Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Program	Electronics & Communication Engineering.	Semester	5
Course Code	20EC53I	Type of Course L:T:P	104:52: 312
Specialization	Automation & Robotics	Credits	24
CIE Marks	240	SEE Marks	160

Rationale:

The growth of automation & robotics has been tremendously high in the recent years and the next few years are to witness great advancement in automation & robotic technology. In consequence, to the technology paradigm shift in the robotics field, Diploma courses in Robotics & Automation will become one of the top most career choices among the students. Robotics and Automation course focuses on the construction and operation, design automation of robotic devices, computer systems for necessary control action, feedback devices and information processing. Through project-based learning, design thinking, and inquiry learning, students will explore the technical skills needed to design and fabricate physical devices. Robotics and Automation is an interdisciplinary branch of Engineering that include Mechanical, Electrical, Electronics, Computer Science, Sensors and Instrumentation, Industrial Automation, Artificial Intelligence and Machine learning, Nanotechnology and Machine Vision. The course provides knowledge and exposure in the field of Automation and Robotics and other related areas of automated production systems.

Pre-requisite

Before the start of this specialization course, you will have prerequisite knowledge gained in the first two years on the following subjects:

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Digital Electronics

2nd year- Analog Electronics, Logic Design using Verilog, Communication Systems, Electronic Measurements and Testing Techniques, PCB Design & Fabrication, Wireless Communication, Embedded C Programming, Industrial Automation, in this year of study, you shall be applying your previous years learning along with specialized field of study into projects and real-world applications.

Instruction to course coordinator.

1. Each Specialized field of study is restricted to a Cohort of 20 students which could include students from other relevant programs.

2. One faculty from the Core Discipline shall be the Cohort Owner, who for teaching and learning in allied disciplines can work with faculty from other disciplines or industry experts.

3. The course shall be delivered in boot camp mode spanning over 12 weeks of study, weekly developmental assessments and culminating in a mini capstone.

4. The industry session shall be addressed by industry experts (in contact mode/online / recorded video mode) in the discipline only.

5. The cohort owner shall be responsible to identify experts from the relevant field and organize industry session as per schedule.

6. Cohort owner shall plan and accompany the cohort for industrial/mines/site/showroom/service Centre visits.

7. Cohort owner shall maintain and document the industrial assignments, weekly assessments, practices and mini project.

8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table

9. The cohort owner along with classroom can augment or use for supplementally teaching on line courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM etc.

10. Report should be maintained for industrial/field visit, such report shall be considered as industrial assignment.

Course outcomes: On successful completion of the course, the students will be able to,

CO1	**Demonstrate and Explain the Concept of Automation & Robotics, its components and applications in Industries.**
CO2	**Build and troubleshoot any automation system in a simulated or Real environment applying necessary Networking Protocols.**
CO3	**Install, troubleshoot and maintain PLC. Interface VFD with HMI and PLC to control motor parameters.**
CO4	**Test and troubleshoot Robotics system to meet defined operational specifications in a simulated or Real environment.**
CO5	**Implement the Robot operating System for various applications.**

Detailed course plan

Week	CO	PO	Days	1st session (9 am to 1 pm)	L	T	P	2ND session (1.30pm to 4.30pm)	L	T	P
	Learning Outcomes			**Introduction to Industrial Automation and Robotics.**							
1	1	1,7	1	**Industrial** automation • Introduction to Automation. • Role & benefits of Automation in Industry. • Challenges faced by the manufacturing industry inManual Process. (Video documentary of any production industry)	2		2	• Present an Overview of Industry 4.0 and Challenges in implementation of Industry 4.0 in India • Importance of industrial automation in the Indian manufacturing industry • Compare and Contrast Leading Automation Component Manufacturers and their Market share.	1		2
			2	• Consider a use case to Demonstrate automation process involved in SMD of a PCB industry (Video demonstration) • Differentiate SMD and SMT	2		2	• Consider a use case to Demonstrate and analyse the following in Medical Electronics /equipment manufacturing Industry - Improving Manufacturing Plant Efficiency - Wastage of material - Adapting to Technological Change ✓ Present the role of Robotics for the above with an example.	2		1
			3	Types of automation in theindustry: ➢ Permanent / Fixed automation. ➢ Programmable/ Flexible automation. ✓ Demonstrate suitable automation for each	2		2	✓ Give a presentation on the role of Robotics in Packaging Industry /any suitable industry using ➢ permanent automation ➢ programmable automation	2		1

