Syllabus of
Second Year for
Bachelor of Vocation
In
Industrial Automation and Mechatronics
W.E.F. - 2021-22

Dr. Babasaheb Ambedkar Technological University,
Vidyavihar, Lonere, Maharashtra 402103

Semester III (Syllabus 2021-22)

Sr. No.	Course Code	Name of the Course	Teaching scheme			Evaluation Scheme			Credits	Total Marks
			L	T	P	IA	MSE	ESE		
General Education										
Theory										
1	BVIMC301	Feedback Control Systems	3	0	0	25	0	25	3	50
2	BVIMC302	Introduction to Electro Hydraulics & Electro Pneumatics	3	0	0	25	0	25	3	50
3	BVIMC303	Computerized Numerical Control Machines	3	0	0	25	0	25	3	50
4	BVIMC304	Microcontrollers & Applications	3	0	0	25	0	25	3	50
		Total							**12**	**200**
Skill Components										
		Lab/Practical								
5	BVIML305	Feedback Control Systems Lab	0	0	1	25	0	25	1.5	50
6	BVIML306	Introduction to Electro Hydraulics & Electro Pneumatics Lab	0	0	1	25	0	25	1.5	50
On-Job-Training (OJT) / Qualification Packs										
			IA			**EA**				
7	BVIME317	Calibration Technician (IAS/CSC/Q0801)	50			150			15	200
Total									**18**	**300**

Semester IV (Syllabus 2021-22)

Sr. No.	Course Code	Name of the Course	Teaching scheme			Evaluation Scheme			Credits	Total Marks
			L	T	P	IA	MSE	ESE		
General Education										
Theory										
1	BVIMC401	Introduction to Embedded Systems	3	0	0	25	0	25	3	50
2	BVIMC402	Process Control Instrumentation	3	0	0	25	0	25	3	50
3	BVIMC403	PLCs & Applications	3	0	0	25	0	25	3	50
4	BVIMC404	Flexible Manufacturing Systems	3	0	0	25	0	25	3	50
		Total							**12**	**200**
Skill Components										
Lab/Practical										
5	BVIML405	Process Control Instrumentation Lab	0	0	1	25	0	25	1.5	50
6	BVIML406	PLCs & Applications Lab	0	0	1	25	0	25	1.5	50
On-Job-Training (OJT) / Qualification Packs										
			IA			**EA**				
7	BVIME417	Industrial Automation Technician (IAS/Q5601)	50			150			15	200
		Total							**18**	**300**

Semester
III
Syllabus

Subject Name: Feedback Control System	
Course Code: BVIMC301	**Semester: III**
Weekly Teaching Hours: TH: 03 PR: 00	**Scheme of Marking TH: IA: 25, ESE: 25, Total: 50**
TH Exam Duration: 01 Hour	**Scheme of Marking PR: --**
Credits: 03	

Unit	Content	Hours
Unit 1	**Basics of Control System** 1.1 Introduction, Definitions and Classifications of control systems. 1.2 Open loop system and Closed loop system. Comparison of open loop and closed loop control system. 1.3 Feedback System, Servomechanisms 1.4 Regulating Systems (Regulators) 1.5 Definition of Laplace Transform, Basic Laplace Transform theorems. 1.6 Inverse Laplace Transform, Use of Laplace Transform in Control System.	**08**
Unit 2	**Block Diagram Representation and Signal Flow Graph** 2.1 Introduction to Transfer Function, Advantages and features of transfer function. 2.2 Simple or Canonical Form of Closed loop control system. 2.3 Rules for Block Diagram Reduction, Procedure to solve block diagram reduction problems. 2.4 Numerical based on closed loop control system. 2.5 Properties based on signal flow graph; Terminologies used in signal flow graph. 2.6 Mason's Gain Formula, Obtaining block diagram from signal flow graph.	**08**
Unit 3	**Time domain analysis** 3.1 Typical test signals, Time domain specifications. 3.2 Steady state response, Types of system. 3.3 Steady state error constants and steady state error, Numerical examples. 3.4 transient response, Numerical, Concept of stability 3.5 Determination of stability by Routh - Hurwitz criterion.	**08**
Unit 4	**Frequency domain analysis:** 4.1 Introduction to frequency response, Advantages of frequency domain analysis 4.2 Polar plots, Numerical, Bode plots, Principle of argument. 4.3 Nyquist criterion, Relative stability from Nyquist criterion, Numerical. 4.4 Definition of Root Locus, Construction of root locus, and Stability from root locus plots, Root counters. 4.5 Effect of addition of poles & zeros on root locus plots.	**08**
Unit 5	**Control System Components** 5.1 Servomotors, Types of servomotors. 5.2 AC Servomotor, DC Servomotor. 5.3 Comparison of Servomotors. 5.4 Stepper Motor, Synchro Transmitter.	**08**

