G. PULLA REDDY ENGINEERING COLLEGE (Autonomous):KURNOOL

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

Affiliated to JNTUA, Anantapuramu

Scheme – 2020

Scheme and Syllabus for Minor Program in

Industrial Robotics (IRT)

Offered by

Department of Electronics and Communication Engineering

G.PULLA REDDY ENGINEERING COLLEGE (AUTONOMOUS): KURNOOL

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MINOR DEGREE IN INDUSTRIAL ROBOTICS (IRT)

Scheme of Instruction and Examination

(Effective from 2020-2021)

S. No	Semester	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	IV	MIR01	Introduction to Robotics	4	4	0	60	40	100
2	V	MIR02	Programmable Logic Controllers	4	3	2	60	40	100
3	VI	MIR03	Machine Learning for Robotics	4	3	2	60	40	100
4	VII	MIR04	Robotic Process Automation	4	3	2	60	40	100
5			MOOCS-1	2	0	0			100
6			MOOCS-2 / Mini Project	2	0	0			100
		Total		**20**					

MOOCs-1	1.Sensors and Actuators Course web link: https://nptel.ac.in/courses/108/108/108108147 2. Artificial Intelligence in robotics Course web link: https://onlinecourses.nptel.ac.in/noc21_ge20/preview
MOOCs-2	1.Introduction to Micro Sensors Course web link: https://onlinecourses.nptel.ac.in/noc21_ee26/preview 2.Automatic Control Course web link: https://nptel.ac.in/courses/112/107/112107240/#

INTRODUCTION TO ROBOTICS (ITR)

Scheme: 2020

Course Code	Category	Hours/Week		Credits	Maximum Marks		
		L	T/P	C	Continuous Internal Assessment	End Exam	TOTAL
MIR01	PCC	4	0	4	40	60	100

Sessional Exam Duration: 1½Hrs | **End Exam Duration: 3 Hrs**

Course Outcomes: At the end of the course the student will be able to

CO1: Interpret terminologies related to Robotics technology.

CO2: Understand various grippers and sensors for robotics.

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

CO4: Analyze basics of principles of robot system integration.

CO5: Integrate knowledge of AI techniques in the area of robotic technology.

UNIT-I

Introduction to robotics : Brief History, Basic Concepts of Robotics such as Definition , Three laws, Elements of Robotic Systems i.e. Robot anatomy, DOF, Misunderstood devices etc., Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc., Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device etc., Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.

UNIT-II

Grippers and Sensors for Robotics: Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot.

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, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS.

UNIT-V

Related Topics in Robotics: Socio-Economic aspect of robotisation. 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 Robotics 2e, TATA McGraw Hills Education (2014)
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006).
3. Dilip Kumar 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, Introduction to Robotics – Analysis, Contro, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
2. J. Angeles, Fundamentals of Robotic Mechanical Systems Theory Methods and Algorithms, Springer (1997).
3. R. D. Klafter, Thomas A. Chmielewski, and Mechael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (2009)

MOOC'S Equivalent Course

1. Robotics By Prof. Dilip Kumar Pratihar, IIT Kharagpur.

Question Paper Pattern:

Sessional Exam: The question paper for sessional examination shall be for 25 marks, covering half of the syllabus for first sessional and remaining half for second sessional exam. The question paper shall consist of three sections with Two Questions (EITHER/ OR Type) in each section. The student shall answer one question from each section.

End Examination: The question paper for End examination shall be for 60 marks. The Question paper shall contain Five Units with Two Questions (Either or Type) from each unit. Each of these questions may contain sub questions. and the student should answer any one question from each unit. Each Question carries 12 marks.

Internal Assessment: 40M

End Exam: 60M

PROGRAMMABLE LOGIC CONTROLLER (PLC)

Scheme: 2020							
Course Code	**Category**	**Hours/Week**		**Credits**	**Maximum Marks**		
		L	**T/P**	**C**	**Continuous Internal Assessment**	**End Exam**	**TOTAL**
MIR02	**PCC**	**3**	**2**	**4**	**40**	**60**	**100**
Sessional Exam Duration: 1½ Hrs				**End Exam Duration: 3 Hrs**			

Course Outcomes: At the end of the course the student will be able to

CO1: Identify and understand the automation concepts for Industries.

CO2: Apply PLC architecture knowledge to select PLC for specific problems.

