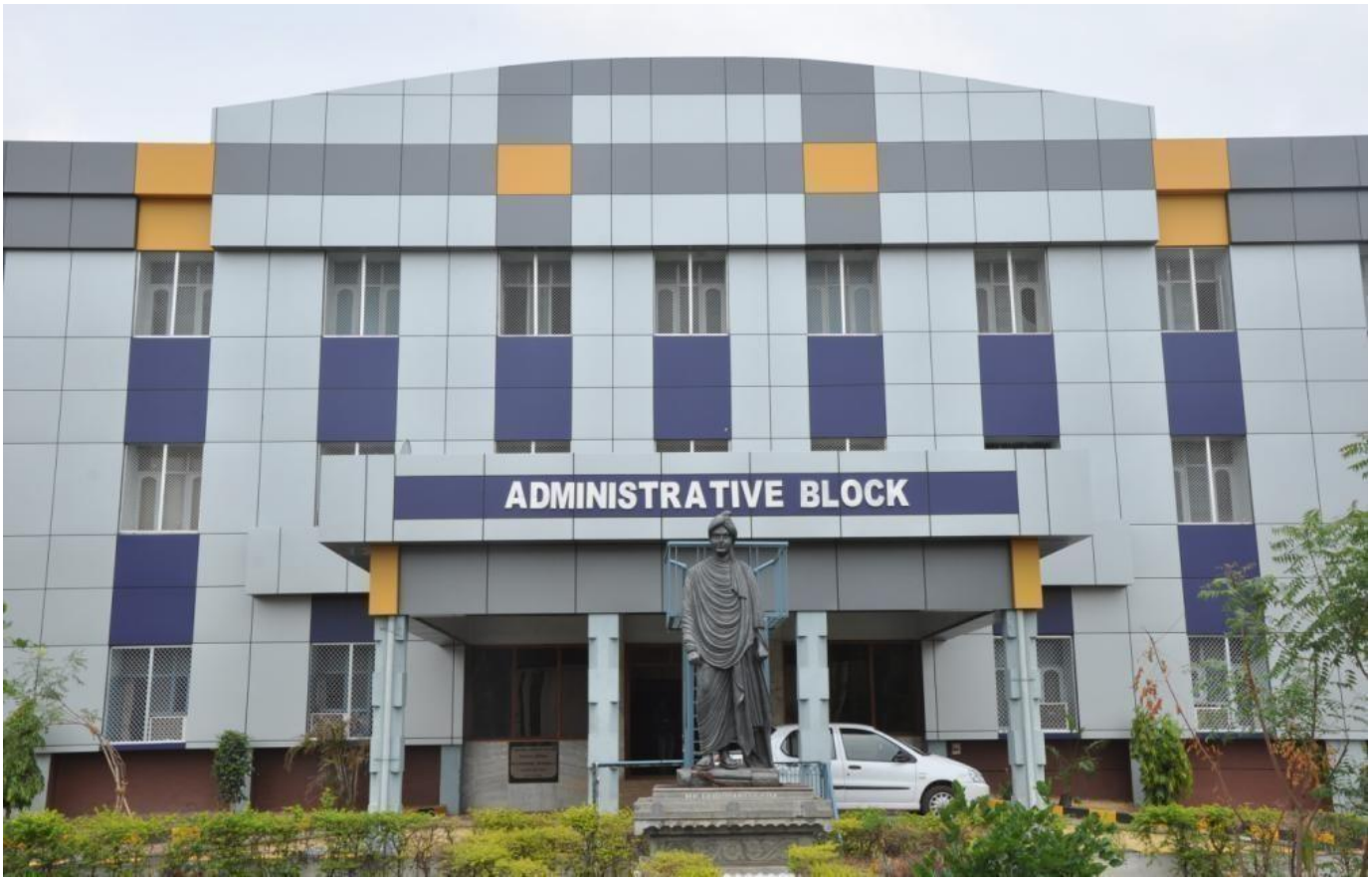
G. PULLA REDDY ENGINEERING COLLEGE (Autonomous): KURNOOL

Accredited by NBA of AICTE and NAAC of UGC with A Grade,

Affiliated to JNTUA, Anantapuramu



Scheme – 2023

Scheme and Syllabus for Minor Program in

Industrial Robotics (IRT)

Offered by

Department of Electronics and Communication Engineering

Minor in Industrial Robotics

(Offered by ECE to other departments)

