-

- Critical thinking in problem solving
- Presentation and communication skills
- Report organization and writing skills
- Independent learning and information integration skills
- Project management skill
- Work as an individual, with support from a supervisor, formulating solutions to day-to-day problems by integrating knowledge and experience gained on the course and outside the course.

Activity

Students or group of students (max.04) have to prepare a comprehensive project proposal based on theory and laboratory courses t they will be covering during the semester under supervision of project guide. After approval of the proposal by the Director, students will be allowed to work on the project. Working Model/ Demonstration model of the project along with the project report have to be submitted to the project guide before the semester end examination. Final evaluation of Laboratory Project – I coursework will be based on power-point presentation, demonstration and viva-voce examination.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO./SYLLABUS./FACULTY OF SCIENCE TECH./B.Voc./37/2021.

It is hereby inform to all concerned and that, on the recommendation of Ad-hoc Board in Vocational Studies & subsequently, Dean, Faculty of Science & Technology the Hon'ble Vice Chancellor has **accepted the following Curriculum of B.Voc. & M.Voc. Courses of Choice Based Credit and Grading System** under the faculty of Science & Technology in his **emergency powers under section 12(7) of the maharashtra public univerities act, 2016 on behalf of the academic council** as appended herewith.

Sr.No.	Name of the B.Voc & M.Voc Syllabus	Semester
1.	B.Voc. Industrial Automation	Semester-VI-Pattern-2018
2.	B.Voc. Industrial Automation	Semester-VI- Uniform Pattern-2019
3.	B.Voc. Industrial Automation	Semester-V- Uniform Pattern-2019
4.	B.Voc. Industrial Automation	Semester-IV- Uniform Pattern-2019
5.	B.Voc. Industrial Automation	Semester-VI-Pattern-2020
6.	B.Voc. Industrial Automation	Semester-V- Pattern-2020
7.	B.Voc. Industrial Automation	Semester-IV-III and II - Pattern-2020
8.	M.Voc. Industrial Automation	Semester-IV-III and II - Pattern-2020
9.	B.Voc. Automobile	Semester-VI-Pattern-2018
10.	B.Voc. Automobile	Semester-VI- Uniform Pattern-2019
11.	B.Voc. Automobile	Semester-V- Uniform Pattern-2019
12.	B.Voc. Automobile	Semester-IV- Uniform Pattern-2019
13.	B.Voc. Automobile	Semester-VI- Pattern-2020
14.	B.Voc. Automobile	Semester-V- Pattern-2020
15.	B.Voc. Automobile	Semester-IV,III and II Pattern-2020
16.	M.Voc. Automobile Technology	Semester-IV,III and II Pattern-2020

This is effective from the **Academic Year 2021-2022** and onwards. This B.Voc. & M.Voc. Curriculum with Structure is also available on the University website www.bamu.ac.in

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

University campus,
Aurangabad-431 004.
Ref. No. SU/B.Voc.Syll./2021/31724-35
Date: 31.05.2021

***

Deputy Registrar,
Academic [Syllabus]
Section.

..2..

Copy forwarded with compliments to :-

1] **The Director, Deen Dayal Upadhyay KAUSHAL Kendra,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

2] **The Principals, affiliated concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

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

Copy to :-

1] The Director, Board of Examinations & Evaluation,

2] The Section Officer, [M.Voc & B.Voc. Unit] Examination Branch,

3] The Section Officer, [Eligibility Unit],

4] The Programmer [Computer Unit-1] Examinations,

5] The Programmer [Computer Unit-2] Examinations,

6] The In-charge, [E-Suvidha Kendra],

7] The Public Relation Officer,

8] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

-=**=-

JK29052021*/-

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Syllabus Of

B.Voc. Industrial Automation

Semester – IV –III & II

(Pattern-2020)

[Effective from 2021 & 2022 & onwards]

NAAC Reaccredited Grade A CGPA – 3.22; 2019

Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad (MS)

Deen Dayal Upadhyay KAUSHAL Kendra

Bachelor of Vocation

Syllabus

Pattern
2020

INDUSTRIAL AUTOMATION

Semester – IV

General Academic Component
Skills Development Component

Professor Mahendra D. Shirsat
Director,
Deen Dayal Upadhyay Kaushal Kendra,
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad (MS) -431 004

Dr. Babasaheb Ambedkar Marathwada University
Deen Dayal Upadhyay Kaushal Kendra
Aurangabad (M.S.)

Director, Deen Dayal Upadhyay KAUSHAL Kendra
director.ddukk@bamu.ac.in

Sr. No.	Name of the Course		Contact Hours Per Week			Evaluation Scheme		Total Marks	Credit
			L	T	P	CIA	SEE		
SEMESTER – IV									
General Academic Component									
1	IAVOC401	Entrepreneurship Development	3	1	0	20	80	100	4
2	IAVOC 402	Internet of Things	3	1	0	20	80	100	4
Elective -I (Any one among IAVOC403A and IAVOC403B)									
3A	IAVOC 403A	Robotics	3	1	0	20	80	100	4
3B	IAVOC 403B	Embedded Robotics	3	1	0	20	80	100	4
Skill Development Component									
Elective -II (Any one among IAVOC404A and IAVOC404B)									
4A	IAVOC 404A	Networking Essential	3	1	0	20	80	100	4
4B	IAVOC 404B	Manufacturing Technology	3	1	0	20	80	100	4
5	IAVOC 405	Lab Course-IV	-	-	8	-	100	100	4
6	IAVOC 406	Laboratory Project-IV	-	-	-	-	200	200	10
							TOTAL	700	30

Professor Mahendra D. Shirsat
Director,
Dean Dr.ral Upadhyay Kaushal Kendra,
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad (MS) -431 004

General Academic Component
Semester – VI

IAVOC 401: Entrepreneurship Development

(4 Credits: 100 Marks)

Learning Objectives:

1. To provide the students with basic traits of entrepreneurship
2. To introduce students with entrepreneurial environment
3. To equip students with basic tools for business plan preparation
4. To equip students with concepts of launching and management of small business

Course Outcomes:

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

1. Explain key concepts underpinning entrepreneurship and its application in the recognition and exploitation of product/ service/ process opportunities
2. Describe Key concepts underpinning innovation and the issues associated with developing and sustaining innovation within organizations
3. Plan creative strategies for pursuing, exploiting and developing new opportunities
4. Analyze basic Issues associated with securing and managing new business ventures

Course Contents:

Unit- 1: Entrepreneur **(09 Hrs)**

Entrepreneurship concept, Entrepreneurship as a career, Required Personality traits for an entrepreneur, Characteristics of an Entrepreneur, Functions of an Entrepreneur, Entrepreneur vs. Manager, Intrapreneur/Corporate Entrepreneur

Unit- 2: Entrepreneur Development **(09 Hrs)**

Types of Entrepreneurs, Motivating Factors to Become Entrepreneur, Entrepreneurial Competencies, Requirements for Successful entrepreneur, Entrepreneur and Economic Development

Unit- 3: Entrepreneurial Environment **(09 Hrs)**

Business Environment, Role of Family and Society, Challenges, Entrepreneurship Development Training and Other Support Organizational Service, Startup Accelerators, Students Standbox and Business Labs, Crowd Funding, Venture Capital, Co-Working Spaces, Boot Camps, Central and State Government Policies and Regulations

Unit- 4: Business Plan Preparation **(09 Hrs)**

Sources of Product for Business, Pre-feasibility Study, Criteria for Selection of Product, Ownership, Capital, Budgeting Project Profile Preparation, Matching Entrepreneur with the Project, Feasibility Report Preparation and Evaluation Criteria

Unit- 5: Launching and Management of Small Business **(09 Hrs)**

Finance and Human Resource Mobilization Operations Planning, Market and Channel Selection, Growth Strategies, Product Launching, Monitoring and Evaluation of Business, Preventing Sickness and Rehabilitation of Business Units, Effective Management of Small Business

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

Reference:

Text:

1. Entrepreneurship: R. D. Hisrich, M. P. Peters, D. A. Shepherd; McGraw Hill India; ISBN: 9789353163457
2. Entrepreneurship Development: E. Gordon, K. Natarajan; Himalaya Publishing House; ISBN: 9789352025404
3. Entrepreneurship Development: S. S. Khanka; S. Chand and Company; ISBN: 8121918014

Suggested Reading:

1. Dynamics of Entrepreneurial Development and Management: V. Desai ; Himalaya Publishing House; ISBN: 9788184884975
2. Entrepreneurial Development: N. P. Srinivasan & G.P. Gupta; S. Chand & Sons, ISBN 9788170148012

General Academic Component
IAVOC 402: Internet of Things

(4 Credits: 100 Marks)

Learning Objectives:

1. To introduce students with building blocks of Internet of Things (IoT) and their characteristics.
2. To provide students with basic knowledge of connectivity technologies employed across IOT domain
3. To acquaint students with basic traits of IOT based system design
4. To provide students with overview of SCADA

Course Outcomes:

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

1. Describe the basic connectivity technologies in IOT
2. Compare physical and logical design of IOT, IOT model specifications
3. Explain role of IOT in industry, agriculture and other sectors
4. Recognize the basic features of SCADA and their role in industrial framework

Course Contents:

Unit- 1: Foundation of IOT **(09 Hrs)**

Origin of terminology, IOT market share, evolution of connected devices, modern day IOT applications, baseline technologies. IOT resulting in address crunch, connectivity terminologies, IOT network configurations; Sensors- features, classes, types, Sensorial Deviations; Actuators- types- hydraulic, pneumatic, thermal, electrical and mechanical; Basics of IOT networking: IoT Components, IoT Interdependencies

Unit- 2: Connectivity Technologies **(09 Hrs)**

6LoWPANs, RPL routings, RFID, MQTT, SMQTT, CoAP, XMPP, AMQP; Communication Protocols: IEEE 802.15.4, Zigbee, 6LoWPAN, Wireless HART, Z-Wave, ISA 100, Bluetooth, NFC, RFID

Unit- 3: IOT Platforms and Design Methodology **(09 Hrs)**

Purpose and requirement specification, process specification, domain model specification, information model specification, service specification, IoT level specification, functional view specification, operational view specification, device and component integration, application developments; Case studies

Unit- 4: Introduction to SCADA **(09 Hrs)**

Introduction of SCADA, Basic Components, Block Diagram of SCADA – MTU, RTU, HMI; Structure of SCADA Systems – Data Acquisition, Data Communication, Data Presentation, Control; Distributed and Networked SCADA System; System Concepts, Advantages and Disadvantages