CO3: Use PLC Ladder diagram for simple applications

CO4: Design real time application using PLC.

CO5: Create prototype for the real time application Using PLC, with 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 commands 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 & IEEE Standard - Protocols - Field bus - Process bus and Ethernet. Case studies.

Text Books:
1 John W Webb & Ronald A Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2. Frank D Petruzella “Programmable Logic Controllers ", McGraw Hill Inc, 2005.
Reference Books:
1.Bolton W, “Mechatronics”, Pearson Education, 2009.
2. Kelvin T Erikson, “Programmable Logic Controllers ", Dogwood Valley Press, 2005.
3. Garry Dunning, “Introduction to Programmable Logic Controllers”, Thomson Delmar Learning, 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 25 marks, covering half of the syllabus for first sessional and remaining half for second sessional exam. The question paper shall consist of three sections with Two Questions (EITHER/ OR Type) in each section. The student shall answer one question from each section. **End Examination:** The question paper for End examination shall be for 60 marks. The Question paper shall contain Five Units with Two Questions (Either or Type) from each unit. Each of these questions may contain sub questions.And the student should answer any one question from each unit. Each Question carries 12 marks.
Internal Assessment: 40M **End Exam: 60M**

MACHINE LEARNING FOR ROBOTICS (MLR)

Scheme: 2020

Course Code	Category	Hours/Week		Credits	Maximum Marks		
		L	T/P	C	Continuous Internal Assessment	End Exam	TOTAL
MIR03	PCC	3	2	4	40	60	100

Sessional Exam Duration: 1½ Hrs | **End Exam Duration: 3 Hrs**

Course Outcomes: At the end of the course the student will be able to

CO1: Understand about the concepts of machine learning

CO2: Understand the types of trees and bias

CO3: Apply the supervised learning methods with various case studies

CO4: Compare the learning methodologies and dimensionality concepts

CO5: Summarize the applications of neural networks in 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 neighbour's – Logistic regression – Perceptron – Binary classification.

UNIT-III

Advanced Supervised Learning: Linear models and gradient descent – Support Vector machines – Naïve Bayes models and probabilistic modelling – Model selection and feature selection – Model Complexity and Regularization.

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. Case Studies: Line following using Supervised Learning techniques – A simulation model for understanding both regression and classification techniques - Study of the effectiveness of the Bias-variance. Obstacle avoidance and navigation of a mobile robot in an unknown environment with the help of Neural Network -Use of stochastic PCA and the PCA neural network to find low dimensional features. Building a feed-forward neural network to ascertain automatic navigational queries.

Text Books:

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. Hal Daume 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 Learning Algorithms', 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 25 marks, covering half of the syllabus for first sessional and remaining half for second sessional exam. The question paper shall consist of three sections with Two Questions (EITHER/ OR Type) in each section. The student shall answer one question from each section.

End Examination: The question paper for End examination shall be for 60 marks. The Question paper shall contain Five Units with Two Questions (Either or Type) from each unit. Each of these questions may contain sub questions. And the student should answer any one question from each unit. Each Question carries 12 marks.

Internal Assessment: 40M

End Exam: 60M

ROBOTIC PROCESS AUTOMATION (RPA)

Scheme: 2020

Course Code	Category	Hours/Week		Credits	Maximum Marks		
		L	T/P	C	Continuous Internal Assessment	End Exam	TOTAL
MIR04	PCC	3	2	4	40	60	100

Sessional Exam Duration: 1½ Hrs | **End Exam Duration: 3 Hrs**

Course Outcomes: At the end of the course the student will be able to

CO1: Understand the concepts of Robotic Process Automation.

CO2: Apply the flow chart mechanism in various calculations.

CO3: Applying 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 Lim Mei Ying · 2018.

Reference Books:

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

Question Paper Pattern:

Sessional Exam: The question paper for sessional examination shall be for 25 marks, covering half of the syllabus for first sessional and remaining half for second sessional exam. The question paper shall consist of three sections with Two Questions (EITHER/ OR Type) in each section. The student shall answer one question from each section.

End Examination: The question paper for End examination shall be for 60 marks. The Question paper shall contain Five Units with Two Questions (Either or Type) from each unit. Each of these questions may contain sub questions. And the student should answer any one question from each unit. Each Question carries 12 marks.

Internal Assessment: 40M

End Exam: 60M