			4	Visit an Agarbhathi manual production Enterprise / Visit a paper plate production Enterprise/or any local manual production Enterprise		4	Submit a report on the manual production adopted and the effectiveness of the company if automation process is used in the Enterprise visited.	1	2
			5	**Developmental Assessment**			Assessment Review and corrective action		3
			6	**Industry Class** on Industry 4.0 Industry Assignment	2	2	Weekly Assignment(1PM-2PM)		1
	Learning Outcomes		**Learn the Importance of Electronics in Automation Industry.**						
2	1,2,3	1,3,6	1	Tutorial (Peer discussion on Industrial assignment)		4	• Case study: Video demonstration of Automatic potato chips production plant • Understand the importance of Electronics in automation of potato chips production plant ✓ Prepare and submit a report on the list of electronics components used in potato chip production plant and its specifications.	1	2
			2	**Variable Frequency Drive (VFD)** • Introduction • Building blocks of VFDs, • specifications, types and working principles.	2	2	• VFD with motor control panel • modules of VFD. • Industrial and domestic applications of VFDs.. ✓ Present a Case study on application of VFD drives for speed control in industry/ institute ✓ submit a report on the above	2	1
			3	Give a presentation on an industry application to INTEGRATE VFD WITH PLC		4	AC, DC, servo and stepper motors – Types , its industrial applications . ✓ Demonstrate all the above motors and their applications	2	1
			4	❖ Visit a near by automation industry and prepare a report on the specifications of VFD, motors, VFD Drives.		4	❖ Visit a near by automation industry and prepare a report on the specifications of VFD ,motors, VFD Drives.		3

		5	**Developmental Assessment**			Assessment Review and corrective action			3
		6	**Industry Class** on use of Electronics in Automation+ Industry Assignments	2	2	Weekly Assignment(1PM-2PM)			1
3	**Learning outcomes**		**Application of Sensors and Actuators in Automation and Robotics**						
	1,2	1	Tutorial (Peer discussion on Industrial assignment)	4		• Discuss the role of sensors in Automation & Robotics • List the selection of sensors in industrial automation system based on the given applications **Practise** Build a circuit for sensing any object using proximity sensor and indicating with LED	1	2
	1,2,3	2	❖ List and identify different types of sensors used in the automation industry visit ✓ Make a report on it with its specifications. **Practise** Build a circuit on proximity sensor/color sensor/sound sensor/temperature sensor(rtd type, capacitive type ,resistive type) and verify its working	1	3	Identify and List different types of sensors used in driverless car (artificial intelligence car). (video demonstration) ✓ Make a report on it with its specifications. ✓ Demonstrate resistive type sensor application using PLC	1	2

		3	• What is process Automation. • Demonstrate a case study on Process automation. ✓ List all the sensors and give its specifications for the above case study. **Practise** Build a circuit using Arduino on the above listed sensors for each given application and verify its working	2	2	• Demonstrate Automatic packaging Line for Lenovo Laptop. ✓ Prepare and submit a report on the components used for automation in the above industry, ✓ Identify and give a presentation on the role of Robots in the above automation process.	1	2

		4	**Actuators**
			• Introduction, its usage in Industrial Automation systems with real time application examples.
			• Contactors and Relays – concept, types, applications
			✓ Demonstrate and explain the role of Actuators in
			   - Automation packaging
			   - Label scanning and printing,
			   - Control solar panel direction,
			
			    Practice
			Build a circuit to Control manually operated motor using contactor and Relay
				2	2	• Industrial Robot actuators- Discuss Actuators based on type of motion and power used .
						