Unit- 5: Comparision of Industrial IOT and SCADA **(09 Hrs)**

Scada Software and Hardware Architecture, Communications in SCADA,DCS, Functionality of SCADA, System Configurations, RTU; PLC v/s DCS v/s SCADA; Comparison of Industrial IOT and SCADA

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

Reference:

Text:

1. Internet of Things: A Hands-on Approach by Arshdeep Bahga and Vijay Madisetti; Universities Press; ISBN- 9788173719547
2. Designing The Internet of Things by Adrian Mcewen and Hakin Cassimally; Willey; ISBN-10: 8126556862
3. The Internet of Things: Enabling Technologies, Platforms, and Use Cases by Pethuru Raj, Anupama C. Raman; Auerbach Publications; ISBN 9781498761284

Suggested Reading:

1. Build Your Own IoT Platform Develop a Fully Flexible and Scalable Internet of Things Platform in 24 Hours by Anand Tamboli; Apress; ISBN-9781484244975
2. Designing the Internet of Things by Adrian McEwen, Hakim Cassimally; Wiley; ISBN 9781118430620
3. Internet of Things with ESP8266 by Marco Schwartz; Packt Publishing; ISBN 9781786468024
4. The Internet of Things, Enabling Technologies, Platforms, and Use Cases by Pethuru Raj and Anupama C. Raman; CRC Press; ISBN 9781498761284

Web:

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/courses/108/106/108106022/

General Academic Component
IAVOC403A: Robotics

(4 Credits: 100 Marks)

Learning Objectives

1. To provide acquaintance with basic parts of industrial manipulators, allied configuration and work-volume
2. To provide ideas on basic sensors and actuators employed in robotics
3. To provide familiarization with necessary safety precautions while working with industrial manipulators
4. To introduce students with versatile application sectors of industrial manipulators

Course Outcomes

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

1. Correlate robot terminologies with standard industrial manipulator
2. Recognize needs of different DOF robots
3. Apply robot kinematics and dynamics to calculate position of end effector
4. Develop idea of programming an industrial manipulator
5. Practice safety protocols while handling robots

Unit- 1: Introduction to Robotics **(09 Hrs)**

Evolution of Robot and Robotics, Laws of Robotics, Progressive advancement in Robotics, Types of Robot, Selection of Robot- Payload, speed, Reach, Sensors in robots, Actuators, Major components and control systems in Industrial Manipulators

Unit- 2: Anatomy of Robot **(09 Hrs)**

Robot Anatomy- Links, Joints and Joints Notation Scheme, Degree of Freedom (DOF), Required DOF in a Manipulator, Arm Configuration, Work Cell, Work Volume, Robot End Effectors – Definition, Classification of End Effectors, Types of Grippers, Human Arm Characteristics, Design and Control Issues, Manipulation and Control basics, Specifications of Robots.

Unit- 3: Robot Kinematics and Dynamics **(09 Hrs)**

Introduction, Representing the position, link description, Joint link connection description, Kinematic modelling of manipulator, Direct and Inverse manipulator Kinematics for 3 and 4 DOF manipulator, Homogenous Transformation, Kinematic Equation using homogenous transformations, Manipulator dynamics- Basics, Introduction to Trajectory Planning

Unit- 4: Robot Programming **(09 Hrs)**

Types of Robot Programming, Robot Coordinate Systems, Robot Programming Language (Typical Syntax Examples), Teach Pendant;

Unit- 5: Robot Applications and Safety **(09 Hrs)**

Typical Industrial Applications of Industrial Manipulators; Safety measures while working with industrial manipulators; Basic maintenance practice

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. Industrial Robotics – M. P. Groover; Mc Graw Hill Education; ISBN: 978- 070249899
2. Robotics and Control – R. K. Mittal, I. J. Nagrath; Mc Graw Hill Education; ISBN: 978-0070482937
3. Robotics Principles and Practice – K.C Jain, Ln. Agarwal; Khanna Publishers; ISBN: 1234567146706

Suggested Reading:

1. Robotics Technology and Flexible Automation - S.R. Deb, S. Deb ; Mc Graw Hill Education; ISBN: 978-0070077911
2. Robotics Control, Sensing, Vision and Intelligence- K. S. Fu. , R. C. Gonzalez. and C.S.G. Lee; Mc Graw Hill Education; ISBN: 978-0070226258
3. Introduction to Robotics- S. K. Saha; Tata Mc Graw Publishing Company Limited; ISBN: 978-0070669000

Web:

1. https://nptel.ac.in/courses/112/105/112105249/

General Academic Component
IAVOC403B: Embedded Robotics

(4 Credits: 100 Marks)

Learning Objectives

1. To acquaint students with the fundamental components of embedded robots
2. To provide students with idea of basic configurations of embedded robots
3. To introduce students to the fundamental traits of Intelligent Robotics

Course Outcomes

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

1. Correlate components of embedded robots with application-oriented objectives
2. Apply different actuation pedagogies in embedded robots
3. Classify basic configurations of embedded robots
4. Recognize role of intelligence in robotics

Unit- 1: Mobile Robots, Controllers and Sensors **(09 Hrs)**

Introduction, Mobile Robots, Embedded Controllers, Interfaces, Operating Systems; Sensors- Classification, Binary Sensor, Analog versus Digital Sensors, Shaft Encoder, A/D Converter, Position Sensitive Device, Compass, Gyroscope, Accelerometer, Inclinometer, Digital Camera

Unit-2: Actuators and Control **(09 Hrs)**

Actuators- DC Motors, H-Bridge, Pulse Width Modulation, Stepper Motors, Servos, BLDC Motor; Control- On-Off Control, PID Control, Velocity Control, Position Control, Multiple Motors- Driving Straight, V-Omega Interface

Unit-3: Basic Robot Configurations **(09 Hrs)**

Driving Robots – Single Wheel Drive, Differential Drive, Tracked Robots, Synchro-Drive, Ackermann Steering, Drive Kinematics; Omni- Directional Robots – Mecanum Wheels, Omni-Directional Drive

Unit-4: Static and Dynamic Balance **(09 Hrs)**

Kinematics, Omni-Directional Robot Design, Driving Program; Concept of Balancing Robots; Walking Robots- Concept, Sensors, Static Balance, Dynamic Balance

Unit- 5: Introduction to Intelligent Robotics **(09 Hrs)**

Intelligent Machine, Approaches to building intelligence, Scope of Intelligence, Layered Behavioural Responses, Behaviour based Robotics; Space robotics and the AI approach, Teleoperation. Telepresence, Semi-autonomous control , The Seven Areas of AI, Simple Case Studies – Walter's Turtle, Braitenberg Vehicles

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. Embedded Robotics – T. Braunl; Springer- Verlag; ISBN- 978-3540343189
2. PIC Robotics – J. Iovine; Mc-Graw Hill; ISBN – 007-1394559
3. Introduction to AI Robotics – R. R. Murphy; A Bradford Book The MIT Press Cambridge, Massachusetts; ISBN - 0-262-13383-0

Suggested Reading:

1. Robot Mechanisms and Mechanical Devices Illustrated – P. E. Sandin; Mc-Graw Hill; ISBN- 0-07-141200-X
2. Robotics Demystified – E. Wise; Mc-Graw Hill; ISBN- 0-07-143678-2.
3. Robotics Control, Sensing, Vision and Intelligence- K. S. Fu. , R. C. Gonzalez. and C.S.G. Lee; Mc Graw Hill Education; ISBN: 978-0070226258

Web:

1. https://nptel.ac.in/courses/106/102/106102220/ (Module 1)

Skill Development Component
IAVOC404A: Networking Essential

(4 Credits: 100 Marks)

Learning Objectives:

1. To provide students with concepts of networking models
2. To introduce students to the diversified strata of data communication protocols
3. Provide students with the basic conceptual tools for building a basic fieldbus network

Course Outcomes

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

1. Describe various Networking Models
2. Correlate Layers in OSI model with operations of factory automation
3. Discuss basic traits of Industrial Data Communication Protocols
4. Apply concepts basic wiring and installation of Fieldbus and Ethernet IP

Course Contents

Unit- 1: Networking and Models **(09 Hrs)**

Introduction to networking, Characteristics, Connection Types, Data Communication Standards and Organizations; Network Topology- Mesh, Star, Bus, Ring Hybrid; Network Applications, Network Components, Network Classification, Interconnection of Networks; Network Models – Introduction, Open Systems Interconnection (OSI) Model, Layers in OSI Model

Unit- 2: TCP/ IP Protocol Suite and Process Automation Networks **(09 Hrs)**

Introduction, Protocol, Architecture, TCP, UDP, IP, Operation, PDUs in Architecture, Addressing- Physical, Logical, Port, Specific; Introduction to Process Automation Networks, Communication Hierarchy in Factory Automation, I/O Bus Networks – Types, Network and Protocol Standards, Advantages; OSI Reference Model, Networking and I/O at Field Level, Networking at Control Level, Enterprise/ Management Level Networking

Unit- 3: Industrial Data Communications **(09 Hrs)**

Introduction, OSI model, RS-232 interface standard, Fiber Optics, Modbus, Data Highway Plus /DH485, HART, AS-I, Device Net, Profibus, Foundation Fieldbus, Industrial Ethernet, TCP/IP, Wireless Fundamentals, Industrial Network Security

Unit- 4: Basic Wiring **(09 Hrs)**

Introduction, Building a Fieldbus Network- NICS, Hubs, Repeaters, Switches, Bridges, Routers, Gateways, Powering Fieldbus Devices, Shielding, Cables, Linking Device, Devices per segment, Polarity, Communication Signals,

Unit- 5: Installing and Commissioning **(09 Hrs)**

Device Commissioning; Wiring and Addressing via Ethernet IP, Ethernet, IEEE Ethernet Standards, Topologies, IP Basics, IP Commissioning, Subnet, Manual and Automatic IP Configuration.

