Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

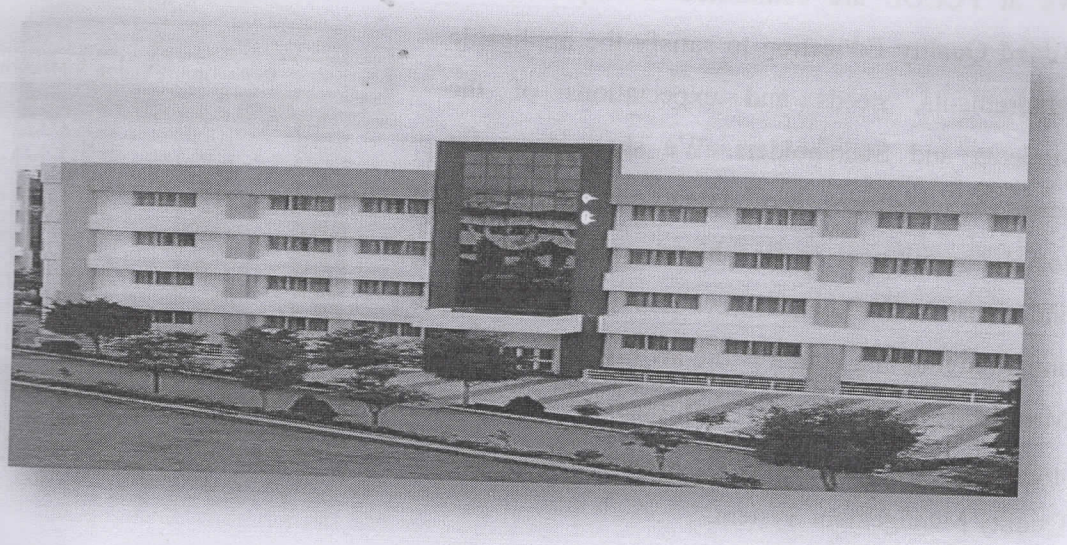
An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune

Curriculum Structure and Syllabus

of

B. Voc. Mechatronics Engineering

(Regulations 2023)



Effective from Academic Year 2024-25

Chairman
BoS B.Voc. Program
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Chairman
Academic Council
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Institute Vision

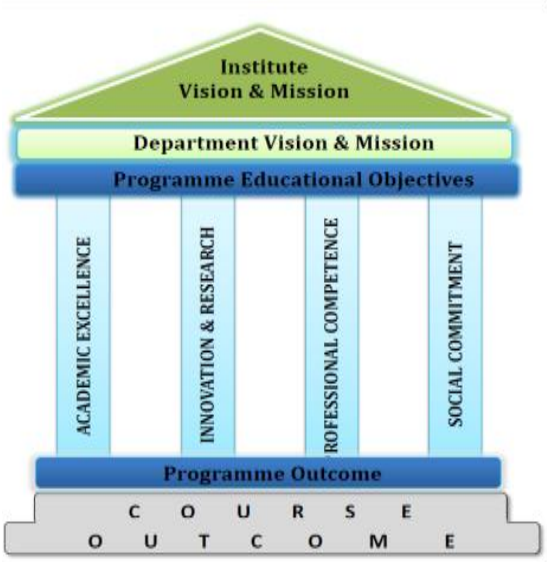
To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations.

Quality Policy

We at PCCOE are committed to impart Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders. We shall strive for academic excellence, professional competence and social commitment in fine blend with innovation and research. We shall achieve this by establishing and strengthening state-of- the-art Engineering and Management Institute through continual improvement in effective implementation of Quality Management System.



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ABBREVIATIONS

Abbreviations	Course Full Name
MJ	Major Course
MI	Minor Course
MD	Multidisciplinary Course
AEC	Ability Enhancement Course
VAC	Value added Course
SEC	Skill Enhancement Course
FA	Formative Assessment
SA	Summative Assessment

CURRICULUM STRUCTURE

STRUCTURE FOR IST YEAR B. Voc. (MECHATRONICS ENGINEERING)

SEMESTER I

B. Voc. Structure	Sem-I		Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**SA**	**TW**	**OR**	**PR**	**Total**
VME21101	MJ	Major Course I:: Sensors and Actuators	3	-	3	3	25	25	50	-	-	-	100
VME21201	MI	Minor Course I: Engineering Drawing	3	-	3	3	25	25	50	-	-	-	100
VME21301	MD	Multidisciplinary Course I: Applied Science	2	-	2	2	20	20	40	-	-	-	80
VME21401	AEC	Ability Enhancement Course I: Writing skills		2	2	1	-	-	-	50	-	-	50
VME21501	VAC	Value added Course I: Health & wellness		2	2	1	-	-	-	50	-	-	50
VME21601	SEC	Internship I: On Job Training: CON/Q1003	-	20	20	10	-	-	-	-	-	200	200
		Total	**8**	**24**	**32**	**20**	70	70	**140**	**100**	**-**	**200**	**580**

SEMESTER II

B. Voc. Structure	Sem-II		Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA1**	**FA2**	**ETE**	**TW**	**OR**	**PR**	**Total**
VME22102	MJ	Major Course II: Microcontrollers	3	-	3	3	25	25	50	-	-	-	100
VME22202	MI	Minor Course II: Basics of Electrical & Electronics	3	-	3	3	25	25	50	-	-	-	100
VME22302	MD	Multidisciplinary Course II: Applied Mathematics	2	-	2	2	20	20	40	-	-	-	80
VME22402	AEC	Ability Enhancement Course II: Soft Skills		2	2	1	-	-	-	50	-	-	50
VME22502	VAC	Value added Course II: IT Tools		2	2	1	-	-	-	50	-	-	50
VME22602	SEC	Internship II: On Job Training.	-	20	20	10	-	-	-	-	-	200	200
		Total	**8**	**24**	**32**	**20**	70	70	**140**	**100**	**-**	**200**	**580**

STRUCTURE FOR IIND YEAR B. Voc. (MECHATRONICS ENGINEERING)
SEMESTER III

B. Voc. Structure		Sem-III	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA 1**	**FA 2**	**SA**	**TW**	**OR**	**PR**	**Tota**
VME23103	MJ	Major Course III: Fluid Power Systems	2	-	2	2	20	20	40	-	-	-	80
VME23104	MJ	Major Course IV: Fluid Power Systems Lab	-	2	2	1	-	-	-	-	-	50	50
VME23203	MI	Minor Course III: Manufacturing Technology	2	-	2	2	20	20	40	-	-	-	80
VME23204	MI	Minor Course IV: Manufacturing Technology Lab	-	2	2	1	-	-	-	-	-	50	50
VME23303	MD	Multidisciplinary Course III: IT Tools II	2	-	2	2	20	20	40	-	-	-	80
VME23403	AEC	Ability Enhancement Course III: Business Communication I		2	2	1	-	-	-	50	-	-	50
VME23503	VAC	Value added Course III: Health & Wellness II		2	2	1	-	-	-	50	-	-	50
VME23603	SEC	Internship III: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**6**	**28**	**34**	20	60	60	**120**	**100**	**-**	**300**	**640**

SEMESTER-IV

B. Voc. Structure		Sem-IV	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA 1**	**FA 2**	**SA**	**TW**	**OR**	**PR**	**Total**
VME24104	MJ	Major Course IV: Industrial Automation	3	-	3	3	25	25	50	-	-	-	100
VME24105	MJ	Major Course IV: Industrial Automation Lab	-	2	2	1	-	-	-	-	-	50	50
VME24205	MI	Minor Course V: Metrology and Measuring Instruments	2	-	2	2	20	20	40	-	-	-	80
VME24404	AEC	Ability Enhancement Course IV: Business Communication II		2	2	1	-	-	-	50	-	-	50
VME24504	VAC	Value added Course IV: Environmental Science		2	2	1	-	-	-	50	-	-	50

VME24604	SEC	Project I: Mini Project	-	4	4	2	-	-	-	-	-	50	50
VME24605	SEC	Internship III: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**5**	**30**	**35**	20	45	45	**90**	**100**	**-**	**300**	**580**

Abbreviation: L- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **FA–**Formative Assessment**, SA**-Summative Assessmen; **TW** – Term Work; **OR** – Oral Exam, **PR** – Practical Exam.

STRUCTURE FOR IIIRD YEAR B. Voc. (MECHATRONICS ENGINEERING)

SEMESTER V

B. Voc. Structure		Sem-V	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA 1**	**FA 2**	**SA**	**TW**	**OR**	**PR**	**Tota**
VME25106	MJ	Robot Kinematics & Dynamics	3	-	3	3	25	25	50	-	-	-	100
VME25107	MJ	Robot Kinematics & Dynamics Lab	-	2	2	1	-	-	-	-	-	50	50
VME25108	MJ	Mounting and Communication of Sensor	3	-	3	3	25	25	50	-	-	-	100
VME25109	MJ	Mounting and Communication of Sensor Lab	-	2	2	1	-	-	-	-	-	50	50
VME25206	MI	Computer Aided Manufacturing	2	-	2	2	20	20	40	-	-	-	80
VME25606	SEC	Internship V: On Job Training	-	20	20	10	-	-	-	-	-	200	200
		Total	**8**	**24**	**32**	20	70	70	**140**	**-**	**-**	**300**	**580**

SEMESTER-VI

B. Voc. Structure		Sem-VI	Teaching Scheme				Examination Scheme						
Course Code	**Course Type**	**Course Name**	**L**	**P**	**H**	**CR**	**FA 1**	**FA 2**	**SA**	**T W**	**OR**	**PR**	**Tota**
VME26110	MJ	Robotic Programming	3	-	3	3	25	25	50	-	-	-	100
VME26111	MJ	Robotic Programming Lab	-	2	2	1	-	-	-	-	-	50	50
VME26207	MI	Product Development	2	-	2	2	20	20	40	-	-	-	80
VME26607	SEC	Project II: Project	-	8	8	4	-	-	-	50	150	-	200
VME26608	SEC	Internship VI: On Job Training	-	20	20	10	-	-	-	-	-	200	200
Total			**5**	**30**	**35**	**20**	**45**	**45**	**90**	**50**	**150**	**250**	**630**

Abbreviation: L- Lecture; **P**- Practical; **H**- Hours; **CR**- Credits; **FA–**Formative Assessment**, SA**-Summative Assessment; **TW** – Term Work; **OR** – Oral Exam, **PR** – Practical Exam.

Course Syllabus
Semester-I

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: I**	
Course:	**Sensors and Actuators**				**Code: VME21101**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. Study of means of measuring various physical variables.
2. Study of different types of sensors and actuators.