						✓ Prepare a report on the usage of actuators for a given real time application in an pharmaceutical industry.
						
						✓ Write a note on actuators vs Robots
							1	2

		5	**CIE 1 – Written and Practice Test**			Assessment Review and corrective action		3
		6	Industry Class on sensors and actuators + Industry Assignment	2	2	Weekly Assignment(1PM-2PM)		1
4	**Learning Outcomes**		**Familiarization of PLC Installation Practices, troubleshooting and programming**					
	3	3,4,7	1	Tutorial (Peer discussion on Industrial assignment)	4	PLC Installation Practices, Editing, and Troubleshooting • PLC Enclosures, Electrical Noise, Leaky Inputs and Outputs , Grounding.	2	1

			• Voltage Variations and Surges Program Editing and Commissioning • Preventive Maintenance ✓ Troubleshoot the Processor Module, Input Malfunctions, Output Malfunctions of a PLC ✓ Prepare a report on the specifications of at least 8 manufacturers of PLC used in different industries			
2	PLC Installation Practices, Editing, and Troubleshooting • Programming and Monitoring • PLC Programming software and their features ✓ Troubleshoot the Processor Module, Input Malfunctions, Output Malfunctions	2	2	Prepare, present and submit a report describing the installation, commissioning, and troubleshooting procedures of any production facility using PLC	1	2
3	**PLC Programming** Classification and sub-classification of PLC programming languages. **Practise** Conduct the following using any one of Textual language and Graphical Form of PLC ➢ DOL starter and record its output ➢ Stair case light application ➢ Water level controller application	1	3	**Practise** ✓ VFD programming using PLC for switching the motor ON/OFF. ✓ VFD programming using PLC for variable motor SPEED.		3
4	**Practise** Switch the Motor ON/OFF using contactor and Relay programmed by PLC	1	3	Analyse a Case Study on E - waste management using PLC . ✓ Prepare, present and submit a report describing a process to manage E – waste using PLC	1	2
5	**Developmental Assessment**			Assessment Review and corrective action		3
6	Industry Class-Industry Expert Talk / Lecture / Interaction on Modern PLC Controllers and its impact on Industry 4.0	2	2	Weekly Assignment (1PM – 2PM)		1

5	Learning Outcomes			Implement Networking in Automation							
	3	1,,3,7	1	Tutorial (Peer discussion on Industrial assignment)		4	**Network in Automation** ➢ Introduction to LANs ➢ Introduction to Serial Interfaces ➢ Common Industrial Buses ➢ Proprietary IO Buses **Practise** – perform networking experiment to provide wired and wireless(IP address and configuration) LAN connection	1		2
			2	**Network in Automation** ➢ Typical Network Architecture ➢ Network Cables & accessories ➢ Use of Fibre Optic Cables **Practise**- crimping practice of CAT5 cables	1	3	Video demonstration of firewall control over network access and restrictions **Practise**- Crimping of co – axial cables (RG6) and demonstrate its uses.	1		2
			3	Check for different pin configurations during the connection of RS 232 and RS 485 protocols. Practise **Practise** ✓ Use the above protocols for a given/specific application. ✓ optical fibre crimping /RS 232 /RS 485 protocol connections	1	3	INDUSTRIAL AUTOMATION PROTOCOLS Explain the importance of using the following protocols and Demonstrate any two of them . ➢ EtherNet/IP ➢ Profibus ➢ Modbus ➢ ProfiNet ➢ DeviceNet ✓ Prepare a report on different types of communication protocols and its uses.	1		2
			4	❖ Industrial Visit to food processing industry (automation, networking, robotics)/ any automation industry		4	❖ Prepare a report on the communication protocols used in food processing industry/any automation industry.		1	2
			5	**CIE 2 – Written and Practice Test**			Assessment Review and corrective action			3