Scheme of Instruction and Examination

(Effective for the students admitted from the academic year 2023-2024 onwards)

S. No	Course Code	Course Title	Credits	Scheme of Instruction periods/week		Scheme of Examination Maximum Marks		
				L	T/P	End Exam Assessment	Internal Assessment	Total (100M)
1	MIR01	Introduction to Robotics	3	3	0	70	30	100
2	MIR02	Programmable Logic Controllers	3	3	0	70	30	100
3	MIR03	Robotics Hardware and Control Lab	1.5	0	3	70	30	100
4	MIR04	Machine Learning for Robotics	3	3	0	70	30	100
5	MIR05	Embedded Systems & Robotics	3	3	0	70	30	100
6	MIR06	Embedded systems And Robotics Interface Lab	1.5	0	3	70	30	100
7	MIR07	Automation Frame works and Tools	3	3	0	70	30	100
	Total		**18**					

INTRODUCTION TO ROBOTICS (ITR)

Scheme:2023							
Course Code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
MIR01	**PC**	**L**	**T/P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		3	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration:2Hrs				**EndExamDuration:3 Hrs**			

Course Outcomes:

At the end of the course the student will be ablet o

CO1: Interpret terminologies related to Robotics field.

CO2: Analyze various grippers and sensors for robotics.

CO3: Apply logic for selection of robotic subsystems and systems.

CO4: Analyze basics of principles of robot system integration.

CO5: Analyze the multiple AI techniques in the area of robotic technology.

UNIT-I

Brief history, basic concepts of robotics such as definition, Three Laws, elements of robotic systems (i.e., robot anatomy, degrees of freedom (DOF), misunderstood devices, etc.), classification of robotic systems on the basis of various parameters such as work volume, type of drive, etc. Associated parameters- resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Introduction to principles and strategies of automation, types and levels of automation, need for automation, and industrial applications of robots.

UNIT-II

Grippers and Sensors for Robotics:

Grippers for Robotics:

Types of grippers, guidelines for designing robotic grippers, force analysis for various basic gripper systems.

Sensors for Robots:

Types of sensors used in robotics, classification and applications of sensors, characteristics of sensing devices, selection of sensors.

UNIT-III

Drives and Control for Robotics: Drive-Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers,
Introduction to closed loop control.

UNIT-IV

Programming and Languages for Robotics

Robot Programming:

Methods of robot programming, WAIT, SIGNAL, and DELAY commands, use of subroutines.

Programming Languages:

Generations of robotic languages and an introduction to various types such as VAL, RAIL, AML, Python, ROS, etc. development of robotic programming languages from WAVE to ROS.

UNIT-V

Related Topics in Robotics: Socio-Economic aspect of robotization. Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, New trends & recent updates in robotics.

Text Books:

1.S.K. Saha, Introduction to Robotics2e, TATA McGraw Hills Education (2014)

2.AsitavaGhoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006).

3.DilipKumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019).

4.R.K.Mittal,I.J.Nagrath, Robotics and Control, TATA McGraw Hill Publishing Co Ltd, New Delhi(2003).

Reference Books:

1.S.B.Niku,IntroductiontoRobotics–Analysis,Contro,Applications,3rdedition,John Wiley&SonsLtd.,(2020)

2. J. Angeles, Fundamentals of Robotic Mechanical Systems Theory Methods and Algorithms,Springer (1997).

3. R.D.Klafter, ThomasA .Chmielewski, andMechaelNegin, RoboticEngineering–An Integrated Approach, EEE, PrenticeHallIndia,PearsonEducationInc.(2009)

MOOC'S Equivalent Course

1.RoboticsByProf. DilipKumarPratihar, IIT Kharagpur.

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

PROGRAMMABLE LOGIC CONTROLLER (PLC)

Scheme: 2023							
Course code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
MIR02	**PC**	**L**	**T/P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		3	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration:2Hrs				**EndExamDuration:3 Hrs**			

Course Outcomes:

At the end of the course the student will be able to

CO1: Analyze the integration of automation in industrial applications.

CO2: Apply PLC operational flow in controlling and wiring modules

CO3: Analyze applications based on PLC Ladder functioning

CO4: Design real time application using PLC.

CO5: Create prototype for the sustainable real time application using HMI

UNIT-I

Introduction to Factory Automation: History and developments in industrial automation. Vertical integration of industrial automation, Control elements in industrial automation, PLC introduction.