Course outcomes:

After learning the course, student will be able to

1. To understand role of Sensor and transducers in instrumentation
2. To understand Motion, Proximity and Ranging Sensors
3. To understand Force, Magnetic and Heading Sensors
4. To understand Optical, Pressure and Temperature Sensors
5. To understand Signal Conditioning and DAQ Systems
6. To understand different actuators

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs.)**
1	**Introduction** Mechatronics system building block, Basics of Measurement and types – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types, sensor selection	7
2	**Motion, Proximity And Ranging Sensors** Motion Sensors – Potentiometers, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT, RVDT, Accelerometer., GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)	7
3	**Force, Magnetic And Heading Sensors** Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers	7
4	**Optical, Pressure And Temperature Sensors** Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermister, RTD, Pt 100, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors	8
5	**Signal Conditioning And DAQ Systems** Amplification – Filtering – Sample and Hold circuits, analog to digital conversion, Data Acquisition: Single channel and multi- channel data acquisition – Data logging – applications - Automobile, Aerospace, Home appliances, Manufacturing	8
6	**Actuators** Stepper and Servo motors, Basics of Stepper and Servo motors, Types of Stepper and servomotors, Construction, working principle, technical specifications and selection, Advantages and Disadvantages, Solenoids: Construction, working principle	8

Text Books:

1. Bolton W., *Mechatronics: Electronics Control Systems in Mechanical and Electrical Engineering*, Pearson Publication, 2019.
2. Ramchandran K. P., Vijayaraghavan G. K., Balasundaram M. S., *Mechatronics: Integrated*

Mechanical Electronic Systems, Willey Publication, 2008.

Reference Books:

1. Alciatore D. G., *Introduction to Mechatronics and Measurement Systems*, Mc-Graw Hill publication, 2019.
2. Mahalik N. P., *Mechatronics Principles, concepts and applications*, Tata Mc-Graw Hill publication, 2016.

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: I**	
Course:	**Engineering Drawing**				**Code: VME21201**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. To develop imagination of physical objects to be represented on paper for engineering communication.
2. To develop the interpretation and manual drawing skills.
3. To develop the physical realization and manual drawing skill

Course Outcomes:

After learning the course, students will be able to

1. Understand the drawing sheets, dimensioning and tolerances
2. Understand and draw the projections of point and line on reference planes, inclined planes.
3. Understand the orthographic projections, first and third angle projections methods, draw orthographic views
4. Understand and draw the Isometric scale, construction of Isometric view of simple objects
5. Understand and draw the development of lateral surfaces of simple solids.
6. Understand and draw the free hand sketches of standard components of machine.

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs.)**
1	**Introduction** Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice, Dimensioning – linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Tolerances – methods of representing tolerances, unilateral and bilateral tolerances, tolerance on linear and angular dimensions, geometrical tolerances.	7
2	**Projection of Line and Planes** Introduction, Projection of points – points on the different quadrants and on the reference planes. Projection of straight lines (only first angle projection method) – Line on the reference planes - perpendicular to one plane and parallel to other plane – inclined to one plane and parallel to the other plane – parallel to both the planes –inclined to both the planes. Projection of planes (only first angle projection method) - Types of planes, Projection of planes perpendicular to both the reference planes, Perpendicular to one plane and parallel to other plane, Perpendicular to one plane and inclined to the other plane, Inclined to both planes.	8
3	**Orthographic Projections** Reference planes, types of orthographic projections – First angle projections, Third angle projections, methods of obtaining orthographic views by First angle method.	6
4	**Isometric View** Introduction, Isometric scale, construction of Isometric view of simple objects from given orthographic.	8
5	**Development of Lateral Surfaces of Solids** Introduction, Development of lateral surfaces of Cone, Cylinder, Pyramid and	8

	Prism.	
6	**Freehand Sketching and introduction of AutoCAD software** Free hand sketching -- FV and TV of standard machine parts – Hexagonal headed nut and bolt, foundation bolts, shafts, keys, couplings, springs, human heights, doors, windows	8

Text Books:

1. Bhatt N.D., and Panchal V.M., *Engineering Drawing*, *Charotar Publishing House*, 2010.
2. Agrawal B., and Agrawal C M "*Engineering drawing*", Tata McGraw Hill Education Private Limited., 2014.

Reference books:

1. Gill P. S., *Engineering drawing*, S.K. Kataria & Sons. 2016.
2. Gopalakrishnan K. R., *Engineering Drawing*, (Vol.I and Vol.II), Dhanalakshmi publishers, 1970.
3. Venugopal K, and Sreekanjana G., *Engineering Graphics*, New Age International Publishers. 2019.
4. Natarajan K. V., *A text book of Engineering Drawing Graphics*. Dhanalakshmi Publishers, 2008.

Program:	B. Voc. (Mechatronics Engineering)		Semester: I			
Course:	Applied Science		Code: VME21301			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	FA 1	FA 2	SA	Total
2	2	2	20	20	40	80

Course Objectives:

To develop an ability of understanding the phenomena with the help of science concepts and relate them to applications.

Course Outcomes:

After learning the course, students will be able to

1. Understand the quality of water, its softening techniques and quality of fuel and its different types.
2. Interpret the optical phenomena - reflection, refraction, polarization with wave nature of light.
3. Understand what is corrosion, its types and its consequences in environment.
4. Summarize production of ultrasonic waves and their applications.

Detailed Syllabus:

Unit	Description	Duration (30Hrs)
1	**Water** Impurities in water, methods of their removal, hardness of water, its types and units. Chemical analysis of water by determination of hardness by EDTA method and its numericals. Disadvantages of hard water in boilers, Water softening techniques: Permutit Water purification by reverse osmosis **Fuel and their Classification** Definition, characteristics, classification into solid, liquid and gaseous fuel. Calorific value of fuels – GCV, NCV and their relation. Coal, its types and their properties, proximate analysis and ultimate analysis. Gaseous fuels- Gaseous fuels: Hydrogen gas as a future fuel, production by steam reforming of methane and coke, storage and transportation. .	8
2	**Optics:** Electromagnetic wave nature of light, electromagnetic spectrum, reflection and refraction of a wave from a plane surface, laws of reflection and refraction, total internal reflection, plane polarized light, Law of Malus.	8
3	**Corrosion** Theory of corrosion. Different types of corrosion: Pitting corrosion, concentration cell corrosion, stress corrosion and soil corrosion. Factors affecting corrosion: nature of metal and nature of environment. Prevention of corrosion by various methods using metallic and non- metallic coatings like – hot dipping, cladding, electroplating and cementation and powder coating.	7
4	**Vibrations &Ultrasonic waves:** Vibration as simple spring mass system, elementary and qualitative concept of free and forced vibrations, resonance Ultrasonic waves, properties of ultrasonic waves, Productions of ultrasonic waves by magnetostriction and piezo-electric effect,application of ultrasonic in industry	7

Text Books:

1. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishing Co., sixteenth edition ,2016.
2. M. N. Avadhanulu ,P.G. Kshirsagar , A text book of Engineering Physics, S. Chand publication ,revised edition, 2015

Reference books:

1. Wiley Editorial, Engineering Chemistry, Wiley India, 2nd edition, 2012.
2. O.G. Palanna, Engineering Chemistry, Tata McGraw-Hill Education, 2009.
3. R. K. *Gaur*, S. L. *Gupta* , Engineering Physics, Dhanpat Rai Publications, 8th edition ,2001.

Program: B. Voc. (Mechatronics Engineering)					**Semester: I**	
Course: Writing Skills					**Code: VME21401**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. To introduce students to effective writing.
2. To expose students to various types of documents
3. To equip students with fundamental skills for effective written communication.

Course Outcomes: After learning the course students will;

1. Understand different writing styles such as descriptive and narrative writing.
2. Write summaries and persuasive letters
3. Write business emails and structured reports
4. Write job applications and resume/CV for job purposes

Detailed Syllabus:

Sr. No	**Description**
1	**Introduction to Effective Writing Skills** Aspects and characteristics of writing skills. Importance of effective writing Skills.
2	**Effective Writing** Structure, Cohesion and Coherence, Grammar, Correctness, Completeness, Logic and other aspects of effective writing skills
3	**Write a descriptive paragraph:** Write a descriptive paragraph about a person, place, or object. Encourage them to use sensory details and vivid language to create a picture in the reader's mind**.**
4	**Write a personal narrative:** Write a personal narrative about a memorable event. Use descriptive language, dialogue, and reflection to make the story come alive.
5	**Write a summary and response:** Read an article or essay and write a summary of the main points, followed by a personal response that explains your thoughts and reactions to the piece.
6	**Writing instructions** Writing clear, concise and compete instructions
7	**Write a persuasive letter** Write a persuasive letter to a local or national government representative, expressing your opinions on a current issue or proposing a solution to a problem.
8	**Business email writing:** Write a business email on a given scenario. Write a formal email, using appropriate tone, format, and language.
9	**Report writing assignment:** Write a report on a given topic. Use clear prompt, a report outline, in a structured and professional format, using appropriate language and terminology.
10	**Job Application/ Cover Letter:** Write a job application in a professional format with all the necessary details.

Instructions:

- First lab activity is mandatory
- Any six assignments other than first lab activity to be conducted

Reference Books:

1. Seely, John. Oxford Guide to *Effective Writing and Speaking*. OUP 2nd edition, 2005
2. Goins, Jeff. *You Are a Writer* (So Start Acting Like One). Tribe Press
3. Brohaugh, William. *Write Tight: Say Exactly What You Mean with Precision and Power*.
4. Janzer. Anne. *The Writer's Process: Getting Your Brain in Gear*. Cuesta Park Consulting, 2016
5. King, Stephen. *On Writing: A Memoir of the Craft*. Scribner, 2010

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: I**	
Course:	**Health and wellness I**				**Code: VME21501**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. Prepare graduates to become wellness, health, fitness, nutrition education or foodservice professionals.
2. Prepare students for a variety of careers in wellness, fitness, food and nutrition education and foodservice.

Course Outcomes: After learning the course students will be able to;

1. Students will be able to describe the principles of health and wellness from a multidimensional and interdisciplinary perspective.
2. Students will be able to think and act ethically in the context of health, nutrition and wellness.

Guideline:

Total: Any 5 experiments/assignments to be conducted

Detailed Syllabus:

Sr. No	**Description**
1	**Psychology of happiness:** What is happiness? What makes us happy? Socio-economic factors and happiness; Positive emotions.
2	**Can we become happier?** Genetic set-point and hedonic adaptation; Sustainable happiness model and intentional activities.
3	**Happiness Activities 1:** Expressing gratitude and positive thinking; Love and kindness; Avoiding overthinking and social comparison.
4	**Happiness Activities 2:** Identifying signature strengths; achieving happiness with “Flow”.
5	**Is happiness sufficient?** The concept of eudaimonic well-being; Self-determination and motivation.
6	**Meaning and purpose in life:** The concept of meaning in life and logo-therapy; Life goals., correlation with program specific case studies.

Reference Books:

1. W. Weiten, and M. A. Lloyd, *Psychology Applied to Modern Life*: Adjustment in the 21st Century, Wadsworth Publishing, 2007
2. R. Harington, *Stress, Health and well-being:* Thriving in the 21st century, Wadsworth Publishing, 2013.
3. I. Boniwell, *Positive psychology in a nutshell*, McGraw-Hill Education, 2012.
4. S. Lyubomirsky, *The how of happiness*, Penguine Press, 2008.

Program: B. Voc. (Mechatronics Engineering)					**Semester: I**	
Course: On Job Training				**Code: VME21601**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Objectives:

1. To expose students to the industry environment and enhance their technical skills while working in private/public enterprises, government agencies, research labs, or any other organized technical club.
2. To apply knowledge and abilities relevant to engineering technology concepts, principles, and techniques to real-life industrial work/projects.
3. To develop higher-order thinking skills to work with people of diverse backgrounds and cultures and work effectively within cross-disciplined environments.