Learning Resources			
Sr. No.	**Title of Book**	**Author**	**Publication**

1	Control System Engineering	I J Nagrath and M Gopal	New Age International Pvt. Ltd.
2	Feedback Control Systems	Uday A Bakshi and S C Goyal	Technical Publications, Pune ISBN 9788189411077
3	Control System Textbook	N K Sinha	New Age International Pvt. Ltd.
4	Management Control Systems	Robert Anthony and Vijay Govindarajan	Mc Graw Hill Education

Sr. No.	**Software / Learning Website**
1	Simulation software:-www.keil.com
2	MATLAB software:- www.mathworks.com
3	MATLAB programming software:- www.matlabhelper.com
4	Software:-www.analyticsvidhya.com

Subject Name: Introduction to Electro Hydraulics & Electro Pneumatics	
Course Code: BVIMC302	**Semester: III**
Weekly Teaching Hours: TH: 03 Tut: 00	**Scheme of Marking TH: IA: 25, ESE: 25 Total: 50**
TH Exam Duration: 01 Hour	**Scheme of Marking PR: --**
Credits: 03	

Unit	Content	Hours
Unit 1	**FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS** 1.1 Introduction to Fluid power, Advantages and Applications 1.2 Fluid power systems – Types of fluids, Properties of fluids and selection 1.3 Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power: Pumping Theory– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps –Problems.	**08**
Unit 2	**HYDRAULIC ACTUATORS AND CONTROL COMPONENTS** 2.1 Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning –Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications 2.2 Accessories: Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.	**08**
Unit 3	**HYDRAULIC CIRCUITS AND SYSTEMS** 3.1 Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electrohydraulic circuits, Mechanical hydraulic servosystems.	**08**
Unit 4	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS** 4.1 Properties of air 4.2 Perfect Gas Laws 4.3 Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, 4.4 Design of Pneumatic circuit –Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, 4.5 Introduction to fluidics and pneumatic logic circuits.	**08**
Unit 5	**TROUBLE SHOOTING AND APPLICATIONS** 5.1 Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, 5.2 Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low-cost Automation – Hydraulic and Pneumatic power packs.	**08**

Learning Resources			
Sr. No.	**Title of Book**	**Author**	**Publication**
1	Oil hydraulics in the service of industry	Anthony Lal	Allied publishers, 1982

2	Basic Fluid Power	Dudelyt, A. Pease and John T. Pippenger	Prentice Hall, 1987
3	Pneumatic systems – Principles and maintenance	Majumdar S.R.	Tata McGraw Hill, 1995
4	Power Hydraulics	Michael J, Prinches and Ashby J. G	Prentice Hall, 1989
5	Hydraulic and Pneumatic controls	Shanmugasundaram.K	Chand & Co, 2006

Subject Name: Computerized Numerical Control Machines	
Course Code: BVIMC303	**Semester: III**
Weekly Teaching Hours: TH: 03 Tut: 00	**Scheme of Marking TH: IA: 25, ESE: 25 Total: 50**
TH Exam Duration: 01 Hour	**Scheme of Marking PR: --**
Credits: 03	

Unit	Content	Hours
Unit 1	**Introduction & CNC Process** 1.1 SRP vs. RP, Prototype vs. Production Machining, Required Tools and Equipment, Lessons and Appendices, Instructional Resources, Recommended Use, Overview of CAD/CAM Process. **1.2 Shop Safety –** Safety Awareness, Shop Clothing, General Safety Practices, CNC Safety Practices.	**08**
Unit 2	**CNC Tools** 2.1 End Mills, Face Mill, Corner Radius Mill, Slot Mill/Slotting Saw, Center-Spot Drill, Twist Drill, Tap, Reamer, Counterbore, Cutting Tool Fundamentals, Rotational Direction, Chip Formation, Chip Load, Climb vs. Conventional Milling, Cutting Speeds and Feeds Formulas, Speed Formula, Feed Formula, Tap Feed Formula, Speed/Feed Examples.	**08**
Unit 3	**Coordinate Systems** 3.1 Cartesian Coordinate System, Number Line, 3D Cartesian Coordinate System, Quadrants, Units, Vertical Machining Center (VMC) Motion, CNC Motion Control. 3.2 CNC Machine Coordinates, Work Coordinate System (WCS), Machine and Tool Offsets, Machine Offset XY, Machine Offset Z, Tool Length Offset (TLO).	**08**
Unit 4	**CNC Programming Language** 4.1 CNC Language and Structure, Program Format, CNC Editor, Alphabetic & Special Character Address Codes, Alphabetic Address Code Definitions, 4.2 G&M Codes, G---Codes, M---Codes, Canned Cycles.	**08**
Unit 5	**CNC Operation** 5.1 **Overview** of CNC Setup and Operation, Machine and Tool Offsets, Fixture Offset XY, Fixture Offset Z, Tool Length Offset (TLO), Haas Control Face, Start/Home Machine, Load Tools, Set Tool Length Offset (TLO), Set Fixture Offset XY, Set Fixture Offset Z, 5.2 Load CNC Program, Run CNC Program, Adjusting Diameter (CDC) Offsets, Shut Down CNC	**08**