UNIT-II

Programmable Logic Controllers: Basics of PLC, Advantages, Capabilities of PLC, Architecture of PLC, Scan cycle, Types of PLC, Types of I/O modules, Power supplies and isolators, configuring a PLC, PLC wiring.

UNIT-III

Programming Of PLC: General PLC programming procedures-Types of Programming-Programming on-off inputs/outputs Simple process control programs using Relay Ladder Logic-Auxiliary Comm. And functions–PLC Basic Functions-Register basics-Timer functions–Counter.

UNIT-IV

PLC Intermediate Functions: PLC intermediate functions: Arithmetic functions, Comparison functions, Skip and MCR functions, Data move systems - PLC Advanced intermediate functions: Utilizing digital bits, Sequencer functions, Matrix functions–PLC Advanced functions: Alternate programming languages, Analog PLC operation.

UNIT-V

HMI Systems: Necessity and Role in Industrial Automation, Text display-operator panels-Touch panels–Panel PCs –Integrated displays, interfacing PLC to HMI. Installation: Installation and maintenance procedures for PLC-Troubleshooting of PLC, PLC Networking standards &I EEE Standard-Protocols-Field bus- Process bus and Ethernet. Case studies.

Text Books:

1.JohnW Webb & RonaldA Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India,2003.

2. Frank D Petruzella “Programmable Logic Controllers", Mc Graw HillInc, 2005.

Reference Books:

1.BoltonW,“Mechatronics”, Pearson Education, 2009.

2.Kelvin TErikson,“Programmable Logic Controllers",Dogwood ValleyPress,2005.
3.Garry Dunning,“Introduction to Programmable Logic Controllers”,Thomson DelmarLearning, 2005.
4.Khalid Kamel,Eman Kamel,“Programmable Logic Controllers”,McGrawhill,2013.

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

ROBOTICS HARDWARE AND CONTROL LAB (RHC (P))

Scheme: 2023							
Course Code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
MIR03	**PCC**	**L**	**T/P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		0	**3**	**1.5**	**30**	**70**	**100**
Sessional Exam Duration: 2Hrs				**EndExamDuration:3Hrs**			

Course Outcomes:

At the end of the course the student will be able to

CO1: Demonstrate proficiency in interfacing and controlling electromechanical actuators (DC motors, servo motors, stepper motors) using microcontroller platforms.

CO2: Integrate various types of sensors (e.g., IR, ultrasonic, accelerometers, encoders) for environmental perception and robot control.

CO3: Design and implement embedded control systems for robotic applications such as autonomous navigation, gesture control, and real-time feedback systems.

CO4: Develop and test wireless and user-input based control methods for robotics using Bluetooth, RF, IR, and voice interfaces.

CO5: Analyze robotic system behavior and performance using sensor data and apply control algorithms like PID for improved accuracy and response.

List of Experiments

1. Encoder Interfacing for Motor Speed and Position Feedback.
2. Robotic Arm with Joystick Control
3. Wireless Communication Using NRF24L01 Modules
4. Gesture-Controlled Robot using Accelerometer (e.g., MPU6050)
5. Obstacle Avoidance Robot with PID Controlled Motors
6. Line Maze Solver Robot Using IR Sensors and Decision Algorithms
7. Voice Controlled Robot Using Speech Recognition Module
8. Infrared Remote-Controlled Robot
9. Automated Docking System for Robot Using Ultrasonic and IR Sensors
10. Real-Time Clock (RTC) Based Scheduled Robot Operations

MACHINE LEARNING FOR ROBOTICS (MLR)

Scheme: 2023							
Course Code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
MIR04	**PC**	**L**	**T/P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		3	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration:2Hrs				**EndExamDuration:3 Hrs**			

Course Outcomes:

At the end of the course the student will be able to

CO1: Analyze the multiple machine learning levels

CO2: Analyze the supervised learning algorithms

CO3: Apply the supervised learning methods with various case studies

CO4: Compare the learning methodologies and dimensionality concepts

CO5: Analyze the role of neural networks in sustainable robotic applications.

UNIT-I

Machine learning–Varieties of Machine learning–Learning Input-Output functions: Types of learning–Input Vectors –Outputs –Training regimes– Noise– Performance Evaluation.

UNIT-II

Foundations Of Supervised Learning: Decision trees and inductive bias–Geometry and nearest neighbor's–Logistic regression–Perception–Binary classification.

