

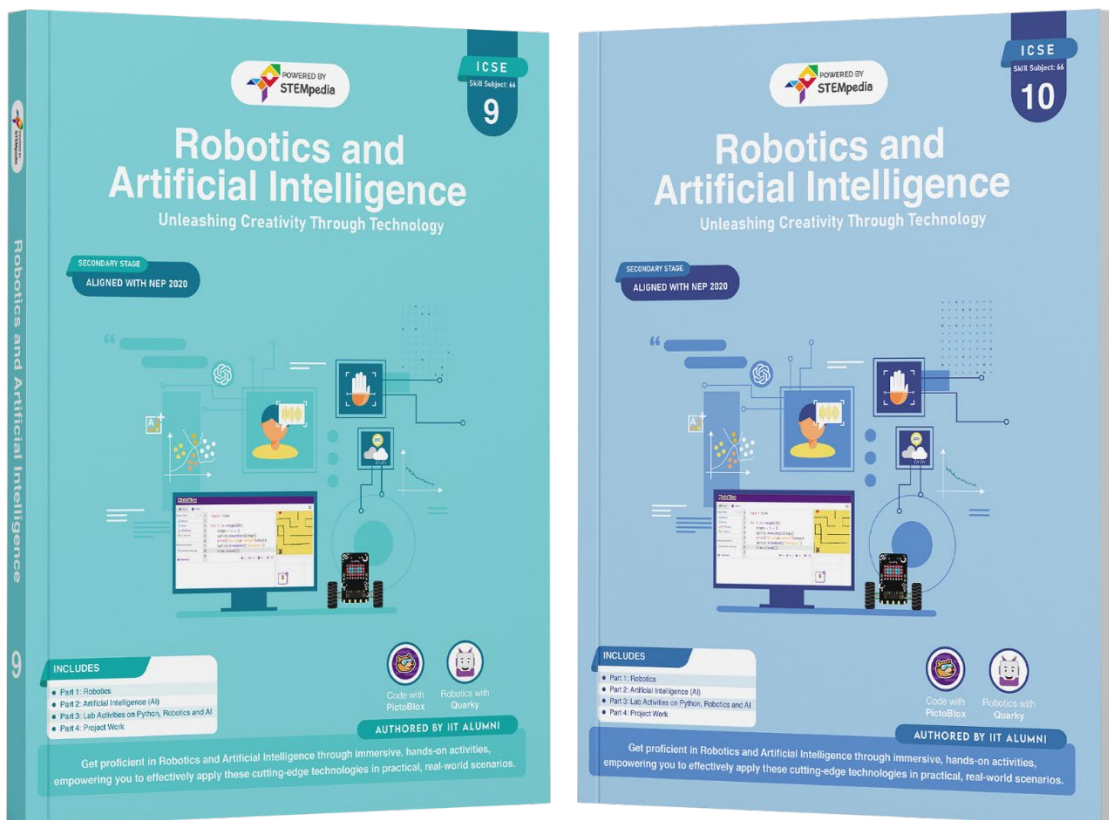


# Robotics and Artificial Intelligence

## Subject Code 66

### ICSE (Class 9 and 10)

Mastering Coding, Artificial Intelligence, and Robotics with Fun Activities  
for ICSE Schools