Outcomes:

On the completion of the OJT, students will be able to –

1. To apply the theoretical knowledge in real-life applications with new perspectives to problem-solving.
2. To practice communication and teamwork skills while building a professional network of prospective employment.
3. To write technical reports and document the project outcomes along with enhancing the technical presentations skills

Guidelines: Students will take on job training in the industry in the domain of Mechatronics Engineering as per the following job description and personal attributes.

Job Role: Mechatronics Maintenance Specialist

	Job Description
	A Mechatronics Maintenance Specialist is responsible for installing, testing, and using sensors, actuators, and microcontrollers in the mechatronics system. The individual is also responsible for carrying out the repair and maintenance of the mechatronics system.
	Personal Attributes
	The individual must have attention to detail, problem-solving skills and the ability to work in coordination with others. The individual must be able to work for long durations with concentration.

Course Syllabus
Semester-II

Program: B. Voc. (Mechatronics Engineering)					**Semester: II**	
Course: Microcontrollers					**Code: VME22102**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course-Objective:

1. Describe the architecture of 8086 microprocessors.
2. Develop programs for microprocessor and microcontrollers environmental issues
3. Compare microprocessors and microcontrollers
4. Understand 8051 microcontroller concepts, architecture and programming

Course Outcomes:

After learning the course, student will be able

1. Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory and Instruction set of 8051.
2. Write 8051 Assembly level programs using 8051 instruction set.
3. Explain the Interrupt system, operation of Timers/Counters and Serial port of 8051.
4. Write 8051 Assembly language program to generate timings and waveforms using 8051 timers, to send & receive serial data using 8051 serial port and to generate an external interrupt using a switch.
5. Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to 8051 / Arduino

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs.)**
1	**8051 Microcontroller:** Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	7
2	**8051 Instruction Set:** Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.	7
3	**8051 Stack, I/O Port Interfacing and Programming:** 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops. Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.	7
4	**8051 Timers and Serial Port:** 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.	8
5	**8051 Interrupts and Interfacing Applications:** 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly language interfacing programming.	8

6	**Introduction to Arduino** role of embedded systems, open source embedded platforms, Introduction to Arduino IDE- features, IDE overview, Programming concepts: variables, functions, conditional statements, Concept of GPIO in Atmega328 based Arduino board, digital input and output. Interfacing of Atmega328 based Arduino board with LED and LCD/serial monitor, serial communication using Arduino IDE, Concept of ADC in Atmega328 based Arduino board, interfacing of Atmega328 based Arduino board with temperature sensor (LM35), LVDT, strain gauge	8

Text Books:

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay "The 8051 Microcontroller and Embedded Systems – using assembly and C", PHI, 2006
2. Kenneth J. Ayala "The 8051 Microcontroller", 3rd Edition, Thomson/Cengage Learning.
3. Barret Steven F, "Arduino Microcontroller Processing for Everyone!", 3rd Ed, Morgan and Claypool Publishers

Reference Books:

1. Manish K Patel "The 8051 Microcontroller Based Embedded Systems", McGraw Hill, 2014
2. Raj Kamal "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005.

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: II**	
Course:	**Basics of Electrical & Electronics**				**Code: VME22202**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. To build strong conceptual understanding and fundamentals of basic electrical circuit, single phase and polyphase AC systems.
2. To impart basic knowledge for conceptual understanding of DC and AC machines
3. To acquire the basic knowledge of digital and analog electronics.
4. Familiarize students with various electrical measuring instruments and drives used in electrical and electronics engineering

Course Outcomes: After learning the course, students will be able to

1. Understand fundamental concepts of electrical engineering, DC circuits and work power and energy.
2. Apply the knowledge of single phase and three phase circuits to determine unknown electrical quantities.
3. Demonstrate the constructional features and operational details of DC and AC machines
4. Understand the concept of a number system and logic gates to implement any logic function.
5. Understand the characteristics and applications of Zener diodes, PN junction diode, LED and Photo diode.
6. Describe the different types of electrical drives and instruments used for voltage, current, and power measurements in various industrial applications.

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs.)**
1	**Elementary Concepts:** Concept of Potential difference. Current and resistance. Series and parallel circuits, Voltage and current dividers, Power and energy calculations, Ohm's law, Kirchhoff's Law, SI units of work Power and Energy, Conversion of energy from one form to another (Electricity bill verification as an activity)	7
2	**Single phase and poly phase A. C. circuits:** Generation of single phase sinusoidal A.C. voltages, AC quantities, phasor representation, Pure R, Pure L, and Pure C circuits, impedance, admittance, concept of active, reactive, apparent power and power factor. **(Verification of power factor for RL and RC circuit on multisim)** Polyphase A.C. Circuits: Introduction to 3 phase supply and its necessity, balance three phase system, relation between line and phase quantities (with phasor diagram), power in three phase circuits for star and delta connection **(Verification of line and phase values for star and delta on simulation platform)**	7
3	**DC and AC machines** **DC Machines:** Construction, working principle of D.C. generator, emf equation of DC generator (derivation not expected), working principle of D.C. motor, types of D.C. motor, Back emf (Numerical), Industrial applications. **(Demonstration of machine parts)**	8

	AC Machines: Single phase transformers: Construction, operating principle, emf equation, voltage and current ratios. Losses, Efficiency and regulation, Autotransformer. **(Understating of direct loading test on single phase transformer)**	
4	**Fundamentals of Digital Electronics: Number System:** Introduction to number system, Conversion of number systems, Binary Code, 1's complement and 2's complement, Introduction to Digital Electronics: Basic logic Gates, Boolean Postulates/laws, De-Morgan Theorems. **(Verification of logic gates on digital trainer kit)**	7
5	**Basics of Semiconductor:** The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Zener Diode, Characteristics, Specifications, Zener Voltage Regulator, Types of Diodes: LED, Photodiode **(Demonstration of above devices on Virtual labs)**	8
6	**Measuring instrument and drives:** Measurement of Voltage, Current, and Power, Study of Energy meters, Use of CT and PT for measurement of power /energy in single phase and three phase Drives: Advantages of electrical and electronic drives, individual and group drive, selection of drives depending on load characteristics. **(Case study on selection of drive)**	8

Text Books:

1. I. J. Nagrath and Kothari (PHI learning Pvt.Ltd). "*Theory and problems of Basic Electrical Engineering*, Eastern Economy Edition.

2. Ashfaq Husain. "*Fundamentals of Electrical Engineering*", 4 th Edition, Dhanpat Rai & Co.),

3. V. N. Mittal and Arvind Mittal,. "*Basic Electrical Engineering*", 2 nd Edition, McGrawHill.

4. V.K. Mehta. "*Basic Electrical Engineering*", 1 st Revised Edition ,S. Chand & Co. Pvt. Ltd. NewDelhi.

5. R.P. Jain, Modern Digital Electronics, Prentice Hall of India,New Delhi 4 th edition

Reference Books:

1. D. C. Kulshreshta . "*Basic Electrical Engineering" ,1 st Edition ,Tata McGraw hill.*

2. B. L. Theraja and A. K. Theraja S. *A textbook of Electrical Technology Vol I S. Chand & amp; Co. Pvt. Ltd. New Delhi,1 st Edition.*

3. B. L. Theraja and A. K. Theraj . *A textbook of Electrical Technology Vol II , S. Chand & amp; Co. Pvt. Ltd. New Delhi,1 st Edition*

4. Edward Hughes. *"Electrical Technology", 10 th Edition ,*Pearson.Ltd..

5. A. K. Sawhney Publisher*: Dhanpat Rai Publications,"* A Course in Electrical and Electronic Measurements and Instrumentation.

6. R. L. Boylestad & Louis Nashlesky *Electronic Devices Circuit Theory,* Pearson Education.

Program:	B. Voc. (Mechatronics Engineering)			Semester: II		
Course:	Applied Mathematics			Code: VME22302		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	FA 1	FA 2	SA	Total
2	2	2	20	20	40	80

Course Objectives: This course aims at enabling students,

1. To familiarize with concepts and techniques in Elementary Calculus and Matrices.
2. To get acquainted with statistic and probability techniques.

Course Outcomes: After learning the course, students will be able to

1. Understand concepts of determinants and matrices and apply to solve simultaneous linear equation system.
2. Solve differentiation and integration of different types of functions.
3. Understand the concepts related to algebra of vectors.
4. Apply statistic and probability techniques on different types of numerical data.

Detailed Syllabus:

Unit	Description	Duration (30 Hrs.)
1.	**Linear Algebra:** Determinants: Definition and expansion of determinants of order 2 and 3, Cramer's rule to solve simultaneous equations in 2 and 3 unknowns Matrices: Definition of a matrix of order m X n and types of matrices, Algebra of matrices, Transpose of a matrix, Minor, cofactor of an element of a matrix, Adjoint of matrix and inverse of matrix by Adjoint method, Solution of simultaneous equations containing 2 and 3 unknowns by matrix inversion method.	7
2.	**Calculus:** **Differentiation:** Definition of derivatives, notations, Derivatives of standard functions, Rules of differentiation, Differentiation of Trigonometric, Exponential and Logarithmic function, Application of Derivatives: Geometrical meaning of derivative, tangent and normal, Maxima and minima. **Integration:** Definition of integration as anti-derivative. Integration of standard function, Rules of integration.	8
3.	**Vectors and Three-Dimensional Geometry:** Introduction to Three-Dimensional Geometry, Vectors: Definition of vector, position vector, Algebra of vectors (Equality, addition, subtraction and scalar multiplication) Dot (Scalar) product with properties, Vector (Cross) product with properties.	7
4.	**Statistics and Probability:** Measures of central tendency (mean, medium & mode) for ungrouped and grouped frequency distribution, Measures of Dispersion: range, mean deviation, standard deviation, Variance and coefficient of variation. Probability: Random Experiments and Events, Definition of probability, Addition and multiplication theorems of probability.	8
	Total	**30**

Text Books:

1. J.K. Tyagi, S. K. Tyagi, Applied Mathematics-I, Khanna Publishing House, 1st Edition, 2012
2. Reena Garg, Engineering Mathematics,, Khanna Publishing House. 1st Edition, 2021

Reference Books:

1. H. K. Dass, Applied Mathematics for Polytechnics, CBS Publishers, India, 11th Edition, 2019
2. Dr. P. K. Shrivastava, Applied Mathematics – I,, Vayu Education of India, 2016
3. H. K. Dass, Dr. R. Verma, Rajesh Verma, Introduction to Engineering Mathematics, Vol. I, S. Chand Publication, 2018
4. H. K. Dass, Dr. R. Verma, Rajesh Verma, Introduction to Engineering Mathematics, Vol. II, S. Chand Publication, 9th Edition, 2019

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: II**	
Course:	**Soft Skills**				**Code: VME22402**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**2**	**-**	**-**	**50**	**50**

Objectives:

1. To introduce students to four skills of language
2. To expose students to public speaking
3. To equip students with fundamental skills for expressing thoughts in effective manner

Course Outcomes:

After learning the course students will be able

1. Understand the importance of listening and reading skills
2. Write well developed paragraphs and instructions
3. Develop skills required for public speaking
4. Present themselves effectively in different contexts

Detailed Syllabus:

Sr No	**Description**
1	**Introduction to Soft Skills with special reference to language skills** Importance, need of soft skills, Soft Skills V/s hard skills
2	**Listening Skills** Importance, Types and techniques for effective listening. Assignment: Listen and summarize the content.
3	**Reading Skills** Tips for effective reading, Types of reading. Assignment: Read the given article/text and summarize in your own words
4	**Speaking Skills 1 – Self Introductions** Tips for effective public speaking **Assignment: Self introductions and describing job profiles.**
5	**Speaking Skills 2 – Group Discussions** **Assignment: Dos and Don'ts of a Group Discussion**
6	**Speaking Skills 3 – Presentations** Assignment: Presenting ideas and thoughts before an audience.
7	**Communication Skills** Types of communication and barriers to communication. Assignment: Role play
8	**Time Management** Time Management prioritizing, urgency and importance, categorizing tasks as high, medium, or low priority, Developing a structured daily, weekly, or monthly schedule to manage time efficiently Assignment: Create a visual schedule or checklist for daily tasks, including schoolwork, chores, and free time.