UNIT-III

Advanced Supervised Learning: Linear models and gradient descent–Support Vector machines–Naïve Bayes models and probabilistic modeling–Models election and features election–Model Complexity and Regularization. Case Studies: Line following using Supervised Learning techniques – A simulation model for understanding both regression and classification techniques

UNIT-IV

Unsupervised Learning: Curse of dimensionality, Dimensionality Reduction, PCA, Clustering–K-means– Expectation Maximization Algorithm–Mixtures of latent variable models–Supervised learning after clustering–Hierarchical clustering.

UNIT-V

Neural Networks: Network Representation, Feed-forward Networks, back propagation, Gradient-descent method. - Introduction to CNNs, Layers of a CNN: Convolution, Pooling, Fully Connected, Feature maps and filters. Role of data analytics in robotic systems, sensor data handling, preprocessing, and visualization, machine learning techniques to robotic data.

TextBooks:

1.Michalski, Carbonell, Tom Mitchell,'Machine Learning',Springer,2014.

2. Peter Flach, 'Machine Learning: The Art and Science of Algorithms that make sense of data', Cambridge 2014.

Reference Books:

1.HalDaume III,'A Course in Machine Learning ',Todo, 2015.

2.Ethem Alpaydin, 'Introduction to Machine Learning',The MIT Press, 2004

3.David MacKay, 'Information Theory, Inference and LearningAlgorithms',Cambridge,2003

4.Bruno Apolloni, Ashish Ghosh, Ferda Alpasian, “Machine Learning and Robot Perception”,Springer,2005.

MOOC’S Equivalent Course

Introduction to Machine Learning By Prof. Balaraman Ravindran, IIT Madras.

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

EMBEDDED SYSTEMS AND ROBOTICS (ESR)

Scheme: 2023

Course Code	Category	Hours/Week		Credits	Maximum Marks		
		L	T/P	C	Continuous Internal Assessment	End Exam	TOTAL
MIR05	PC	3	0	3	30	70	100

Sessional Exam Duration:2Hrs **EndExamDuration:3Hrs**

Course Outcomes:

At the end of the course the student will be able to

CO1: Analyze the trends and applications of embedded systems

CO2: Analyze the microcontroller operations through block diagram and programming model

CO3: Analyze the Arduino pin structure and it's programming environment

CO4: Apply the interfacing procedures to control multiple peripherals.

CO5: Analyze the impact of various embedded processors in robotic applications.

UNIT-I

Embedded Systems: Overview of Embedded Systems, Features, Requirements and Applications of Embedded Systems, Recent Trends in the Embedded System Design, Common architectures for the ES design, Embedded Software design issues, Communication Software, Introduction to Development and Testing Tools.

UNIT-II

Microcontrollers for Embedded Systems : Von- Neumann and Harvard architectures, Introduction to 8051 family microcontrollers, 8051 architecture, Register banks and Special Function Registers, Block Diagram, Addressing Modes, Instruction Set, Timers, Counters, Stack Operation

UNIT-III

Arduino: Block Diagram, Basics Hardware Overview, Download and Install the Arduino IDE, Arduino IDE Sketch, Understanding Arduino Syntax, Delay programming, Serial Monitor Interface, String Programming.

UNIT-IV

Interfacing: Multiple Sensor Interfacing, Digital I/O Control, Analog I/O Control. Building robot Applications using Arduino: obstacle avoidance robot, Line Follower Robot.

UNIT-V

Impact on Robotics: Overview of Robotics, Pattern recognition and robots, Use of Embedded Systems in Robotics, Robots and Computer Vision.

TextBooks:

1. Mazidi Muhammad Ali, Mazidi Janice Gillespie & McKinlay Rolin D, The 8051 Microcontroller and Embedded Systems, 2nd Edition, Pearson Education, 2008.
2. Shibu K.V, Introduction to Embedded Systems ,Mc Graw Hill ,1st Edition,2009.

ReferenceBooks:

1. Arsheep Bahga , Vijay Madisetti ,Internet of Things: A Hands-On Approach Paperback,2015

Web Reference:

https://onlinecourses.nptel.ac.in/noc17_cs22/course

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

EMBEDDED SYSTEMS AND ROBOTICS INTER FACE LAB (ESRI (P))

Scheme: 2023								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
MIR06	**PC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		0	**3**	**0**	**1.5**	**30**	**70**	**100**
Sessional Exam Duration: 2Hrs					**EndExamDuration:3Hrs**			

Course Outcomes:

At the end of the course the student will be able to

- **CO1**: Interface and program basic input/output devices such as LEDs, sensors, and motors using 8051 and Arduino platforms.
- **CO2:** Design and implement motor control systems including DC motors and servo motors with PWM techniques.
- **CO3**: Develop simple robotic applications such as line following and obstacle avoidance robots by integrating multiple sensors.
- **CO4**: Utilize wireless communication modules like Bluetooth to remotely control embedded systems and robots.
- **CO5**: Analyze sensor data and implement real-time monitoring systems with displays and user inputs to enhance robotic functionality.