Learning Resources			
Sr. No.	**Title of Book**	**Author**	**Publication**
1	CNC Machine & Automation	BAJAJ SAINI & RAI	North Publication
2	An Introduction to NC/CNC Machine	S. Vishal	S. K. Kataria & Sons.
3	Numerical Control of Machine Tools	Martin,S.	Hodder Ltd.

Subject Name: Microcontrollers & Applications	
Course Code: BVIMC304	**Semester: III**
Weekly Teaching Hours: TH: 03 Tut: 00	**Scheme of Marking TH: IA: 25, ESE: 25 Total: 50**
TH Exam Duration: 01 Hour	**Scheme of Marking PR: --**
Credits: 03	

Unit	Content	Hours
Unit 1	**Basics of Microprocessor & Microcontroller** 1.1 Microprocessor, microcomputers, and microcontrollers (basic introduction and comparison). 1.2 Types of buses, address bus, data bus and control bus. 1.3 Harvard and Von-neuman architecture; 8051 microcontrollers: Architecture, Pin configuration. stack, memory organization. 1.4 Boolean processor, saving options - idle power mode. 1.5 Derivatives of 8051 (8951, 8952, 8031, 8751)	**08**
Unit 2	**8051 Instruction Set and programming** 2.1 Addressing modes 2.2 Instruction set (Data transfer, Logical, Arithmetic, Branching, Machine control, Stack operation, Boolean). 2.3 Embedded C language programming 2.4 Software development cycle: editor, assembler, cross compiler, linker, locator, compiler. 2.5 Assembler Directives: ORG, DB, EQU, END, CODE, DATA	**08**
Unit 3	**8051 Timers, Interrupts, Serial and Parallel Communication** 3.1 Timer/Counters: SFRs: TMOD, TCON, Timer/Counter - Logic and modes, Simple programs on timer to generate time delay. 3.2 Interrupts-SFRs:- IE, IP, Simple programs on interrupts 3.3 Serial communication - SFRs: SCON, SBUF, PCON, Modes of serial communication. Simple programs on serial communication. 3.4 I/O port structure and configuration - P0, P1, P2, P3	**08**
Unit 4	**8051 Memory and I/O device Interfacing** 4.1 Memory interfacing: - Program and data memory 4.2 I/O Interfacing: - LED, relays, keyboard, LCD, seven segment display, Stepper motor. 4.3 Interfacing DAC - 0808 with 8051 and its simple programming 4.4 Interfacing ADC - 0808/09 with 8051 and its simple programming.	**08**
Unit 5	**Applications of 8051 Microcontroller** 5.1 Square wave generation using port pins of 8051. 5.2 Square and triangular Waveform generation using DAC. 5.3 Water level controller. 5.4 Temperature controller using ADC (0808/09). 5.5 Stepper motor control for clockwise, Anti-clockwise rotation. 5.6 Traffic light con-roller	**08**

Learning Resources			
Sr. No.	**Title of Book**	**Author**	**Publication**

1	8051 Microcontroller Architecture, Programming and Application	Kenneth J. Ayala	PHI Learning New Delhi, July 2005, ISBN: 978-1401861582
2	Microcontroller Theory and Application	Ajay V. Deshmukh	McGraw Hill, New Delhi, 2017, ISBN- 978-0070585959
3	Microcontrollers Principle and Application	Ajit Pal	PHI Learning, New Delhi, 2014, ISBN: 978-81-203-4392-4
4	The 8051 Microcontroller and Embedded system Using Assembly and C	Muhammad Ali Mazidi. Gillispie Mazidi.Roli, n D.Mckinlay Janice	Pearson /Prentice Hall,, 2nd edition, Delhi,2008, ISBN 978¬8177589030
5	Microcontroller Architecture Programming, Interfacing and System Design	Raj Kamal	Pearson Education, Delhi, 2012, SBN:9788131759905
6	Microprocessors and Microcontrollers	Sunil Mathur, Jeebananda Panda	PHI Learning, NewDelhi, 2016, ISBN:978-81-203-5231-5
7	Architecture programming and System Design	Krishna Kant	PHI Learning New Delhi, 2016,ISBN:978-81-203