9	**Problem-Solving Skills** Basics of problem solving, critical thinking, brainstorm ideas and try different approaches to find solutions, Steps in problem solving.

Instructions:

1. First lab activity is mandatory
2. Any six assignments other than first lab activity to be conducted

Reference Books:

1. Rao Prasad N D V, English Grammar and Composition, S. Chand and Co. Pvt. Ltd, 2017.
2. Salaria R.S., and Kumar K.B., Effective Communication Skills, Khanna book publishing co. (P)Ltd, 2020.
3. Patil Z.N., Walke B., Thorat A., and Merchant Z., English For Practical Purposes, Macmillan Publication,2016.
4. Mishra S., and Muralikrishna C., Communication Skills for Engineers, Pearson India Publication,2011.
5. Bhatia V., Business Communication, Khanna book publishing co. (P)Ltd, 2013.

Program: B. Voc. (Mechatronics Engineering)					**Semester: II**	
Course: IT Tools I					**Code: VME22502**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Course Objectives:

1. To understand use of computer-based system in communication and fundamentals of Internet
2. To learn and understand MS office world using simple tools.

Course Outcomes: After learning the course, students will be able to

1. Demonstrate the computer components and how they are used for communication and networking.
2. Comprehend the use of MS office and Internet Communication

Guideline:

Total: 6 experiments/assignments to be conducted

Detailed Syllabus:

Sr No	**Description**
1	Study of Basic Computer fundamentals.
2	Demonstrate and Study of different types of computer networks and internet.
3	Create and manage professional documents using MS word.
4	Create and manage data using MS excel.
5	Create and manage presentation using power point.
6	Study of Internet Communication: Email, Social Media, etc.

Text Books:

1. Kumar B., *Mastering MS Office: Concise Handbook with screenshots*, V&S Publishers, 2017.
2. Orchids, *Microsoft Office 2007*, MS Office Series, 2018
3. Jain S., Kartika Geeta, *Microsoft Office 2010 Training Guide*, BPB Publications 2015.
4. Kurose James F., and Ross Keith W., *A Computer Networking: A top-down approach featuring the internet*, Pearson Publication, 2017.
5. Thareja Reema, *Fundamentals of Computers*, Oxford University Press, 2019.

Reference Books:

1. Ed Tittel, and Muthukumaran B., *Computer Networking*, Schaum's Outlines, TATA Mcgraw Hill Publications, 2006.
2. Peter Norton, *Introduction to Computers*, Tata Mcgraw Hill Publication, 2005.

Program: B. Voc. (Mechatronics Engineering)					**Semester: II**	
Course: On Job Training				**Code: VME22602**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Objectives:

1. To expose students to the industry environment and enhance their technical skills while working in private/public enterprises, government agencies, research labs, or any other organized technical club.
2. To apply knowledge and abilities relevant to engineering technology concepts, principles, and techniques to real-life industrial work/projects.
3. To develop higher-order thinking skills to work with people of diverse backgrounds and cultures and work effectively within cross-disciplined environments.

Outcomes:

On the completion of the OJT, students will be able to –

1. To apply the theoretical knowledge in real-life applications with new perspectives to problem-solving.
2. To practice communication and teamwork skills while building a professional network of prospective employment.
3. To write technical reports and document the project outcomes along with enhancing the technical presentations skills

Guidelines: Students will take on job training in the industry in the domain of Mechatronics Engineering as per the following job description and personal attributes.

Job Role: Mechatronics Maintenance Specialist

	Job Description
	A Mechatronics Maintenance Specialist is responsible for installing, testing, and using sensors, actuators, and microcontrollers in the mechatronics system. The individual is also responsible for carrying out the repair and maintenance of the mechatronics system.
	Personal Attributes
	The individual must have attention to detail, problem-solving skills and the ability to work in coordination with others. The individual must be able to work for long durations with concentration.

Course Syllabus
Semester-III

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: - III**	
Course:	**Fluid Power Systems**				**Code: VME23103**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. To study governing laws used in fluid power systems
2. To study fluid power applications
3. To study the working principles of various components
4. To study the selection of different components
5. To study how to design fluid power systems
6. To study low-cost automation.

Course outcomes:

After learning the course, students will be able to

1: Understand the working principle of components used in hydraulic & pneumatic systems

2: Identify various applications of hydraulic & pneumatic systems

3: Selection of appropriate components required for hydraulic and pneumatic systems

4: Analyze hydraulic and pneumatic systems for industrial/mobile applications

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs)**
1	**Basics of Fluid Power and Pumps** Fluid power basics, advantages and limitations, fluid power distribution, standard symbols, energy loss in hydraulic systems. Pumps - types, classification, principle of working and constructional details of vane pumps, gear pumps	8
2	**Actuators and Power Unit** Linear and rotary actuators- types, construction and characteristics. Cylinder mountings, cushioning of cylinders. Power units and accessories - types of power units, reservoir assembly, and constructional details. Accumulators, Intensifiers	7
3	**Fluid Power Control and Hydraulic Circuits** Direction control valves - center positions, methods of actuation, Flow control valves - pressure and temperature compensated. Pressure control valves - pressure reducing valve,sequence valve, check valves, Hydraulic circuits: Simple reciprocating, regenerative, speed control (meter in, meter out and bleed off), sequencing, synchronization, traverse and feed, automatic reciprocating	8
4	**Pneumatics – Components, Control Valves and Circuits** Compressor- working and constructional details. Comparison of pneumatic with hydraulic power transmissions. filters, pressure regulators, lubricators, mufflers, direction control valves, pneumatic actuators, shuttle valve, two pressure valve, quick exhaust valve and time delay valves, electro-pneumatics. Speed regulating methods, pneumatic circuits, time delay etc. Application of pneumatics in low cost automation and in industrial automation.	7

Text Books:

1. Esposito A, Fluid Power with application, Prentice Hall
2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill

3. Majumdar S.R, Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill
4. Stewart H. L, Hydraulics and Pneumatics , Taraporewala Publication

Reference books:

1. Pipenger J.J, Industrial Hydraulics, McGraw Hill
2. Pinches, Industrial Fluid Power, Prentice Hall
3. Yeaple, Fluid Power Design Handbook
4. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books
5. ISO - 1219, Fluid Systems and components, Graphic Symbols
6. Standard Manufacturer's Catalogues

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: III**	
Course:	**Fluid Power Systems Lab**				**Code: VME23104**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. To study governing laws used in fluid power systems
2. To study fluid power applications
3. To study the working principles of various components
4. To study the selection of different components
5. To study how to design fluid power systems
6. To study low-cost automation

Course Outcomes:

After learning the course, students will be able to

1. Understand the working principle of components used in hydraulic & pneumatic systems
2. Identify various applications of hydraulic & pneumatic systems
3. Selection of appropriate components required for hydraulic and pneumatic systems
4. Analyze hydraulic and pneumatic systems for industrial/mobile applications

Detailed Syllabus:

Assignment No.	**Description**
1	Following experiments to be done on hydraulic trainer / using software such as Automation Studio (any 3) a) Regenerative circuit b) Speed control circuit c) Sequencing circuit d) Traverse and feed circuit etc.
2	Following experiments to be done on pneumatic trainer/ / using software such as Automation Studio (any 3) a) Automatic reciprocating circuit b) Speed control circuit c) Pneumatic circuit involving Shuttle valve/ Quick exhaust valve / Two pressure valve d) Electro pneumatic circuits
3	Test on pressure relief valve/flow control valve using software such as Automation Studio
4	Test on linear /rotary actuator using software such as Automation Studio
5	Design of simple hydraulic systems used in practice using manufacturers' catalogue andanalysis using software such as Automation Studio
6	Design of simple pneumatic systems used in practice using manufacturers' catalogues andanalysis using software such as Automation Studio.
7	Industrial visit to study Hydraulic / Pneumatic based Automation systems

8	Assignment: Symbols for different components as per standards

Text Books:

1. Esposito A, *Fluid Power with application*, Prentice Hall
2. Majumdar S.R, *Oil Hydraulic system- Principle and maintenance* ,Tata McGraw Hill
3. Majumdar S.R, *Pneumatics Systems Principles and Maintenance* ,Tata McGraw Hill
4. Stewart H. L, *Hydraulics and Pneumatics* , Taraporewala Publication

Reference books:

1. Pipenger J.J, *Industrial Hydraulics*, McGraw Hill
2. Pinches, *Industrial Fluid Power*, Prentice Hall
3. Yeaple, *Fluid Power Design Handbook*
4. Andrew A. Parr, *Hydraulics and Pneumatics*, Elsevier Science and Technology Books
5. ISO - 1219, *Fluid Systems and components*, Graphic Symbols
6. Standard Manufacturer's Catalogues

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: III**	
Course:	**Manufacturing Technology**				**Code: VME23203**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. Comprehensive knowledge of manufacturing processes used within the manufacturing industry.
2. Impart insights of manufacturing technology by describing the principles of operations, tools, merits and limitations.

Course outcomes:

After learning the course, students will be able to

1. **Describe** the principle of operation involved in casting processes and its applications.
2. **Select** different forming operations used for different products.
3. **Comprehend** the machining processes used in manufacturing industries for different applications.
4. **Select** the appropriate joining process for producing the required joint.

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs.)**
1	**Casting Processes:** Introduction to casting process, classification of casting processes, sand casting process, pattern and mould making, melting, solidification, casting defect and their remedy, special casting processes, applications of casting processes.	8
2	**Metal forming processes:** Sheet metal forming: blanking, punching, bending, deep drawing, spin forming, types of press machines. Bulk metal forming: types and working principle of rolling, extrusion, drawing, forging etc. Forming defects and their remedy, applications of forming processes.	8
3	**Machining Processes:** Introduction to single point and multipoint cutting operations: lathe, drilling, milling. Introduction to finishing operations: broaching, grinding, lapping, buffing, honing.	8
4	**Joining Processes:** Introduction to Joining processes: types of weld, types of joints, welding, welding symbols, brazing, soldering, adhesive bonding. Defects in joining processes.	6

Text Books

1. *Production Engineering and production technology*, P. C. Sharma, S. Chand Publication, 8th Edition, 2019.
2. *Manufacturing Engineering & Technology*, Serope Kalpak Jian, Steven Schmid, 9th Edition, Pearson, 2020.

Reference Books

1. *Manufacturing Technology*, Volume I & II, P. N. Rao, McGraw Hill Education (India) Private Limited. 5th Edition, 2019.
2. *Workshop Technology*, Chapman, Vol. 1, 2, 3. CRC Press, 25 September 2019.
3. *Manufacturing Science*, Amitabha Ghosh, Ashok Kumar Mallik, East-West Press Pvt. Ltd 2nd Edition, 2010.
4. *Fundamentals of Modern Manufacturing*, Mikell P Groover, 4th Edition, John Wiley & Sons, 15 Jul 2020.