		6	**Industry Class** on Networking in Automation	2		2	Weekly Assignment (1 PM-2PM)		1
	Learning Outcomes		**Familiarise with automation simulation software & DCS/SCADA/HMI**						
6	1,2,3	1,3,5	1	Tutorial (Peer discussion on Industrial assignment)		4	• Programmable Automation Controllers (PACs)-Role of PACs in modern industries. *Comparison between PLCs and PACs ✓ Prepare a report to Compare different brands of PLC hardware and software for a given application.	1	2
			2	Identify the suitable industry and explain the following PLC application . ➢ Controlling Geared DC motor with PLC. ➢ Controlling Stepper motor with PLC. ➢ Controlling Motor direction– Forward & Reverse. • Prepare and submit a report on the above. Also simulate the above using any simulation software.	1	3	• Implement/Simulate a Counter to count the object detected on the conveyor at the packaging department with any of below process and update onto PLC. ➢ Metal Detector Sensor with PLC ➢ Plastic Detector Sensor with PLC ➢ Distance measurement sensor integrating with PLC ➢ Color Detection sensor with PLC. ➢ Magnetic sensor with PLC **Note**: Trial version of SIEMEN PLANT Simulation Software(flow of material and logistics software) can be used	1	2
			3	Distributed Control System(DCS) ➢ Concept of DCS ➢ Data Acquisition ➢ Data Control ➢ Typical DCS Architecture ❖ PREPARE a report on the application of DCS/SCADA/HMI in a food processing industry/any automation industry.	1	3	Supervisory Control & Data Acquisition (SCADA) and HMI 1. Introduction to SCADA 2. Concept of Real time software 3. SCADA Architecture 4. Communication table for signal exchange 5. Introduction to communication protocols	1	2

			(from previous visit)			6. Creation of Database 7. Interfacing with PLC 8. Operating Screens 9. Application programming 10. Simulation / RUN time 11. Alarms, Trends & Bar graphs 12. Historical Data Management PREPARE a report on the application of DCS/SCADA/HMI in a food processing industry/ any automation industry. (from previous visit) **Practice** Interface SCADA, HMI integration in any automation industry using any simulation software.		
		4	Familiarize with the installation and tools of any simulation software used for automation.	2	2	Design, simulate and automate any application in automation industry with open-source software	1	2
		5	**Developmental Assessment**			Assessment Review and corrective action		3
		6	**Industry Class** on PLC applications and & DCS/SCADA/HMI	2	2	Weekly Assignment (1PM-2PM)		1
7	**Learning Outcomes.**		**Understand and Implement Arduino/PLC based Projects.**					
	1,2,3	2,3,4	1	Tutorial (Peer discussion on Industrial assignment)		4	• Overview of the Development of Arduino based projects using open-source simulation softwares. • Advantages of Arduino based projects • Differentiate Arduino controller and other microcontrollers ✓ Demonstrate a Case study on Comparison of Arduino with PLC	1	2

		2	A parking plot has a certain capacity of cars/two wheelers. Number of empty spots should be displayed on the display outside the Parking Plot and the spots available is to be indicated by LEDs ✓ Implement the above using Arduino board in your college premises			4	If Sump water level is minimum, send an alert to mobile and allow the inlet water. when the sump level is maximum, stop the inlet water. Switch on the motor if the overhead water tank is empty, only when the water in sump is sufficient. ✓ Implement the above in your college premises. **Note:** 1.Write a code in PLC simulator software 2. Turn water pump motor ON/OFF using PLC on Hardware. 3.Implement speed control of motor by using VFD		3
		3	Display the number of students in a classroom at any time of the day ✓ Implement the above using Arduino board in your classroom	1	3		The lights and fans should switch OFF if no one is present in the room. ✓ Implement it in your Labs/classrooms using Arduino	1	2
		4	To switch ON the street light during dark and automatically switch OFF during the Day time using Arduino ✓ Implement the above suitably in your college premises.	1	3		❖ Virtual tour on industries related to PLC applications in industries (ex. John distilleries, GTTC Centers)		3
		5	**CIE 3 – Written and Practice Test**				Assessment Review and corrective action		3
		6	**Industry Class** on development and simulation of Arduino projects	2	2		Weekly Assignment (1 PM-2PM)		1
8	**Learning Outcomes.**		**Introduction to Robotics**						
	1,4	1,3.7	1	Tutorial (Peer discussion on Industrial assignment)			4	CASE STUDY: Automatic Stamping Labelling Machine 1. Building a small Conveyor by interfacing the	1	2