Sr. No.	**Software / Learning Website**
1	Simulation software: - www.keil.com
2	Microcontroller: - www.faqs.org/microcontroller
3	Microcontroller: - https://nptel.ac.in/course.html
4	Memory: - www.slideshare.net/aismahesh/memory-8051
5	Software: - www.edsim51.com
6	Microcontroller project: - www.8051projects.net/download-c4-8051-projects.html

Subject Name: Feedback Control System Lab	
Course Code: BVIML305	**Semester: III**
Weekly Practical Hours: PR: 01 Tut: 00	**Scheme of Marking TH: --**
TH Exam Duration: --	**Scheme of Marking PR: IA: 25, ESE: 25, Total: 50**
Credits: 1.5	

Sr. No.	List of Practical
1	Simulation of first order differential equation on MATLAB.
2	Simulation of second order differential equations on MATLAB.
3	Finding transfer function from frequency response plots.
4	Analysis of control system using MATLAB and basic command.
5	MATLAB programming.
6	MATLAB simulation program.
7	MATLAB and its basic command.
8	Solution of state space equation using MATLAB Program.

Subject Name: Introduction to Electro Hydraulics and Electro Pneumatics Lab	
Course Code: BVIML306	**Semester: III**
Weekly Practical Hours: PR: 01 Tut: 00	**Scheme of Marking TH: --**
TH Exam Duration: --	**Scheme of Marking PR: IA: 25, ESE: 25, Total: 50**
Credits: 1.5	

Sr. No.	List of Practical
1	A] Study of Construction and working Hydraulic pumps and Pneumatic B] Study of Hydraulic and Pneumatic valves. C] Study of solenoid valves, limit switches. Pressure, flow control valve
2	Basic hydraulic circuit for the working of double acting cylinder and a hydraulic motor.
3	Basic pneumatic circuit for the working of single and double acting cylinder.
4	Speed control circuits. Different Metering methods Inlet & outlet flow control (meter-in & meter-out circuit)
5	Circuits for the Use of different direction control valves and valve actuation in single And double acting cylinder, and multi actuation circuit.
6	Hydraulic Counter-balancing circuit.
7	Hydraulic or Pneumatic Regenerative circuit.
8	Hydraulic or Pneumatic Sequencing circuit.
9	Hydraulic Unloading circuit.
10	Circuit with cam operated pilot valves operating a pilot operated 4way direction control

Qualification Pack

Subject Name: Calibration Technician (CSC/Q0801)	
Course Code: BVIME317	**Semester: III**
Weekly Skilling Hours: PR: 24 Tut: 00	**Scheme of Marking TH: --**
PR Exam Duration: 06 Hours	**Scheme of Marking PR: IA: 50, ESE: 150, Total: 200**
Credits: 15	

Syllabus for this qualifier pack is available on
https://www.cgsc.in/pdf/Final%20Curriculum_Calibration%20Technician.pdf

Semester
IV
Syllabus

Subject Name: Introduction to Embedded Systems	
Course Code: BVIMC401	**Semester: IV**
Weekly Teaching Hours: TH: 03 Tut: 00	**Scheme of Marking TH: IA: 25, ESE: 25 Total: 50**
TH Exam Duration: 01 Hour	**Scheme of Marking PR: --**
Credits: 03	