Program:	**B. Voc. (Mechatronics Engineering)**			**Semester: III**		
Course:	**Manufacturing Technology Lab**			**Code: VME23204**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. To introduce various machine tools and demonstration on machining
2. To develop skills through hands on experience.

Course Outcomes:

After learning the course, students will be able to

1. **Follow** the safety Practices on shop floor
2. **Perform** different machining operations using appropriate process parameters.
3. **Fabricate** given part using suitable joining process.
4. **Operate** Computerized Numerical Machines.

Detailed Syllabus:

Assignment No.	Description
1	**Safety Practices** Demonstrate safety practices to be followed while working on the different machines.
2	**Introduction to different machining processes.** Demonstration of Manufacturing processes (Machining: Turning, Drilling, Milling and grinding using one simple machine component and sheet metal operations): Working, operation and types.
3	**Manufacturing of Job** Manufacturing of a useful component or assembly using different machining processes.
4	**Fabrication of Job** Fabrication of a utility component using suitable joining process. (Welding/Soldering/Brazing)
5	**CNC Machining** Introduction to G and M codes of CNC part programming and manufacturing one job on Vertical Machining Centre (VMC) / Turning Centre

Text Books:

1. *A Course in Workshop Technology*, B. S. Raghuwanshi, Dhanpat Rai and Co., Vol II, 2017.

Reference Books:

1. *Elements of Workshop Technology*, Vol. I and II, Hajra Chaudhary, Media promoters and publishers Pvt. Ltd., 2013
2. *Manufacturing Technology*, Volume I & II, P. N. Rao, McGraw Hill Education (India) Private Limited, Fifth Edition 2018
3. *Fundamentals of Manufacturing Engineering*, D. K. Singh, Ane's Books. Pvt. Ltd. 1st Edition, 2008.
4. *CAD/CAM: Principles and Applications*, P N Rao, Tata McGraw-Hill Education, 2017.
5. *Workshop Technology*. Vol. 1 & 2, Raghuvanshi, B. S., Dhanpat Rai & Co. (P) Ltd, Delhi., 2009

Online Resource

https://www.vlab.co.in/broad-area-mechanical-engineering

Program: B. Voc. (Mechatronics Engineering)					**Semester: III**	
Course: IT Tools II					**Code: VME23303**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. To develop advanced skills in using word processing and spreadsheet software for complex tasks and automation.
2. To introduce students to digital multimedia tools for image, audio, video editing, and screen casting.

Course outcomes:

After learning the course, students will be able to

1. Use word processors to Create and manage long documents with tables of contents, indexing, cross-references, and footnotes.
2. Utilize advanced spreadsheet features like VLOOKUP, nested functions, data validation, scenarios, and basic macros/VBA.
3. Perform basic image editing, audio/video editing, screen recording, and use online multimedia tools.
4. Collaborate effectively using cloud storage, file sharing, online office suites, and project management tools.

Detailed Syllabus:

Unit	Description	Duration (30 Hrs)
1	**Advanced Word Processing** Working with long documents (Table of contents, indexing, cross-references, footnotes), Using mail merge for bulk emails/letters, collaborating on documents (Track changes, comments), Protecting and securing documents	8
2	**Advanced Spreadsheet Features** Advanced functions (VLOOKUP, IF, Nested IFs, etc.), Data validation and data entry forms, Scenarios and goal seek analysis, Introduction to macros and VBA	8
3	**Digital Multimedia** Image editing basics, Audio/video editing introduction, Screen recording and screencasting, Online multimedia tools	8
4	**Collaboration and Cloud Tools** Cloud storage (Google Drive, OneDrive), File sharing and collaboration, Online office suites, Introduction to project management tools, AI-based Automation (Zapier, Co-Pilot)	6

Text Books:

1. Shelly Cashman Series. 2019. *Office 365 & Office 2019 Introductory*, 1st Edition, Cengage Learning, Boston.
2. Jennifer Duffy. 2018. *Multimedia Foundations: Core Concepts for Digital Design*, 2nd Edition, Focal Press, Burlington.

Reference Books:

1. Joan Lambert and Joyce Cox. *2013. Microsoft Word 2013 Step by Step*, Microsoft Press, Redmond.
2. Curtis Frye. *2013. Microsoft Excel 2013 Step by Step*, Microsoft Press, Redmond.
3. David W. Beskeen, et al. 2015. *Microsoft Office 2016 Illustrated Introductory*, First Course, Cengage Learning, Boston.
4. Katherine Murray. 2018. *Modern Desktop Environments for Virtual, Cloud, and Mobile Users*, Pearson Education, London.

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: III**	
Course:	**Business Communication - I**				**Code: VME23403**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. To introduce learners to the basics of Business Communication & enhance their professional competence.
2. To instruct learners on techniques of personal branding through emotional & social skills

Course Outcomes:

After learning the course students will be able to;

1. Apply knowledge of fundamentals of communication in given situations
2. Communicate effectively using non-verbal codes
3. Write professional letters
4. Demonstrate business negotiations and social skills.

Detailed Syllabus:

Assignment No.	**Description**
1	**Art of Business Communication** Introduction to the art of Business Communication, Role and importance in professional and personal life, Ice-breaking activities for various scenarios, Professional Greetings, Making & Responding to Requests.
2	**Introduction to Business Communication** Types of Communication, Principles and Barriers to Communication, Overcoming Barriers to communication **Assignment:** Explain different types of communication. Provide examples of barriers to communication from your own experiences and suggest ways to overcome it.
3	**Talking about opinions and perceptions** Get recognized in the crowd: Introducing self in business environment Understand purpose of introduction, tailor self-introduction for gaining attention, find out USP (individuality, skills etc) and emphasize, assertive and expressive, Express opinions confidently in business environment, Speak with purpose, use persuasive communication.
4	**Non-Verbal communication & Body Language** Importance of Non-Verbal Communication, Non Verbal Codes, Kinesics, Haptics, Proxemics, Chronemics, Para-language, Artifacts **Assignment:** Case Study of the role of body language in a given situation
5	**Business Correspondence** Art of writing Business Letters (Understand different formats, writing with purpose, difference between day-to-day language and formal language) Write a professional resume or CV. Use a professional format. Highlight skills, experiences, and qualifications relevant to the target job or industry. **Assignment:** Developing formal business letters for different purposes

6	**Mock Business Meetings** Self- Grooming, Art of persuasion, Techniques of Short Speech & Effective Delivery of Extempore & Debate.
7	**Professional Etiquette and Networking** Understanding and practicing professional etiquette in various business settings, Building and maintaining professional relationships through networking.
8	**Negotiation Simulation:** Negotiation exercise, practicing persuasive communication, active listening, and conflict resolution skills. **Assignment:** Compose a pitch /oral presentation on the given topic and submit the write-up of the same. (Evaluation will be based on both oral and written content.)
9	**Emotional & Social Skills** Situational Conversations & Rapport Building through Role Play, Emotional Intelligence: Testing and Improving EI **Assignment:** Provide step by step solutions in the form of practical examples for the given case studies.

Instructions:

- All assignments are suggestive however, course teacher may devise another assignment to evaluate students
- First lab activity is mandatory

Reference Books:

1. Rao Prasad N D V, *English Grammar and Composition*, S. Chand and Co. Pvt. Ltd, 2017.
2. Salaria R.S., and Kumar K.B., *Effective Communication Skills*, Khanna book publishing co. (P) Ltd, 2020.
3. Patil Z.N., Walke B., Thorat A., and Merchant Z., *English For Practical Purposes*, Macmillan Publication, 2016.
4. Mishra S., and Muralikrishna C., *Communication Skills for Engineers*, Pearson India Publication, 2011.
5. Bhatia V., *Business Communication*, Khanna book publishing co. (P) Ltd, 2013.

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: III**	
Course:	**Health and Wellness II**				**Code: VME23503**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. Prepare graduates to become wellness, health, fitness, nutrition education or foodservice professionals.
2. Prepare students for a variety of careers in wellness, fitness, food and nutrition education and foodservice.

Course Outcomes:

After learning the course students will be able to;

1. Students will be able to describe the principles of health and wellness from a multidimensional and interdisciplinary perspective.
2. Students will be able to think and act ethically in the context of health, nutrition and wellness.

Detailed Syllabus:

Assignment No.	**Description**
1	Positive psychology: what do you understand by positive psychology? What are benefits of positive psychology?
2	Identifying strengths: what do you understand by strengths? Classification of strengths, developmental assets. Identifying your personal strengths
3	Living well at every stage: what is resilience? Positive youth development, Life tasks of adulthood.
4	Self-efficacy: Definition, the neurobiology of self-efficacy, self-efficacy's influence in life arenas.
5	Mnemonics: method of loci, peg word system, key word method, Recall of Name, Recall of words.
6	Optimism: learned optimism -Seligman, primary prevention, primary enhancement.

Instructions:

- Any 5 practical assignments to be conducted.

References Books:

1. W. Weiten, and M. A. Lloyd, *Psychology Applied to Modern Life: Adjustment in the 21st Century*, Wadsworth Publishing, 2007
2. R. Harington, Stress, *Health and well-being: Thriving in the 21st century*, Wadsworth Publishing, 2013.
3. Boniwell, *Positive psychology in a nutshell*, McGraw-Hill Education, 2012.
4. S. Lyubomirsky, *The how of happiness*, Penguine Press, 2008.

Program:	**B. Voc. (Mechatronics Engineering)**					**Semester: III**
Course:	**On Job Training (ELE/Q7107)**					**Code: VME23603**
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Course Objectives:
To do the on job training to acquire the knowledge about the PLC, SCADA and Panel designing.

Course outcomes:
After learning the course, students will be able to

1. Integrate PLC with the SCADA system.
2. Analyse motion control to ensure the correct functioning of various components.
3. Design panels using AutoCAD electrical toolset.
4. Select the appropriate transmitters or sensors according to the required industrial applications.

Guidelines: Students will do On Job Training (Industry/In house) in the domain of Mechatronics as per the following job description and personal attributes.

Job Role: Mechatronics Designer and System Integrator

Job Description

A Mechatronic Designer and System Integrator is responsible for the designing of controlled motion systems through the integration of functional elements from a multitude of disciplines. The individual works in all aspects of the development of smart machine manufacturing from design to testing in industries such as robotics, human-machine interaction, medical and assistive technology, etc.

Personal Attributes

The individual must have attention to detail and problem-solving skills. The person must be able to work collaboratively with a diversity of professionals to deliver projects successfully.

Reference Books:

1. Mechatronics Designer and System Integrator, ELE/Q7107, Version 2, NSQF Level 6, Electronics Sector Skill Council of India

Course Syllabus
Semester-IV

Program: B. Voc. (Mechatronics Engg.)					**Semester: IV**	
Course: Industrial Automation					**Code: VME24105**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:

1. Understand automation technologies and identify advantages, limitations and applications of the same.
2. Develop ability to recognize, articulate and solve industrial problems using automation technologies.

Course outcomes:

After learning the course, students will be able to

1. Understand the basics of PLC programming.
2. Understand the different parameters of PLC.
3. Design different process control applications through ladder logic.
4. Analyze & explain different functions of PLC.
5. Build and experiment with PLC based SCADA systems for various industrial applications.

