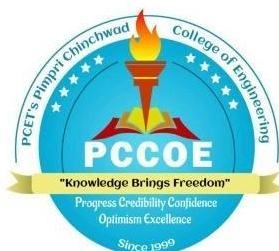


**Pimpri Chinchwad Education Trust's
PIMPRI CHINCHWAD COLLEGE OF
ENGINEERING**

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044
An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune



**Curriculum Structure of
B. Voc. Mechatronics Engineering
and
Syllabus of B. Voc. Program
(Approved by Board of Studies, B. Voc. Program, PCCOE)
(Course 2021)**

"Knowledge Brings Freedom"

Progress Credibility Confidence



Effective from Academic Year 2021-22

Institute Vision

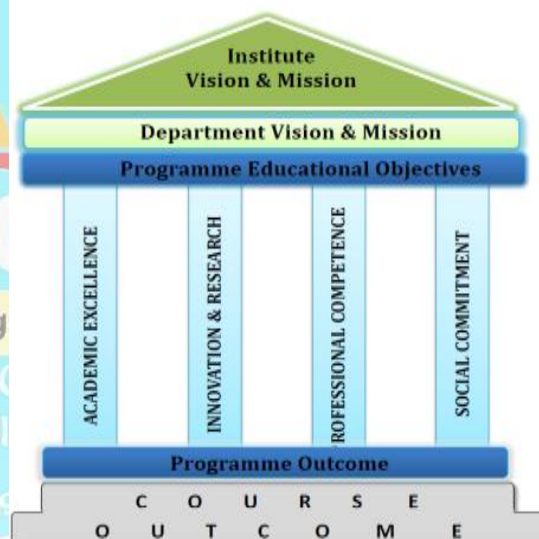
To Serve the Society, Industry and all the Stakeholders through the **Value-Added Quality Education.**

Institute Mission

To serve the needs of society at large by establishing State-of-the-Art Engineering, Management and Research Institute and impart attitude, knowledge and skills with quality education to develop individuals and teams with ability to think and analyze right values and self-reliance.

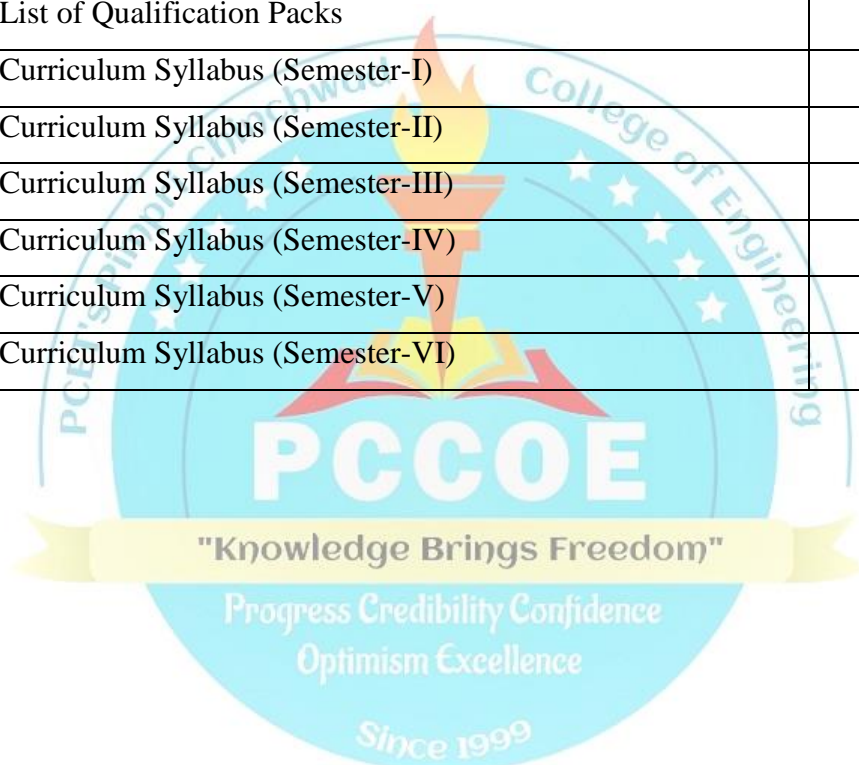
Quality Policy

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.



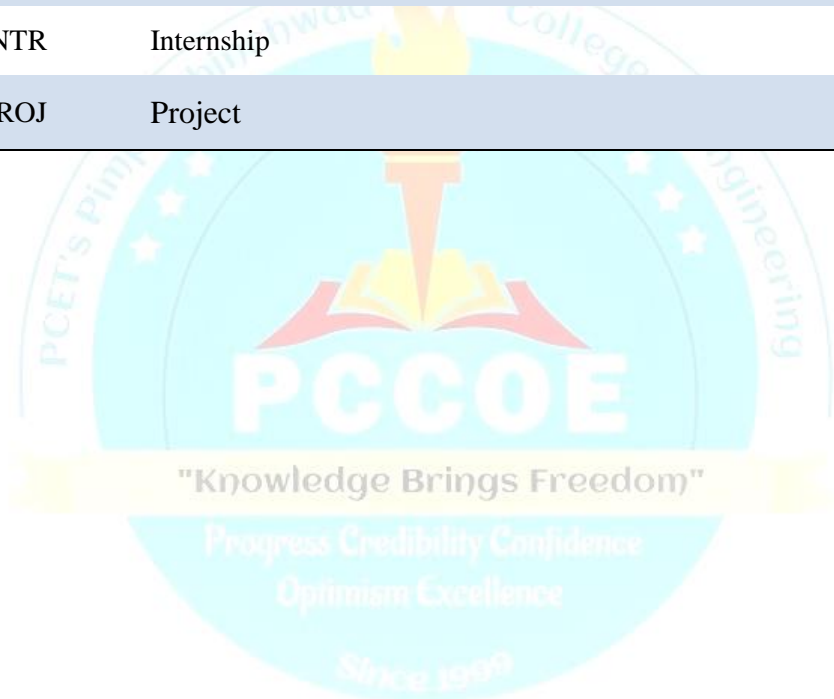
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ABBREVIATIONS

Abbreviations	Course Full Name
PCC	Professional Core Course
BSC	Basic Science Course
ECC	Engineering core/Science course
HSMC	Humanities, Social Sciences, and Management Course
INTR	Internship
PROJ	Project



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	IE1	IE ₂	ETE	TW	OR	PR	Tota
C4.GE.01	BSC	Applied Science	3	-	3	3	20	30	50	-	-	-	100
C4.GV.01	ECC	Engineering Drawing	3	-	3	3	20	30	50	-	-	-	100
C4.GV.02	ECC	Basic Electricity & Electronics	3	-	3	3	20	30	50	-	-	-	100
M4.GV.03	PCC	Professional Core Course I (Sensors and Actuators)	3	-	3	3	20	30	50	-	-	-	100
C4.GP.01	BSC	Applied Science Lab	-	3	3	1.5	-	-	-	-	-	50	50
C4.VP.01	ECC	Basic Electricity & Electronics Lab	-	3	3	1.5	-	-	-	-	-	50	50
M4.QP.01	INTR	On Job Training (ELE/Q7105)	-	30	30	15	-	-	-	-	-	200	200
Total			12	36	48	30	80	120	200	-	-	300	700

SEMESTER II

B. Voc. Structure			Sem-II		Teaching Scheme				Examination Scheme				
Course Code	Course Type	Course Name	L	P	H	CR	IE1	IE ₂	ETE	TW	OR	PR	Tota
C5.GE.01	BSC	Applied Mathematics	3	-	3	3	20	30	50	-	-	-	100
C5.GV.01	ECC	IT Tools	3	-	3	3	20	30	50	-	-	-	100
C5.GE.02	HSMC	Language I	3	-	3	3	20	30	50	-	-	-	100
M5.GV.02	PCC	Professional Core Course II (Microcontrollers)	3	-	3	3	20	30	50	-	-	-	100
M5.VP.01	PROJ	Mini Project	-	6	6	3	-	-	-	-	100	-	100
M5.QP.01	INTR	On Job Training (ELE/Q7105)	-	30	30	15	-	-	-	-	-	200	200
Total			12	36	48	30	80	120	200	-	100	200	700

Abbreviation: L- Lecture; P- Practical; H- Hours; CR- Credits; IE 1 – Internal Evaluation-1; IE 2 – Internal Evaluation-II; ETE – End Term Examination; TW – Term Work; OR – Oral Exam; PR – Practical Exam.

**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	IE 1	IE 2	ETE	TW	OR	PR	Total
C6.GE.01	HSMC	Language II (Soft Skills for Professionals)	3	-	3	3	20	30	50	-	-	-	100
C6.GE.02	HSMC	Introduction to Entrepreneurship	3	-	3	3	20	30	50	-	-	-	100
M6.GV.01	PCC	Manufacturing Technology	3	-	3	3	20	30	50	-	-	-	100
M6.GV.02	PCC	Fluid Power and PLC	3	-	3	3	20	30	50	-	-	-	100
M6.VP.01	PCC	Manufacturing Technology Lab	-	3	3	1.5	-	-	-	-	-	50	50
M6.VP.02	PCC	Fluid Power and PLC Laboratory	-	3	3	1.5	-	-	-	-	-	50	50
M6.QP.01	INTR	On Job Training (ELE/Q7107)	-	30	30	15	-	-	-	-	-	200	200
Total			12	36	48	30	80	120	200	-	-	300	700

SEMESTER-IV

B. Voc. Structure			Sem-IV		Teaching Scheme		Examination Scheme						
Course Code	Course Type	Course Name	L	P	H	CR	IE 1	IE 2	ET E	TW	OR	PR	Total
M6.GE.03	HSMC	Management and Entrepreneurship	3	-	3	3	20	30	50	-	-	-	100
M6.GV.03	PCC	Engineering Materials	3	-	3	3	20	30	50	-	-	-	100
M6.GV.04	PCC	Metrology and Measuring Instruments	3	-	3	3	20	30	50	-	-	-	100
M6.GV.05	PCC	Manufacturing Automation & Ergonomics	3	-	3	3	20	30	50	-	-	-	100
M6.VP.03	PCC	Engineering Materials Laboratory	-	3	3	1.5	-	-	-	-	-	50	50
M6.VP.04	PCC	Metrology and Measuring Instruments Laboratory	-	3	3	1.5	-	-	-	-	-	50	50
M6.QP.02	INTR	On Job Training (ELE/Q7107)	-	30	30	15	-	-	-	-	-	200	200
Total			12	36	48	30	80	120	200	-	-	300	700

Abbreviation: L- Lecture; P- Practical; H- Hours; CR- Credits; IE 1 – Internal Evaluation-1; IE 2– Internal Evaluation-II; ETE – End Term Examination; 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	IE 1	IE 2	ET E	TW	OR	PR	Total
M7.GV.01	PCC	Robot Kinematics & Dynamics	3	-	3	3	20	30	50	-	-	-	100
M7.GV.02	PCC	Mounting and Communication of sensor	3	-	3	3	20	30	50	-	-	-	100
M7.GV.03	PCC	Robotic Programming	3	-	3	3	20	30	50	-	-	-	100
M7.GV.04	PCC	Instrumentation for Robotics & Automation	3	-	3	3	20	30	50	-	-	-	100
M7.VP.01	PCC	RKD & MCS Lab	-	3	3	1.5	-	-	-	-	-	50	50
M7.VP.02	PCC	RP & IRA Lab	-	3	3	1.5	-	-	-	-	-	50	50
M7.QP.01	INTR	On Job Training (ELE/Q7106)	-	30	30	15	-	-	-	-	-	200	200
Total			12	36	48	30	80	120	200	-	-	300	700

SEMESTER-VI

B. Voc. Structure		Sem-VI	Teaching Scheme				Examination Scheme						
Course Code	Course Type	Course Name	L	P	H	CR	IE 1	IE 2	ET E	TW	OR	PR	Total
M7.GV.05	PCC	Troubleshooting and Maintenance of Robots	3	-	3	3	20	30	50	-	-	-	100
M7.GV.06	PCC	Robotic Simulation	3	-	3	3	20	30	50	-	-	-	100
M7.VP.03	PROJ	Project	-	18	18	9	-	-	-	50	150	-	200
M7.QP.02	INTR	On Job Training (ELE/Q7106)	-	30	30	15	-	-	-	-	-	200	200
Total			6	48	54	30	40	60	100	50	150	200	600

Abbreviation: L- Lecture; P- Practical; H- Hours; CR- Credits; IE 1 – Internal Evaluation-1; IE 2– Internal Evaluation-II; ETE – End Term Examination; TW – Term Work; OR – Oral Exam, PR – Practical Exam.