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. Fieldbus and Networking in Process Automation – S. K. Sen; CRC Press; ISBN-978-1466586765PIC
2. Industrial Automation- IDC Engineering Pocket Guide first Edition ISBN1 875955 09 7

Suggested Reading:

1. Data Communications Networking- B. A. Forouzan; McGraw-Hill Education Pvt. Ltd.; ISBN:978-0073250328

Skill Development Component
IAVOV404B: Manufacturing Technology

(4 Credits: 100 Marks)

Learning Objectives:

1. To introduce students with basic traits of manufacturing technology
2. To acquaint students with basic manufacturing processes
3. To familiarize with necessary safety precautions while working with machine tools
4. To provide overview of Advance Manufacturing Framework

Course Outcomes:

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

1. Recognize process of welding and cutting in manufacturing framework
2. Describe functions and operations of lathe machine and apply concepts of turning to perform operations on lathe machine
3. Describe functions and operations of milling machine and classify attachments of milling machines for specialized operations
4. Explain the basic concepts of FMS and Rapid Manufacturing

Course Contents:

Unit- 1: Manufacturing Processes – I **(09 Hrs)**

Introduction to Manufacturing, Materials in Manufacturing, Manufacturing Processes, Production Systems, Manufacturing Economics, Basic Safety measures; Welding – Introduction, Weldability and classification of welding processes; Common welding defects;

Unit- 2: Manufacturing Processes – II **(09 Hrs)**

Metal Cutting - Types of Cutting, Classification of Cutting Tools, Important Terminologies, Principal Angles of Single Point Tools, Tool Signature, Reference Planes; Chips – Formation, Types, Breakers; Cutting speed, Feed and depth of Cut, Sources of heat in metal cutting, Tool Failure, Tool Life and factors affecting tool life, Cutting tool materials

Unit- 3: Manufacturing Processes – III **(09 Hrs)**

Drilling Operation, Types of drilling machine, Drilling Machine operations; The Lathe and its Principle of Working, Types of lathe, Parts of Lathe, Standard Lathe Operations, Lathe tools, Tool geometry, Speed, Feed and Depth of Cut, Cutting Tool materials, Coolants

Unit- 4: Manufacturing Processes - IV **(09 Hrs)**

Introduction, Working Principle, Types on Milling machine, Principal parts of column type milling machine, Main attachments for milling machine, Milling methods, Milling cutters (principal types), Angles of a plain milling cutter, Number of teeth in cutter, Milling operations (Broad classification), Cutting speed and feed, Coolants, Concept of indexing

Unit- 5: Modern Concepts in Manufacturing **(09 Hrs)**

Flexible Manufacturing -Introduction and Definition, Basic Components of FMS, Test of Flexibility, Different Types of FMS, Types of FMS Layouts, Factors Influencing the FMS Layouts, Advantages and Disadvantages, Manufacturing Cell Concept, CAM, CIM; Rapid Prototyping- Introduction, Basic Principles, Rapid Prototyping Technologies, Rapid Tooling, Limitations

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

Reference:

Text:

1. Workshop Technology (Volume – 1 and 2): S. K. Hajra Chowdhury, A. K. Hajra Chowdhury, N. Roy; Media Promoters & Publishers Pvt. Ltd.; ISBN - 8185099154
2. Flexible Manufacturing System Author : H. K. Shivanand, M. M. Benal, V. Koti : ISBN-9788122418705
3. Fundamentals of Modern Manufacturing - Materials, Processes, and Systems: Mikell P. Groover; Wiley; ISBN: 9781118231463

Suggested Reading:

1. Workshop Technology (Part - 2): W. A. J. Chapman; Routledge; ISBN 9780415503044
2. Manufacturing Processes: Serope Kalpakjian and Steven Schmid; Pearson Publication; ISBN 9788131705667
3. A Course in Workshop Technology (Vol 2): B. S. Raghuwanshi; Dhanpat Rai and Co Pvt. Ltd.; ISBN: 9781020092015

Web:

1. https://nptel.ac.in/courses/112/105/112105126/
2. https://www.youtube.com/watch?v=tiarT1YS-lM
3. https://www.youtube.com/watch?v=YoslM2Sxihs
3. https://www.youtube.com/watch?v=toTYb7Sirm0&t=10s

IAVOC 405: Laboratory Coursework – IV

(4 Credits: 100Marks)

There are three sections in laboratory course work corresponding to theory courses taught in the semester. Students have to perform at least 60% experiments from each section. Students have to opt for any one section from Section IIA / IIB and any one section from Section IIIA / IIIB according to elective course chosen in Theory Section.

Section I:Experiments based on Internet of Things

Section Outcome

On completion of this section experiments, students should be able to –

1. Use ESP8266 and develop mini projects
2. Develop SCADA GUIfor tank filling, valve, lamp.
3. Demonstrate M2M communication via cloud

List of Experiments

1. Experiment with controlling of LED using Bluetooth module
2. Experiment with reading Data from DHT11 using ESP8266
3. Experiment with cloud data logging (analog data)
4. Experiment with cloud data logging (digital data)
5. Experiment with controlling LED from a cloud dashboard
5. Experiment with M2M communication via cloud
6. Experiment with cloud-based e-mail notification from a sensor
7. Experiment with cloud-based sms notification from a sensor
8. Opening Delta DIA-View SCADA software
9. Defining Text, Time and Date on a SCADA GUI
10. Defining Button and Indicator/Lamp on a SCADA GUI
11. Defining Tank filling in a SCADA GUI
12. Defining Valve display in a SCADA GUI
13. Defining Analog Meter in a SCADA GUI
14. Defining animation in SCADA
15. Interfacing of SCADA and PLC based process

Section IIA: Experiments based on Robotics

Section Outcome:

On completion of this section experiments, students should be able to –

1. Conceptualize concept of controlled and programmed motion with DC motor with loaded/no load condition
2. Program a stepper motor for controlled motion
3. Program an AC Servo motor for controlled operation motion
4. Perform fundamental handling of a six-axis articulated industrial robot

List of Experiments:

1. Study of Position Control for different values of angular position commands.
2. Study of Position Control System for different values of forward gain at different values of angular position commands.
3. Study of effect of loading on the speed of a DC motor in open loop and closed loop configuration using variable gain error amplifier
4. Study of Speed control of a DC motor using variable gain error amplifier
5. Study of operation of a stepper motor
6. Programming an AC servo motor for controlled operation
7. Study of Teach Pendant of an Industrial Six Axis Articulated Robot
8. Zeroing of Industrial Six Axis Articulated Robot
9. Jogging of Industrial Six Axis Articulated Robot (Axis Mode, World Coordinate Mode)
10. Programming of Six Axis Articulated Robot for Joint Motion
11. Programming of Six Axis Articulated Robot for Linear Motion
12. Programming of Six Axis Articulated Robot for Circular Motion
13. Tool Centre Point Calibration of Six Axis Articulated Robot
14. Programming Input and Output channels of Six Axis Articulated Robot
15. Development of Simple Pick and Place mimic program with Six Axis Articulated Robot

Section IIB: Experiments based onEmbedded Robotics

Section Outcomes:
On completion of this section experiments, students should be able to –

1. Apply standard open-source prototyping platform for controlling of
   a. DC rotary actuators
   b. Sensors
   c. Basic intelligent robotic platforms

List of Experiments:

1. Study of Position Control for different values of angular position commands.
2. Study of effect of loading on the speed of a DC motor in open loop and closed loop configuration using variable gain error amplifier
3. Study of Speed control of a DC motor using variable gain error amplifier
4. Interfacing of DC motor to standard opensource prototyping platform using Transistorized H-Bridge Circuit for – ON-OFF Control, Direction Control, Speed Control
5. Interfacing of DC motor to standard opensource prototyping platform using L298N for – ON-OFF Control, Direction Control, Speed Control
6. Interfacing of bipolar stepper motor to standard opensource prototyping platform using L298N for – ON-OFF Control, Direction Control, Speed Control
7. Interfacing of bipolar stepper motors (02) to standard opensource prototyping platform using L298N for – controlling X-Y platform
8. Interfacing DC servo motor to standard opensource prototyping platform for- ON-OFF Control, Direction Control, Speed Control
9. Interfacing multiple DC servo motors to standard opensource prototyping platform using PCA 9685 for- sequential ON-OFF, Direction Control, Speed Control
10. Design and Development of a basic 5 axis robot using DC servo motors and standard opensource prototyping platform

11. Design and Development of a Line-Following Robot using standard opensource prototyping platform
12. Design and Development of a Obstacle avoiding Robot using standard opensource prototyping platform
13. Design and Development of a standard opensource prototyping platform controlled robot using Bluetooth module
14. Study of Voice Recognition system using Google Speech API
15. Study of Colour and Shape Detection System

Section IVA: Experiments based onNetworking Essential

Section Outcomes:

On completion of this section experiments, students should be able to –

1.Perform basic communication with
   a. PLCs
   b. Human Machine Interface (HMIs)
   c. VFDs

List of Experiments:

1. Study of Addressing in TCP/IP
2. Study of Ping Command
3. Study & Implementation of cable Designs in Networking
4. Implementation of Peer to Peer Network
5. Implementation of Client Server Network
6. Implementation of Star topology using 100Base Tx
7. Implementation of Bus topology using 10Base2
8. Study of performance of Token Bus Protocol
9. Implementation of Ring Topology using DB9
10. Communication of a PLC to PC using MODBUS TCP/IP
11. Communication of a PLC to PC using RS 232
12. Communication of a PLC to HMI using MODBUS TCP/IP
13. Communication of a VFD to PLC using MODBUS TCP/IP
14. MODBUS communication of VFD and PLC
15. Communication of a VFD, PLC and HMI for controlling an Induction motor through HMI

(PLC, HMI and Drives should of AB/ABB/Siemens/Delta/ Mitsubishi/Schneider make)

Section IVB: Experiments based onManufacturing Technology

On completion of this section experiments, students should be able to –

1. Study basic Manufacturing Technology processes
2. Demonstration of experiments based on flexible sorting station
3. Study of complex flexible production system

List of Experiments:

1. Making of single V-butt joint between given workpieces by arc welding
2. Preparing of T-fillet joint on given workpieces by arc welding
3. Drilling holes of required size in upright drilling machine and tapping the drilled hole
4. Performing facing and taper turning on a cylindrical workpiece in a lathe
5. Getting a required shape and size from a given workpiece by step turning, knurling and chamfering operation in a lathe
6. Getting a required shape and size from a given workpiece by facing, turning and thread cutting operation in lathe
7. Study of different parts of a colour, shape/contour, MOC based flexible sorting station
8. Experiment with retrieval of modular workpieces from cartridge assembly and moving the workpieces through a linear transport system under different conditions of test station and rejection condition
9. Sorting of finished products on basis of their shape/ contour in a flexible sorting station
10. Sorting of finished products on basis of their material of construction (MOC) in a flexible sorting station
11. Sorting of finished products on basis of their colour in a flexible sorting station
12. Study of operation of a Rotary Indexing Table
13. Sorting of finished products on basis of their material of construction (MOC) in a rotary
14. indexing table
15. Study of a complex flexible production system. (students should prepare a detailed report of the system)

IAVOC 406: Laboratory Project-IV

(10 credits – 200 marks)

Course Outcomes:

On completion of this course, students should gain-

- Critical thinking in problem solving
- Presentation and communication skills
- Report organization and writing skills
- Independent learning and information integration skills
- Project management skill
- Work as an individual, with support from a supervisor, formulating solutions to day-to-day problems by integrating knowledge and experience gained on the course and outside the course.