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs)**
1	**Introduction to Industrial Automation** Need and benefits, Automation Hierarchy, Basic components of Automation systems, Types of automation systems: Fixed, Programmable, Flexible, Different systems for industrial automation: PLC, HMI, SCADA, DCS, Drives	8 Hrs
2	**Introduction to PLC** What is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks and limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc.	7 Hrs
3	**Working of PLC** Basic operation and principles of PLC, Scan Cycle, Memory structures, I/O structure, Programming terminal, power supply	8 Hrs
4	**Instruction Set** Basic instructions like latch, master control self - holding relays, Timer instruction like retentive timers, resetting of timers, Counter instructions like up counter, down counter, resetting of counters, Arithmetic Instructions (ADD, SUB, DIV, MUL etc	7 Hrs
5	**Ladder Diagram Programming** Programming based on basic instructions, timer, counter, and comparison instructions using ladder program.	8 Hrs
6	**Applications of PLCs** Object counter, On-off control, Car parking, Sequential starting of motors, Traffic light control, Motor in forward and reverse direction, Filling of Bottles, control of Fluid power systems	7 Hrs

Text Books:

1. John W. Webb, Ronald A. Reis, "*Programmable Logic Controllers*", 5th Ed., PHI, 2012.

2. John R. Hackworth, Fredrick D. Hackworth Jr., "*Programmable Logic Controllers: Programming Methods and Applications*", Pearson,

3. William Bolton, "*Programmable Logic Controllers*", 4th Edition, Elsevier.

Reference Books:

1. L.A. Bryan and E. A. Bryan, "*Programmable Controllers – Theory and implementation*," Second edition, An Industrial text company publication, USA, 1997.

2.. Richard L. Shell and Ernest L. Hall, "*Handbook of industrial automation*," CRC press 2000

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: IV**	
Course:	**Industrial Automation Lab**				**Code: VME24106**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. To familiarize students with programming in PLCs.
2. To implement ladder diagrams for practical applications.
3. To learn interfacing PLC with other technologies
4. To develop different applications in PLC in control systems.

Course Outcomes:

After learning the course, students will be able to

1. Design PLC ladder logic program.
2. Interface the PLC trainer with the PC and application trainer kit with the PLC trainer.
3. Simulate the PLC programming and observe the output.

Detailed Syllabus:

Assignment No.	**Description**
1	Write and implement a simple ladder logic program using digital inputs and outputs for PLC.
2	Write and implementation of simple ladder logic program using timer 1) On delay timer 2) Off delay timer
3	Write and implementation of simple ladder logic program using counter. 1) UP counter 2) Down counter
4	To study about conveyor control system using PLC
5	To study the traffic light controller system by using PLC
6	Interfacing of PLC software with fluid power systems and its implementation.

Text Books:

1. John W. Webb, Ronald A. Reis, "*Programmable Logic Controllers*", 5th Ed., PHI, 2012.

2. John R. Hackworth, Fredrick D. Hackworth Jr., "*Programmable Logic Controllers: Programming Methods and Applications*", Pearson,

3. William Bolton, "*Programmable Logic Controllers*", 4th Edition, Elsevier.

Reference Books:

1. L.A. Bryan and E. A. Bryan, "*Programmable Controllers – Theory and implementation*," Second edition, An Industrial text company publication, USA, 1997.

2.. Richard L. Shell and Ernest L. Hall, "*Handbook of industrial automation*," CRC press 2000

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: IV**	
Course:	**Metrology and Measuring Instruments**				**Code: VME24205**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA 1**	**FA 2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:
Students are expected to learn Measurement standards, Comparators, Gear and thread terminology and advanced measurement.

Course outcomes:
After learning the course, students will be able to

1. Design the limit gauges for given application
2. Select the appropriate comparator for different applications
3. Understand the advanced metrology systems
4. Identify the type of error in the system.

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs)**
1	**Fundamentals of Dimensional Metrology** Engineering Metrology, Measurement Standard, Abbe's principle, Calibration and traceability, Geometric Form Measurement, Design of limit gauges.	8
2	**Comparators, Thread and Gear Metrology** Comparators: Mechanical, Pneumatic, Optical, Electrical. Measurement of Thread form: Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method), Gear Metrology: Introduction, Gear tooth Vernier, Constant chord, Base tangent, Gear Rolling Tester, Profile Projector.	7
3	**Surface Roughness Measurement and Advances in metrology** Surface Roughness Measurement: Introduction to Surface texture, Parameters for measuring surface roughness, Surface roughness measuring instrument: TalySurf, Coordinate Measuring Machine (CMM).	8
4	**Fundamentals of instrumentation** Basic functional elements of measurement system and instrumentation need of measurement, Methods and applications of measurements, Errors in measurement, Storage and display devices, digital voltmeter and ammeter, power & energy measurement.	7

Text Books:

1. Narayana K.L., *Engineering Metrology*, Scitech Publications Pvt. Ltd., 2013.
2. Gupta I.C., *Engineering Metrology*, Dhanpatrai Publications, 2019.

Reference Books:

1. Jain R.K., *Engineering Metrology*, Khanna Publication, 2005.

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: IV**	
Course:	**Business Communication - II**				**Code: VME24404**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA 1**	**FA 2**	**TW**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Course Objectives:

1. To introduce learners to the basics of Business Communication & enhance their professional competence.
2. To instruct learners on techniques of personal branding through emotional & social skills.

Course Outcomes:

After learning the course students will be able to;

1. Demonstrate the skills of handling customer and clients
2. Use digital tools effectively to present or communicate as per situation
3. Appear confidently for business meetings and interviews
4. Write professional drafts and proposals.

Detailed Syllabus:

Assignment No.	**Description**
1	**Interpersonal Communication Skills** Developing active listening and empathy skills in business interactions, Managing conflict and difficult conversations in the workplace
2	**Handling Customer Inquiries and Complaints** Strategies for responding to customer inquiries promptly and courteously, Techniques for addressing customer complaints effectively to maintain customer satisfaction Assignment: Develop a comprehensive response plan for handling customer inquiries and complaints, focusing on promptness, courtesy, and satisfaction maintenance.
3	**Digital and Visual Communication Tools** Utilizing digital tools and platforms for effective business communication. Assignment: Create a visually engaging presentation or document using digital tools, demonstrating effective communication techniques to enhance impact.
4	**Social Networking** Content: What is Social networking; networking through social media platforms like LinkedIn, Indeed, for professional purposes. Assignment: Create and launch a full-fledged LinkedIn profile with all relevant details. Submit printouts of LinkedIn Bio, Qualifications and Other important sections.
5	**Interview Skills** Researching the company and role, practicing responses to common questions, and preparing questions to ask the interviewer. Assignment: Develop a set of interview questions tailored to a specific job role, considering both traditional and behavioral-based questions.
6	**Business Storytelling** Crafting compelling stories and using storytelling techniques for business communication.

7	**Understanding Business Documents** Introduction to common business documents (e.g., invoices, receipts).
8	**Business Plan: Writing & Presentation** Content: Elevator pitch, Business plan proposal, presenting a business proposal Assignment: Create a basic business plan proposal and present it in the form of an Elevator pitch.
9	**Advanced Business Writing Skills** Techniques for writing business documents, such as proposals, executive summaries, and business plans, Incorporating data and research into written communication effectively Assignment: Create proposal for business purpose in a professional format.

Instructions:

- All assignments are suggestive however; course teacher may devise other assignments to evaluate students.
- Any five assignments are mandatory.

Reference Books:

1. Rao Prasad N D V, *English Grammar and Composition*, S. Chand and Co. Pvt. Ltd, 2017.
2. Salaria R.S., and Kumar K.B., *Effective Communication Skills*, Khanna book publishing co. (P) Ltd, 2020.
3. Patil Z.N., Walke B., Thorat A., and Merchant Z., *English For Practical Purposes*, Macmillan Publication, 2016.
4. Mishra S., and Muralikrishna C., *Communication Skills for Engineers*, Pearson India Publication, 2011.
5. Bhatia V., *Business Communication*, Khanna book publishing co. (P) Ltd, 2013.

Program:	B. Voc. (Mechatronics Engineering)				Semester: IV	
Course:	Environmental Science				Code: VME24504	
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	FA 1	FA 2	PR	Total
2	2	1	-	-	50	50

Objectives:

To study components of the environment, their function, quality, issues related to the environment, the effect of quality degradation on human beings, and their solutions.

Course Outcomes:

After learning the course, students will be able to

1. Measure atmospheric metrological parameters and interpret the results.
2. Determine water quality parameters and interpret the results.
3. Distinguish different component of the environment and their function and sustainable development.

Detailed Syllabus:

Assignment No.	Description
	Any Five experiments from assignments 1 to 9.
1	**Experiment Name –** Measurement and interpretation of metrological parameters of the atmosphere. **Content** Use a weather sensor or weather station to measure metrological parameters such as temperature, wind direction, wind speed, humidity, rainfall, air pressure, solar radiation, etc**.**
2	**Experiment Name –** Determine the water quality of a given location using a water monitoring kit. **Content** Determine the water quality, such as pH, Temperature, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Turbidity, etc., of a given location using a water monitoring kit. Compare results with BIS standards.
3	**Experiment Name –** Determine total hardness of water sample. **Content** Determine total hardness of various types of water samples. Compare results with standards and write observations/conclusions.
4	**Experiment Name –** Prepare water audit report of the college/house/locality/colony/ industry. **Content** Prepare a water audit report of the college/house/locality/colony/ industry for water quantity and quality with observations and recommendations.
5	**Experiment Name –** Visit a Water Treatment Plant (WTP) or Sewage Treatment Plant (STP). **Content** Study various unit's operations and processes of water and wastewater treatment.
6	**Experiment Name –** Inspect solid and liquid discharge of the college/colony/industry and develop a management plan. **Content** Inspect solid and liquid discharge of the college/colony/industry and develop a management plan with schematic diagrams and photographs.

7	**Experiment Name –** Determine the noise level to find out its direct exposure to communities. **Content** Determine noise level using a sound level meter or noise dosimeter at various locations. Compare the results with standards and write observations/conclusions.
8	**Experiment Name –** Propose a model for pollutant removal. **Content** Propose a model for the treatment or removal of any type of contaminant or pollutant from water/ wastewater/air/soil. Demonstrate the mechanism of working and its application.
9	**Assignment Name** – Calculate environmental footprint. **Content** Calculate environmental footprint such as water footprint/ carbon footprint/ energy footprint, etc.

Text Books:

1. Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi, 35th Edition (2015).

2. Environmental Science: A Practical Manual Author: G. Swarajya Lakshmi ISBN: 9788178002286

Reference Books:

1.*Standard Methods for examination of water and wastewater*, Mary Franson, American Public Health Association.

2.*IS 10500:2012* Drinking water specifications.

3. IS 3025: 2013, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi.

4. *Water Supply and Sanitary Engineering*, G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi, 9th Edition, (2010).

Program:	**B. Voc. (Mechatronics Engineering)**			**Semester: IV**		
Course:	**Mini Project**			**Code: VME24604**		
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
4	**4**	**2**	**-**	**50**	**-**	**50**

Guidelines to the Students:

1. **Group Size:** The student will carry the project work individually or by a group of students. Optimum group size is in 3 students. However, if project complexity demands a maximum group size of 4 students, the committee should be convinced about such complexity and scope of the work.
2. **Selection and approval of Topic:** Topic should be related to real life application/Thrust areas in the above application fields but not limited to.
   OR
   The investigation of practical problem in manufacture and / or testing of mechatronics equipment's in Industry.