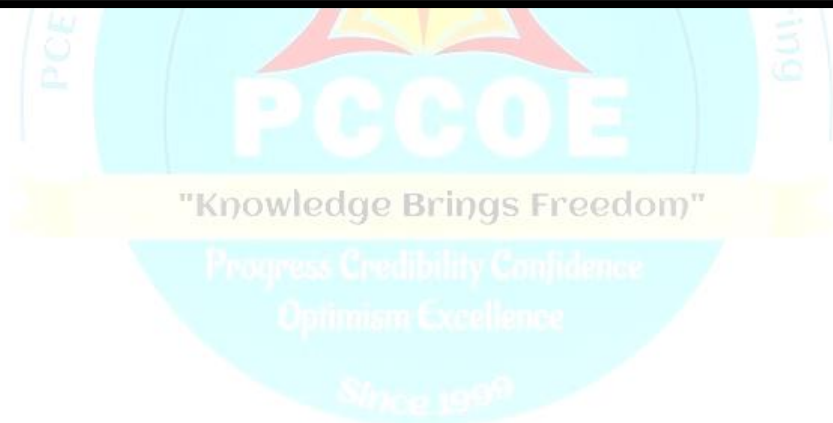
LIST OF QUALIFICATION PACKS (QP)

Course code	QP code	Name of QP
M4.QP.01	ELE/QP7105	Mechatronics Maintenance specialist
M5.QP.01	ELE/QP7105	Mechatronics Maintenance specialist
M6.QP.01	ELE/QP7107	Mechatronics Designer and System Integrator
M6.QP.02	ELE/QP7107	Mechatronics Designer and System Integrator
M7.QP.01	ELE/QP7106	Robotics Automation Lead
M7.QP.02	ELE/QP7106	Robotics Automation Lead



Course Syllabus

Semester-I



Program: B. Voc. (MECHATRONICS ENGG)				Semester: I		
Course: Applied Science				Code: C4.GE.01		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (36 Hrs)
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. Alkalinity - its determination and numerical. Disadvantages of hard water in boilers,. Water softening techniques: Permutit and Ion exchange method. Water purification by reverse osmosis and electro-dialysis methods.					6
2	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. Petroleum and brief idea of refining into various factions and their characteristics and uses. Octane number and cetane number, knocking and anti-knocking agents. Synthesis reaction, properties, advantages and disadvantages of Biodiesel. Gaseous fuels- Gaseous fuels: Hydrogen gas as a future fuel, production by steam reforming of methane and coke, storage and transportation. .					6
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.					6
4	Units and dimensions M.K.S. fundamentals & derived units, S.I. base units, supplementary units and derived units, Dimensions of various physical quantities, uses of dimensional analysis.					6
5	Optics: wave nature of light, reflection and refraction of a wave from a plane surface, total internal reflection, plane polarized light, Law of Malus					6
6	Ultrasonics: Productions of ultrasonic waves by magnetostriction and piezo-electric effect, application of ultrasonics in industry					6
Text Books:						
1. Jain and Jain, <i>Engineering Chemistry</i> , Dhanpat Rai Publishing Co., 2016.						
2. Avadhanulu M. N., Kshirsagar P.G., <i>A text book of Engineering Physics</i> , S. Chand publication, 2015.						
Reference books:						
1. Wiley Editorial, <i>Engineering Chemistry</i> , Wiley India, 2012.						
2. Palanna O.G., <i>Engineering Chemistry</i> , Tata McGraw-Hill Education, 2009.						
Gaur R. K., Gupta S. L., <i>Engineering Physics</i> , Dhanpat Rai Publications, 2001.						

Program: B. Voc. (MECHATRONICS ENGG)			Semester: I			
Course: Engineering drawing			Code: C4.GV.01			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (36 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.					6
2	Projection of Line and Planes Introduction, Projection of points – points on the different quadrants and on the reference planes. Projection of straight lines – 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- 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.					6
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.					6
5	Development of Lateral Surfaces of Solids Introduction, Development of lateral surfaces of Cone, Cylinder, Pyramid and Prism.					6
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, screw thread forms, welded joints, riveted joints.					6
Text Books 1. Bhatt N.D., and Panchal V.M., <i>Engineering Drawing</i> , Charotar Publishing House, 2010. 2. Agrawal Besant, and Agrawal C M “ <i>Engineering drawing</i> ”, Tata McGraw Hill Education Private Limited., 2014. Reference books: 1. Gill P.S., <i>Engineering drawing</i> , S.K. Kataria & Sons., 2016. 2. Gopalakrishnan.K.R., <i>Engineering Drawing</i> , (Vol.I and Vol.II), Dhanalakshmi publishers, 1970. 3. Venugopal. K, and Sreekanjana G., <i>Engineering Graphics</i> , New Age International Publishers. 2019. 4. Natarajan K. V., <i>A text book of Engineering Drawing Graphics</i> . Dhanalakshmi Publishers, 2008.						

Program: B. Voc. (MECHATRONICS ENGG)			Semester: I			
Course: Basics of Electrical & Electronics			Code: C4.GV.02			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (36 Hrs)
1	Electromagnetism: Flux, flux density, reluctance, MMF, permeability and field strength, their units and relationships; comparison of electric and magnetic circuit, Series magnetic circuit with air-gap, comparison of electric and magnetic circuit, force on current carrying conductor placed in magnetic field, Fleming’s left-hand rule. Faradays laws of electromagnetic induction, Fleming’s right-hand rule, statically and dynamically induced e.m.f, self and mutual inductance, coefficient of couplings. Energy stored in magnetic field.					6
2	Single Phase AC Circuits: Generation of single phase sinusoidal A.C. voltages, AC quantities, phasor representation, R-L-C series &, parallel circuit (No Numerical), impedance, admittance, concept of active, reactive, apparent power and power factor. 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.					6
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. AC Machines: Single phase transformers: Construction, operating principle, emf equation, voltage and current ratios. Losses, Efficiency and regulation, Auto-transformer.					6
4	Network Theory: Kirchhoff’s Current and Voltage Laws, Independent and dependent sources and their interconnection, power calculations, Mesh, Super mesh, Node and Super Node analysis. Source transformation and source shifting. Superposition, Thevenin’s, Norton’s and Maximum Power Transfer Theorems.					6
5	Electronic Devices and Circuits PN Junction diode: Structure, principle of operation, Photo diode, LED, Bipolar Junction Transistors: structure, Principle of operation, Characteristics, Rectifiers and power supplies: Half wave and full wave rectifier, capacitor filter, Zener voltage regulator, Amplifiers and oscillators: Common emitter amplifier, feedback oscillators, RC phase shift oscillator, Analog Integrated Circuits: operational amplifiers (OPAMP), inverting and non-inverting amplifiers, comparator, Electronic Instrumentation: Digital multimeter, CRO, digital storage oscilloscope, function generator.					6
6	Digital Electronics Number System & Logic Gates: Introduction to number system, weighted & non-weighted coding system, Conversion of number systems, Signed & unsigned numbers, Binary arithmetic, Binary subtraction using 2’s complement, Introduction to logic gates, Boolean Laws.					6

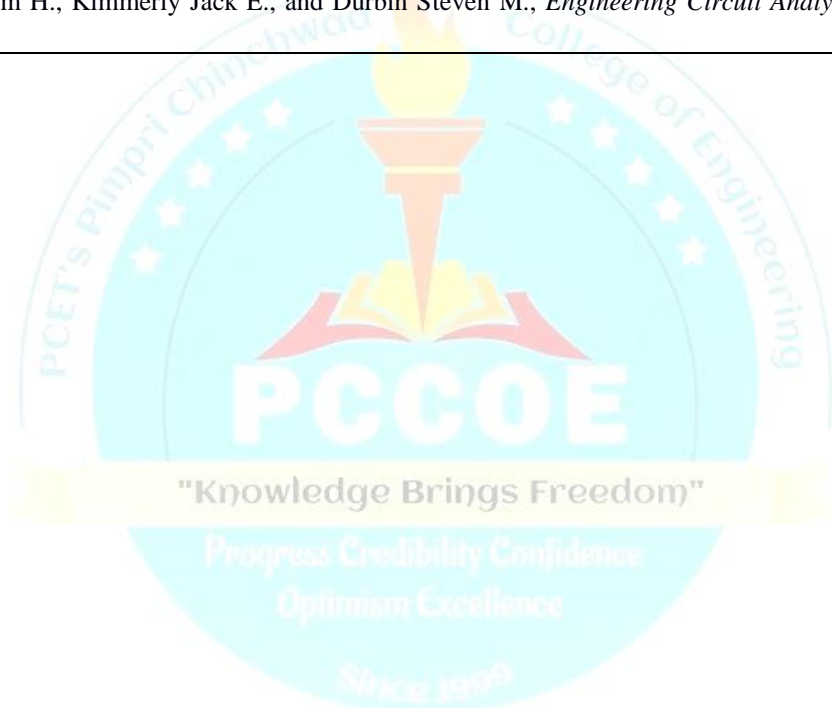
Books:

Text Books:

1. Nagrath I. J. and Kothari, *Theory and Problems of Basic Electrical Engineering*, PHI Learning Private Limited, 2016.
2. Husain Ashfaq, *Fundamentals of Electrical Engineering*, Dhanpat Rai & Co., 2010.
3. Mittal V. N. and Mittal Arvind, *Basic Electrical Engineering*, McGraw Hill., 2006.
4. Mehta V.K., *Basic Electrical Engineering*, S. Chand & Co. Pvt. Ltd. New Delhi, 2012.
5. Bell, D. A., *Electronic Devices and Circuits*, Oxford University Press, 2008.
6. Tomasy W., *Advanced Electronic Communication system*, PHI Publishers, 2003.
7. M. Morris Mano, *Digital Logic and Computer Design*, Prentice Hall of India, 2004.

Reference Books:

8. Kulshreshta D.C., *Basic Electrical Engineering*, Tata McGraw Hill, 2009.
9. Theraja B.L. and Theraja A.K., *A textbook of Electrical Technology*, S. Chand & Co. Pvt. Ltd. New Delhi, 2007.
10. Hughes Edward, Hiley John, Ian McKenzie-Smith, and Keith Brown, *Electrical and Electronic Technology*, Pearson, 2016.
11. Neaman Donald, *Electronic Circuit Analysis and Design*, Tata McGraw Hill, 2006.
12. Hayt William H., Kimmerly Jack E., and Durbin Steven M., *Engineering Circuit Analysis*, TataMcGraw Hill, 2012.