Unit	Content	Hours
Unit 1	**Introduction to Embedded Systems** 1.1 Block diagram of embedded system with hardware components 1.2 Harvard and Von-Neumann Architecture, RISC and CISC Processors 1.3 Features of 8051, PIC, AVR and ARM microcontrollers with their applications. 1.4 Characteristics of embedded systems: Processor Power, Memory, Operating Systems, Reliability, Performance, Power Consumption, NRE Cost, Unit Cost, Size, Flexibility, Time-to-prototype, Time-to-Market, Maintainability, Correctness and Safety. 1.5 Classification of Embedded System: small scale, medium scale, sophisticated, stand-alone, reactive/real time (Soft and Hard Real Time)	**09**
Unit 2	**Programming using Embedded C** 2.1 Programming with Embedded C: arithmetic and logical operations, data transfer with memory and port, decision control and looping 2.2 Timer/Counter program using embedded C for given microcontroller 2.3 Serial communication using embedded C for given microcontroller 2.4 Interrupt control program using embedded C for given microcontroller	**09**
Unit 3	**Communication standards** 3.1 Modes of data communication: serial parallel, synchronous and synchronous communication 3.2 Serial communication standards: RS232 3.3 MAX232 as a bidirectional level converter 3.4 Communication protocols i. Serial communication 12C, CAN, USB, script peripheral 3.5 Interface (SPI), synchronous serial protocol (SSP) i. Parallel communication protocols: PCI, PCI-X 3.6 Features of advanced serial protocol: IrDA, Bluetooth, ZigBee	**09**
Unit 4	**Interfacing Input and Output** 4.1 Interface the various input, output and special devices to the microcontroller 89C51/AVR 4.2 Output Devices: LED, LCD, relays, 7-segment displays, multiplex 7-Segment display 4.3 Input Devices: key, matrix keyboard 4.4 Motor: stepper motor, DC motor 4.5 ADC/DAC: 8-bit ADC/DAC (0808/09) 4.6 Sensor: Temperature sensor (LM35)	**09**
Unit 5	**Case Studies** 5.1 General Purpose Embedded System – Camera, Washing Machine, Microwave Oven 5.2 Real Time Operated Embedded System – Space Shuttle, Military RADAR System	**04**

Learning Resources			
Sr. No.	**Title of Book**	**Author**	**Publication**
1	8051 Microcontroller Architecture, Programming and Application	Ayala, Kenneth	Cenage learning, 3rd edition, New Delhi,2007, ISBN: 978-8131502006
2	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Janice, Gelispe and Mckinlay, Roline D.	Pearson, 2nd edition, Delhi, 2008, ISBN: 9788177589030
3	Microcontroller Principle and Application	Pal, Ajit	PHI, New Delhi,2014, ISBN: 9788120343924
4	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill Education, New Delhi, 2011, ISBN: 9780070585959
5	Microcontroller Architecture Programming, Interfacing and System Design	Rajkamal	Pearson Education India, Delhi, 2012, ISBN: 9788131759905
6	The Embedded Software Primer	David E. Simon	Addison-Wesley, Delhi ISBN: 9780201615692

Sr. No.	**Software / Learning Website**
1	Simulation Software :- WWW.keil.com
2	https://www.arduino.cc
3	https://scilab-arduino.fossee.in
4	www.nptel.ac.in/courses/Webcourse-contents/IITKANPUR/microcontrollers/micro/ui /Course_home2 5.html
5	www.nptelvideos.in/2012/11/real-time-systems.html
6	RTOS:- https://www.youtube.com/watch?v=rpdygqOI9mM
7	www.intorobotics.com/8051-microcontroller-programming-tutorialssimulators-compilers-and-programmers
8	www.electrofriends.com/articles/electronics/microcontroller-electronics-articles/8051-8951/8051 8951-microcontroller-instruction-set
9	www.ikalogic.com/part-l-introduction-to-8051-microcontrollers
10	www.binaryupdates.com/switch-with-8051-microcontroller
11	www.mikroe.com/chapters/view/64/chapter-l-introduction-to-microcontrollers
12	https://www.8051projects.net/download-c4-8051-projects.html
13	https://www.elproctis.com/difference-between-avr-arm-8051-and-pic-microcontroller

Subject Name: Process Control Instrumentation	
Course Code: BVIMC402	**Semester: IV**
Weekly Teaching Hours: TH: 03 Tut: 00	**Scheme of Marking TH: IA: 25, ESE: 25 Total: 50**
TH Exam Duration: 01 Hour	**Scheme of Marking PR: --**
Credits: 03	