Activity

Students or group of students (max.04) have to prepare a comprehensive project proposal based on theory and laboratory courses they will be covering during the semester under supervision of project guide. After approval of the proposal by the Director, students will be allowed to work on the project. Working Model/ Demonstration model of the project along with the project report have to be submitted to the project guide before the semester end examination. Final evaluation of Laboratory Project – IV coursework will be based on power-point presentation, demonstration and viva-voce examination.

NAAC Reaccredited Grade A
CGPA – 3.22; 2019

Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad (MS)

Deen Dayal Upadhyay KAUSHAL Kendra

Bachelor of Vocation

Syllabus

Pattern 2020

Professor Mahendra D. Shirsat
Director,
Deen Dayal Upadhyay Kaushal Kendra.
Dr. Babasaheb Ambedkar
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INDUSTRIAL AUTOMATION

SEMESTER –III

Director, Deen Dayal Upadhyay KAUSHAL Kendra
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Dr. Babasaheb Ambedkar Marathwada University ★ Deen Dayal Upadhyay Kaushal Kendra ★ Aurangabad (M.S.) ★

Course Structure and Syllabus Sem III (Pattern2020)
Bachelor of Vocation (B. Voc)
in Industrial Automation

SEMESTER – III									
General Academic Component									
1	IAVOC301	Energy and Environment	3	1	0	20	80	100	4
2	IAVOC302	Embedded Systems	3	1	0	20	80	100	4
Elective -I (Any one among IAVOC303A and IAVOC303B)									
3A	IAVOC303A	Electrical Drives	3	1	0	20	80	100	4
3B	IAVOC303B	PC based Instrumentation	3	1	0	20	80	100	4
Skill Development Component									
Elective -II (Any one among IAVOC304A and IAVOC304B)									
4A	IAVOC304A	Process Control Fundamental	3	1	0	20	80	100	4
4B	IAVOC304B	Building Automation	3	1	0	20	80	100	4
5	IAVOC305	Lab Course-III	-	-	8	-	100	100	4
6	IAVOC306	Laboratory Project-III	-	-	-	-	200	200	10
							TOTAL	700	30

Glossary and Notes:

CIA: Continuous Internal Assessment

SEE: Semester End Examination

L: Theory Lecture **T:** Tutorial

P: Practical/ Hands-on

IAVOC: Industrial Automation Vocational

General Academic Component

IAVOC301: Energy and Environment

(4 Credits: 100 Marks)

Learning Objectives

1. To provide an outline of concepts on conventional and non-conventional energy to students
2. To provide students with overview of environment pollution and waste management
3. To help students correlate social issues, environment, and sustainability
4. To introduce students to basic environmental acts in India and environment management standards

Course Outcomes

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

1. Describe basic concepts of conventional and non-conventional energy
2. Recognize elements of primary non-conventional energy resources
3. Correlate pollution, role of human being, and threats to environment
4. Discuss ethical and legislative issues related to environment
5. Express the needs and basic routes towards environment sustainability

Course Contents

Unit 1: Fundamentals of Energy **(09 Hrs.)**

Global energy consumption profile, Oil crisis of 1973, Classification of energy resources, Consumption trends of primary energy resources, Importance of non-conventional energy resources, Energy chain, Common forms of energy, Advantages and disadvantages of conventional energy resources, Salient features of non-conventional energy resources, environmental aspects of energy, Sustainable development, Energy density of fuels

Principles of energy conservation, Energy conservation ACT 2001, General electrical ECOs, Cogeneration, Need of energy storage, Overview of energy storage methods

Unit 2: Non-conventional Energy Sources **(09 Hrs.)**

Solar energy basics, Solar thermal systems, Basics of solar photovoltaic; Wind Energy fundamentals, Environmental aspects of wind energy generation; Biomass energy, Usable form of biomass- composition and fuel property, Biomass resources and conversion technologies, Urban waste to energy conversion, Biogas production from waste biomass. Basics of financial and economic evaluation.

Unit 3: Environment Pollution and Waste Management **(09 Hrs.)**

Pollution- Causes, Effect, Control Measures; Nuclear hazards, Role of an individual in preventing pollution, Climate Change, Global Warming, Acid rain, Ozone Layer Depletion, Nuclear Accidents; Disaster management.

Waste Management – Solid Waste Management, Causes, Effects and control measures of Urban and Individual waste, Municipal Solid Waste, Vermicomposting, Hazardous waste.

Unit 4: Social Issues and Environment **(09 Hrs.)**

Human Population – Population growth, Global profile, Urbanization, Environmental and Human health, Values and Human rights.

Sustainable development, Waste conservation, Wasteland reclamation, Consumerism and waste products.

Environmental Ethics- Issues and possible solutions

Unit 5: Environment Regulations **(09 Hrs)**

Environmental Acts - Environment Protection, Air (Prevention and Control of Pollution Act), Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environment legislation, Public Awareness.

Environment Management Standards – ISO 14000, BHARAT and EURO Stages, Environmental Clearance/ Permission for establishing Industries

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. Textbook for Environmental Studies–Erach Bharucha for University Grants Commission; University Press; 2004New Delhi, India
2. Environmental Management- N. K. Uberoi; Excel Books; 2013New Delhi; India
3. Non-Conventional Energy Resources; B. H. Khan; 2006 Tata McGraw-Hill Education; India

Suggested Reading:

1. Environmental Science and Engineering- Glynn Henry J., Gary W. Heinke; 2004.; Pearson Education, Inc, NY
2. Non-Conventional Energy Sources- G. D. Rai , 2006; Khanna Publishers, India

Web:

1. **https://onlinecourses.nptel.ac.in/noc18_ge09/preview**
2. https://nptel.ac.in/courses/127106004/
3. https://nptel.ac.in/courses/122106030/

General Academic Component

IAVOC302: Embedded Systems

(4 Credits: 100 Marks)

Learning Objectives

1. To provide an outline of concepts on conventional and non-conventional energy to students
2. To provide students with overview of environment pollution and waste management
3. To help students correlate social issues, environment, and sustainability
4. To introduce students to basic environmental acts in India and environment management standards

Course Outcomes

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

1. Describe basic concepts of conventional and non-conventional energy
2. Recognize elements of primary non-conventional energy resources
3. Correlate pollution, role of human being, and threats to environment
4. Discuss ethical and legislative issues related to environment
5. Express the needs and basic routes towards environment sustainability

Course Contents

Unit 1: Introduction to Arduino and Programming Environment **(09 Hrs.)**

Introduction - What is Arduino, Introduction to Arduino family, Arduino Shields; Creating an Arduino Programming Environment – Exploring microcontroller Internals, Moving beyond machine codes, Creating Arduino programs, Installing the Arduino IDE, Overview of Arduino IDE, Exploring IDE – Menus, Toolbar, Message Area and Console Window, Setting Up Arduino IDE, Using Serial Monitor; Building a Basic Arduino sketch, Interfacing Concept with Electronic Circuits

Unit 2: C for Arduino - I **(09 Hrs.)**

Basics of C - Working with variables, Operators, Exploring Arduino functions; Structured Commands – *if* Statement, Grouping multiple statements, *else* Statements, *else if* Statements, Comparison conditions, Creating compound conditions, Negating a Condition check, *Switch* Statement; Programming Loops – Understanding Loops, *while* Loops, *do-while* loops, *for* Loops, Using arrays in Loops, Using multiple variables, Nesting Loops, Controlling Loops

Unit 3: C for Arduino – II **(09 Hrs.)**

Concept of string, C-style strings, Arduino *String* object, Manipulating string objects; Concept of data structure, Creating data structure, Manipulating data structure, Arrays of structures; Creating Functions – Basic Function use, Returning a value, Passing values to functions, Handling Variables in Functions

Unit 4: Operation with Real World Devices – I **(09 Hrs.)**

Concept of Library, Using standard libraries; Digital Interfaces – Digital overview, Working with Digital inputs and outputs; Analog Devices – Analog overview, Analog Input, Modifying input result, Using input mapping, Changing reference voltage, Analog output; Analog output dependent on digital and analog input; Interfacing of Sensors – Momentary push button and pull up resistors, IR proximity sensor, Rotation (pot), Photoresistor, LM35, Ultrasonic distance measuring; Overview of spectrum of sensors

Unit 5: Operation with Real World Devices – II **(09 Hrs.)**

Interfacing of Motors – DC motor, Servo motor, Stepper motor; Interfacing an LCD; LCD library, LCD shield, Combined operation of sensor and LCD; Connecting Arduino with network – Ethernet shield Library, Basic Network Program

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. Sams Teach Yourself Arduino Programming in 24 Hours- Richard Blum; Pearson Education; ISBN - 9789332552432
2. Learning C for Arduino- Syed Omar Faruk Towaha; Packt; ISBN - 9781787120099

Suggested Reading:

1. Make: Getting Started with Arduino- Massimo Banzi, M. Shiloh; O'Reilly; ISBN - 9781449363338
2. Getting Started with Sensors: Measure the World with Electronics, Arduino, and Raspberry- PiKimmo Karvinen; O'Reilly; ISBN - 978-1449367084
3. Learn Arduino Prototyping – Kallol Basu Roy Choudhary; Packt; ISBN - 978-1788290685

Web:

1. https://www.arduino.cc
2. https://learn.sparkfun.com

General Academic Component

IAVOC303A: Electrical Drives

(4 Credits: 100 Marks)

Learning Objectives

1. To provide students with fundamental knowledge in dynamics and control of electric motors.
2. To enable students towards recognition/identification for need of appropriate drives for different applications.
3. To equip students with basic wiring and programming knowledge of standard industrial VFD.