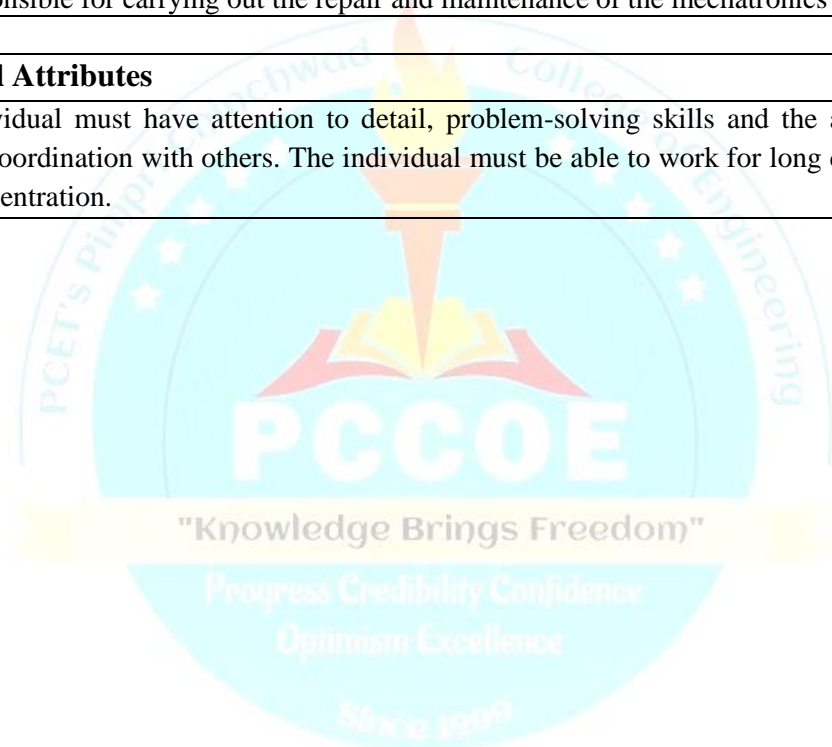
Program: B. Voc. (MECHATRONICS ENGG)				Semester: I		
Course: Profession Core Course I (Sensors and Actuators)				Code: M4.GV.03		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (36 Hrs)
1	INTRODUCTION 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					6
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)					6
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					6
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					6
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					6
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					6
Text Books:						
1. Bolton W., <i>Mechatronics: Electronics Control Systems in Mechanical and Electrical Engineering</i> , Pearson Publication, 2019.						
2. Ramchandran K. P., Vijayaraghavan G. K., Balasundaram M. S., <i>Mechatronics: Integrated Mechanical Electronic Systems</i> , Willey Publication, 2008.						
Reference Books:						
1. Alciatore D. G., <i>Introduction to Mechatronics and Measurement Systems</i> , Mc-Graw Hill publication, 2019.						
2. Mahalik N. P., <i>Mechatronics Principles, concepts and applications</i> , Tata Mc-Graw Hill publication, 2016.						

Program: B. Voc. (MECHATRONICS ENGG)			Semester: I			
Course: Applied Science Lab			Code: C4.GP.01			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
3	3	1.5	-	50	-	50
Guidelines:						
1. Total experiments to be conducted are four from Part A and four from Part B						
2. Total : 8 experiments/assignments to be conducted						
Detailed Syllabus:						
Part A: Applied Chemistry (Any four)						
Expt .	Description					
1.	Determination of total hardness of water sample by EDTA method (two water samples).					
2.	Determination of total alkalinity of the water sample..					
3.	Determination of pH and conductance of different water sample solutions.					
4.	Proximate analysis of solid fuel.					
5.	Electrodepositon of Zinc (Zn) over Cu plates or Fe plates.					
Part B: Applied Physics (Any four)						
Expt .	Description					
1.	To determine least counts and take readings with given measuring instruments					
2.	To verify Snell's law of refraction					
3.	To verify law of Malus					
4.	To determine critical angle for given transparent medium					
5.	To determine velocity of ultrasonic waves in a given liquid					
Text Books:						
1. Jain and Jain, <i>Engineering Chemistry</i> , Dhanpat Rai Publishing Co.,2016.						
2. Avadhanulu M.N., Kshirsagar P.G., <i>A text book of Engineering Physics</i> , S. Chand publication, 2015.						
3. Virmani O.P., and A.K. Narula, <i>Applied Chemistry Theory and Practice</i> , New age International (P) Ltd., 1995.						
Reference books:						
1. Wiley Editorial, <i>Engineering Chemistry</i> , Wiley India, 2012.						
2. Palanna O.G., <i>Engineering Chemistry</i> , Tata McGraw-Hill Education, 2009.						
3. Gaur R.K., and S.L. Gupta, <i>Engineering Physics</i> , Dhanpat Rai Publications,2001.						
4. Mendham J., Denny R.C., Barnes J.D., and Vogels Thomas M.J.K., <i>Text book of Qualitative Chemical Analysis</i> . Pearson Education Ltd.. 1989.						

Program: B. Voc. (MECHATRONICS ENGG)			Semester: I			
Course: Basics of Electrical & Electronics Lab			Code: C4.VP.01			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
3	3	1.5	-	50	-	50
Guidelines:						
1. Total experiments to be conducted are four from Part A and four from Part B						
2. Total : 8 experiments/assignments to be conducted						
Detailed Syllabus:						
Part A: Basic Electricity (Any four)						
Expt.	Description					
	To study of various wiring accessories, earthing system and safety precautions while working with electrical systems					
	To measure steady state response of series RL and RC circuits on AC supply and observations of voltage and current waveforms.					
	To verify the relation between phase and line quantities in three phase balanced star and delta connections of load.					
	Perform speed control of DC Shunt Motor to plot characteristics.					
	To determine efficiency and regulation of single-phase transformer by direct loading test.					
Part B: Basic Electronics (Any four)						
Expt.	Description					
1.	Verification of Kirchhoff's laws/Superposition Theorem/Thevenin's Theorem/Norton's Theorem					
2.	Testing & Measurements of various Electronic components.					
3.	Study of Cathode Ray Oscilloscope and measurement of different parameters using CRO/DSO.					
4.	Study of Multimeter for measurement of electronic components.					
5.	Study of Function generator.					
Text Books:						
1. Nagrath I. J., and Kothari, <i>Theory and problems of Basic Electrical Engineering</i> , PHI learning Pvt.Ltd., 2013.						
2. Husain Ashfaq, <i>Fundamentals of Electrical Engineering</i> , Dhanpat Rai & Co., 2002.						
3. Mittal V. N., and Mittal Arvind, <i>Basic Electrical Engineering</i> , McGrawHill. 2006.						
4. Mehta V.K., <i>Basic Electrical Engineering</i> , S. Chand & Co. Pvt. Ltd., 2012.						
5. Bell, D. A., <i>Electronic Devices and Circuits</i> , Oxford University Press, 2008.						
6. Tomasy, W., <i>Advanced Electronic Communication system</i> , PHI Publishers, 2003.						
7. M. Morris Mano, <i>Digital Logic and Computer Design</i> , Fourth edition, Prentice Hall of India, 2004.						
Reference Books:						
8. Kulshreshta D.C., <i>Basic Electrical Engineering</i> ,Tata McGraw hill, 2009.						
9. Theraja B.L., and Theraja A. K., <i>A textbook of Electrical Technology Vol I</i> S. Chand & Co. Pvt. Ltd., 2005.						
10. Theraja B.L., and Theraja A. K., <i>A textbook of Electrical Technology Vol II</i> , S. Chand & Co. Pvt. Ltd., 2005.						
11. Hughes Edward, Electrical Technology, and Neaman Donald, <i>Electronic Circuit Analysis and Design</i> , Tata McGraw Hill, 2006.						
12. WilliamH. Hayt, Jack E Kimmerly, and Durbin Steven M., <i>Engineering Circuit Analysis</i> , TataMcGraw Hill, 2012.						

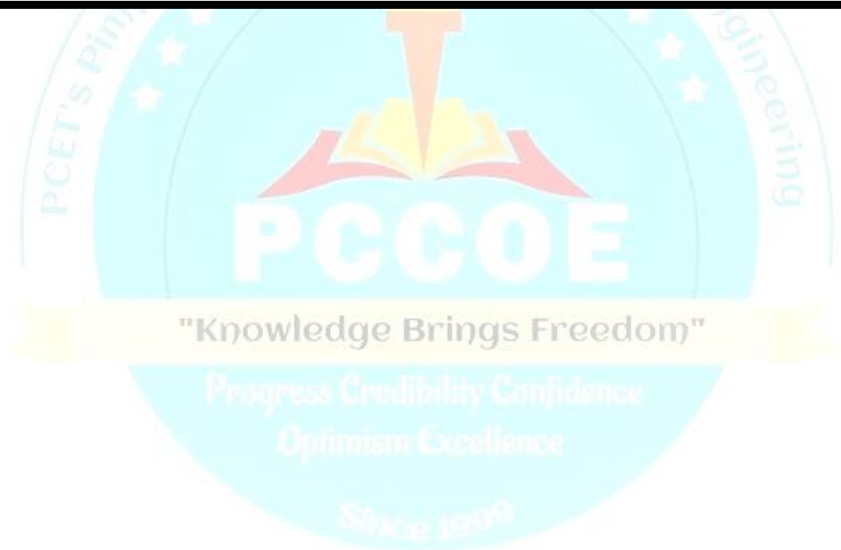


Program: B. Voc. (MECHATRONICS ENGG)			Semester: I			
Course: On Job Training (ELE/Q5901)			Code: M4.VP.01			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
30	30	15	-	-	200	200
Guidelines: Students will take on job training in the industry in the domain of Mechatronics Engineering as per the following job description and personal attributes.						
	Job 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					
2.	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



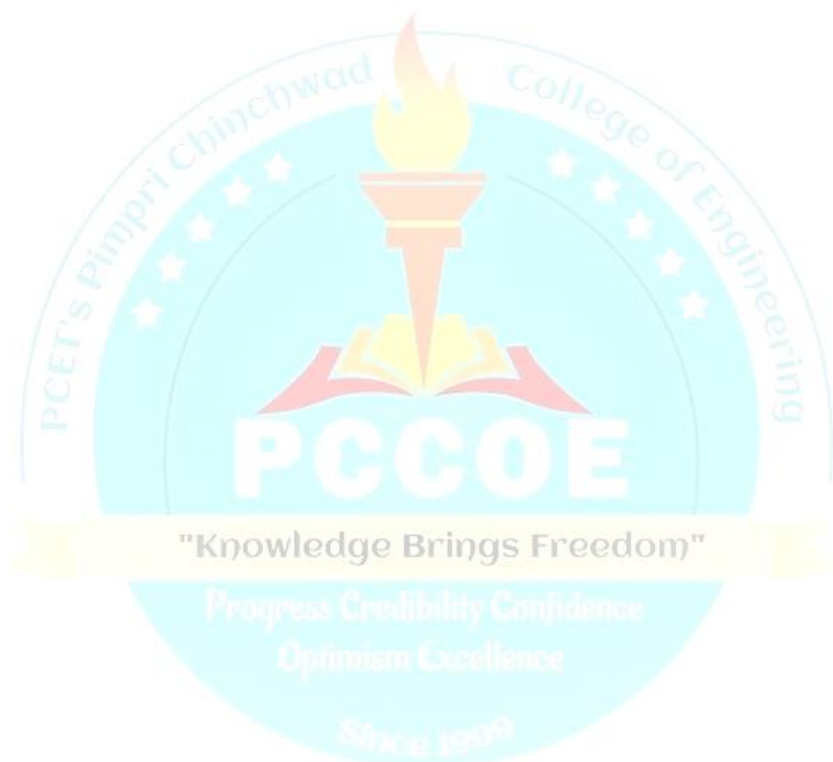
Program: B. Voc. (MECHATRONICS ENGG)			Semester: II			
Course: Applied Mathematics			Code: C5.GE.01			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (36 Hrs)
1.	Linear Algebra: Determinants: Definition 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.					6
2.	Calculus I: Limits: Definition of Limit, Limits of algebraic, trigonometric, exponential and logarithmic functions with simple examples 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.					6
3.	Calculus II: Integration: Definition of integration as anti-derivative. Integration of standard function, Rules of integration. Definite Integrals: Definition of definite integral, Properties of definite integral with simple problems					6
4.	Differential Equations: Definition of differential equation, order and degree of differential equation. Formation of differential equation, Solution of differential equations of first order and first degree such as variable separable type, Homogeneous Differential equations					6
5.	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.					6
6	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.					6

Text Books:

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

Reference Books:

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



Program: B. Voc. (MECHATRONICS ENGG)				Semester: II		
Course: Language I				Code: C5.GE.02		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (36 Hrs)
1	Listening Skills – Importance of Listening, Hearing v/s Listening, Types of Listening, Techniques to improve listening skills, Receiving messages / Instructions					4
2	Reading Skills – Importance and Types of Reading, Techniques of effective Reading, Types of Reading Comprehensions.					4
3	Grammar & Vocabulary Grammar - Articles, Prepositions, Tenses, Subject-Verb Agreement, Types of Sentences, Common errors of grammar. Vocabulary – Synonyms, Antonyms, Words often confused, Collocations, Prepositional Phrases, General and Professional English words					10
4	Speaking Skills– Accuracy v/s Fluency, Proper Pronunciation, Pace and Tone, Self introductions, Narrating incidents, Making Enquiries, Agreeing/Disagreeing, Group Discussions.					6
5	Writing Skills Coherence and Cohesion in writing, Stages of writing, Writing instructions, Describing Objects, Letter writings, Reports writing					6
6	Communication Skills Importance of Effective Communication, 7C Principles of Communication, Types of Communication, Barriers to Communication, How to remove the barriers					6
Text Books:						
1. Wren & martin, and Rao Prasada N. D. V., <i>English Grammar and Composition</i> , S. Chand and Co. Pvt. Ltd, 2017.						
Reference Books:						
1. Salaria R.S., and Kumar Kul Bhushun , <i>Effective Communication Skills</i> , Khanna book publishing co. (P)Ltd, 2020.						
2. Patil Z.N., Walke B., Thorat A., and Merchant Z., <i>English For Practical Purposes</i> , Macmillan Publication, 2016.						
3. Mishra S., and Muralikrishna C., <i>Communication Skills for Engineers</i> , Pearson India Publication, 2011.						
4. V. Bhatia, <i>Business Communication</i> , Khanna book publishing co. (P)Ltd, 2013.						