Unit	Content	Hours
Unit 1	**Process Characteristics:** 1.1 Types of processes- dead time single & multi capacity, self & non-self-regulating, interacting & non-interacting, Linear & non-linear, 1.2 Process gain, process reaction curve 1.3 process time constant & constant step analysis method for finding time constant 1.4 PID control of processes, Process simulator.	**09**
Unit 2	**Introduction to Chemical Process Control:** 2.1 Incentives for Chemical Process Control, Design aspects and Hardware for a Process Control System 2.2 Modelling of Chemical Processes Development of a mathematical model, 2.3 State Variables and State Equations, Additional Equations, Additional Elements of the Mathematical Models 2.4 Dead Time Modelling Difficulties The input-output Model; Degrees of freedom and process controllers; Transfer function of a process with single/multiple outputs.	**09**
Unit 3	**Analysis and Design of Advanced Control systems:** 3.1 Feedback control systems with large dead time or inverse response; cascade, selective and split range control; feed forward and ratio control; adaptive and inferential control systems.	**07**
Unit 4	**Control Systems for various processes:** 4.1Development of control loops, Design aspects and selection criterion for field instruments and instrumentation scheme for boiler, compressors, pumps, chiller, evaporators, dryer, cooling tower, distillation column, 4.2 CSTR Design aspects of Instrumentation for Power, Water and Waste-Water Treatment, Food and Beverages, Pharmaceuticals (Introduction to International Standards S88, S95 and US FDA 21CFR 11), Cement, Automobile and Building Automation. 4.3 Composite controllers: PI, PD, PID controllers- o/p equation, response	**06**
Unit 5	**Analysis & properties of some common loops:** 5.1 Flow, pressure level, temperature, composition, pH etc., linear & non-linear controllers, review of PID with limitations (offset, saturation in D, & reset windup) rate before reset, PID variations & tuning , digital controller(position & velocity algorithms, effect of sampling time) hardware structures, features & specification, single loop & multi loop controller & the application programs (PID, Timer, counter, dead time, lead lag, linearise, add-subtract-multiplication-division of two input signals temp, pressure compensation of gas flow, sq. root, median selector, pattern program, radio set, adaptive gain, feed forward, valve lineariser etc.) non-linear controller-two state, three state, proportional time, dual mode optimal switching. 5.2 Chemical and biochemical sensors: Polymers, chemically modified Electrodes (CME), affinity sensors, Potentiometric and Amperometric devices, catalytic sensors, Gas sensors etc.	**09**

Learning Resources			
Sr. No.	**Title of Book**	**Author**	**Publication**
1	Process control Instrumentation Technology	Johnson, C. D.	Prentice Hall, 8th edition, United StatesofAmerica,2014 ISBN: 978-0131194571
2	Process Control Systems	F. G. Shinskey	Tata- McGraw Hill, 3'"Edition, 2010 ISBN: 9780071067386
3	Control System Engineering	Magrath, J.J.; Gopal, M.	Anshan Publishers (2008) ISBN:9781848290037
4	Modern control Engineering	Ogata, K.	PHI, 5th Edition, NEW DELHI, 2010 ISBN: 978812034010
5	Instrumentation Engineers Handbook: Process Control	B. G. Liptak	Chilton Book Company Penram. lst Edition, Mumbai. 2007 ISBN: 9788187972174
6	Programmable logic Controllers	Petruzella, F.D.	Tata- McGraw Hill, 3'"Edition, 2010 ISBN: 9780071067386

Sr. No.	**Software / Learning Website**
1	www.scilab.org
2	www.openplc.fossee.in
3	www.github.com/FOSSEE/OpenPLC
4	www.dreamtechpress.com /ebooks
5	www.nptelvideos.com/control_systems/
6	www.in.mathworks.com/solutions/control-systems.html?s_tid=srchtitle
7	www.edx.org/course?subject=Engineering&course=all&language=English
8	www.plcs.net
9	www.ab.rockwellautomation.com> Allen-Bradley
10	www.plc-training-rslogix-simulator.soft32.com/free-download/

Subject Name: PLCs & Applications	
Course Code: BVIMC403	**Semester: IV**
Weekly Teaching Hours: TH: 03 Tut: 00	**Scheme of Marking TH: IA: 25, ESE: 25 Total: 50**
TH Exam Duration: 01 Hour	**Scheme of Marking PR: --**
Credits: 03	