*Authored By*

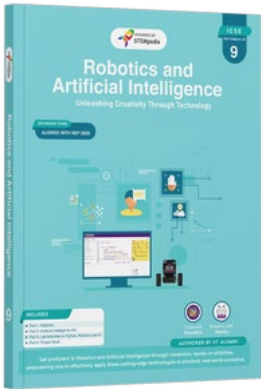

**Pankaj Kumar Verma**

*Chief Technology Officer, STEMpedia  
B. Tech, IIT Kanpur*

**Khushbu Chauhan**

*AI & Robotics Expert, STEMpedia  
BE, Gujarat Technological University*

## Robotics & Artificial Intelligence Book (ICSE) - Class 9 to 10

Feature	Class 9	Class 10
		
<b># of Pages</b>	223	233
<b># of Chapters</b>	7	8
<b># of Activities</b>	30	40
<b>Subject Covered</b>	Class 9 Robotics & Artificial Intelligence Subject Code 66	Class 10 Robotics & Artificial Intelligence Subject Code 66
<b>Software and Hardware Used</b>	Windows 10, PictoBlox Python, PictoBlox AI, PictoBlox Machine Learning Environment, Python Libraries, Quarky, Arduino	Windows 10, PictoBlox Python, PictoBlox AI, PictoBlox Machine Learning Environment, Python Libraries, Quarky, Arduino
<b>Competition</b>	Access to Codeavour	Access to Codeavour
<b>Technologies Covered</b>	Robotics, Artificial Intelligence, Data Science and Machine Learning	Robotics, Artificial Intelligence, Data Science and Machine Learning
<b>Sessions Required</b>	Total 80 – (40 Lab Sessions, 40 Classroom Learning Sessions)	Total 80 – (40 Lab Sessions, 40 Classroom Learning Sessions)
<b>Resources for Teachers</b>	Lesson Plan, Lecture Slides (Textual, Images, Video)	
<b>Certification</b>	Yes (15 lab activities)	Yes (15 lab activities)
<b>Book Sections</b>	Part A: Robotics Part B: Artificial Intelligence (AI) Part C: Lab Activities Part D: Project Work / Field Visit / Student Portfolio	Part A: Robotics Part B: Artificial Intelligence (AI) Part C: Lab Activities Part D: Project Work / Field Visit / Student Portfolio
<b>TOC for Robotics</b>	Unit 1: Introduction to Robotics Unit 2: Robot as a System Unit 3: Concepts in Robotics	Unit 1: New Age Robotic Systems Unit 2: From Robots to Cobots Unit 3: Components of Robots as a System Unit 4: Integrating Robots as a System
<b>TOC for Artificial Intelligence</b>	Unit 1: Introduction to Artificial Intelligence (AI) Unit 2: Role of Data and Information, Evolution of Computing Unit 3: Introduction to Data and Programming with Python Unit 4: AI Concepts and AI Project Framework	Unit 1: Decision making in Machines/ Computers Unit 2: Machine Intelligence and Cybersecurity in Computing Unit 3: Components of AI Project Framework

		Unit 4: Introduction to Data and Programming with Python
<b>TOC for Lab Activities</b>	Basics of Python Programming – 12 Activities Robotics with Quarky – 7 Activities AI with PictoBlox – 6 Activities ML with PictoBlox – 5 Activities	Advance Python – 17 Activities Robotics with Quarky – 10 Activities AI with PictoBlox – 2 Activities ML with PictoBlox – 10 Activities AI and Robotics – 1 Activity
<b>TOC for Project Work</b>	Capstone Project – Codeavour Sample Projects Built by Community Answer Keys	Capstone Project – Codeavour Sample Projects Built by Community Answer Keys

## FAQs about Class 9 and 10 Robotics and AI Books

### 1. What are the core subjects covered in the Class 9 and 10 Robotics & AI books?

The Class 9 book delves into the basics of Robotics and Artificial Intelligence, introducing subject-specific terminology, foundational theories, and practical applications. In contrast, the Class 10 book builds on this knowledge by exploring advanced topics in robotics, AI, data science, and machine learning.

### 2. How extensive are these books in terms of content and chapters?

- The Class 9 book spans 223 pages and encompasses 7 well-structured chapters, providing a comprehensive overview of the basics.
- The Class 10 book is slightly more extensive, with 233 pages divided into 8 chapters, focusing on more advanced topics.

### 3. Can you describe the practical activities included in these books?

Class 9 includes 30 activities, ranging from basic Python programming to introductory robotics and AI applications. Class 10 advances these concepts with 40 activities, incorporating advanced Python programming, AI with PictoBlox, machine learning projects, and more hands-on robotics tasks.

### 4. What software and hardware are required for these courses?

Both classes necessitate Windows 10, PictoBlox for Python, AI, and machine learning environments, along with Python Libraries. Quarky and Arduino are also essential for the practical robotics components.

### 5. Do the books offer opportunities for external engagement like competitions?

Yes, both books provide access to Codeavour, an international platform that encourages students to participate in coding and robotics competitions, fostering an environment of learning and healthy competition.

### 6. What resources are available for teachers?

Teachers are equipped with a comprehensive suite of resources, including detailed lesson plans, lecture slides, and visual aids. These resources are designed to facilitate effective instruction and enhance student engagement.

### 7. Is there a certification process upon course completion?

Students can attain a certification upon successful completion of at least 15 lab activities. This certification acknowledges their proficiency in the fundamental concepts of Robotics and AI.

### 8. How is the content in these books organized?

Each book is methodically segmented into four parts: Robotics, Artificial Intelligence, Lab Activities, and Project Work/Field Visits/Student Portfolio. This structure ensures a balanced mix of theoretical knowledge and practical application.

## 9. What is the total number of sessions required for each class?

Both the Class 9 and Class 10 courses are designed to be completed over 80 sessions. This structured approach ensures comprehensive coverage of the curriculum.