Course Outcomes

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

1. Explain four quadrantal diagram of speed torque characteristics
2. Discuss different modes of DC motor speed control
3. Discuss different modes of Induction motor speed control
4. Accomplish wiring and basic programming with a standard industrial VFD

Course Contents

Unit 1 : Electrical Drives- Introduction **(07 hrs)**

Introduction to electrical drives, Classification of drives, Classification of control schemes, Components of Electrical drives; Types of loads, Dynamics of Electric Drives, Four Quadrant Operation, Equivalent Drive, Parameters, Friction Components, Nature of Load Torque, Dynamics of Motor – Load Combination, Determination of Moment of Inertia, Steady State Stability

Unit 2: DC Drives **(10 hrs)**

Characteristics of DC Motor, Speed-Torque characteristics of separately excited DC motors and Series DC motor; Field control of Series Motor, Motoring and Braking of Separately Excited and Series DC motors, Speed Control of Separately Excited DC motor using Controlled Rectifiers, Speed torque characteristics of Full controlled Converter-fed separately excited DC motor, Dual Converter fed DC motor, Multi quadrant operation using Field Current Reversal, DC chopper-fed Separately Excited DC motor for Motoring and Braking, Two and Four Quadrant DC chopper, Dynamic braking of DC motor, Counter-current Braking, Regenerative Braking

Unit 3: AC Drives **(11 hrs)**

Induction Motor Drives, Basic operation of three phase induction motor, operation with non-sinusoidal supply, Stator current of Induction motor with non-sinusoidal supply, operation of Induction motor with Unbalanced Voltage Supply, Single Phasing of Induction Motor, Braking of Induction Motor, Dynamic Braking (Ac and DC) Speed control of induction motor using stator voltage regulator, Variable Voltage/Variable Frequency Control of Induction Motor, Open Loop V/F Control, Slip Speed Control of Induction Motor, Constant Volt/ Hz Control of Induction Motor, Closed Loop Volt/ Hz Control of Induction Motor with Slip Speed Regulation, Multi Quadrant Operation of Induction Motor Drive

Unit 4: Industrial Applications of Drives **(07 hrs)**

Steel Mills, Cement Mills, Textile Mills, Sugar Mills, Electric Traction, Machine Tools

Unit 5: Variable Frequency Drive (VFD) **(10 hrs)**

VFD Fundamentals, Pulse width modulation, carrier frequency, fundamental frequency, control modes for speed and torque; Cold test to check the healthiness of VFD; Connection of cables to the power terminals, Continuity test with the help of as per drawings. Drive installation and programming (Based on standard Allen Bradley/Siemens/Mitsubishi/ABB/ Delta VFD) : common wiring connection, equipment/components used in typical VFD panel, parameters and programming, menu navigation and LCD display, common parameters, braking method; basic troubleshooting in VFD- over temperature fault, over current fault, over voltage fault.

Unit 6: Tutorial **(15 hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. A First Course On Electrical Drives (SECOND EDITION)S. K. Pillai; 2001;; New Age International PVT LTD ; New Delhi (India), ISBN- 81-224-0166-X
2. Electrical Drives; N. K. DEP. K. SEN; Prentice Hall of India Private Limited; New Delhi (India), ISBN-978-81-203-1492-4
3. A Textbook of Electrical Technology (Volume II); 2015 - B. L. Theraja, A. K. Theraja; S. Chand Publishing; New Delhi (India), ISBN- 268-7-31005-275-3
4. Variable Frequency Drives: Installation and Troubleshooting – Gary D. Anderson; ISBN-978-15-027-7089-9

Suggested Reading:

1. Fundamentals of Electrical Drives (SECOND EDITION) Gopal K Dubey; 2001;; Narosa Publishing House; New Delhi (India)
2. Fundamentals of Electrical Drives; Veltman André, PulleDuco W.J., de Doncker R.W.; Springer Netherlands
3. Fundamentals of Industrial Drives; B. N. Sarkar; Prentice Hall of India Private Limited; New Delhi (India)
4. Industrial Electronics: Circuits, Instrument and Control Technique Terry Bartlet; 2006; (INDIA EDITION); Cengage Learning India PVT LTD; Delhi (India)

Web:

1. https://nptel.ac.in/courses/108/104/108104140/
2. https://www.nptel.ac.in/courses/108102046/
3. https://nptel.ac.in/courses/108108077/35
4. https://nptel.ac.in/courses/108104011/2

General Academic Component

IAVOC303B: PC based Instrumentation

(4 Credits: 100 Marks)

Learning Objectives:

1. To introduce students to hardware aspects of a personal computer essential for real world interfacing
2. To provide essential programming concepts with C/VB for PC based instrumentation
3. Introduce students to diversified strata of I/O cards for real time application requirements
4. To provide essential conceptual development of basic interfacing applications with Serial and USB port of PC

Course Outcomes

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

1. Describe general structure of PC based instrumentation
2. Develop basic routines for interfacing with C/VB
3. Correlate different standard I/O cards with real time application requirements
4. Develop basic interfacing applications with Serial and USB port of PC

Course Contents

Unit- 1: Computer Aided Instrumentation, Buses and Standards **(09 hrs)**

Introduction to PC based instrumentation, PC architecture, General structure of PC based instrumentation, Advantages and disadvantages of computer-based instrumentation, Comparison with other control systems, Introduction to various instrumentation packages like Lab View, Genie etc. Buses and Standards – Introduction, BUS types, The I/O BUS - ISA bus, EISA Bus, PCI bus, GPIB, RS 232

Unit- 2: Interfacing Using C/ VB **(09 hrs)**

C/VB as an interfacing language, Small routines for interfacing, Graphics designing through C/VB, File generation for data storage, Data acquisition through C/VB, Real time interfacing and display, Software compensation techniques

Unit-3: I/O Interfacing Cards for Process Control **(09 hrs)**

Opto Input-Output card – Introduction, Block Diagram Description, Installation and Programming, Main features, Specifications, Application areas; High performance Analog Data acquisition card with DIO and Timer/Counter -Introduction, Installation and programming, Main features, Block diagram description, CP-168U Universal PCI Serial Board Overview; Applications - Event triggering, Industrial measurements, Process control

Unit- 4 Serial Port Interfacing Technique **(09 hrs)**

Serial Port (SP) Interfacing Techniques - Introduction to serial port, Serial port as output port, Programming of SP, Serial port as input port and its programming

Unit- 5: USB Port Interfacing Techniques **(09 Hrs)**

USB Port Interfacing Techniques - Introduction to USB port, USB port as output port, Programming of USB, USB port as input port and its programming

Unit 6: Tutorial **(15 hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

References:

Text:

1. IBM PC And Clones – B. Govindrajalu; Mc Graw Hill Publication Pvt. Ltd.; ISBN: 683-9-84761-497-9
2. Troubleshooting, Maintaining & Repairing PCs – S. J. Bigelow; Osborne/ Mc-Graw Hill; ISBN: 9780072132724
3. Serial Port Complete – Jan Axelson; Lake View Research; ISBN- 978-1931448062
4. USB Complete- The Developer's Guide – Jan Axelson: Lake View Research; ISBN-9781931448086

Suggested Readings:

1. The Indispensable PC Hardware Book – H. P. Messemer; Addison-Wesley Professional; ISBN - 978-0201596168

IAVOC 205: Laboratory Coursework – II
(4 Credits: 100Marks)

There are three sections in laboratory course work corresponding to theory courses taught in the semester. Students have to perform at least 60% experiments from each section. Students have to opt for any one section from Section IIA / IIB and any one section from Section IIIA / IIIB according to elective course chosen in Theory Section.

IAVOC 205: Laboratory Coursework – II
(4 Credits: 100Marks)

There are three sections in laboratory course work corresponding to theory courses taught in the semester. Students have to perform at least 60% experiments from each section. Students have to opt for any one section from Section IIA / IIB and any one section from Section IIIA / IIIB according to elective course chosen in Theory Section.

Section I: Experiments based on Embedded Systems

Section Outcome

On completion of this section experiments, students should be able to develop prototype for solving real life problems

List of Experiments:

1. Installation of Arduino IDE and getting Arduino Uno connected to IDE
2. LED interfacing to Arduino Uno: Blinking, Slow glowing/dimming of LED, Momentary Push Button Switch controlled operation of LED
3. Interfacing of potentiometer to Arduino Unoand printing of voltage developed across potentiometer in serial monitor
4. LED, Momentary Push Button Switch, Potentiometer interfacing to Arduino Uno: Glowing/Dimming of LED- controlled by Switch and Potentiometer
5. Interfacing ofLM 35 to Arduino Uno and printing of temperature in serial monitor
6. Interfacing of LCD to Arduino Uno: temperature reading from LM35
7. Interfacing of LCDand temperature + humidity sensor to Arduino Uno
8. Interfacing of a flow sensor to Arduino Uno and printing of flow in serial monitor
9. Development of a distance monitor using Arduino Uno and Ultrasonic transmitter/receiver
10. Development of a soil humidity-based plant watering system
11. Interfacing a DC motor toArduino Uno: Using toggle switches to Start/Stop and Direction Control of Motor, Using Potentiometer to control speed of motor
12. Interfacing a DC motor to Arduino Uno (L293D shield)
13. Interfacing DC servo motor to Arduino Uno
14. Interfacing DC servo motor to Arduino Uno (l293D shield)
15. Interfacing stepper motor to Arduino Uno (using transistor/ MOSFET)
16. Interfacing stepper motor to Arduino Uno (L293D shield)

Section IIA: Experiments based on Electrical Drives

Section Outcomes

1. Recognize Speed-Torque characteristics of DC motors in different configuration
2. Recognize Speed-Torque characteristics of AC (squirrel cage induction) motors in different configuration
3. Wire and program a VFD for controlling speed of single phase/three phase induction motor (1 HP)

List of Experiments:

1. Study of Speed – Torque Characteristics of Separately Excited DC Motor using Open loop Armature Voltage Variation.
2. Study of Speed – Torque Characteristics Series DC Motor using Open loop Armature Voltage Variation.
3. Study of Speed – Torque Characteristics Shunt DC Motor using Open loop Armature Voltage Variation.
4. Study of Speed- Torque Characteristics of Single-Phase capacitor start inductor motor
5. Study and Measurement of Slip in a Squirrel Cage Three Phase Induction Motor
6. Study of Speed- Torque Characteristics of Squirrel Cage Three Phase Induction Motor
7. Study of single phase half wave control converter
8. Study of Standard Manual of at least 2 Industry Grade Drives (Make- AB/Siemens/Delta/ ABB/ Mitsubishi/ Schneider) – Overview and precautions, Basic Installation/ Wiring, Display and Control Keys, Start Up, Basic Parameter setting.
9. Wiring of standard (Make- AB/Siemens/Delta/ ABB/ Mitsubishi/ Schneider) VFD with a three phase induction motor and standard control panel elements.
10. Programming a VFD (Make- AB/Siemens/Delta/ ABB/ Mitsubishi/ Schneider) for Start/Stop and controlling Speed of Motor using Keypad
11. Programming a VFD (Make- AB/Siemens/Delta/ ABB/ Mitsubishi/ Schneider) for Start/ Stop controlling Speed of Motor using Remote Switch and Potentiometer