						Geared DC motors and Free wheels. 2. Selection of Pneumatic valves to hold the labelling stamp 3. Interfacing Pneumatic linear actuator and Pneumatic Valve 4. Constructing the proper arrangements for Pneumatic valves, Pneumatic pipes, actuator and labelling stamp 5. Interfacing of Proximity sensor to PLC and testing by installing at the entry and exit position of conveyor 6. Interfacing the Indicators, 24vSwitches and Proper arrangement for power supply for wholeunit 7. Interfacing of 2 to 3 typesof Pneumatic actuators to get differentiate depend on the load and stroke length ✓ Identify the role of sensors, actuators and robot in the above case study and discuss its importance ✓ Demonstrate the actuator vs robot with reference to any other industrial application.		
		2	• Introduction to Robotics • Explain the need for Robotics in Automation industries • Types of robots. • Work Volume • Degree of Freedom- Forward and Back, Up and Down, Left and Right, Pitch, Yaw, Roll (video demonstration of different types of Robots)	2	2	Joint Notation & Type of joints in robot- Linear Joint (L Joint), Orthogonal Joint (O Joint), Rotational Joint (R Joint), Twisting Joint (T Joint), Revolving Joint (V Joint)	3	

		3	• Discuss the types of sensors used in industrial robot & their application
			• End Effectors-
			  ➢ Grippers, Tools
			  ➢ Types of grippers
			  ➢ Factors to be considered for Selecting a Gripper
			
			(video demonstration of different types of sensors used in Robots)
				2	2	• Introduction to Open Source Software- Robo Analyser Software/Robo studio/Gazebo.
						
						• Study the various tools in Robo Analyser Software /ROBO studio/Gazebo
						
						✓ Simulate any simple activity using Robo Analyser Software/Robo studio/Gazebo
								3

		4	Simulate any industry application of picking and placing an object from one place to another using Robo Analyser Software or any simulator	1	3	Simulate any industry application of picking and placing an object from one place to another using Robo Analyser Software or any simulator	1	2
		5	**Developmental Assessment**			Assessment Review and corrective action		3
		6	**Industry Class** on Robotic components + Industry Assignment	2	2	Weekly Assignment (1PM – 2PM)		1
9	**Learning Outcomes.**		**ROBOTIC CONTROL SYSTEMS**					
	4	1,3	1	Tutorial (Peer discussion on Industrial assignment)	4	Introduction and overview of robotic systems and their dynamics (Forward and inverse dynamics. Properties of the dynamic model and case studies. Introduction to nonlinear systems and control schemes) ✓ Prepare a report on the working dynamics for a given condition.	1	2
			2	Joint space and task space control schemes (Position control, velocity control, trajectory control and force control)	2	2	Discuss and make a report on use of Artificial Intelligence in robotics	1	2