Note: The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by internal/external guides. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.

Detailed Syllabus:

Task	**Description**
1	A Project based learning approach will be followed for this course and hence the experiments will be a small project built by the students with the help of any any microcontroller/ Arduino for the following application fields (Thrust areas). **The application fields (Thrust areas) are as follows:** Agricultural, Health and Hygiene, Industry automation, Smart Cities, Logistics, Energy, Transportation, Communication and Networking, Cyber security, Robotics, Quality Education, Digital India etc. **The student should be able** to interface different sensors and actuators (simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor etc.) to 8051 or Arduino for any application of their choice.

Program:	**B. Voc. (Mechatronics Engineering)**					**Semester: IV**
Course:	**On Job Training (ELE/Q7107)**					**Code: VME24605**
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Course Objectives:

1. To do the on job training to acquire the knowledge about the advanced automation process.
2. To learn about the safety at workplace.

Course outcomes:

After learning the course, students will be able to

1. Install the advanced automation processes in mechatronics about Human Machine Interface (HMI), automated material handling system and Internet of things (IoT).
2. Understand the practices relating to health, safety and security that to use in the workplace.
3. Understand the various essential skills required for jobs and career development

Guidelines: Students will do On Job Training (Industry/In house) in the domain of Mechatronics as per the following job description and personal attributes.

Job Role: Mechatronics Designer and System Integrator

Job Description

A Mechatronic Designer and System Integrator is responsible for the designing of controlled motion systems through the integration of functional elements from a multitude of disciplines. The individual works in all aspects of the development of smart machine manufacturing from design to testing in industries such as robotics, human-machine interaction, medical and assistive technology, etc.

Personal Attributes

The individual must have attention to detail and problem-solving skills. The person must be able to work collaboratively with a diversity of professionals to deliver projects successfully.

Reference Books:

1. Mechatronics Designer and System Integrator, ELE/Q7107, Version 2, NSQF Level 6, Electronics Sector Skill Council of India

Course Syllabus
Semester-V

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: V**	
Course:	**Major course: Robot Kinematics & Dynamics**				**Code: VME25106**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:
To provide knowledge about
1. Different types of robot linkage, frame
2. Kinematics and Dynamics of Robot
3. Motion planning and control of robot manipulator

Course outcomes:
After learning the course, students will be able to
1. Identify Elements of Robots
2. Calculate Kinematics of serial robot
3. Calculate Kinematics of parallel robot
4. Calculate Velocity and static analysis of robot
5. Evaluate dynamics behaviour of robots
6. Evaluate Motion, trajectory of robotic arm

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs.)**
1	**Mechanisms in robots** Position and orientation of a link of robot. Degree of freedom (DoF) for robot joint, Different types of robot mechanism, Elements of robot Mechanism, Drive system used for robot mechanism, Types of wheel used in robots, Numerical based on DoF.	08 Hrs.
2	**Kinematics of serial robots** Introduction, Homogeneous transformations, Representation of joints, link representation using D- H parameters, Direct and inverse kinematics for the serial manipulator, Examples of kinematics of common serial manipulators, Inverse kinematics solution, Numerical based on translational transformation & rotational transformation.	08 Hrs.
3	**Kinematics of parallel robots** Degrees-of- freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop closure equations, Direct kinematics problem, Closed-from and numerical solution.	08 Hrs.
4	**Velocity and static analysis of robot manipulators** Linear and angular velocity of links, Velocity propagation, Formation of Jacobian matrix, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Law of control for Second order system, Statics of serial and parallel manipulators, Force analysis of robot system	07 Hrs.
5	**Dynamics of serial and parallel manipulators** Mass/Inertia and their Positions of links, Lagrangian/Eularian/Newtonian approaches for formulation of equations of motion for serial and parallel manipulators, Formation using, Lagrangian approach only, Examples of a planar 2 link/joint and four-bar mechanism, Recursive dynamics, Numerical limited to 2 link and 2 joints (Revolute and Prismatic joint)	07 Hrs.
6	**Motion planning and control**	07 Hrs.

	Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link Simulation, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Concept of work envelope & sub systems of robot (Motion - Recognition - Control).	

Text Books:

1. Groover M. P., “Industrial Robotics: Technology, Programming and Applications, Tata McGraw Hill Publication
2. Taghirad H.D, “Parallel Robots: Mechanics and Control”, CRC Press.
3. Moore S. W., Bohm H., and, Jensen V., “Underwater Robotics: Science, Design &Fabrication”, Marine Advanced Technology Education (MATE) Center, 2010
4. Bock T., Linner T., “Robot Oriented Design: Design and Management Tools for the Deployment of Automation and Robotics in Construction”, Cambridge University Press

Reference Books:

1. RiadhZiaer (Ed) The future of Humanoid Robots- Research and applications“, Intech Publications, 2012.
2. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
3. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011.
4. Mejia O. D. M., Gomez J. A. E., (eds.), “Aerial Robots: Aerodynamics, Control and Application” InTech Open Publications.

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: - V**	
Course:	**-: Robot Kinematics & Dynamics Lab**				**Code: VME25107**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA1**	**FA2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

1. Develop skills in using modern software tools and techniques for robotics applications.

Course Outcomes:

After learning the course, students will be able to

1. Prepare a model of kinematics of robot using modern tool/software
2. Prepare a model of dynamics behavior of robots using modern tool/software
3. Create robot joint trajectory of robotic arm using modern tool/software

Detailed Syllabus:

Assignment	**Description**
1	Introduction to Robot Kinematic and Dynamics Analysis software and its commands.
2	To study and prepare a model of Forward kinematics of robot by using Robo Analyzer.
3	To study and prepare a model of Inverse kinematics of robot by using Robo Analyzer.
4	To study and prepare a model of Forward Dynamics of robot by using Robo Analyzer.
5	To study and prepare a model of Inverse Dynamics of robot by using Robo Analyzer.
6	To Create Robot Joint trajectories by using Robo Analyzer.

Text Books:

1. Groover M. P., “Industrial Robotics: Technology, Programming and Applications, Tata McGraw Hill Publication
2. Bock T., Linner T., “Robot Oriented Design: Design and Management Tools for the Deployment of Automation and Robotics in Construction”, Cambridge University Press

Reference Books:

1. RiadhZiaer (Ed), The future of Humanoid Robots- Research and applications‟, Intech Publications, 2012.
2. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
3. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011.

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: V**	
Course:	**Major course: Mounting and Communication of Sensor**				**Code: VME25108**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:
To provide knowledge about
1. Sensor Mounting and location principle
2. Sensor calibration methods
3. Communication and networking of sensors

Course outcomes:
After learning the course, students will be able to
1. Identify different sensor Mounting and accessories
2. Understand calibration methods of sensor
3. Examine sensor mounting through site visit.
4. Understand Communication techniques of sensor
5. Examine sensor communication techniques through site visit
6. Identify Sensors in HMI

Detailed Syllabus:

Unit	**Description**	**Duration (45 Hrs.)**
1	**Sensor Mounting and Location Principle** Introduction to sensor mounting, different type of sensor mounting, Mounting procedure of different type of robotics sensor (tactile, proximity, pressure, force, velocity, vision sensor etc.).	08 Hrs.
2	**Calibration Methods of Sensors** Introduction to sensor calibration, need of calibration, different types of sensor calibration methods, Measurement characteristic of sensor, Calibration examples for different sensors.	08 Hrs.
3	**Sensor Interfacing** Introduction to sensor interfacing, different methodologies of sensor interfacing, IoT devices for sensor interfacing, Sensor interfacing applications.	08 Hrs.
4	**Communication techniques of sensors** Communication and networking of sensors, control of manufacturing process, detection of machining faults, diagnostic systems, resonance vibration analyzer, sensing motor current for signature analysis, temperature sensing.	07 Hrs.
5	**Data Communication System** Introduction to DAQ, Components of a Data Acquisition System; Sampling, Aliasing, Sample and hold circuit, Quantization; Analog-to-digital converters (4 bit Successive Approximation type ADC); Digital-to-Analog converters (4 bit R2R type DAC), Numerical based on ADC & DAC.	07 Hrs.
6	**Case Studies on Sensor Mounting & Location/Sensor Communication** Students are required to visit any relevant industry or identify lab set up in department and prepare a case study report covering sensor mounting and location principle for the same.	07 Hrs.

Text Books:

1. Walteneus Dargie, Christian Poellabaur ,Wiley edition, Fundamentals of wireless sensor Network
2. D Patranabis, Sensors and transducers, second edition PHI publication

Reference Books:

1. Horst Ezichos, Measurement, Testing and Sensor Technology, springer publication
2. Clarence W. de Silva, Sensor System Fundamentals and application Taylor and Francis

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: - V**	
Course:	**-: Mounting and Communication of Sensor Lab**				**Code: VME25109**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA1**	**FA2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

To provide knowledge about

1. Learn how to interface different sensors to acquire the data in Mechanical Engineering.
2. Use of different sensors used in any mechatronics system

Course Outcomes:

After learning the course, students will be able to

1. Demonstrate knowledge of interfacing any sensor to acquire the data.
2. Develop skills in using software tools and techniques for mechatronics applications.
3. Acquaint with modern tools/software in Mechatronics engineering

Detailed Syllabus:

Assignment	**Description**
1	Experiment on interfacing of suitable sensor with DAQ and LabView.
2	Experiment on measurement of load using load cell with DAQ interface
3	Experiment on measurement of displacement/deformation using DAQ and LabView
4	Demonstration of any one real life mechatronics system application
5	Examine sensor mounting through site visit.
6	Examine sensor communication techniques through site visit

Text Books:

1. Walteneus Dargie, Christian Poellabaur ,Wiley edition, Fundamentals of wireless sensor Network
2. D Patranabis, Sensors and transducers, second edition PHI publication
3. Gary Johnson / Lab VIEW Graphical Programing II Edition / McGraw Hill 1997.

Reference Books:

1. Horst Ezichos, Measurement, Testing and Sensor Technology, springer publication
2. Clarence W. de Silva ,Sensor System Fundamentals and application Taylor and Francis

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: V**	
Course:	**Minor course: Computer Aided Manufacturing**				**Code: VME25206**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. To understand the fundamentals of Numerical Control (NC) machine tools.
2. To gain knowledge about the principles and components of Computer Numerical Control (CNC)
3. To explore modern manufacturing systems such as Flexible Manufacturing Systems (FMS)

Course outcomes:

After learning the course, students will be able to

1. Identify and describe the different elements and classifications of NC machine tools.
2. Explain the structure and functions of the Machine Control Unit (MCU) in NC systems.
3. Demonstrate proficiency in NC Part Programming.
4. Analyze the role of modern trends technologies in manufacturing.