Section IIB: Experiments based on PC based Instrumentation

Section Outcomes

On completion of this section experiments, students should be able to apply Personal Computers for basic level actuation and data acquisition functions

List of Experiments:

1. Controlling a Relay and Sequential Operation of Relays through PC Serial Port
2. Design of a Graphical Display Panel on Monitor to control Relays through PC Serial Port
3. Generation of different waveforms through PC Serial Port
4. Generation of different waveforms through PC USB Port
5. Design of a Graphical Display Panel on Monitor to control Waveforms through PC Serial Port
6. Design of a Graphical Display Panel on Monitor to control Waveforms through PC USB Port
7. Controlling On/OFF, Direction and Speed of a DC motor using PC USB/ Serial Port
8. Controlling On/OFF, Direction and Speed of a DC motor using PC USB/ Serial Port
9. Design of a Graphical Display on Panel Monitor for exp no. 7
10. Design of a Graphical Display on Panel Monitor for exp no. 8
11. Interface LM 35 to PC for acquisition of Data and storing of data
12. Design of a Graphical Display on Panel Monitor for exp no. 8

    Install and Program CP-168U Universal PCI Serial Board for –

13. Display behaviour trend of an analog input signal

14. Interlocking experiments by comparing two or more input analog signals
15. Controlling digital outputs with change in inputs signals

Section IIIA: Experiments based on Process Control Fundamentals

Section Outcomes

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

1. Implement necessary transmitters in a process control system
2. Explain basic elements and parameters of a control system
3. Apply PID controller for basic feedback control process

List of Experiments:

1. Study of Temperature and Level Transmitter
2. Study of Flow and Pressure Transmitter
3. Study of I/P and P/I converter
4. Study of basic blocks of an analogue PID controller using simulated systems
5. Study of basic ON/OFF controller
6. Study of open and closed loop system (with and without disturbance)
7. Study of steady state error
8. Study of proportional, integrator and derivative controller (independent action)
9. Study of controller in composite modes (PI, PD, PID)
10. Study of PID controller operation in open and closed loop.
11. Study of installed and inherent characteristics of Equal Percent Valve
12. Study of installed and inherent characteristic of Linear Valve
13. Study of Quick Opening valve characteristic
14. Configuration of Industrial PID controller for feedback flow control system
15. Configuration of Industrial PID controller for feedback pressure control system
16. Wiring and configuration of Industrial PID controller for feedback temperature control system

Section IIIB: Experiments based on Building Automation

Section Outcomes

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

1. Recognize the spectrum of applications of automation in smart building
2. Describe the instrumentation and underlying technical practices in commissioning of automated/intelligent elements in smart buildings

This is a purely study and assignment-based coursework. Students should visit Intelligent building of hospital/hotel/airport and submit assignments.

1. Assignment on HVAC.
2. Assignment on Direct Digital Control of an HVAC system.
3. Assignment on lighting- control systems.
4. Assignment on fire alarm systems.
5. Assignment on access Control System.

6. Assignment on CCTV systems.
7. Assignment on building system integration.

IAVOC 306: Laboratory Project-II
(10 credits – 200 marks)

Course Outcomes:
On completion of this course, students should gain-

- Critical thinking in problem solving
- Presentation and communication skills
- Report organization and writing skills
- Independent learning and information integration skills
- Project management skill
- Work as an individual, with support from a supervisor, formulating solutions to day-to-day problems by integrating knowledge and experience gained on the course and outside the course.

Activity

Students or group of students (max.04) have to prepare a comprehensive project proposal based on theory and laboratory courses t they will be covering during the semester under supervision of project guide. After approval of the proposal by the Director, students will be allowed to work on the project. Working Model/ Demonstration model of the project along with the project report have to be submitted to the project guide before the semester end examination. Final evaluation of Laboratory Project – II coursework will be based on power-point presentation, demonstration and viva-voce examination.

NAAC Reaccredited Grade A
CGPA – 3.22; 2019

Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad (MS)

Deen Dayal Upadhyay KAUSHAL Kendra

Bachelor of Vocation

Syllabus

Pattern 2020

Professor Mahendra D. Shirsat
Director,
Deen Dayal Upadhyay Kaushal Kendra,
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad (MS) -431 004

INDUSTRIAL AUTOMATION

SEMESTER –II

Director, Deen Dayal Upadhyay KAUSHAL Kendra
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Dr. Babasaheb Ambedkar Marathwada University ★ Deen Dayal Upadhyay Kaushal Kendra ★ Aurangabad (M.S.)

Course Structure and Syllabus Sem II (Pattern2020)
Bachelor of Vocation (B. Voc)
in Industrial Automation

SEMESTER – II									
General Academic Component									
Sr. No.	Course Code	Name of the Course	Contact Hours Per Week			Evaluation Scheme		Total Marks	Credit
			L	T	P	CIA	SEE		
1	IAVOC201	Industrial Safety Practices	3	1	0	20	80	100	4
2	IAVOC202	PLC Fundamentals	3	1	0	20	80	100	4
3	IAVOC203	Control Panel and Wiring	3	1	0	20	80	100	4
Skill Development Component									
4	IAVOC204	Hydraulics and Pneumatics	3	1	0	20	80	100	4
5	IAVOC205	Lab Course-II	-	-	8	-	100	100	4
6	IAVOC206	Laboratory Project-II	-	-	-	-	200	200	10
							TOTAL	700	30

Glossary and Notes:

CIA: Continuous Internal Assessment

SEE: Semester End Examination

L: Theory Lecture **T:** Tutorial

P: Practical/ Hands-on

IAVOC: Industrial Automation Vocational

General Academic Component

IAVOC201: Industry Safety Practices

(4 Credits: 100 Marks)

Learning Objectives

1. To introduce students with basic postulates of safe work environment and practices
2. To provide basic ideas on fatigue, accidents, hazards and personal protection to students
3. To provide students with essential knowledge of safe working practice
4. To introduce students with legal aspects and safety regulations at workplace

Course Outcomes

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

1. Discuss basic postulates of safe work environment and practices
2. Recognize threats of fatigue, accidents, hazards and Personal Protection
3. Adapt safe working practices
4. Correlate legal aspects of safety and necessary preventive measures in workplace

Course Contents:

Unit 1: Basics of Industrial Safety **(10hrs)**

Safety Responsibility and Organization, Occupational Health and Safety Program, Safety Policy, Safety inspection, Safety Planning, Safety Measures in Manufacturing Industry, Employee's participation in safety, Supervisory Responsibility in Safety, Relationship of safety with plant design, equipment design and work environment, Regulatory Agencies and Statutory Bodies; Main Provisions of Factory Act 1948; Safety Symbols – Safety Signs and Colours, Categories, Posting Signs, Training and Maintenance

Unit 2: Industrial Accidents and Hazards **(08hrs)**

Introduction, Classification of Accidents in Industry, Causes and Prevention of Accidents, Accident Reporting; Classification of Hazards, Hazard Management Program, Major Industrial Hazards, Machine Guarding, Industries involving hazardous processes, Machine Guarding; Handling Emergencies- Workplace emergency, Emergency Planning concepts, Emergency Action plan, Onsite and Offsite planning, Fire Emergency procedure

Unit 3: Environmental factors in Industry - I **(09hrs)**

Environment, Need of Environmental Control, Environmental Factors in Industry, Effect of environmental factors on Human body and mind; Lighting- Importance of adequate lighting, terminologies, Recommended Illumination Values of Industrial Buildings and Processes, Principles of Good Illumination, Colour Codes used in industries; Heat Control- Heat Stress, Heat Stress Disorders, Preventing Heat Stress, Heat Stress Indices, Thermal Comfort, Conditions for Thermal Comfort

Unit 4: Environmental factors in Industry - II **(09hrs)**

Ventilation and Air Conditioning, Legal Requirements, Health Effects of Improper ventilation, Methods of ventilation, Air conditioning system selection; Noise and its types, Hazardous Noise, Legal requirements, Sound levels, Noise Control; Health effects of vibration, Effective

Management of Vibration; Industrial Fatigue, Types of Fatigue, Effects of Fatigue, Fatigue Indicators, Management and Mitigation of Fatigue, Sleep Cycle

Unit 5: Preventive Machineries **(09hrs)**

Personal Protective Equipment (PPE)- Need, Legal Requirements, Types of PPE, Suitable PPE, Training in use of PPE, Maintenance of PPE; Occupational Health Problems- Occupational Diseases, Medical Examinations in Industry, Medical Records, First Aid

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

Reference:

Text:

1. Industrial Safety and Environment – A. K. Gupta; University Science Press; ISBN 978-8131804544

Suggested Reading:

1. Grimaldi and Simonds, Safety management: ATTBS publishers, New Delhi 2001; ISBN-81-85386-06-4
2. Industrial safety and pollution control handbook; National Safety Council and Associate publishers pvt. ltd; Hyderabad;

Web:

1. https://nptel.ac.in/courses/110/105/110105094/

General Academic Component

IAVOC202: PLC Fundamentals

(4 Credits: 100 Marks)

Learning Objectives

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

Course Outcomes

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

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

Course Contents:

Unit 1: Introduction to PLCs **(08hrs)**

Overview: Programmable Logic Controllers, Parts of a PLC, Principles of Operation, Modifying the Operation, PLC Size and Application; PLC Hardware Components: The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing Unit (CPU), Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs)

Unit 2: PLC Programming Basics **(10 hrs)**

Logic Fundamentals: The Binary Concept, AND, OR, and NOT Functions, The AND Function, The OR Function, The NOT Function, The Exclusive-OR (XOR) Function, Boolean Algebra, Developing Logic Gate Circuits from Boolean Expressions, Producing the Boolean Equation for a Given Logic Gate Circuit, Hardwired Logic versus Programmed Logic; Programming Basics: Processor Memory Organization (Program Files, Data Files), Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of Operation

Unit 3: Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs

(09 hrs)

Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors (Proximity Sensor, Magnetic Reed Switch, Light Sensors, Ultrasonic Sensors, Strain/Weight Sensors, Temperature Sensors, Flow Measurement, Velocity and Position Sensors), Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Writing a Ladder Logic Program Directly from a Narrative Description; Program examples