			✓ Prepare a report on the working dynamics for a given condition.					
		3	Discuss the Applications in Unmanned systems, Defence, Medical and Industries. ✓ Prepare a report for usage of Robot in any of the above mentioned systems	1	3	Simulation of Basics of control: Open loop Closed loop Control P,PD,PI,PID Controllers using any simulation software. (Using MATLAB Trial version)		3
		4	Introduction to camera , Camera calibration, Vision Application in Robotics (automated navigation guidance by vision system) **Practice** Build a simple Line following ROBO using Arduino/Build a simple obstacle detection ROBO using Arduino	1	3	❖ visit to automation industries . (ex. GTTC center) ✓ Make a report on different types of ROBOTs used in automation industry		3
		5	**CIE 3 – Written and Practice Test**			Assessment Review and corrective action		3
		6	**Industry Class** on Robotic control systems	2	2	Weekly Assignment (1PM-2PM)		1
10	**Learning Outcomes**		**Robotics projects**					
	4	1	Tutorial (Peer discussion on Industrial assignment)	4		• Demonstrate a Case Study on Automated Guided Vehicle for Material Handling • Understanding the concept of AGV in different industrial sectors Example: Remote controlled AGV, Magnetic tape based AGV	1	2
	2,3,4	2	Demonstration of ROBOT WITH 2 DOF, 3 DOF Robot path planning using Robotic simulation software/Robo Analyser.		4	Demonstrate a Case study on MOBILE ROBOTICS ✓ prepare a report on use of MOBILE ROBOTICS in different industries.		3

			Present a Robotic Coordinate system using arobot • Joint co-ordinate system • Rectangular co-ordinate system • User or object coordinate system • Tool coordinate system. **Steps to define user co-ordinate system.** Defining X, Y, Z co-ordinate system Verifying co-ordinate system by multiple motion movements ✓ Simulate the above using ROBO Analyser software or any simulation software Refer the below links **https://www.youtube.com/watch?v=bAdqazixuRY** **https://www.youtube.com/watch?v=lv6op2HHIuM**	1	3	• Create a new model in Simulation Software- Robo Analyser Software or any simulation software. • Importing different types of robot • Identify the position variation in robots • Perform Robot axis movements			3
			3					
			Perform Mechanical and Electrical Installation check of robot • Checking of proper installation of the safety sensors • Checking of Physical grounding of robot and other peripheral devices (cable trays, fences,fixtures, electric boxes etc.). • Checking of the electric connections- Earthing cable,power cable, Pneumatic pipes etc ❖ Make a checklist and perform it on the industrial robot seen during the industrial visit.	1	3	**Do it Yourself** Build a TurtleBot personal Robot.			3
			4					

			5	**Developmental Assessment**			Assessment Review and corrective action			3
			6	**Industry Class** on simulation/Real time robotic projects	2		2	Weekly Assignment(1PM-2PM)			1
	Learning Outcomes			**Robot Programming**						
11	4	2,3,4,7	1	Tutorial (Peer discussion on Industrial assignment)		4		Program a ROBO to trace a circular path using any simulation software			3
			2	Program a ROBO to trace a rectangular and square path using any simulation software		4		Program a ROBO to trace a elliptical path using any simulation software			3
			3	Program a ROBO to trace different Triangular path using any simulation software		4		Program a ROBO to trace a trapezoidal path using any simulation software			3
			4	Simulate a program to move a robot in a cubic and cuboidal shape.		4		Simulate a program to move a robot in a conical and cylindrical shape.			3
			5	**CIE 4 – Written and Practice Test**				Assessment Review and corrective action			3
			6	**Industry Class** on development and simulation of robotic programming + Industry Assignment	2		2	Weekly Assignment (1PM-2PM)			1
12	4,5	1,5,7		**Learning Outcomes.**				**Robot Operating System-ROS**			
			1	Tutorial (Peer discussion on Industrial assignment)		4		Introduction to ROS, Installation and Packages	2	1	
			2	ROS communication Tools (Topic, Services, Action)	2		2	Visualization and creation of custom environment with a robot	1		2
			3	Mapping of robot environment and navigation with mobile robot	1	1	2	ROBOT PATH Planning for AGV.	1		2
			4	Build a MAZE solving ROBOT in Real environment	1		3	Build a MAZE solving ROBOT in Real environment.	1		2