Program: B. Voc. (MECHATRONICS ENGG)				Semester: II		
Course: IT Tools				Code: C5.GV.01		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (36 Hrs)
1	Introduction to Computer : Evolution of Computers & its applications, Basics of Hardware and Software, Central Processing Unit, Input devices, Output devices, Computer Memory & storage, Application Software, Systems Software, Utility Software, Open source and Proprietary Software, Mobile Apps					6
2	Introduction to Internet and WWW : Basic of Computer Networks, Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN), Network Topology, Concept of Internet & WWW, Applications of Internet, Website Address and URL, Introduction to IP Addresses, Internet Protocol, Modes of Connecting Internet (Hotspot, Wi-Fi, LAN Cable, Broadband, USB Tethering), Identifying and uses of IP/MAC/IMEI of various devices, Web Browsers (Internet Explorer/Edge, Chrome, Mozilla Firefox, Opera etc.), Surfing the web, Search Engines,					6
3	Word Processing : Word Processing Basics, Creating a New Document, Opening and Closing Documents, Save and Save As, Using The Help, Page Setup, Page Layout, Borders, Watermark, Print Preview, Printing of Documents, Saving a Document as PDF file, Text Selection, Cut, Copy and Paste, Font, Color, Style and Size selection, Alignment of Text, Undo & Redo, AutoCorrect, Spelling & Grammar, Find and Replace, Formatting the Text, Creating and using user-defined Styles, Paragraph Indentation, Bullets and Numbering, Change case, Header & Footer, Insert & Draw Table, Changing cell width and height, Alignment of Text in cell, Delete / Insertion of Row, Column and Merging & Splitting of Cells, Border and Shading.					6
4	Spreadsheet : Elements of Spread Sheet, Creating of Spread Sheet, Concept of Cell Address [Row and Column] and selecting a Cell, Entering Data [text, number, date] in Cells, Page Setup, Printing of Sheet, Saving Spreadsheet, Opening and Closing, Modifying / Editing Cell Content, Formatting Cell (Font, Alignment, Style), Cut, Copy, Paste & Paste Special, Changing Cell Height and Width, Inserting and Deleting Rows, Column, AutoFill, Sorting & Filtering, Freezing panes, Formulas, Functions and Charts, Using Formulas for Numbers (Addition, Subtraction, Multiplication & Division), AutoSum, Functions (Sum, Count, MAX, MIN, AVERAGE), sort, Filter, Pivot table Charts (Bar, Column, Pie, Line).					6
5	Presentation : Creation of Presentation, Creating a Presentation Using a Template, Creating a Blank Presentation, Inserting & Editing Text on Slides, Inserting and Deleting Slides in a Presentation, Saving a Presentation, Inserting Table, Adding ClipArt Pictures, Inserting Other Objects, Resizing and Scaling an Object, Creating & using Master Slide, Presentation of Slides, Choosing a Set Up for Presentation, Running a Slide Show, Transition and Slide Timings, Automating a Slide Show, Working with Color and Line Style, Adding Video and Sound, Adding Headers, Footers and Notes, Printing Slides and Handouts.					6
6	E-mail and Social Networking : Structure of E-mail, Using E-mails, Opening Email account, Mailbox: Inbox and Outbox, Creating and Sending a new E-mail, replying to an E-mail message, Forwarding an E-mail message, Searching emails, Attaching files with email, Email Signature, Social Networking & e-Commerce, Facebook, Twitter, LinkedIn, Instagram, Instant Messaging (WhatsApp, Facebook Messenger, Telegram), Introduction to Blogs.					6

Text Books:

1. Bittu Kumar, “*Mastering MS Office: Concise Handbook with screenshots*”, V&S Publishers, 2017
2. Orchids “*Microsoft Office 2007*”, MS Office Series, 2018
3. Prof. Satish Jain, Geeta kartika, “*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. Reema Thareja, “*Fundamentals of Computers*”, Oxford University Press; Second edition (1 May 2019)

Reference Books:

1. Ed Tittel and B Muthukumaran, “*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 ENGG)				Semester: II		
Course: Professional core course II (Microcontrollers)				Code: M5.GV.02		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (36 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.					6
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.					6
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.					6
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.					6
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.					6
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					6
Text Books: 1. Mazidi Muhammad Ali, Mazidi Janice Gillespie, and McKinlay Rollin D., <i>The 8051 Microcontroller and Embedded Systems – using assembly and C</i> , PHI, 2006 2. Ayala Kenneth J., <i>The 8051 Microcontroller</i> , Thomson/Cengage Learning, 2005. 3. Barret Steven F., <i>Arduino Microcontroller Processing for Everyone</i> , Morgan, and Claypool Publishers, 2013.						
Reference Books: 1. Patel Manish K., <i>The 8051 Microcontroller Based Embedded Systems</i> , McGraw Hill, 2014. 2. Kamal Raj, <i>Microcontrollers: Architecture, Programming, Interfacing and System Design</i> , Pearson						

Education, 2005.

Program: B. Voc. (MECHATRONICS ENGG)			Semester: II			
Course: Mini Project			Code: S5.VP.01			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
6	6	3	-	-	100	100
Guidelines to the Students: <ol style="list-style-type: none"> 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					
	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 ENGG)			Semester: II			
Course: On Job Training (ELE/Q7105)			Code: N5.QP.01			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
30	30	15	-	-	200	200
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 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:					
1.	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

Progress Credibility Confidence
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Program: B. Voc. (MECHATRONICS ENGG)				Semester: III		
Course: Soft Skills for Professionals				Code: C6.GE.01		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (45 Hrs)
1	Introduction to Soft Skills: What are Soft Skills, Importance of Soft Skills, Soft Skills v/s Hard Skills, Ways to Develop Soft Skills, Traits of a Pleasant Personality					8
2	Language Skills: Interactive Nature of Communication, Importance of Context, Formal and Informal, Language Functions, Introducing - Making Requests - Asking for / Giving Permission, Giving Instructions and Directions, Agreeing / Disagreeing, Seeking and Giving Advice, Conversational Manners					8
3	Communication Skills: Oral and Written Communication, Body Language, Basics of Email Writing, Attending and Coordinating Meetings, Telephonic Conversational Skills, Business Expressions, Public Speaking Skills					7
4	Self Management: Importance of Self Grooming, Dress Sense, Self Awareness, Developing Right Attitude, Developing Assertiveness, Being Fit, Work Scheduling, Punctuality, Time Management, Stress Management					8
5	People Skills: Creating Positive Impression, People-Networking Skills, Building Trust And Rapport With People, Interpersonal Skills, Presentation Skills					7
6	Work Skills: Listening as a Team, Contributing as a Team, Process of Problem-Solving, Work Ethics, Professionalism, Taking Initiatives					7
Text Book 1. Prashant Sharma, <i>Soft Skills - Personality Development for Life Success</i> , BPB, Publications, 2018. Reference books: 1. Jay, <i>Effective Presentation</i> , Pearson, 2009. 2. Mishra, and C. Muralikrishna, <i>Communication Skills for Engineers</i> , Pearson, 2011. 3. Gopalaswamy Ramesh, <i>The Ace of Soft Skills: Attitude, Communication and Etiquette For Success</i> , Pearson Education, 2010. 4. Mitra Barun K., <i>Personality Development & Soft Skills</i> , Oxford University Press, 2012. 5. Mishra Rajiv K., and Rupa & Co., <i>Personality Development the Complete Manager –Life Skills for Success</i> , ICAFI University, 2004.						

Program: B. Voc. (MECHATRONICS ENGG)				Semester: III		
Course: General foundation course – I (Introduction to Entrepreneurship)				Code: C6.GE.02		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (45 Hrs)
1	The Entrepreneur: Why to become entrepreneur ,Types of Entrepreneur , Concept of Social Enterprise and Social Entrepreneurship, Social Entrepreneurs, Rural Entrepreneurship, Family Business Entrepreneurship, The entrepreneurial decision process, Case Study of Entrepreneurship in different Sectors					8
2	Skills for Successful Entrepreneurs: Communication Skills, Creativity and Problem solving, Innovation, Negotiation Skills, Risk management Case Study of Successful Entrepreneurs- Cases of Tata, Birlas, Kirloskar and new generation entrepreneurs in India					8
3	Inter Personal Relationship and Understanding Individual Behavior Importance of maintaining good inter personal relationship with related people in business, Need for leadership in the enterprise development, Characteristics of a good leader, Various styles of Leadership, Definition Personality, importance of personality in Performance, Ego State, Johari window- Transactional Analysis					8
4	Business Opportunity Identification Concept of Business Opportunity, What is a business idea, How to generate Business Ideas? Business Opportunities Identification Process, Business Value Chain, different sections of the business value chain for potential opportunities.					7
5	Business Organizations and Business Laws: Types of Business Organizations -Sole Proprietorship, Joint Hindu Family Business, Partnership, Limited Liability Partnership (LLP), Corporate Governance, Franchising, Business Laws in India to start Business					7
6	Government Initiatives: Role of Government in promoting Entrepreneurship in India, Start up India, Atmanirbhar Bharat, Make in India Assistance to an Entrepreneur, Industrial Park , Special Economic Zone , MSME Act , MSME policy in India, Financial assistance to MSME, Various Government schemes - PMEGP, CGTMSE, PMKVY, Mudra loan, Case studies of Start ups, Role of Institutional Support					7
Reference Books: 1. S.S. Khanna, <i>Entrepreneurial Development</i> , S. Chand Publication, 2011 2. Poornima M., <i>Entrepreneurship Development, and small business management</i> , Charantimath, Pearson Publication, 2018. 3. Arya Kumar, <i>Entrepreneurship</i> , Pearson Publication, 2012. 4. Kavita Singh, <i>Organizational Behavior</i> , Vikas Publishing House, 2015.						