- These 80 sessions are typically divided equally between lab sessions and classroom learning. This division ensures that students get an equal mix of theoretical knowledge and practical application.
- While there's a recommended number of sessions, schools and educators have the flexibility to adapt the pace based on the students' needs and learning speed.

## 10. Are the books aligned with any specific educational curriculum or standards?

Yes, they adhere to the ICSE curriculum standards with a designated Subject Code of 66, ensuring that the content is relevant and standardized for educational purposes.

## 11. How do the books address the ethical implications of AI?

The books include thoughtful discussions on the ethical considerations and responsibilities surrounding AI technology, emphasizing the importance of ethical decision-making in technological advancements.

## 12. Can you elaborate on the hands-on engagement aspect of these books?

Hands-on engagement is a cornerstone of these books, achieved through a variety of lab activities, practical projects, and the use of interactive platforms like PictoBlox and Quarky. These elements enable students to apply theoretical knowledge in real-world scenarios.

## 13. What are the primary objectives of the course?

The course aims to equip students with fundamental knowledge in Robotics and AI, develop expertise through a blend of teaching methods, provide engaging hands-on experiences, prepare students for future AI advancements, and introduce ethical considerations in technology.

## 14. Are these books suitable for independent learning, or are they focused on classroom instruction?

While primarily designed for classroom instruction, the structure, detailed content, and resource availability also make these books suitable for self-guided learning, allowing students to explore Robotics and AI at their own pace.

## 15. What types of assessments are included in the books?

The books include a range of assessments, including multiple-choice questions, short answer questions, and higher-order thinking questions, to evaluate and enhance students' understanding of the topics.

## 16. How is Python programming integrated into the curriculum?

Python programming is a fundamental part of the curriculum, used to teach basic and advanced programming concepts. It is also employed in AI applications and machine learning modules, providing a practical context for programming skills.

## 17. Are there any prerequisites for students starting these courses?

A basic understanding of computers and a keen interest in technology will be beneficial, but there are no strict prerequisites. The books are designed to introduce and build on concepts progressively.

## 18. How do the books support project-based learning?

They emphasize project-based learning through dedicated sections on project work. These sections provide examples, guidelines, and frameworks for applying theoretical knowledge in practical, real-world scenarios, encouraging creativity and critical thinking.

## 19. What kind of support is available for schools implementing these books in their curriculum?

Schools implementing these books receive extensive support, including detailed curriculum guides, teaching resources, lesson plans, and continuous updates to ensure that the content remains relevant and engaging.

## 20. What roles do PictoBlox and Quarky play in enhancing practical learning?

### PictoBlox:

- **Interactive Learning Platform:** PictoBlox serves as an interactive platform that simplifies the learning of complex AI concepts. It's designed to make programming and AI accessible and engaging for students.
- **Hands-on AI Experience:** With PictoBlox, students can experiment with real AI tools, such as image classification, object detection, and natural language processing. This hands-on approach helps demystify AI and makes it tangible.
- **Python Programming:** PictoBlox also offers a Python coding environment, enabling students to learn and apply Python programming in AI projects. This exposure is vital in building foundational coding skills in a language widely used in the industry.
- **Project-Based Learning:** The platform supports project-based learning, where students can work on AI projects from concept to execution, reinforcing their learning through practical application.

### Quarky:

- **Robotic Tool for Practical Experience:** Quarky is a robotic tool that provides hands-on experience in robotics. It allows students to explore various aspects of robotic movements, sensor usage, and control systems.
- **Understanding Robotics Concepts:** By using Quarky, students gain a deeper understanding of robotics concepts, learning how to assemble and program robots, which is essential in comprehending the mechanics and electronics in robotics.
- **Creativity and Problem-Solving:** Engaging with Quarky encourages creativity and problem-solving skills. Students learn to build and program robots to perform specific tasks, adapting their designs and code to achieve desired outcomes.

## 21. What ICSE Skill Subject is covered in these books?

Both the Class 9 and Class 10 books cover the ICSE Skill Subject "Robotics & Artificial Intelligence" under Subject Code 66.

- **Curriculum Alignment:** The content and structure of these books are aligned with the ICSE syllabus, ensuring that they meet educational standards and requirements.
- **Holistic Skill Development:** This subject aims to equip students with a blend of theoretical knowledge and practical skills in Robotics and AI, preparing them for future technological landscapes and careers in STEM fields.

# Robotics and Artificial Intelligence

Unleashing Creativity Through Technology

SECONDARY STAGE

ALIGNED WITH NEP 2020



## INCLUDES

- Part 1: Robotics
- Part 2: Artificial Intelligence (AI)
- Part 3: Lab Activities on Python, Robotics and AI
- Part 4: Project Work



Code with  
PictoBlox



Robotics with  
Quarky

AUTHORED BY IIT ALUMNI

Get proficient in Robotics and Artificial Intelligence through immersive, hands-on activities, empowering you to effectively apply these cutting-edge technologies in practical, real-world scenarios.