Unit 4: Programming Timers and Counters **(09 hrs)**

Timers: Industrial Timers, Types of Timing Operations, Timer Instructions, On-Delay Timer Instruction, Off-Delay Timer Instruction, Retentive Timer, Cascading Timers; Counters: Counter Instructions, Up-Counter, Down-Counter, Up/Down Counter, Cascading Counters

Unit 5: PLC Application Concepts **(09 hrs)**

Types of Processes, Structure of Control Systems (On/Off Control, PID Control, Motion Control), Data Communications (Data Highway, Serial Communication, Ethernet/IP, Modbus, Fieldbus, PROFIBUS-DP); Supervisory Control and Data Acquisition (SCADA): Introduction, Basic Components, Block Diagram of SCADA, Functionality of SCADA; PLC Application Examples

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

Reference:

Text-

1. Programmable Logic Controllers– F. Petruzella (Mc Graw Hill Publishing Company); ISBN - 9780073373843
2. Programmable Logic Controllers– W. Bolton; Newnes (Elsevier) ; eBook ISBN – 9780080462950, Paperback ISBN: 9780750681124
3. Programmable Logic Controllers: Programming Methods and Applications-J. R. Hackworth, F. D. Hackworth Jr, Pearson India Education Services Pvt. Ltd; ISBN - 9788177587715, 8177587714

Suggested Reading-

1. Programmable Logic Controllers: Principles and Applications - J.W. Webb, R. A. Reiss; Prentice Hall of India; ISBN – 9780130416728
2. Programmable Controllers: Theory and Implementation - L. A. Bryan, E. A. Bryan ;An Industrial Text Company Publication; ISBN – 978-1856177511
3. Programmable Logic Controllers– J. A. Rehg, G. J. Sartori; Pearson; ISBN – 9780135048818

Web:

1. www.instrumentationtools.com

General Academic Component

IAVOC203: Control Panel and Wiring

(4 Credits: 100 Marks)

Learning Objectives

1. To provide students with foundation electrical concepts required for Control Panel Wiring
2. To acquaint students with electrical safety measures while working in AC circuits
3. To provide students with necessary information about different components of Control Panel
4. To give students generic concepts of designing and wiring MCC

Course Outcomes

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

1. Identify components installed in a control panel and recognize their role in overall operation
2. Apply basic electrical safety measures while working in AC circuits
3. Conceptualize front panel and back panel layout of an MCC with standards
4. Design and Implement basic MCC panel wiring
5. Implement wiring of a PLC for basic I/O operations

Course Contents:

Unit 1: Foundation Elements **(08hrs)**

Review of concepts - Current, Voltage and Power, AC & DC; Line, Neutral, and Earth; 1-ph (L-N), 3- ph (RYB - N), Star and Delta Connections, Current and Voltage relations in Star and Delta Connections, Relays; Personal Safety-Guidelines; Use of Rubber soled Shoes, Gloves and Goggles, Conductivity of Water, EarthingPit, Earthing Plates & Strips, ESD; Drawings – Types, Wiring Diagram, Elementary Diagram, Single Line Diagram; Symbols

Unit 2: Basic Panel Elements and Cables **(10Hrs)**

Introduction of a typical Control Panel (MCC) – Front Panel and Back End Overview; Power Supply, Busbar, SFUs, MCB, ELCB, RCCB and MPCB, Contactors and Auxiliary Contactors (NO/NC); Push Buttons, NO/NC Elements, Selector/Key Switches, CT and PT, Voltmeter, Ammeter, Energy meter, Multifunction Meter; Terminal Blocks & Din Rails, Plastictrunking, Connector blocks; Indicators, Alarm Annunciators; Timers, Counters. Wire types and preparation - Insulation materials, Conductors, Wire specifications, Standard Wire Gauge, Coaxial and screened wire, Multiway cables, Insulation removal, Forming the wire, Soldering, Crimped joints, Screw clamp terminals; Cable/Wire specification

Unit 3: Control Panel Wiring and Troubleshooting **(10Hrs)**

SLD Preparation (Basic Concepts), Determining BOQ of Components, Checking received material for specifications as per drawing, Creating Channel layout, Selecting the correct Conductor, Testing for Shorts / Continuity, Cutting required lengths, Using Ferrules & Cable lugs, TerminalTightening Torque,Checking the circuits, Dressing the Cables, Using Cable Glands (Single Compression /Double Compression), Cable forming – Cable forms, Continuous lacing, Breakouts, Spot ties, Laying the wires, Twisted pairs, Cable markers, Connections and Conductor and cable runs, Conductors of different circuits; Earthing the

protective bonding circuit Screen connections, System earth terminals; Testing Power Supply, Testing Relays & Contactors, Testing CT/PT, Testing Pushbuttons, Indicating Lamps & Selector Switches, Ammeter & Energy meter, Testing Voltmeter, Troubleshooting of Control Panels

Unit 4: Field Wiring – I **(09Hrs)**

Designing of basic Control Circuits Using Contactors, Relays, Timers etc.; Designing of Basic 1-phase Motor control circuit using start/ Stop momentary switches and Indicators; Basic DOL circuit for 3-phase motor with protection; DOL circuit for 3-phase motor with protection & current-voltage-energy measurement; Basic Star/Delta circuit for 3-phase motor with protection; DOL circuit for 3-phase motor with protection & current-voltage-energy measurement

Unit 5: Field Wiring – II **(08Hrs)**

Components of a AC Drive system, VFD Terminals, Wiring for VFD I/Os with 3-phase motor; Components of a Soft starter, Soft starter Terminals, Wiring for Soft Starter I/Os with 3-phase motor; Components of a Programmable Logic Controller (PLC), PLC Terminals, Wiring for PLC I/Os

Unit 6: Tutorial **(15 Hrs)**

Assignments; Seminars; Exercises based on Unit 1 to 5

Reference:

Text:

1. Electrical Technology – (Vol. 1 & 2)- A. K. Theraja, B. L. Theraja; S. Chand Publishers, ISBN - 9788121924405
2. Grob's Basic Electronics- M. E. Schultz; Mc Graw Hill Pvt. Ltd., ISBN – 9780070634329, 0070634327
3. Electrical Safety Handbook- J. Cadick, M. Capeli-Schellpfeffer, A. Winfield; Mc. Graw Hill; ISBN-13 - 978-0071745130, ISBN-10 : 0071745130
4. Industrial Control Wiring Guide - Bob Mercer; Newnes (Elsevier); ISBN - 0750631406
5. Wiring Diagram Book- Schneider; Square D,; 1993
6. Programmable Logic Controllers: Principles and Applications- J.W. Webb, R. A. Reiss; Prentice Hall of India; ISBN - 9788120323087

Suggested Reading:

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

Web:

Students are advised to go through YOUTUBE videos on regular lecture topics, especially on Motor wirings.

Skill Development Component

IAVOC20: Hydraulics and Pneumatics

(4 Credits: 100 Marks)

Learning Objectives

1. To acquaint students with the basic tools of hydraulic and pneumatic control
2. To equip students with fundamental tools for basic hydraulic and pneumatic circuit design
3. To equip students with basic design tools to develop sequential circuits in pneumatic/electropneumatic based automation

Course Outcomes

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

1. Recognize basic hydraulic and pneumatic elements in a standard circuit
2. Describe operation of basic hydraulic and pneumatic actuators/ control elements
3. Construct circuit diagram for basic hydraulic and pneumatic circuits according to application demand
4. Develop simple automated application employing hydraulic/ pneumatic elements

Course Contents

Unit 1: Fluid Power fundamentals and Hydraulic pumps **(09 Hrs)**

Introduction, Advantages and Disadvantages of fluid power system, Applications; Physical Properties of Hydraulic Fluids; Governingprinciples in hydraulics- Fluid level, Pascal's Law; Flow of hydraulic fluid- laminar andturbulent, Bernoulli's principle; Reynold's number; Frictional losses in flows throughhydraulic systems; Darcey-Weisbach formula; losses in pipe, valve and fittings; Components of a typical FluidPower System;Types of fluid power system-Hydrostatic and Hydrodynamic; Classification of pumps –PD and NPD pumps; Pumping Theory- PD pumpsand parameters; Pumps based on Delivery of oil flow; Gear pumps (Internal Gear Pump,External Gear Pump, Lobe Pump, Gerotor Pump) and Vane pumps, Volumetric Displacementand Theoretical Flow Rate Calculation, Pump Efficiency; ANSI Symbols.

Unit 2: Hydraulic Elements in Design of Circuits – I **(09 Hrs)**

Hydraulic cylinders- Basic Operation, Construction, Types - Single and Double ActingCylinder; Special purpose Cylinder; specification of hydraulic cylinder; cylinder force,velocity and power, cylinder load due to moving weight; Cushioning in Cylinder; ANSIsymbols.

Introduction to Design of Hydraulic Circuits; Control elements and their function; Directioncontrol valve – classification, Pilot operated DCVs; Check valves;

Unit 3: Hydraulic Elements in Design of Circuits – II **(09 Hrs)**

Pressure Control valves,Direct Acting Relief valve, Pilot operated relief valve, Pressure Reduction valve, Sequence valve, Counterbalance valve; ANSI symbols.

Flow control valves- Counter- Orifice Principle, Effect of pressure on operation, Effect of flow control valve on relief of system; Throttle valve (with and without pressure compensation),location of flow control valves (Meter in, Meter Out, Bleeder Operation),

Ancillary Hydraulic Components- Accumulators-(Types, size, Application Circuits); Filters;Reservoir; Intensifier; Pressure Switch; Manifold; fluid conductors.

Unit 4: Pneumatic System- Concepts, Components and Design Basics **(09 Hrs)**

Introduction; Comparison of Pneumatic/Hydraulic/and Electrical System; Air compressionsystem- Types of Compressor, Compressor specifications; Air preparation elements;Arrangement of a complete pneumatic system; compressed air behaviours.Understanding pneumatic components- Pneumatic Actuators, Direction Control Valves.Design of pneumatic circuits- fluid power circuit design; switching valve position; control airv/s signal air; Notation/ Numbering of Valves Building of pneumatic circuits; Application ofLogic valves-AND, OR; Speed control circuit; Application of time delay valve.

Unit 5: Basic Hydraulic and Pneumatic Circuits **(09 Hrs)**

Basic hydraulic cylinder acting circuits, Counterbalance Valveapplication, pressure sequence valve application, two handed safety circuit, auxillary power backed circuit using accumulator; Single and Double Acting Cylinder Operation, Air Pilot Control, Two step Speed Control,Position Sensing in Pneumatic Cylinders- Signal flow in pneumatic circuits for pressuresensing; Roller lever valve circuits- Notation; Multicylinder Pneumatic circuits- Two Cylinder Movement; Overlapping of Signals;Displacement Diagram of multicylinder operation; Sequential circuit design- cascade method.