List of Experiments

1. LED Blinking and Delay Functions (8051 & Arduino)
2. DC Motor Control using H-Bridge (L293D)
3. Interfacing Ultrasonic Sensor (HC-SR04) for Distance Measurement
4. Line Follower Robot using IR Sensors
5. Obstacle Avoidance Robot
6. Servo Motor Control using PWM
7. Temperature Monitoring using LM35 with LCD Display
8. Bluetooth-based Robot Control via Android App (HC-05 Module)
9. Interfacing a Keypad and Display for Robot Command Input
10. Speed Control of DC Motor using Potentiometer (Analog Input)

AUTOMATION FRAMEWORKS AND TOOLS (AFT)

Scheme: 2023							
Course Code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
MIR07	**PC**	**L**	**T/P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
		3	**0**	**3**	**30**	**70**	**100**
Sessional Exam Duration: 2Hrs					**EndExamDuration:3Hrs**		

Course Outcomes:

At the end of the course the student will be able to

CO1: Analyze the Robotic Process Automation functioning.

CO2: Apply the flow chart mechanism in various calculations.

CO3: Apply Blue Prism tool for debugging process

CO4: Design system managing techniques.

CO5: Create application for process automation using Blue Prism tool.

UNIT-I

Introduction to RPA and Blue Prism, Blue Prism Installation and architecture of Blue Prism, Introduction to Process Studio and Creating a simple Process.

UNIT-II

Data Item, Calculation Stage, Multi-Calculation Stage, Decision Stage, Choice Stage, Loop Stage, Collection Stage, Anchor stage, Note stage.

UNIT-III

Debugging a Process Step In, Step Out, Step Over, Break point, Introduction to Object Studio and Creating a simple object Read Stage, Write Stage, wait stage, Action Stage, Navigate Stage, Code Stage, creating a simple object Application Modeler, Spying Elements, Attributes, Launch, Attach and Detach, Error Management Exceptions, Recover and Resume, Throwing Exceptions, Preserving the current exception, Exception Bubbling, Exception Blocks.

UNIT-IV

Case Management, Work Queue creation, Queue Items, Checking Queue in Control Room, Control Room, running a process in Control Room, publishing a process, Log Viewer, Scheduler, System Manager, Credential Manager, Environment Variables, User Roles, Concept of VBO's, Importing a
VBO Types of Inbuilt VBO's.

UNIT-V

Release Manager Creation of a package, exporting a process, Importing a process. Introduction to Surface Automation, Font Smoothening, Region Mode, Automation using surface automation.
Advanced Topics, Casting, Initialize and Clean Up, Dynamic Attributes, Global Send Keys and Send Key Events, Best Coding Practices.

Text Books:

1.Blue Prism Master Class: Developer & Professional Developer, Prasanna Kumar Ballepalli·2019.

2.Robotic Process Automation with Blue Prism Quick Start Guide Create Software Robots and Automate Business Processes by LimMeiYing·2018.

Reference Books:

1.The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems 1st ed. Edition By TomTaulli, Apress, 2014.

Question Paper Pattern:

Sessional Exam:

The question paper for Sessional Examination shall be for 40 marks. The question paper shall consist of Four questions and all questions are compulsory. Question No.1 shall contain Five compulsory short answer questions for a total of Ten marks. Question No.2 to 4 shall be EITHER/OR Type for Ten marks each. Student shall Answer any one of them. Each of these questions may contain sub-questions.

End Examination:

The question paper for End Examination shall be for 70 marks. The Question paper shall contain Six Questions and all questions are compulsory. Question No.1 shall contain Ten compulsory short answer questions for a total of Twenty marks (with Two short answer questions from each unit). Question No.2 to 6 shall be EITHER/OR Type for Ten marks each and shall cover one Unit of the Syllabus for each question. Student shall Answer any one of them. Each of these questions may contain sub-questions.

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