Unit	Content	Hours
Unit 1	**PLC Overview** 1.5 Definition & History of PLC 1.6 Basic structure & Components of PLC, Principle of Operation, need and benefits of PLC in automation 1.7 Description of different parts of PLC: CPU-function, scanning cycle, speed of execution, Power supply – block diagram and function of each block 1.8 Selection of PLC – Why Use PLC, PLC I/O Modules, 1.9 Memory & How it is used 1.10 PLC advantages & Disadvantages, 1.11 PLC vs Computers, 1.12 Overview of Micro PLCs. 1.13 Conventional ladders vs PLC Ladder logic 1.14 What is Logic? Overview of Logic functions 1.15 Number systems & Codes, 1.16 Hardwired Logic vs Programmed logic, 1.17 Programming word level logic instructions, Relation of digital gate logic to contact/coil logic, Relay logic, Relay Sequencers.	**09**
Unit 2	**PLC Hardware and Programming** 2.1 Discrete input modules: Block diagram, specifications of AC input modules and DC input modules. Sinking and sourcing concept in DC input modules 2.2 Discrete output modules: Block diagram description, specifications of AC output module and DC output modules 2.3 Analog input and output mod diagram, specifications 2.4 I/O addressing of PLC: Addressing data files, format of logical address, different addressing types 2.5 PLC Instruction set: Relay instructions, timer and counter instructions, data movement instructions, logical and comparison instructions 2.6 PLC Programs using Ladder programming language. 2.7 Basic Functions: PLC Timer & Counter functions, Timer & Counter Industrial applications, Arithmetic functions, Comparison functions, Jump functions, Data handling functions, Digital Bit functions, PLC matrix Functions, Advanced PLC Functions: Analog PLC operation, PID control of Continuous processes. 2.8 Write a PLC program for a) controlling lubricating oil being dispensed from a tank, b) Automatic water sprinkler system of a garden.	**09**
Unit 3	**PLC Installation, Troubleshooting & Maintenance** 3.1 Installation: Consideration of operating environment, receiving test, check & assembly, Electrical Noise, Leaky inputs & outputs, Grounding, voltage variations & surges, Circuit protections & wiring, Program Editing & Commissioning. Troubleshooting: Processor module, Input & Output malfunctions, Ladder logic program. PLC Maintenance.	**07**

Unit 4	**Process Controllers** 4.1 Process Control System: Block diagram, functions of each block 4.2 Control actions: i. Discontinuous mode- ON-OFF controllers-equation, neutral zone ii. Continuous modes: Proportional Controller - offset, proportional band. Proportional, Integral and Derivative controllers -o/p equation, response, characteristics, 4.3 Composite controllers: PI, PD, PID controllers- o/p equation, response	**06**
Unit 5	**Process Control with HMI & SCADA** 5.1 SCADA (Supervisory control and data acquisition): Block diagram, RTU (Remote terminal unit), Functions of RTU, MTU (Main terminal unit), functions of MTU, operating interfaces & applications, 5.2 HMI (Human Machine Interface, Interfacing technique of PLC with HMI.	**09**

Learning Resources

Sr. No.	Title of Book	Author	Publication
1	Process control instrumentation Technology	Johnson, C. D.	Prentice Hall, 8th edition, United States of America,2014 ISBN: 978- 0131194571
2	Intro. To Programmable logic control	Dunning, Gary	Cenage Learning, United States of America, 2005 ISBN: 9781401884260
3	Control System Engineering	Magrath, J.J.; Gopal, M.	Anshan Publishers (2008) ISBN: 9781848290037
4	Modern control Engineering	Ogata, K.	PHI, 5th Edition, NEW DELHI,2010 ISBN: 978812034010
5	Programmable logic controllers and industrial automation an introduction	Mitra, Madhuchhanda; Gupta, Samarjit Sen	Penram.lst Edition, Mumbai. 2007 ISBN: 9788187972174
6	Programmable logic Controllers	Petruzella, F.D.	Tata- McGraw Hill, 3'"Edition, 2010 ISBN: 9780071067386

Sr. No.	Software / Learning Website
1	www.scilab.org
2	www.openplc.fossee.in
3	www.github.com/FOSSEE/OpenPLC
4	www.dreamtechpress.com /ebooks
5	www.nptelvideos.com/control_systems/
6	www.in.mathworks.com/solutions/control-systems.html?s_tid=srchtitle
7	www.edx.org/course?subject=Engineering&course=all&language=English
8	www.plcs.net
9	www.ab.rockwellautomation.com> Allen-Bradley
10	www.plc-training-rslogix-simulator.soft32.com/free-download/

Subject Name: Flexible Manufacturing Systems	
Course Code: BVIMC404	**Semester: IV**
Weekly Teaching Hours: TH: 03 Tut: 00	**Scheme of Marking TH: IA:25, ESE: 25 Total: 50**
TH Exam Duration: 01 Hour	**Scheme of Marking PR: --**
Credits: 03	