		5	**Developmental Assessment**			Assessment Review and corrective action		3
		6	**Industry Class** on Robot Operating System+ Industry Assignment	2	2	Weekly Assignment(1PM-2PM)		1
13			*Internship* a) **Secondary research on various industries and their operations to identify at least 3 companies along with the areas of work interest and develop an internship plan that clearly highlights expectations from the industry during the internship.** b) **Design and develop a cover letter for an internship request to all 3 identified companies and the resume to be submitted to potential companies.** c) **Prepare for an internship interview to highlight your interests, areas of study, career aspirations and personnel competence – including the areas of learning you expect to learn during internship**			*Project* a) **Identification of the problem statement (from at least 3 known problems) the students would like to work as part of the project – either as provided by faculty or as identified by the student. Document the impact the project will have from a technical, social and business perspective.** b) **Design and develop the project solution or methodology to be used to solve at least one of the problems identified.** c) **Prepare a project plan that will include a schedule, WBS, Budget and known risks along with strategies to mitigate them to ensure the project achieves the desired outcome.**		40

References

Sl. No	Description
1	Automation, Production Systems, and Computer-Aided Manufacturing- Mikell P Grover, Prentice-Hall International publication.
2	Automating Manufacturing Systems with PLC by Hugh Jack.
3	Programmable logic Controllers by W. BOLTON.
4	Hand book of Modern Sensors" Physics, Designs and Applications- JACOB FRADEN-Springer Publications.
5	Springer Handbook of Automation by Shimon Y. Nof.
6	Robotics technology and flexible automation – S.R. DEB and S.DEB.
7	R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
8	John J.Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education.
9	M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.
10	B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998
11	Automatic stamping Labelling machine using PLC -https://youtu.be/5QRKnYz4QP4
12	Color detection sensor using PLC - https://youtu.be/2Ax0bqZjkeU
13	https://rigbetellabs.com
14	http://NigelStanford.com/y/a-/Automatica
15	https://www.kuka.com/timo

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1– Written and practice test	4	30
Week 5	CIE 2– Written and practice test	4	30
Week 7	CIE 3– Written and practice test	4	30
Week 9	CIE 4– Written and practice test	4	30
Week 11	CIE 5– Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			**240**
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		**3**	**60**
SEE 2 – Practical		**3**	**100**
TOTAL SEE MARKS (B)			**160**
TOTAL MARKS (A+B)			**400**

*The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods.

Assessment framework for CIE (1 to 5)
Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam – 4hrs

Programme	Electronics & Communication Engineering		Semester	V
Course	Automation & Robotics		Max Marks	30
Course Code	20EC53I		Duration	4 hours
Name of the course coordinator				

Note: Answer one full question from each section.

Qn.No	Question	CL L3/L4	CO	PO	Marks
	Section-1 (Theory) – 10 marks				

1.a)	For a given application implement the following condition in PLC environment to automate the process .
	    i) A LOW is generated from the output of the system when BCD is present
	 BCD →0
	    ii) A HIGH is generated from the output of the system when BCD is not there
	 Non BCD →1
		L3/L4	CO1,CO2	1,7	5

b)	with an example explain how VFD drives are interfaced with PLC for motor speed control in industry	L3	CO3	1,3,6	5
2.a)	Identify and list the sensors used in conveyor belt in a specified automation industry	L4	CO1,CO2	1,7	5
b)	Demonstrate how the conveyor belt movement and speed is controlled .	L4	CO3	1,3,6	5
	Section-2 (Practical) - 20 marks				
3)	In a given orange juice the pH value is ideally observed to be 5.7 . But the juice is monitored to be 6.7 which makes it in-edible. Automate the system , so that a neutral solution is added for the juice whenever it is changed its concentration wrt its ideal value. simulate using any simulation software	L3/L4	CO1,CO2	1,2,3,7	20
4)	Implement a PLC environment for a water level controller automation from sump to tank	L3/L4	CO1,,CO2	1,2,3,7	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme	: Electronics & Communication Engineering			
Semester	: V.			
Course	: Automation & Robotics		**Max Marks: 100**	
Course Code	: 20EC53I		**Duration: 3 Hrs**	

Instruction to the Candidate: Answer one full question from each section.