Unit 6: Tutorial **(15 Hrs)**

Assignments on Basic maintenance Practice in Hydraulics and Pneumatics

References:

Text:

1. Fluid Power with Application- Anthony Esposito; Pearson Publication,ISBN-97801351136904
2. Introduction to Hydraulics and Pneumatics – S. Ilango, V. Soundararajan; PHI LearningPvt. Ltd.; ISBN- 8120344065
3. Oil Hydraulic Systems: Principles and Maintenance-S. R. Majumdar; McGraw Hill (India)Pvt. Ltd., ISBN – 0074637487
4. Pneumatic Systems (Principal and maintenance)- S R Majumdar; McGraw Hill (India) Pvt. Ltd.; ISBN- 0074602314

Suggested Reading:

1. Hydraulic and Pneumatic Controls – K. Shanmuga Sundaram; S. Chand Limited; ISBN-8121926351
2. Pneumatic and Hydraulic Systems-W. Bolton; Butterworth Heinemann, ISBN – 00750638362
3. Hydraulics and Pneumatics: A Technician's and Engineer's Guide - A. Parr; ButterworthHeinemann, ISBN – 0080966748
3. Pneumatic Controls- P. Joji; Willey India Pvt. Ltd., ISBN- 9788126515424
4. Antony Barber; 1997 (Eighth Ed.); Pneumatic Handbook; Elsevier Science Ltd.; ISBN-

allowed to work on the project. Working Model/ Demonstration model of the project along with the project report have to be submitted to the project guide before the semester end examination. Final evaluation of Laboratory Project – IIcoursework will be based on power-point presentation, demonstration and viva-voce examina

5. Design sequential circuits using basic pneumatic components and sensors.
6. Design logic based pneumatic circuits.

List of Experiments:

1. Study of Double Acting Cylinder working using 4/3 way and 4/2 way valve. (HandLever Operated Spring Return Type)
2. Study of Single Acting Cylinder working using 4/3 way Hand Lever Operated SpringReturn Type valve.
3. Study of hydraulic motor working using 4/3 way and 4/2 way valve. ((Hand LeverOperated Spring Return Type)
4. Study of Bleed –off circuit, Meter-IN circuit and Meter-OUT circuit
5. Study working of Sequence Valve
6. Study working of Solenoid operated Direction Control Valves.
7. Implementation of a 3/2 way single pilot operated valve to operate a SAC & 5/2 way spring returned pilot operated valve to operate a DAC.
8. Study of 'OR' and 'AND' logic using pneumatic components & Study of 5/2 way push button actuation valve.
9. Implementation of 3/2 and 5/2 roller level operated valve for automated sequential operation.
10. Implementation of foot level operated valve and disc rotary valve to operate a DAC.
11. Implementation of solenoid operated direction control valve in pneumatic circuits.
12. Implementation of a unidirectional flow control valve to control speed of a pneumaticmotor.

IAVOC 206: Laboratory Project-II

(10 credits – 200 marks)

Course Outcomes:

On completion of this course, students should gain-

- Critical thinking in problem solving
- Presentation and communication skills
- Report organization and writing skills
- Independent learning and information integration skills
- Project management skill
- Work as an individual, with support from a supervisor, formulating solutions to day-to-day problems by integrating knowledge and experience gained on the course and outside the course.

Activity

Students or group of students (max.04) have to prepare a comprehensive project proposal based on theory and laboratory courses t they will be covering during the semester under supervision of project guide. After approval of the proposal by the Director, students will be

Section II: Experiments based on Control Panel and Wiring

Section Outcomes

On completion of this section experiments, students should be able to-

1. Read wiring diagrams
2. Recognize elements in a standard MCC panel
3. Interpret requirements for designing of an MCC panel (for fractional to low HP induction motors) / PLC panel
4. Implement wiring of a 3-phase fractional HP motor for DOL, Star/Delta, VFD based control

List of Experiments:

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

Section III: Experiments based on Hydraulics and Pneumatics

Section Outcomes

On completion of this section experiments, students should be able to-

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

IAVOC 205: Laboratory Coursework – II
(4 Credits: 100Marks)

There are three sections in laboratory course work corresponding to theory courses taught in the semester. Students have to perform at least 60% experiments from each section.

Section I: Experiments based on Programmable Logic Controllers

Section Outcome

On completion of this section experiments, students should be able to –

1. Hardware PLCs (AB – Micro 820/ Micrologix 1400/ Delta DVP series) with Analog and Digital I/O devices
2. Develop ladder diagrams as per situational demands (lower to intermediate level complexity)
3. Develop real time projects using PLCs

List of Experiments:

1. Identification of PLC I/O Terminals and I/O Wiring with basic I/O devices.
2. Interfacing a PLC with to its programming software, uploading program in PLC
3. Develop ladder expressions for logic gates, hardware/ software implementation (basic gates)
4. Development of ladder expressions for gated oscillator, latched contacts, always energized and always de-energized contacts
5. Development of ladder expressions for Timer operation (situation can be developed); hardware and software implementation
6. Development of ladder expression for cascaded operation of Timer, (situation can be developed); hardware and software implementation
7. Development of ladder expression for Counter, (situation can be developed); hardware and software implementation
8. Development of ladder expression for Water Tank Level Control; hardware and software implementation
9. Development of ladder expression for Conveyor Control; hardware and software implementation
10. Development of Ladder Expression for linear bottle filler system; hardware and software implementation
11. Development of Ladder Expression for traffic light control system; hardware and software implementation
12. Development of Ladder Expression for 3 floor elevator control system; hardware and software implementation
13. Interfacing of HMI panel to PLC and basic I/O Operation
14. Study of a SCADA based Process Control .

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO./SYLLABUS./FACULTY OF SCIENCE TECH./B.Voc./37/2021.

It is hereby inform to all concerned and that, on the recommendation of Ad-hoc Board in Vocational Studies & subsequently, Dean, Faculty of Science & Technology the Hon'ble Vice Chancellor has **accepted the following Curriculum of B.Voc. & M.Voc. Courses of Choice Based Credit and Grading System** under the faculty of Science & Technology in his **emergency powers under section 12(7) of the maharashtra public univerities act, 2016 on behalf of the academic council** as appended herewith.

Sr.No.	Name of the B.Voc & M.Voc Syllabus	Semester
1.	B.Voc. Industrial Automation	Semester-VI-Pattern-2018
2.	B.Voc. Industrial Automation	Semester-VI- Uniform Pattern-2019
3.	B.Voc. Industrial Automation	Semester-V- Uniform Pattern-2019
4.	B.Voc. Industrial Automation	Semester-IV- Uniform Pattern-2019
5.	B.Voc. Industrial Automation	Semester-VI-Pattern-2020
6.	B.Voc. Industrial Automation	Semester-V- Pattern-2020
7.	B.Voc. Industrial Automation	Semester-IV-III and II - Pattern-2020
8.	M.Voc. Industrial Automation	Semester-IV-III and II - Pattern-2020
9.	B.Voc. Automobile	Semester-VI-Pattern-2018
10.	B.Voc. Automobile	Semester-VI- Uniform Pattern-2019
11.	B.Voc. Automobile	Semester-V- Uniform Pattern-2019
12.	B.Voc. Automobile	Semester-IV- Uniform Pattern-2019
13.	B.Voc. Automobile	Semester-VI- Pattern-2020
14.	B.Voc. Automobile	Semester-V- Pattern-2020
15.	B.Voc. Automobile	Semester-IV,III and II Pattern-2020
16.	M.Voc. Automobile Technology	Semester-IV,III and II Pattern-2020

This is effective from the **Academic Year 2021-2022** and onwards. This B.Voc. & M.Voc. Curriculum with Structure is also available on the University website www.bamu.ac.in

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

University campus,
Aurangabad-431 004.
Ref. No. SU/B.Voc.Syll./2021/31724-35
Date: 31.05.2021

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Deputy Registrar,
Academic [Syllabus]
Section.

..2..

Copy forwarded with compliments to :-

1] **The Director, Deen Dayal Upadhyay KAUSHAL Kendra,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

2] **The Principals, affiliated concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

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

Copy to :-

1] The Director, Board of Examinations & Evaluation,

2] The Section Officer, [M.Voc & B.Voc. Unit] Examination Branch,

3] The Section Officer, [Eligibility Unit],

4] The Programmer [Computer Unit-1] Examinations,

5] The Programmer [Computer Unit-2] Examinations,

6] The In-charge, [E-Suvidha Kendra],

7] The Public Relation Officer,

8] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

-=**=-

JK29052021*/-

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Syllabus Of

B.Voc. Industrial Automation

Semester – V & VI

(Pattern-2020)

[Effective from 2021 & 2022 & onwards]

NAAC Reaccredited Grade A CGPA – 3.22; 2019

Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad (MS)

Deen Dayal Upadhyay KAUSHAL Kendra

Bachelor of Vocation
Syllabus

Pattern
2020

INDUSTRIAL AUTOMATION
Semester –V and VI

Professor Mahendra D. Shirsat
Director,
Deen Dayal Upadhyay Kaushal Kendra,
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad (MS) -431 004

Dr. Babasaheb Ambedkar Marathwada University ★ Deen Dayal Upadhyay Kaushal Kendra ★ Aurangabad (M.S.)

Director, Deen Dayal Upadhyay KAUSHAL Kendra
director.ddukk@bamu.ac.in

Course Structure and Syllabus Sem V (Pattern2020)
Bachelor of Vocation (B. Voc)
in Industrial Automation

In Plant Training – I

Students should complete their In Plant Training (off campus) in relevant industry for the period of 10-12 weeks and submit a detailed report of the same to the department. The student should also collect evaluation sheet (in sealed envelope) from the industry coordinator and submit it to the department/college. Internal evaluation of the candidate during the In-Plant Training will be evaluated by the concerned Industry and the Semester End Evaluation will be performed by Department/ University.

Course Structure and Syllabus Sem VI (Pattern2020)
Bachelor of Vocation (B. Voc)
in Industrial Automation

In Plant Training - II

Students should complete their In Plant Training (off campus) in relevant industry for the period of 10-12 weeks and submit a detailed report of the same to the department. The student should also collect evaluation sheet (in sealed envelope) from the industry coordinator and submit it to the department/college. Internal evaluation of the candidate during the In-Plant Training will be evaluated by the concerned Industry and the Semester End Evaluation will be performed by Department/ University.