Unit	Content	Hours
Unit 1	**INTRODUCTION** 1.1 Introduction to Manufacturing Systems: Components, Classification Scheme, Single Station Automated Cells, 1.2 Applications of Single Station Automated Cells, Fundamentals of Manual Assembly Lines, Analysis of Manual Assembly Lines, Line Balancing Algorithms, Considerations in Assembly Line Design.	**09**
Unit 2	**FLEXIBLE MANUFACTURING SYSTEM** 2.1 Introduction, Components of FMS, Applications, Benefits, FMS planning and Implementation issues, 2.2 Quantitative Analysis of FMS. Fundamentals of NC Technology, Computer Numerical Control, Distributed Numerical Control, 2.3 Applications of NC, NC part programming. Sample NC programs including step, groove, taper, and profile turning.	**09**
Unit 3	**PRODUCTION LINES** 3.1 Automated Production Lines: Fundamentals, Applications, Analysis of Transfer Lines, Fundamentals of Automated Assembly Lines, 3.2 Cellular Manufacturing Part Classifications and Coding, 3.3 Applications of Group Technology, Quantitative analysis of Cellular Manufacturing.	**07**
Unit 4	**PRODUCTION PLANING** 4.1 Process Planning, Computer Aided Process Planning, Concurrent Engineering and Design for Manufacturing, Advanced Manufacturing Planning, Material Requirement Planning, Capacity Planning, Shop Floor Planning, 4.2 Inventory Control, Lean Production, Just in Time Production Systems, Automation.	**06**
Unit 5	**QUALITY CONTROL** 5.1 Quality Programs in Manufacturing: Process Variability and Process capability, Statistical Process Control, 5.2 Six Sigma, Taguchi Methods in Quality Engineering, ISO 9000. Coordinate Measuring Machine, Machine Vision, Non-contact, Non-Optical Inspection Techniques.	**09**

Learning Resources			
Sr. No.	**Title of Book**	**Author**	**Publication**
1	Automation, Production Systems, and Computer Integrated Manufacturing	Mikell P. Groover	Prentice Hall Publishing New Delhi; ISBN 978-81-203-3418-2

Subject Name: Process Control Instrumentation Lab	
Course Code: BVIML405	**Semester: IV**
Weekly Practical Hours: PR: 01 Tut: 00	**Scheme of Marking TH: --**
TH Exam Duration: --	**Scheme of Marking PR: IA: 25, ESE: 25, Total: 50**
Credits: 1.5	

Sr. No.	List of Practical (Any 08)
1	Design of an electronic ON-OFF controller and plot the characteristics of natural zone of controller
2	Design an electronic PID controller and study its response for step input.
3	Design electronic temperature transmitter for transmitting temperature from 50OC -90O C to 4 -20mA.
4	To determine the mathematical model of the given process (anyone)
5	Study the close loop flow control system
6	To study the Tuning of a controller using different algorithm.
7	To study the adaptive control system
8	To study the cascade and Ratio control systems.
9	To study the design aspect of instrumentation scheme for boiler, compressors, pumps, chiller, evaporators, dryer, cooling tower, distillation column, CSTR Design aspects of Instrumentation for Power, Water and Waste-Water Treatment, Food and Beverages, Pharmaceuticals (any three)
10	To study the Chemical and biochemical sensors.

Subject Name: PLCs and Application Lab	
Course Code: BVIML406	**Semester: IV**
Weekly Practical Hours: PR: 01 Tut: 00	**Scheme of Marking TH: --**
TH Exam Duration: --	**Scheme of Marking PR: IA: 25, ESE: 25, Total: 50**
Credits: 1.5	

Sr. No.	List of Practical (Any 08)
1	Simple Start/Stop Ladder Logic Relay
2	Simple Push Button On/Off Ladder Logic
3	PLC Program Example with On Delay Timer
4	PLC Program Example with Off Delay Timer
5	PLC Program Example with On Retentive Timer
6	Star Delta PLC Ladder Diagram
7	Ladder Diagram for DOL Motor Starter
8	Traffic Light Ladder Logic Diagram
9	Ladder Logic Diagram for Bottle Filling Plant
10	PLC Ladder Diagram for Elevator Control
	11, 12, 13 Implement Experiments 8, 9 and 10 Using PLC Hardware

Qualification Pack

Subject Name: Industrial Automation Technician (CSC/Q0801)	
Course Code: BVIME417	**Semester: IV**
Weekly Skilling Hours: PR: 24 Tut: 00	**Scheme of Marking TH: --**
PR Exam Duration: 06 Hours	**Scheme of Marking PR: IA: 50, ESE: 150, Total: 200**
Credits: 15	

Syllabus for this qualifier pack is available on
http://www.iascsectorskillcouncil.in/iascadm/images/IndustrialAutomationTehnician.pdf