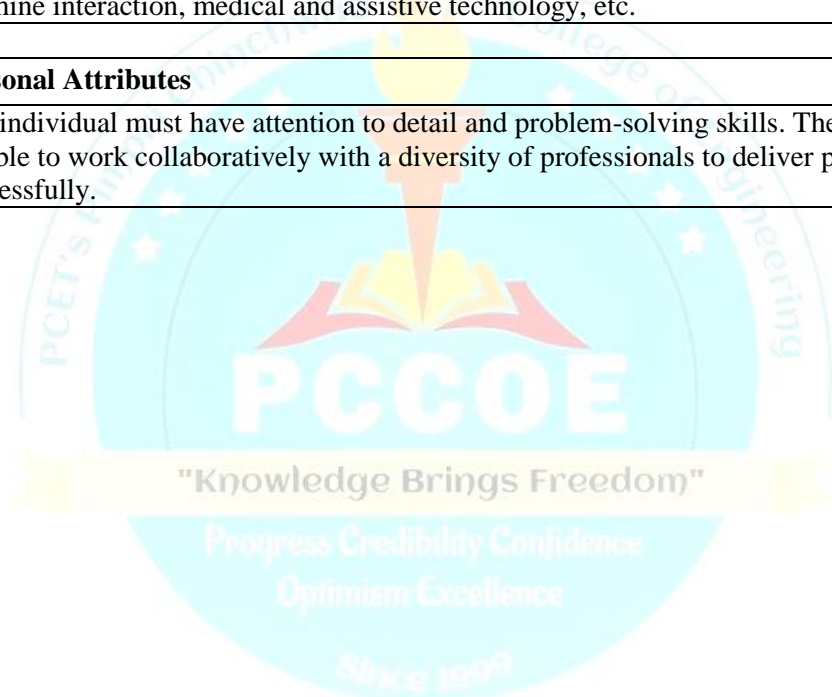
Program: B. Voc. (MECHATRONICS ENGG)				Semester: III		
Course: PCC III : Manufacturing Technology				Code: M6.GV.01		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (45 Hrs)
1	Metal casting processes: Introduction to Sand Casting: Sand Mould, Type of patterns, Pattern Materials, Pattern allowances. Moulding sand Properties Moulding methods and processes-materials. Moulding sand ingredients, essential requirements					8
2	Machining process: Cutting parameters: cutting speed, feed and depth of cut, Single and multi point cutting tool and its geometry, Introduction and working principle of lathe, shaper, planar, milling, grinding, broaching and CNC and conventional machine tools, Super finishing operations like honing, laping, buffing, shaving etc.					7
3	Metal cutting: Cutting Tool Materials: Characteristics of tool materials, various types of cutting tool materials, coated tools, cutting tool selection. Shapes and type of tools and its usage for specific applications and its nomenclature. Types of tool wear, tool life, factors governing tool life, Purpose and types of cutting fluids, basic actions of cutting fluids, effect of cutting fluid on tool life, selections of cutting fluid.					8
4	Metal Forming Introduction of metal forming processes. Drawing, extrusion, forging, rolling and its types, Tools and Toolings: Varities of Dies, punches etc, Machinery: Types of presses, hammers, extrusion machinery rolling mill etc.					8
5	Welding Introduction to welding: purpose of welding, methods of welding, Welding parameters like temp, gas pressure, electrode distance, electric current, voltage etc Types of welding: electric arc, spot, seam, gas, MIG, TIG, Robotic welding.					7
6	Soldering and Brazing Types of electrodes for different metals, varities of metals and according processes, Heat and distortion control, Fixtures and clamps					7
Text Books: 1. Rajput R.K., <i>Manufacturing Technology</i> , Firewall Media, 2007. 2. Sharma P.C., <i>Production Technology</i> , S. Chand, 1999.						
Reference books: 1. Rao P. N., <i>Manufacturing Technology</i> , Tata McGraw-Hill Education, 2013. 2. Kalpakjian, <i>Manufacturing Engineering and Technology</i> , Pearson, 2009.						

Program: B. Voc. (MECHATRONICS ENGG)				Semester: III		
Course: PCC IV : Fluid Power and PLC				Code: M6.GV.02		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (45 Hrs)
1	Basics of fluid power Need and importance of hydraulic and pneumatic, Hydrostatic and hydrodynamic definitions, properties of fluid, Pascal’s law, Continuity equation and Bernoulli’s equation. Advantages and limitations of hydraulic and pneumatic systems					8
2	Hydraulic system construction, working applications and selection criteria. Other Elements such as filters, manifold, receivers, coolers and connectors. Hydraulic Actuators- Type, working and applications. Control Valves- Type, designation, symbols, working and applications,					8
3	Pneumatic system Pipes- Type, applications and properties. Air Compressor- Type (Reciprocating and rotary), working and selection. Pneumatic Cylinders- Type, symbol, cushion, assemblies, mounting and, Pneumatic Valves- Type, symbols, working, applications and selection. Air Motors- Type, working and applications. Other Elements - Air receivers, filters, pressure regulator, lubricator. Introduction to Solenoid valves- their working and types					8
4	Hydraulic and Pneumatic Circuits Concept, Meaning and ISO symbols. Brief on designing of hydraulic and pneumatic circuits. Applications					6
5	PLC basics Introduction – Parts of PLC, Principles of operation , PLC hardware components – I/O section Analog I/O Section Analog I/O modules –digital I/O modules CPU processor memory module , Programming devices – PLC programming Simple instructions – Manually operated switches – Mechanically operated and Proximity switches					8
6	Timers, Counters and Their Applications Timer instructions ON DELAY, OFF DELAY and RETENTIVE Timers ,UP COUNTER, DOWN COUNTER and UP DOWN COUNTERS , Control instructions – Data manipulating instructions, math instructions; Applications of PLC – Simple materials handling applications.					6
Text Books: 3. Esposito Anthony, <i>Fluid Power with Applications</i> , Pearson Education, 2014. 4. Majumdar S.R., <i>Oil Hydraulics Systems- Principles and Maintenance</i> , Tata McGrawHill, 2001. 5. Bolton, <i>Mechatronics, A Multidisciplinary approach</i> , Prentice Hall, 2009.						
Reference Books: 1. Shanmugasundaram K., <i>Hydraulic and Pneumatic controls</i> , Chand & Co., 2006. 2. Majumdar S.R., <i>Pneumatic systems – Principles and maintenance</i> , Tata McGraw Hill, 2006. 3. Michael J., Princhess, and Ashby J.G, <i>Power Hydraulics</i> , Prentice Hall, 1995.						

Program: B. Voc. (MECHATRONICS ENGG)			Semester: III			
Course: PCC III LAB : Manufacturing Technology Laboratory			Code: M6.VP.01			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
3	3	1.5	-	50	-	50
Guidelines: Any 5 Experiments from the following list						
Detailed Syllabus:						
Expt.	Description					
	To prepare a job on a lathe machine using right selection of tools (nose radius) and tooling.					
	To prepare a job involving side and face milling on a milling machine by using right cutter with right setting and right tools.					
	Determine the Tool Life while Milling a component on the Milling Machine and usage and setting of wiper insert.					
	Determine Tool Wear of a cutting tool while drilling on a Drilling Machine					
	Exercise of Printed circuit board using soldering					
6	To prepare a job by using electric arc welding.					
7	Preparation of LAP/BUTT by using gas welding.					
8	Preparation of job by using Brazing					

Program: B. Voc. (MECHATRONICS ENGG)			Semester: III			
Course: PCC IV LAB : Fluid Power and PLC Laboratory			Code: M6.VP.02			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
3	3	1.5	-	50	-	50
Guidelines: Any 5 Experiments from the following list						
Detailed Syllabus:						
Expt.	Description					
	Study of control of single acting / double-acting cylinder Circuit on Hydraulic Trainer					
	Controlling the Speed of the Cylinder Using Metering In and out valve circuit.					
	Single Cycle Automation of Double Acting Cylinder Using Limit Switch.					
	Operation of double-acting cylinder using double solenoid valve.					
	Make the Ladder diagram logics gates.					
6	Actuation of Single Acting Cylinder with ON Delay Timer Using PLC.					
7	Control of Double Acting Cylinder with UP Counter Using PLC.					
8	Operation of Single Acting Cylinder with AND Logic Using PLC					
9	Operation of Single Acting Cylinder with OR Logic Using PLC.					
10	Automation of Single Acting Cylinder Using PLC.					
11	Automation of Double Acting Cylinder Using PLC					

Program: B. Voc. (MECHATRONICS ENGG)			Semester: III			
Course: On Job Training (ELE/Q7107)			Code: M6.QP.01			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
30	30	15	-	-	200	200
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 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.					



Course Syllabus

Semester-IV



Program: B. Voc. (MECHATRONICS ENGG)				Semester: IV		
Course: General foundation course – II Management and Entrepreneurship				Code: C6.GE.03		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (45 Hrs)
1	Management: Meaning, Definition, Need and Process of Management Managerial levels/Hierarchy: Top Level, Middle Level, Lower Level Five Functions of Management: Planning, Organizing, Staffing, Directing, Controlling, Managerial Skills: Technical Skill, Human Skill, Conceptual Skill					8
2	Marketing Management: Definition & Functions of Marketing- Scope of Marketing, Core concepts of marketing: -Need, Want, Demand, Customer Value, Exchange, Customer, Satisfaction, Customer Delight, Customer loyalty, Company orientation towards market place, Segmentation, Target Marketing & Positioning,					8
3	Marketing Mix: Marketing Mix, 7P's - Product, Price, Place, Promotion, People, Process, Physical evidence, Product Life Cycle					8
4	Startup opportunities Meaning of Startup, The Rise of The startup Economy, Startup Policy, Startup opportunities, Registration and Legal Process of Startups. The Startup Ecosystem - Entrepreneurship in India.					7
5	Market Survey and Research: What is a market survey? Process of conducting a market survey, Primary and secondary sources of information, Market survey tools, Preparation of schedule, Techniques of data collection, Questionnaire					7
6	Business Plan The Business plan as an entrepreneurial tool, Elements of Business Plan, Market Analysis, Technical Analysis, Financial Analysis, Economic Analysis, SWOT analysis, Internal and External Environment Analysis					7
Reference Books: 1. Khanka S.S., <i>Entrepreneurial Development</i> , S.Chand Publication, 2013. 2. Charantimath Poornima M., <i>Entrepreneurship Development and small business management</i> , Pearson Publication, 2018. 3. Kumar Arya, <i>Entrepreneurship</i> , Pearson Publication, 2012. 4. Singh Kavita, <i>Organizational Behaviour</i> , Vikas Publishing House, 2015. 5. Kotler Philip, Keller K., Koshy Abraham, and Mithileshwar Jha, <i>Marketing Management: A South Asian Perspective</i> , Pearson Education, 2013.						

Program: B. Voc. (MECHATRONICS ENGG.)				Semester: IV		
Course: PCC V : Engineering Materials				Code: M6.GV.03		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (45 Hrs)
1	Introduction to Crystal Structure Coordination number, atomic packing factor, Simple Cubic, BCC,FCC and HCP Structures, Crystal imperfections–point, line, surface and volume imperfections, composite materials-MMC, PMC.					8
2	Mechanical Behavior Mechanical Properties of engineering material, Tensile, compression, flexural, Hardness, toughness, Mechanism of elastic & plastic deformation (slip and twinning), Theory of dislocation.					7
3	Ferrous and non-ferrous metal Definition, classification, properties and applications of Iron and Steel-Cast Iron, Stainless Steel, Tool Steel, Copper, Aluminium, Lead, Tin, Zinc, Nickel, Magnesium.					8
4	Iron Carbon Diagram Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, structure & property relationship, classification and application of steels.					8
5	Heat treatment Time Temperature Transformation diagrams, continuous cooling transformation diagrams. Heat treatment of steels: Annealing, Normalizing, Hardening & Tempering, quenching media.					7
6	Non Destructive testing Difference between destructive and non-destructive testing, Ultrasonic testing NDT, Magnetic particle inspection NDT, Acoustic emission NDT, Dye penetrant NDT, Radiography NDT, Eddy Current NDT.					7
Text Books:						
1. Kodgire V. D., <i>Material Science and Engineering</i> , Everest publishing house, 2017.						
2. Callister W. D., <i>Introduction to Material Science and Engineering</i> , John Wiley, 2018.						
Reference books:						
1. Dieter George E., <i>Mechanical Metallurgy</i> , McGraw-Hill, 2017.						
2. Smith Charles O., <i>The Science of Engineering Material</i> , Prentice Hall, 1977.						

Program: B. Voc. (MECHATRONICS ENGG)				Semester: IV		
Course: PCC VI : Metrology and Measuring Instruments				Code: M6.GV.04		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Description					Duration (45 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					8
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)					7
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
5	Position and Temperature Measurement Classification of sensor/transducers, Position sensors: Potentiometer, LVDT, RVDT, digital encoder, LIDAR (light detection and ranging), Linear scale, Proximity sensors: Optical, Inductive, Capacitive, Temperature sensor: RTD, Thermocouples, pyrometer, Infrared thermometer					8
6	Miscellaneous Measurement Force/Pressure Sensors: Piezoelectric, strain gauges, Flow sensors: Electromagnetic, Ultrasonic, hot-wire anemometer, Level Sensors: Capacitive, Optical, Conductive, Measurement of speed/velocity: Stroboscope, Noncontact type of tachometers.					7
Reference books:						
1. Narayana K.L., <i>Engineering Metrology</i> , Scitech Publications Pvt. Ltd., 2013.						
2. Gupta I.C., <i>Engineering Metrology</i> , Dhanpatrai Publications, 2019.						
3. Farago Francis T., Curtis Mark A., <i>Handbook of dimensional measurement</i> , Industrial Press Inc. 2007.						
4. ASTM, <i>Handbook of Industrial Metrology</i> , Prentice Hall of India Ltd, 2018.						
5. Kulkarni V. A., and Bewoor A. K., <i>Quality Control</i> , John Wiley Publication, 2009.						
6. Wordsworth Harrison M., and Godfrey Stefeen, <i>Modern Methods for Quality control and Improvement</i> , Willy Publication, 2016.						
7. Davim J. Paulo, <i>Mechatronics</i> , Wiley publication, 2011.						
8. Histan, <i>Introduction to Mechatronics</i> , Mc Graw Hill, 2012.						
Text Books:						
1.Jain R.K., <i>Engineering Metrology</i> , Khanna Publication, 2005.						
2. I. C. Gupta, <i>Engineering Metrology</i> , Dhanpath Rai, 2019.						
3. Bewoor A. K., and Kulkarni V. A., <i>Metrology and Measurements</i> , Tata McGraw hill Publication, 2009.						