## ICSE Robotics and Artificial Intelligence for Class 9 - Subject Code 66

Total Marks: 100 (Theory – 50 + Practical 50)

The ICSE Robotics and AI curriculum for Class 9 is an innovative educational programme designed to equip students with foundational knowledge and practical skills in Robotics and Artificial Intelligence (AI). This curriculum is motivated by the growing significance of AI and robotics in our modern world. It aims to prepare students for the future by providing them with the tools and understanding necessary to navigate and contribute to a rapidly evolving technological landscape.

Key aims of the course include:

- **Developing Fundamental Knowledge:** Equip students with essential Robotics and AI concepts and applications.
- **Building Expertise:** Use a blend of classroom teaching, lab work, and projects for comprehensive subject understanding.
- **Hands-on Engagement:** Provide active learning with cutting-edge technologies in Robotics and AI.
- **AI-Readiness Preparation:** Introduce key AI concepts such as Data Analysis, Computer Vision, and Natural Language Processing.
- **AI Project and Python Programming Introduction:** Familiarize students with AI project processes and fundamental Python programming.
- **Ethical AI Understanding:** Highlight the ethical aspects and responsibilities in AI technology.

### Salient Features of the Book

This comprehensive book is segregated into four parts:

- **Part 1 – Robotics:** This section covers the basics of Robotics, including an introduction to the field, classification of robots, real-world applications, and detailed studies of robot components and concepts.
- **Part 2 – Artificial Intelligence:** This section provides an in-depth look at AI, covering its introduction, role of data, Python programming, AI concepts, and project framework.
- **Part 3: Lab Activities on Python, Robotics, and Artificial Intelligence:** This section of the book is dedicated to practical, hands-on activities that complement the theoretical knowledge gained in the previous sections. It includes diverse activities in Python programming, Robotics using the Quarky platform, and AI introduction through PictoBlox.
- **Part 4: Project Work and Miscellaneous:** This section focuses on project-based learning, encouraging students to apply their knowledge in real-world scenarios. It includes a Capstone Project – Codeavour, a showcase of sample projects from the community, and answer keys for self-evaluation.

### Role of PictoBlox and Quarky in Enhancing Practical Learning

- **PictoBlox:** PictoBlox is an intuitive and engaging Python platform that simplifies complex AI concepts for students. It uses interactive activities such as image classification, object detection, and natural language processing to make learning AI accessible and enjoyable.
- **Quarky:** Quarky is a robotic tool that offers students a hands-on experience in robotics. It allows students to explore robotic movements, sensor usage, and control systems in a practical setting, thus deepening their understanding of robotics.

### Chapter Specific Features

- **Modern Technological Content:** Tailored to match the technological interests of today's students.
- **Activity-Based Learning:** Focus on practical activities for interactive concept understanding.
- **Step-by-Step Guidance:** Detailed instructions for easy understanding of lessons and projects.
- **Challenging Exercises:** MCQ, answered short answer type questions, and higher-order questions to test and enhance topic comprehension.

## Table of Contents for Class 9 – Robotics and AI Book | ICSE

### Part 1: Robotics

#	Lesson Name	Page
<b>Unit 1</b>	<b>Introduction to Robotics</b>	<b>1</b>
Section 1	<b>Understanding Robots</b> - Why Robots? Defining a Robot, Characteristics of a Robot, Benefits of Robots Over Humans, Robots in Hazardous Environments	<b>1</b>
Section 2	<b>Evolution of Robots</b>	<b>6</b>
Section 3	<b>Three Laws of Robotics</b>	<b>8</b>
Section 4	<b>Classification of Robots</b> - Classification Based on Terrain (Aerial, Ground, Underwater Robots), Classification Based on Controls (Manual Robots, Automatic Robots)	<b>9</b>
Section 5	<b>Bio-inspired Robots</b> – Humanoids, Birds, Snakes, Insects, Four-Legged Robots	<b>14</b>
Section 6	<b>Real World Robots and Their Applications</b> – Domestic, Industry, Medical, Defence, Entertainment, Agriculture	<b>16</b>
<b>Unit 2</b>	<b>Robot as a System</b>	<b>24</b>
Section 1	<b>Building Blocks of the Robots</b> - Power Supply, Actuators, Sensors, Control Systems, End Effector, Communication System, User Interface, Structural Frame or Chassis, Locomotion or Mobility System, Software and Firmware of a Robot	<b>24</b>
Section 2	<b>Mechanical, Electronics and Computation in Robot</b>	<b>35</b>
Section 3	<b>Design Aspects of Different Types of Robots</b> - Humanoid Robots, Aerial Robots (Drones), Underwater Robots (Autonomous Underwater Vehicles, AUVs), Mobile Robots, Industrial Robotic Arm	<b>36</b>
<b>Unit 3</b>	<b>Concepts in Robotics</b>	<b>45</b>
Section 1	<b>Type of Motion</b> - Linear Motion, Working of Pneumatic Actuators, Angular Motion, Circular Motion, Motion in One-Dimension, Motion in Two-Dimensions	<b>45</b>
Section 2	<b>Joints and Its Types</b> - Prismatic Joints, Prismatic Joints, Spherical Joints	<b>49</b>
Section 3	<b>Links and Its Types</b> - Rigid Links, Soft Links	<b>51</b>
Section 4	<b>Using Links and Joints</b>	<b>52</b>
Section 5	<b>Degree of Freedom of a Robot</b> – Definition, Identification through Illustration, Quarky Robotic Arm, Quarky Humanoid Robot, Quarky Quadruped Robot, Practical Considerations	<b>54</b>