Q.No	Question	CL	CO	Marks
	Section-1			
1.a)	Consider a beverage industry and illustrate the role of inventory management to sustain continuous production.	L4		10
b)	Analyse the role of Industry 4.0 in enhancing the existing production methodology through automation. Illustrate with an example.	L3	1	10
2.a)	How would you filter out damaged or rotten fruits as well as unwanted debris during the intial cleaning process in a beverage industry	L4		10
b)	Illustrate the role of sensor to check the quantity of beverage filled in a bottle.	L3		10
	Section-2			
3.a)	How would you choose to change the filling of kissan Jam from Glass containers to sachet on the same production lines. Explain the role of VFD in the production line	L4		10
b)	Mention the requirement of PLC in the above automation	L3	3	10
4.a)	Consider a plant, manufacturing tyres using a permanent automation structure.Is it possible to make the manufacturing through programmed automation at any stage of the manufacturing process. Justify your answer.	L4		10
b)	Describing the installation, commissioning, and troubleshooting procedures facility in paint manufacturing industry using PLC	L3		10
	Section- 3			
5.a)	How would you Test and Analyse the functionality of Dam shutter control system to meet exact operational specifications . Explain the Networking protocols used.	L4		10
b)	Test and Analyse the PLC based Airport baggage system considering 4 different locations.	L4	2	10

			L3		10
6.a)	Consider elevator in a 10-storey building, write the troubleshoot results for smart elevator controlling system by considering all the possible outcomes of a elevator. Analyse the Networking in its Automation.		L3		10
b)	Consider the case of a PLC based automatic robotic Car washing system and report the test results.		L3		10
Section-4					
7.a)	Analyse and report the test results for 5 axis robotic arm controlled by touchscreen display.		L4		10
b)	Troubleshoot and write the analysis report for operation of line follower robot in textile industry.		L4	4	10
8.a)	Consider biscuit manufacturing company, report the test results by considering the case of robots used in final inspection and packaging section in biscuit manufacturing.		L4		10
b)	Considering the application of robotic gesture control system for gaming company, analyse and list out the results.		L3		10
Section-5					
9.a)	Why we need ROS for the development of Robots, give some examples.		L4		10
b)	How to develop simple self balancing robot system		L3	5	10
10.a)	How to test the functionality and specific parameters of an 3 axis robotic hand build using ROS.		L4		10
b)	Give the application of ROS over microcontroller program.		L3		10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
	1. Design and develop any sensor based smart PLC application in simulated or real environment. OR 2. Design and develop any PLC/Arduino based robotic automated system in simulated or real environment.	
1	Writing the program/ Design	20
2	Building the circuit/ simulation	20
3	Conduction of the experiment/project	20
4	Troubleshoot/Result	20

5	Viva voce	20
Total		**100**

Equipment / Software List with specification for a batch of 20 students.

Sl No	Equipment's	Specification	Quantity
1	PLC Systems with digital I/P, O/P modules and software	12/24v Dc/relay 6 Digital Inputs , 4 Digital Outputs, ethernet card standard micro Sd card integrated webserver	2
2	HMI / HMI DEMOBOARDS with software	7 inch panel, 24 V DC	2
3	PLC control panel	With mounting arrangement for PLC power supply pushbutton switch etc.	2
4	1) PLC kit with suitable software 2) Arduino uno kits & Arduino IDE software 3) voltage current sound dust sensors 4) pick and place robot with external arm set 5) Relevant sensors for various experiments	as per industry standards.	1
5	Variable frequency drive (VFD)	2 HP	2
6	Arduino/Raspberry Pi board		5