4. M. Mahajan , *Metrology*, 2012.
5. Rajput R.K., *Mechatronics*, Nirali Publication, 2022.8. Galyer J.F & Shotbolt C.R., *Metrology for engineers*
9. Judge A.W., *Engineering Precision Measurements*, Chapman and Hall
10. Francis T. Farago, Mark A. Curtis, *Handbook of dimensional measurement*.
11. ASTM, *Handbook of Industrial Metrology*, Prentice Hall of India Ltd.
12. Connie Dotson, *Fundamentals of Dimensional Metrology*, Thomson, 4th Edition.

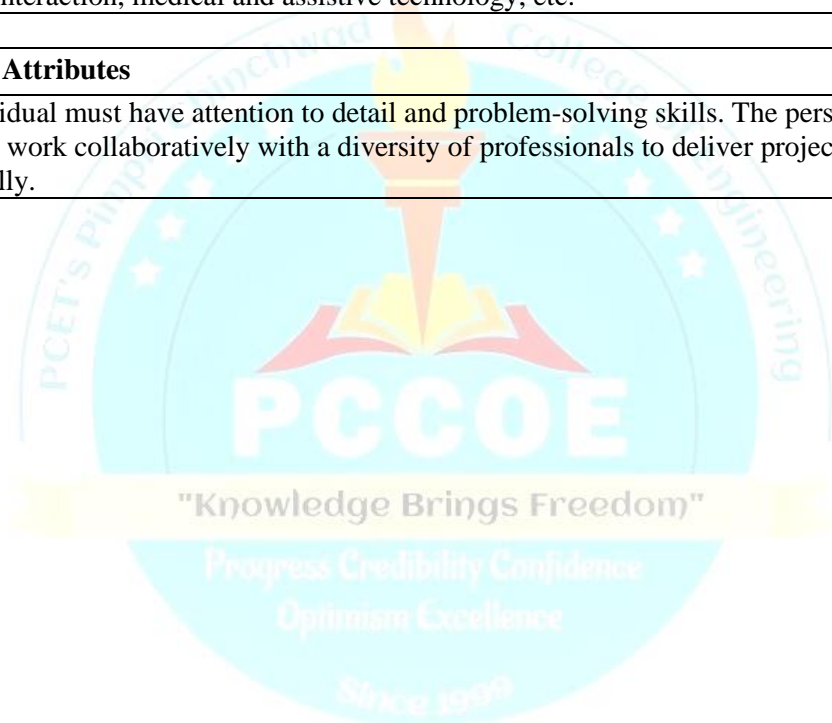


Program: B. Voc. (MECHATRONICS ENGG)			Semester: IV			
Course: PCC VII : Manufacturing Automation & Ergonomics			Code: M6.GV.05			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Detailed Syllabus:						
Unit	Introduction					Duration (45 Hrs)
1	Introduction Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and tool changing and machine tool control transfer the automation. Manufacturing automation principles and elements in product realization					7
2	Automated Flow Lines Assembly systems □ Methods, Mechanical buffer storage control function, Design and fabrication consideration. • Assembly process and systems assembly line					8
3	Automated Flow Line balancing line balancing methods, ways of improving line balance, flexible assembly lines. Latest technologies being employed in Industry 4.0 era for achieving higher efficiency					8
4	Advancement in Manufacturing Application of Nanotechnology and allied field, AFM, SEM, TEM, Advanced electronic Packaging					8
5	Introduction To Robotics □ Classifications of robots, Work envelopes, manipulators- Electronic and Pneumatic manipulators, end effectors. Applications of Robots					7
6	Introduction to Ergonomics Evolution of Ergonomics, Introduction, Definitions of Ergonomics, The Scope of Ergonomics, Aspects of Ergonomics Application Areas of Ergonomics, Man and Machine Interaction					7
Text Books: 1. Grover Mikell P., <i>Automation, Production Systems and Computer-Integrated Manufacturing</i> , Pearson Education, ISBN: 0132393212, 2020. 2. Esposito Anthony, <i>Fluid Power with Applications</i> , Pearson Education, 2005. 3. Majumdar S.R., <i>Oil Hydraulics Systems- Principles and Maintenance</i> , Tata McGraw Hill, 2003. 4. Bolton, <i>Mechatronics - A Multidisciplinary approach</i> , Prentice Hall, 2009.						
Reference Books: 1. Viswanandham N., and Narhari Y., <i>Performance Modeling of Automated Manufacturing Systems</i> , Prentice-Hall. ISBN: 0136588247, 2019. 2. Princes Michael J., and Ashby J. G. <i>Power Hydraulics</i> . Prentice Hall. 1989.						

Program: B. Voc. (MECHATRONICS ENGG)			Semester: IV			
Course: PCC V LAB : Engineering Materials Laboratory			Code: M6.VP.03			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
3	3	1.5	-	50	-	50
Guidelines: Any 5 Experiments from the following list						
Detailed Syllabus:						
Expt.	Description					
	Tension test for ductile material using extensometer on Universal Testing Machine. (Discussion on Stress-strain diagram for ductile and brittle materials, factor of safety).					
	Compression test for Brittle material on Universal Testing Machine.					
	Shear test of ductile material on Universal Testing Machine.					
	Experimental verification of flexural formula in bending by 3 point bending method.					
	Experimental verification of torsional formula.					
6	Impact testing of materials					
7	Non-destructive testing of materials: Dye penetrant, magnaflux, Ultrasonic, Eddy current.					
8	Heat treatment: Annealing, Normalizing, Hardening and Tempering.					
9	Specimen preparation for microscopic study.					
10	Microstructure observation and analysis of ferrous and non-ferrous materials.					
11	Hardness test: Brinell, Vickers. Rockwell, etc.					

Program: B. Voc. (MECHATRONICS ENGG)			Semester: IV			
Course: PCC VI & VII LAB: Metrology and Measuring Instruments Laboratory			Code: M6.VP.04			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
3	3	1.5	-	50	-	50
Guidelines: Any 5 Experiments from the following list						
Detailed Syllabus:						
Expt.	Description					
	Demonstration of linear and angular measuring instruments, slip gauges and their applications.					
	Calibration of measuring instrument, like Pressure gauge, Dial gauge, Micrometer, Vernier (any one) (Refer ISO 17025).					
	Verification of dimensions and geometry of given components using Mechanical /Pneumatic/Electrical comparator.					
	Measurement of complex components such as thread, gear, etc.					
	Demonstration of surface inspection using optical flat and surface roughness measurement using surface roughness tester.					
6	To measure temperature using any temperature sensor/transducer.					
7	To measure the load by using load cell and its comparison with mechanical load.					
8	Case study on sensor/transducer selection for any one real life application and prepare detailed report for the same.					
9	Flow/Level measurement using suitable sensor/transducer.					
10	Demonstration and use of various proximity sensors in mechanical industry.					
11	Speed measurement of mechanical system/application using instruments based on non-contact and contact type principles and its comparison.					

Program: B. Voc. (MECHATRONICS ENGG)			Semester: IV			
Course: On Job Training (ELE/Q7107)			Code: M6.QP.02			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
30	30	15	-	-	200	200
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 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.					





Course Syllabus

Semester-V

Program: B. Voc. (MECHATRONICS ENGG)			Semester: V			
Course: Robot Kinematics & Dynamics (RKD)			Code: M7.GV.01			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Course Objectives: To provide knowledge about <ol style="list-style-type: none">1. Different types of robot linkage, frame2. Kinematics and Dynamics of Robot3. Motion planning and control of robot manipulator						
Course Outcome: After learning this course students will able to <ol style="list-style-type: none">1. Identify Elements of Robots2. Calculate Kinematics of serial robot3. Calculate Kinematics of parallel robot4. Calculate Velocity and static analysis of robot5. Evaluate dynamics behavior of robots6. 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 for robot joint, Different types of robot mechanism, Elements of robot Mechanism, Drive system used for robot mechanism, Types of wheel used in robots.					8
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.					8
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.					8
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					7
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.					7

	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)	
6	Motion planning and control 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.	7

Text Books:

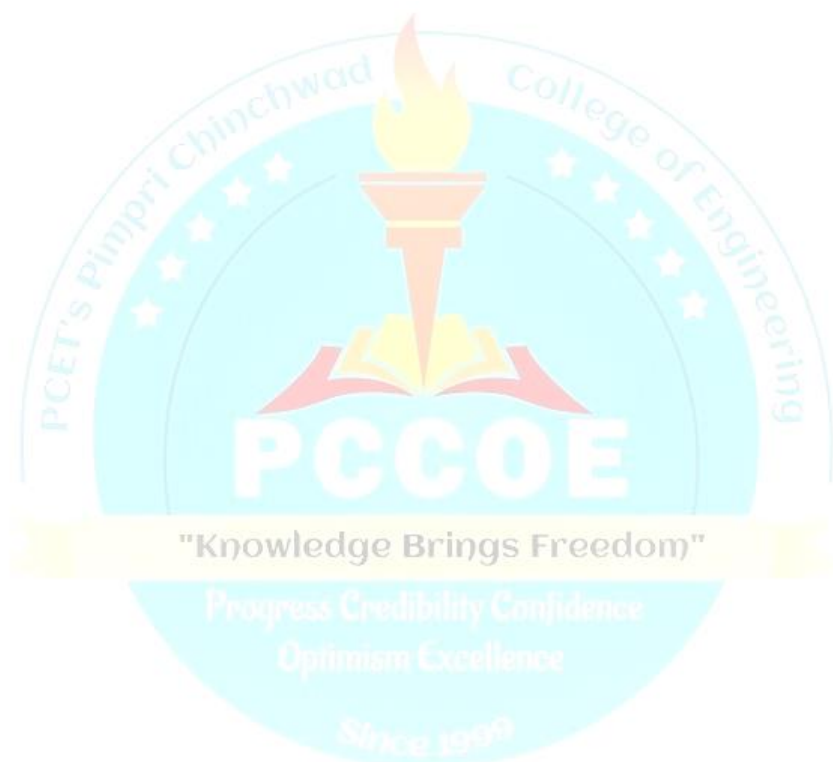
1. Groover M. P., "Industrial Robotics: Technology, Programming and Applications, Tata McGraw Hill Publication
2. Taghirad H.D, "Parallel Robots: Mechanics and Control", CRC Press.
3. Moore S. W., Bohm H., and, Jensen V., "Underwater Robotics: Science, Design & Fabrication", Marine Advanced Technology 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 ENGG)			Semester: V			
Course: Mounting and Communication of sensor (MCS)			Code: M7.GV.02			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Objectives: To provide Knowledge about <ol style="list-style-type: none"> 1. Sensor Mounting and location principle 2. Sensor calibration methods 3. Communication and networking of sensors 						
Course Outcome: After learning this course students will able to <ol style="list-style-type: none"> 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.).					8
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					8
3	Sensor Interfacing Introduction to sensor interfacing, different methodologies of sensor interfacing, IoT devices for sensor interfacing, Sensor interfacing applications					8
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.					7
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);					7