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs)**
1	**Fundamentals of Numerical Control** Elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system. Definition and designation of control axes, MCU structure and functions, Methods of improving accuracy and productivity using NC.	08 Hrs
2	**NC Part Programming:** Features of CNC, Elements of CNC machines, NC Part Programming- (a) Manual (word address format) programming Examples Drilling, Turning and Milling; canned cycles.	07 Hrs
4	**Computer Integrated manufacturing system:** Group Technology, Computer aided process Planning-Retrieval and Generative System. Flexible Manufacturing System (FMS), Manufacturing Execution System; Overview, Components and Functionality, Relationship between MES and ERP, Benefits of MES.	08 Hrs
6	**Smart Manufacturing:** IoT in Smart Machines, Data analytics in manufacturing, Cyber-security for manufacturing. Automated material handling & Cobots. Overview of 3D printing Technology	07 Hrs

Text Books:

1. Automation, Production System and Computer Integrated Manufacturing, by Mikell P. Grover, Prentice Hall of India Pvt Ltd.
2. CAD/CAM – Theory and Practice, by Ibrahim Zeid, McGraw Hill.
3. Computer Aided Manufacturing, by Cheng, Pearson India. 4. CAD/CAM: Principles and Operations, by P. N. Rao, McGraw Hill.

Reference Books:

1. CAD/CAM: Computer Aided Design and Manufacturing, by M. Groover, Pearson India. CAD/CAM: Concepts and Applications by Alavala, PHI India.
2. Computer Aided Manufacturing, by Srinivas, Oxford University Press.

Program:	**B. Voc. (Mechatronics Engineering)**					**Semester: V**
Course:	**Internship V: On Job Training**					**Code: VME25606**
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Course Objectives:

1. To do the on job training to acquire the knowledge about the advanced automation process.
2. To learn about the safety at workplace.

Course outcomes:

After learning the course, students will be able to

1. Design and monitor all the computer-controlled systems and robotic devices used within industrial and commercial facilities.
2. Understand the practices relating to health, safety and security that to use in the workplace.
3. Understand the various essential skills required for jobs and career development

Guidelines: Students will do On Job Training (Industry/In house) in the domain of Mechatronics as per the following job description and personal attributes.

Job Role: Mechatronics Designer and System Integrator

Job Description

A Robotics Automation Lead designs and monitors all the computer-controlled systems and robotic devices used within industrial and commercial facilities to reduce human intervention and maximize efficiency. The individual assists manufacturing, mechanical, and electronics engineers in all phases of process design, development, production, testing, installation of the robot and operations.

Personal Attributes

The individual must have managerial, organisational and problem-solving skills. The person must have good written and verbal communication skills with the ability to multi-task and coordinate with multiple parties simultaneously to achieve the work objectives.

Course Syllabus
Semester-VI

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: VI**	
Course:	**Major course: Robotic Programming**				**Code: VME26110**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**3**	**3**	**25**	**25**	**50**	**100**

Course Objectives:
To provide knowledge about
1. Different types of robot commands and robot Languages.
2. Different robot programming applications

Course outcomes:
After learning the course, students will be able to
1. Classify different programming languages
2. Identify and execute different commands in VAL-I
3. Identify and execute different commands in VAL-II
4. Identify and execute different commands in RAPID
5. Develop robot simulation model in Virtual software
6. Develop robot programming applications

Detailed Syllabus:

Unit	Description	Duration (45 Hrs.)
1	**Basics of Robot Programming** Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism (Pitch, Roll & Yaw)-Interpolation- Interlock commands Operating mode of robot, Jogging Types, Robot specifications- Motion commands, end effectors and sensors commands.	07 Hrs.
2	**VAL Language** Robot Languages-Classifications, Structures- VAL language commands- motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications.	08 Hrs.
3	**VAL-II** Programming-basic commands, applications- Simple problem using conditional statements- Simple pick and place applications-Production rate calculations using robot. AML Language- General description, elements and functions, Statements, constants and variables-Program control statements- Operating systems, Motion, Sensor Commands-Data processing.	08 Hrs.
4	**RAPID Language** RAPID language basic commands- Motion Instructions-Pick and place operation using Industrial robot- manual mode, automatic mode, subroutine command-based programming. Move master command language-Introduction, syntax, simple problems.	08 Hrs.
5	**Practical Study of Virtual Robot** Robot cycle time analysis-Multiple robot and machine Interference-Process chart Simple Problems- Virtual robotics, Robot studio online software-Introduction, Jogging, components, work planning.	07 Hrs.
6	**Robot Programming Applications** Robot programming synthesis, robot programming for foundry, press work and heat	07 Hrs.

	treatment, welding, machine tools, material handling, warehousing assembly, etc., automatic storage and retrieval system.	

Text Book: -

1. Deb. S. R. “Robotics Technology and Flexible Automation”, Tata McGraw Hill publishing company limited.

2. Mikell. P. Groover, “Industrial Robotics Technology”, Programming and Applications, McGraw Hill Co, 1995.

3. Klafter. R.D, Chmielewski.T.A and Noggin’s, “Robot Engineering: An Integrated Approach”, Prentice Hall of India Pvt. Ltd., 1994.

Reference Book:-

1. Fu .K. S, Gonzalez .R. C. & Lee .C.S.G, “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book co, 1987.

2. Craig .J. J, Introduction to Robotics Mechanics and Control, Addison- Wesley, 1999.

Program:	**B. Voc. (Mechatronics)**				**Semester: - VI**	
Course:	**-: Robotic Programming Lab**				**Code: VME26111**	
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**FA1**	**FA2**	**PR**	**Total**
2	**2**	**1**	**-**	**-**	**50**	**50**

Objectives:

To provide knowledge about

1. Different types of robot commands and robot Languages.
2. Different robot programming applications

Course Outcomes:

After learning the course, students will be able to

1. Classify different programming languages
2. Identify and execute different commands in VAL-I and VAL-II
3. Identify and execute different commands in RAPID

Detailed Syllabus:

Assignment	**Description**
1	Write a program for palletizing operation by robot
2	Write a program for depalletizing operation by robot
3	Write a program for Pick Place operation by robot
4	Write a program for object sorting by robot manipulator based on colour, shape, material etc.
5	Demonstration of Arduino kit/pic controller/PLC for any robotic application
6	Industrial Visit to any robotic component manufacturing industry

Text Book: -

1. Deb. S. R. “Robotics Technology and Flexible Automation”, Tata McGraw Hill publishing company limited.

2. Mikell. P. Groover, “Industrial Robotics Technology”, Programming and Applications, McGraw Hill Co, 1995.

3. Klafter. R.D, Chmielewski.T.A and Noggin’s, “Robot Engineering: An Integrated Approach”, Prentice Hall of India Pvt. Ltd., 1994.

Reference Book:-

1. Fu .K. S, Gonzalez .R. C. & Lee .C.S.G, “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book co, 1987.

2. Craig .J. J, “Introduction to Robotics Mechanics and Control”, Addison- Wesley, 1999.

Program:	**B. Voc. (Mechatronics Engineering)**				**Semester: VI**	
Course:	**Minor course: Product Development**				**Code: VME26207**	
Teaching Scheme			**Evaluation Scheme**			
Lecture	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
2	**2**	**2**	**20**	**20**	**40**	**80**

Course Objectives:

1. This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front-end processes.
2. At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

Course outcomes:

After learning the course, students will be able to

1. To analyze the product design and development processes in industry.
2. To understand the components and their functions of product design and development processes and their relationships from concept to customer over whole product lifecycle.
3. To evaluate the methodologies for product design, development and management.
4. To illustrate product development to satisfy customer needs and evaluate cost of the product.

Detailed Syllabus:

Unit	**Description**	**Duration (30 Hrs.)**
1	**Fundamentals of Product development** Need for developing products, the importance of engineering design, types of design and design process, relevance of product lifecycle issues in design, designing to codes and standards, societal considerations in engineering design, generic product development process, various phases of product development-planning for products, establishing markets, market segments- relevance of market research.	08 Hrs.
2	**Customer-Centric Product Development** Identifying customer needs –voice of customer, customer populations, hierarchy of human needs gathering methods, affinity diagrams – needs importance, establishing engineering characteristics, competitive benchmarking, quality function deployment, house of quality, product design specification, case studies.	07 Hrs.
3	**Creative Thinking and Product design** Creative thinking, creativity and problem solving, creative thinking methods, generating design concepts, systematic methods for designing, functional decomposition, physical decomposition, functional representation, morphological methods, TRIZ- axiomatic design.	08 Hrs.
4	**Product Development and Costing** Decision making, decision theory, utility theory, decision trees, concept evaluation methods, Industrial design, prototyping and testing, cost evaluation and categories of cost, value analysis in costing.	07 Hrs.

Text Books:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9.

2. George E. Dieter, Linda C. Schmidt, “Engineering Design”, McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9.

Reference Books:

1. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education, ISBN 9788177588217.
2. Yousef Haik, T. M. M. Shahin, “Engineering Design Process”, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141.
3. Clive L.Dym, Patrick Little, “Engineering Design: A Project-based Introduction”, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7.

Program:	B. Voc. (Mechatronics Engineering)			Semester: VI		
Course:	Project II: Project			Code: VME26607		
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
8	8	4	50	-	150	200

Course Objectives:

1. To provide an opportunity of designing and building complete systems or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills.

Course Outcomes: After learning the course, the students should be able to

1. Demonstrate sound academic fundamentals to formulate and analyze complex Mechanical engineering problems.
2. Provide creative/ innovative solutions for complex engineering problems.
3. Design Mechanical systems/products/processes for providing solutions to environmental issues/ needs of society/Industry/ safety issues.
4. Work effectively as a team member / Leader in order to manage the project work and finance.
5. Write a report on the research work and present it effectively.

Guidelines to the Students:

1. **Group Size:** The student will carry the project work individually or by a group of students. Optimum group size is in 4 students. However, if project complexity demands a maximum group size of 5 students, the committee should be convinced about such complexity and scope of the work.
2. **Selection and approval of Topic:** Topic should be related to real life application/Thrust areas in the above application fields but not limited to.

   OR

   The investigation of practical problem in manufacture and / or testing of mechatronics equipment's in Industry.

Note: The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by internal/external guides. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.

The evaluation of project will be done considering the performance of students in Reviews 1, 2, and the final examination.

Program:	**B. Voc. (Mechatronics Engineering)**					**Semester: VI**
Course:	**Internship VI: On Job Training**					**Code: VME26608**
Teaching Scheme			**Evaluation Scheme**			
Practical	**Hours**	**Credit**	**TW**	**PR**	**OR**	**Total**
20	**20**	**10**	**-**	**200**	**-**	**200**

Course Objectives:

1. To do the on job training to acquire the knowledge about the advanced automation process.
2. To learn about the safety at workplace.

Course outcomes:

After learning the course, students will be able to

1. Design and monitor all the computer-controlled systems and robotic devices used within industrial and commercial facilities.
2. Understand the practices relating to health, safety and security that to use in the workplace.
3. Understand the various essential skills required for jobs and career development

Guidelines: Students will do On Job Training (Industry/In house) in the domain of Mechatronics as per the following job description and personal attributes.

Job Role: Mechatronics Designer and System Integrator

Job Description

A Robotics Automation Lead designs and monitors all the computer-controlled systems and robotic devices used within industrial and commercial facilities to reduce human intervention and maximize efficiency. The individual assists manufacturing, mechanical, and electronics engineers in all phases of process design, development, production, testing, installation of the robot and operations.

Personal Attributes

The individual must have managerial, organisational and problem-solving skills. The person must have good written and verbal communication skills with the ability to multi-task and coordinate with multiple parties simultaneously to achieve the work objectives.