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.	7
Text Book: - <ol style="list-style-type: none"> 1. Walteneus Dargie, Christian Poellabaur ,Wiley edition ,Fundamentals of wireless sensor Network 2. D Patranabis ,Sesnors and transducers, second edition PHI publication Reference Book:- <ol style="list-style-type: none"> 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 ENGG)			Semester: V			
Course: Robot programming (RP)			Code: M7.GV.03			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Objectives: <div>1. To provide Knowledge about</div> <div>2. To Understand different types of robot programming</div> <div>3. To learn different robot commands</div> <div>4. To understand different robot programming applications</div>						
Course Outcome: After learning this course students will able to <div>1. Classify different programming languages</div> <div>2. Identify and execute different commands in VAL-I</div> <div>3. Identify and execute different commands in VAL-II</div> <div>4. Identify and execute different commands in RAPID</div> <div>5. Develop robot simulation model in Virtual software</div> <div>6. develop robot programming applications</div>						
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-Interpolation- Interlock commands Operating mode of robot, Jogging Types, Robot specifications- Motion commands, end effectors and sensors commands					8
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					8
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.					8
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					7

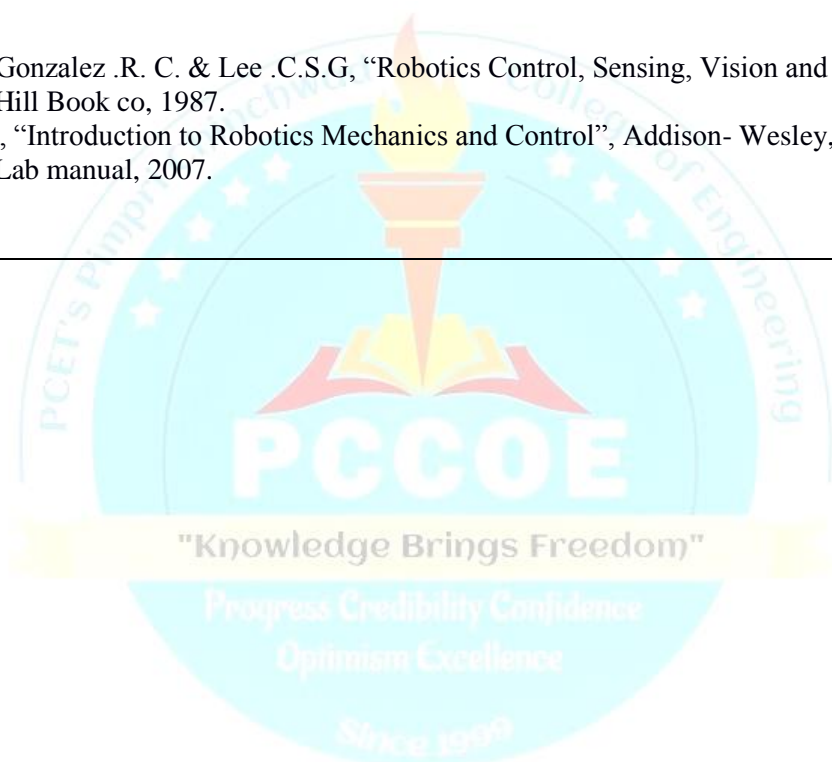
5	Practical Study of Virtual Robot Robot cycle time analysis-Multiple robot and machine Interference-Process chart Simple Problems- Virtual robotics, Robot studio online software-Introduction, Jogging, components, work planning	7
6	Robot Programming Applications Robot programming synthesis, robot programming for foundry, press work and heat treatment, welding, machine tools, material handling, warehousing assembly, etc., automatic storage and retrieval system	7

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

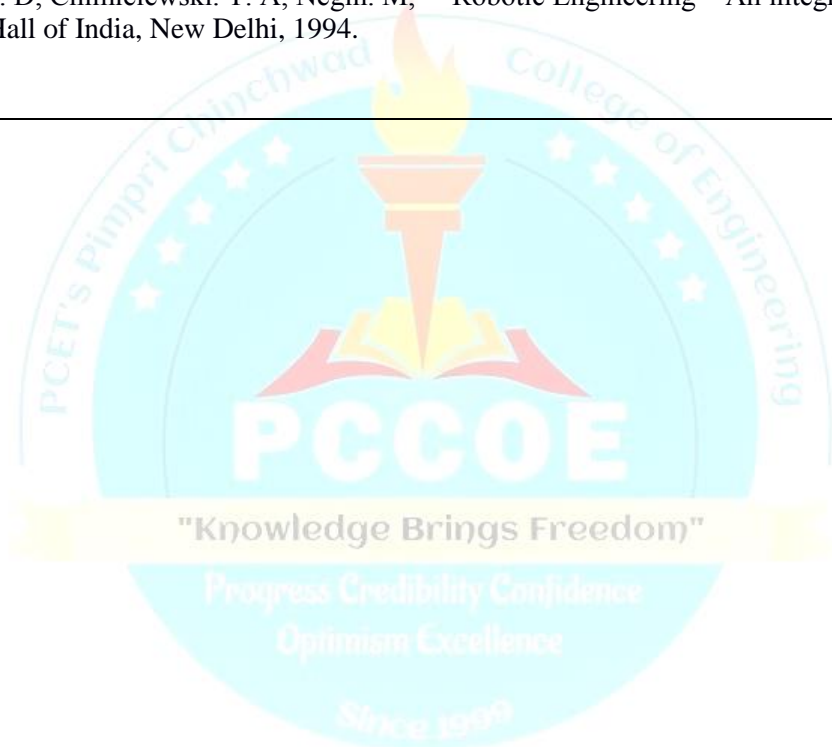
Reference Book:-

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.
3. Robotics Lab manual, 2007.

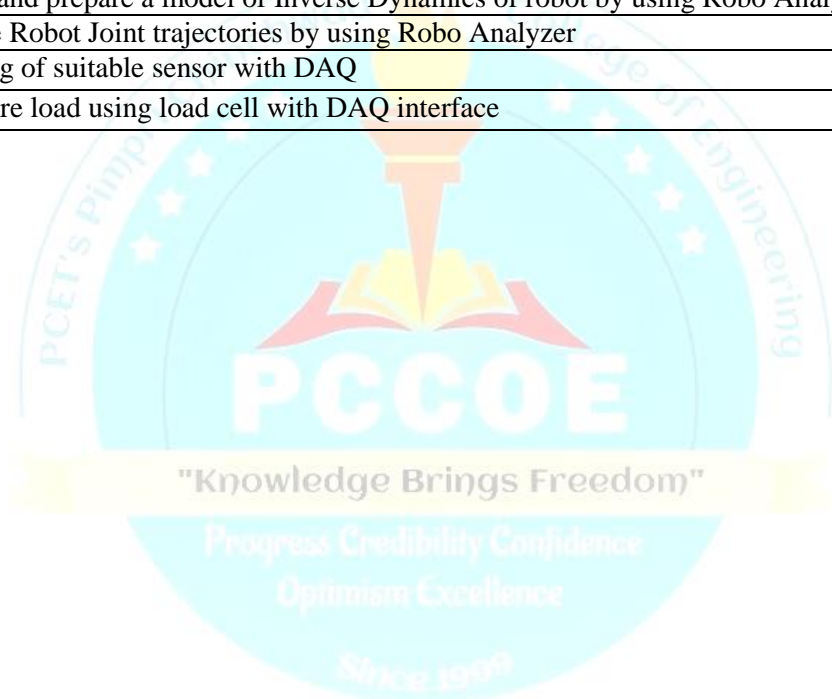


Program: B. Voc. (MECHATRONICS ENGG)			Semester: V			
Course: Instrumentation For Robotics and Automation (IRA)			Code: M7.GV.04			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Objectives: To provide Knowledge about						
1. Classification by coordinate system and control system						
2. Acquire Knowledge on Different types of Power Sources and Sensors						
3. Classification of Manipulators, Actuators and Grippers						
4. Acquire Knowledge of kinematics and Applications of different Robots						
Course Outcome: After learning this course students will able to						
1. Acquire knowledge on different types of Power Sources (actuators) and Sensors,						
2. Classification of Manipulators, Actuators and Grippers Acquire knowledge on different applications of various types of robots.						
3. Analyze the direct and the inverse kinematic problems and calculate the manipulator dynamics						
4. Able to identify the applications of robots in different process						
5. operations.						
Detailed Syllabus:						
Unit	Description					Duration (45Hrs)
1	Basic Concepts in robotics Definition, Anatomy of the robot; Basic structure of robot; Specifications and Classification of the robot; Safety Measures in robotics; Industrial Applications of Robots					8
2	Smart Sensors Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Lidar 2D- 3D Lidar Sensor, Application of smart sensors: Automatic robot control & automobile engine control.					8
3	Design of Robotics Manipulators and Grippers Introduction: Robot manipulator, Classification, Design Procedure of Mechanical Grippers, Gripper force Analysis and Gripper Design, Design of Vacuum Grippers, Selection criteria for Robotics Grippers					8
4	Robotics Vision Techniques Microprocessors and Microcontrollers based robotic controllers, Peripheral Interfacing with microcontrollers and its programming in C, Arduino/PIC platform as robotic controller, Sensors & Actuators, Gripper's interfacing with robotic controller, Selection criteria for selection of controller					7
5	Robotic controllers and accessories Robot cycle time analysis-Multiple robot and machine Interference-Process chart Simple Problems- Virtual robotics, Robot studio online software-Introduction, Jogging, components, work planning					7

6	PLC based Robots Introduction, Architecture of PLC, Programming devices, PLC programming, Timers, Counters and Their Applications, PLC Program for Robotic case studies like Pick and Place application, Robot Sorting System etc.	7
<p>Text Book: -</p> <ol style="list-style-type: none"> 1. Mikell. P, Weiss. G. M, Nage. I R. N and Odraj .N.G, "Industrial Robotics", McGraw Hill Singapore, 1996. 2. Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai, 1998. R18 B.Tech. 3. Industrial Automation and Robotics, A. K. Gupta and S. K. Arora, University Science Press 4. Robotics and Industrial Automation, R. K. Rajput, S. Chand, New Delhi <p>Reference Book:-</p> <ol style="list-style-type: none"> 1. Deb. S.R, "Robotics technology and flexible Automation", John Wiley, USA 1992. 2. Asfahl. C.R, —Robots and manufacturing Automation", John Wiley, USA 1992. 3. Klafter. R. D, Chimielewski. T. A, Negin. M, —Robotic Engineering – An integrated approach", Prentice Hall of India, New Delhi, 1994. 		



Program: B. Voc. (MECHATRONICS ENGG)			Semester: V			
Course: RKD and MCS Lab			Code: M7.VP.01			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
3	3	1.5	-	50	-	50
Guidelines: Any 5 Experiments from the following list						
Detailed Syllabus:						
Expt.	Description					
	Introduction to Robot Kinematic and Dynamics Analysis software and its commands					
	To study and prepare a model of Forward kinematics of robot by using Robo Analyzer					
	To study and prepare a model of Inverse kinematics of robot by using Robo Analyzer					
	To study and prepare a model of Forward Dynamics of robot by using Robo Analyzer					
	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					
7	Interfacing of suitable sensor with DAQ					
8	To measure load using load cell with DAQ interface					



Program: B. Voc. (MECHATRONICS ENGG)			Semester: V			
Course: RP and IRA Lab			Code: M7.VP.02			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	PR	OR	Total
3	3	1.5	-	50	-	50
Guidelines: Any 5 Experiments from the following list						
Detailed Syllabus:						
Expt.	Description					
	Write a program for palletizing operation by robot					
	Write a program for depalletizing operation by robot					
	Write a program for Pick Place operation by robot					
	Write a program for object sorting by robot manipulator based on colour , shape, material etc.					
	Study and Characteristic of different actuator of robots					
6	Demonstration of Smart sensor used in sensor lab.					
7	Study of Robot Vision Techniques					
8	Demonstration of microcontroller kit for any robotic application					
9	Demonstration of Arduino kit/pic controller/PLC for any robotic application					
10	Study and comparison of different robot operating system /Explore RoS for Industrial Application. /Develop Motor Simulation through RoS					
11	Industrial Visit to any robotic component manufacturing industry.					
12	Study and Characteristic of different actuator of robots					
13	Demonstration of Smart sensor used in sensor lab.					
14	Study of Robot Vision Techniques					

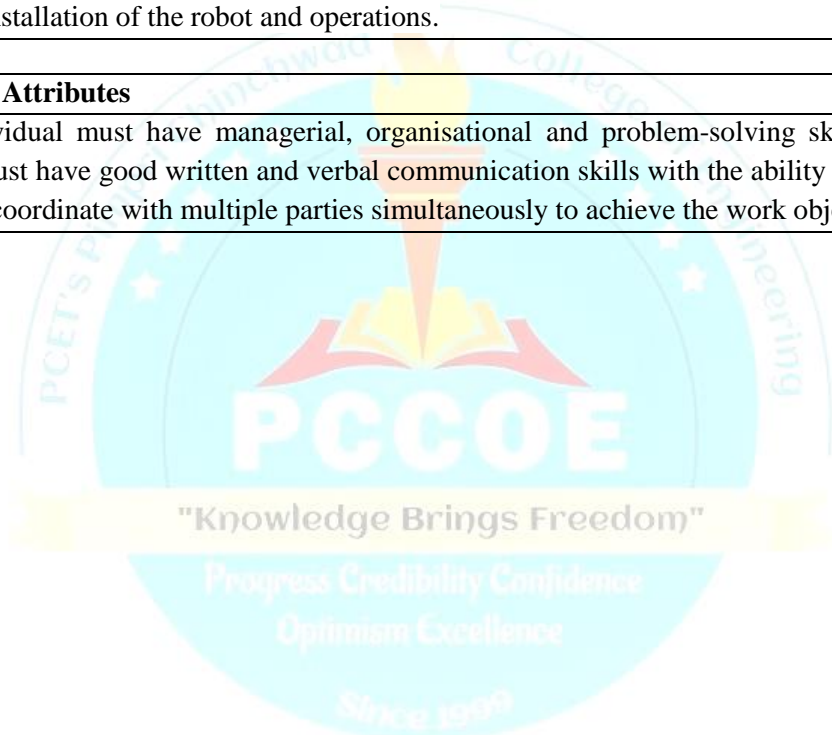
"Knowledge Brings Freedom"

Progress Credibility Confidence

Optimism Excellence

Since 1999

Program: B. Voc. (MECHATRONICS ENGG)			Semester: V			
Course: On Job Training (ELE/Q9801)			Code: M7.QP.01			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	OR	PR	Total
30	30	15	-	-	200	200
Guidelines:						
Students will take on job training in the industry in the domain of MTR as per the following job description and personal attributes.						
	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					
1.	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

Progress Credibility Confidence
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Program: B. Voc. (MECHATRONICS ENGG)			Semester: VI			
Course: Troubleshooting And Maintenance in Robotics & Automation			Code: M7.GV.05			
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Objectives: To provide Knowledge about <ol style="list-style-type: none"> 1. Trouble shooting procedure in automation 2. Maintenance method in automation 						
Course Outcome: After learning this course students will able to <ol style="list-style-type: none"> 1. Identify the fault in automation system 2. Identify the fault in service robotics system and understand the maintenance procedure service robotics system 3. Identify the fault in field robotics system and understand the maintenance procedure field robotics system 4. Identify the fault in PLC system Understand the maintenance procedure for PLC system 5. Identify the fault in manufacturing robots' system Understand the maintenance procedure for manufacturing robotics system 6. Examine Trouble shooting and Maintenance procedure through field visit 						
Detailed Syllabus:						
Unit	Description					Duration (45 Hrs)
1	Troubleshooting and Maintenance Methods in Automation Introduction Troubleshooting and Maintenance Methods in Automation, Benefits of maintenance in robotics system, Troubleshooting and Maintenance Methods of Automated CNC.					8
2	Troubleshooting and Maintenance of Robots Troubleshooting and Maintenance of Service Robots for their different components such as actuator, sensor, power pack, controller, Maintenance plan for service robots					8
3	Troubleshooting and Maintenance of Field Robots Troubleshooting and Maintenance of Field Robots for their different components such as actuator, sensor, power pack, controller, Maintenance plan for field robots					8
4	Troubleshooting and Maintenance of PLC Introduction to PLC system, Troubleshooting and Maintenance PLC system components.					7
5	Troubleshooting and Maintenance Robots in Manufacturing Troubleshooting and Maintenance of manufacturing Robots for their different components such as actuator, sensor, power pack, controller, Maintenance plan for manufacturing robots					7
6	Case Study on Troubleshooting and Maintenance of Robot 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					7

Text Book: -

1. Frank lamb, Maintenance and Troubleshooting in Industrial Automation.
2. Programmable Logic Controllers, Principles and Applications”; John W. Webb, Ronold A Reis, 5th Edition, Prentice Hall of India Pvt. Ltd

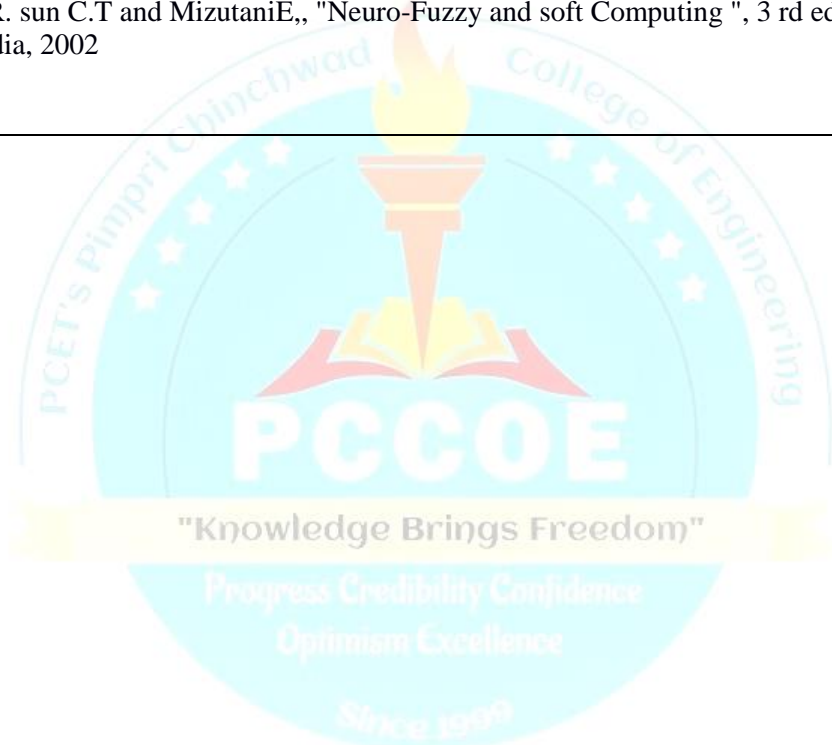
Reference Book:-


1. Mark R Miler, Rex Miler ,Robots and Robotics principle system and industrial application
2. B Xing,TshilidziMarwala ,Smart Maintenance for Human- Robot Interaction Springer publication

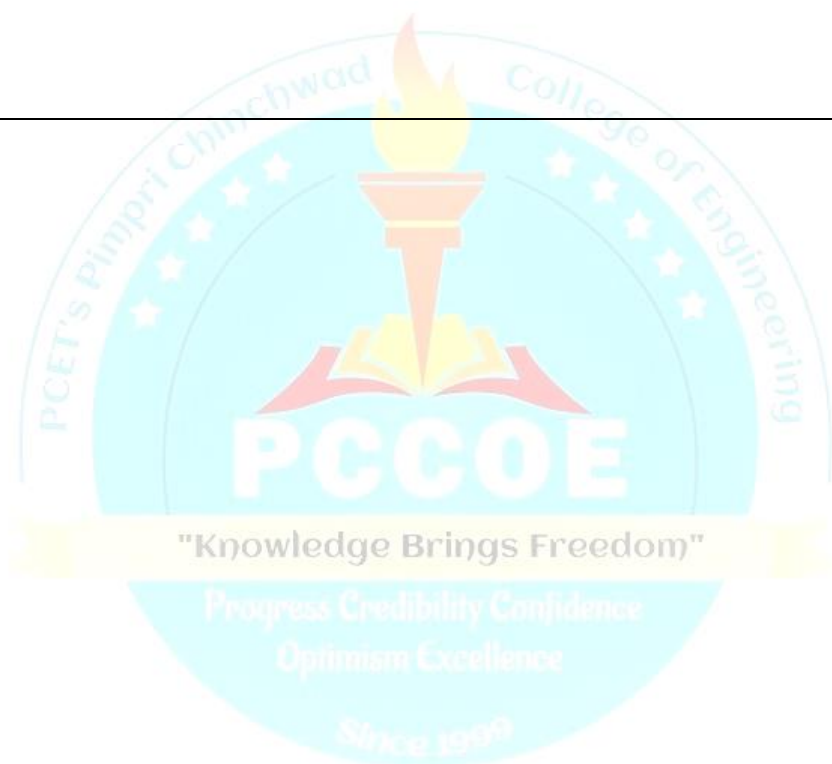


Program: B. Voc. (MECHATRONICS ENGG)				Semester: VI		
Course: Robotic Simulation				Code: M7.GV.06		
Teaching Scheme			Evaluation Scheme			
Lecture	Hours	Credit	IE 1	IE 2	ETE	Total
3	3	3	20	30	50	100
Objectives: To provide Knowledge about						
1. Different types of Modelling strategies						
2. Optimization and design of system techniques						
3. Different types of simulation software						
Course Outcome: After learning this course students will able to						
1. To Define Different type of Modelling strategies						
2. To Develop Mathematical Model by using different modelling technique						
3. To Design and optimize the system						
4. To Design Fuzzy Model						
5. To Simulate Model by different simulation software						
Detailed Syllabus:						
Unit	Description					Duration (45Hrs)
1	Introduction to Modelling strategy System, environment, input and output variables, State variables; Static and Dynamic systems; Hierarchy of knowledge about a system and Modeling Strategy. Introduction of Physical Modeling; Dimensions analysis, Dimensionless grouping of input and output variables of find empirical relations, similarity criteria and their application to physical models, Simplification techniques of physical models.					8
2	Modelling of System with Known Structure Deterministic model-(a) distributed parameter models in terms of partial identification and their solutions and (b) lumped parameter models in terms of differential and difference equations, state space model, transfer functions block diagram and sub systems, stability of transfer functions, modelling for control					8
3	Modeling Based on Expert Knowledge Fuzzy sets, Membership functions, Fuzzy Inference systems, Expert Knowledge and Fuzzy Models, Design of Fuzzy Controllers. Testing of Fuzzy controller.					8
4	System Simulation Basics of simulation, Steps in simulation, Discrete event system simulation, Advantages and disadvantages of simulation, Decision making with simulation. Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Distributed lag models, Cobweb models Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies.					7
5	Simulation Software Comparison of simulation packages with programming languages, classification of simulation software, Description of a general-purpose simulation package, Design					7

	of scenario and modules, dialog box, database, animation, plots and output, interfacing with other software, summary of results. Examples with MATLAB SIMULINK etc	
6	Optimizations and Design of Systems Summary of gradient-based techniques: Nontraditional Optimizations techniques genetic Algorithm (GA)- coding, GA operations elitism, Modified GA, Application using MATLAB	7
Text Book: - <ol style="list-style-type: none"> 1. Shannon, R. E., "System Simulation: the Art and Science", Prentice Hall Inc. 1990 2. Pratab. R " Getting started with MATLAB" Oxford university Press 2009 Reference Book:- <ol style="list-style-type: none"> 1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2 nd Edition. Academic press, 2000 2. Ogata K , "Modern control Engineering" 3 rd edition. Prentice hall of India 2001 3. Jang J.S.R. sun C.T and MizutaniE., "Neuro-Fuzzy and soft Computing ", 3 rd edition, Prentice hall of India, 2002 		



Program: B. Voc. (MECHATRONICS ENGG)				Semester: VI		
Course: Project				Code: M7.VP.03		
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	OR	PR	Total
18	18	9	50	150	-	200
Detailed Syllabus:						
Unit	Description					Duration (18 Hrs)
1	On the basis of learning in the vocational degree, a project to be taken up by the student strengthening his/ her vocational skills					18
						



Program: B. Voc. (MECHATRONICS ENGG)			Semester: VI			
Course: On Job Training (ELE/Q9801)			Code: M7.QP.02			
Teaching Scheme			Evaluation Scheme			
Practical	Hours	Credit	TW	OR	PR	Total
30	30	15	-	-	200	200
Guidelines:						
Students will take on job training in the industry in the domain of MTR as per the following job description and personal attributes.						
	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.					