### Part 2: Artificial Intelligence (AI)

#	Lesson Name	Page
<b>Unit 1</b>	<b>Introduction to Artificial Intelligence (AI)</b>	<b>62</b>
Section 1	<b>Understanding Artificial Intelligence</b> – What is Intelligence? A Glimpse into Animal Intelligence, Understanding Artificial Intelligence	<b>62</b>
Section 2	<b>History of Artificial Intelligence</b>	<b>64</b>
Section 3	<b>Applications of Artificial Intelligence</b> - E-commerce, Automobiles, Social Media, Agriculture, Robotics, Banking, Search Engine, Face Recognition, Augmented/Virtual Reality (AR/VR)	<b>65</b>
Section 4	<b>Benefits of Using AI</b>	<b>68</b>
Section 5	<b>Ethical Considerations of AI</b> - Bias and Prejudice, Fairness, Accountability, Transparency, Interpretability and Explainability	<b>71</b>



<b>Unit 2</b>	<b>Role of Data and Information, Evolution of Computing</b>	<b>79</b>
Section 1	<b>Data and Information</b> - Data and Information (Qualitative vs Quantitative, Discrete vs Continuous, Primary vs Secondary), Data Acquisition, Data Sources	<b>78</b>
Section 2	<b>Types of Data</b> - Audio Data, Visual Data, Numeric Data, Text Data	<b>82</b>
Section 3	<b>Evolution of Computing</b> - Deterministic Computing and Deterministic Problems, Deterministic vs Probabilistic Nature of Real-Life Problems, The Advent of AI and the Probabilistic Approach, AI Discretion, and the Human Element	<b>89</b>
<b>Unit 3</b>	<b>Introduction to Data and Programming with Python</b>	<b>97</b>
Section 1	<b>Introduction to Python</b> - Getting Started with Python, Getting Started with Python, Python Statements, Python Comments, Keywords, Identifiers, Indentation, Taking Inputs with Sprite	<b>97</b>
Section 2	<b>Variables and Data Types</b> – Variables, Constants, Data Types in Python (Numbers, Sequences, Sets, Maps)	<b>104</b>
Section 3	<b>Python Operators I</b> – Operators, Arithmetic Operators, Python Output, User Input in Python, Explicit Type Conversion in Python,	<b>107</b>
Section 4	<b>Python Operators II</b> - Comparison Operators, Logical Operators, Assignment Operators	<b>110</b>
Section 5	<b>Lists</b> - Creating a List, Accessing List Elements, Adding Elements to a List, Removing Elements from a List, Slicing in Lists, List Methods	<b>113</b>
Section 6	<b>Flow of Control and Conditions</b> - The if Statement, The if...else Statement, The if...elif...else Statement, Nested if Statements, Shorthand Conditional Statements, The for Loop in Python, The while Loop in Python, Nested Loop, Break Statement, Continue Statement, Pass Statement	<b>118</b>
Section 7	<b>Functions</b> - Types of Functions, Importance of Functions for Modularity, User Defined Functions	<b>126</b>
Section 8	<b>Introduction to tools for AI</b> - PictoBlox AI, Python Modules for AI in PictoBlox, Machine Learning for Kids	<b>128</b>
<b>Unit 4</b>	<b>AI Concepts and AI Project Framework</b>	<b>136</b>
Section 1	<b>AI Concepts</b> - Broad AI and Narrow AI, Expert Systems in AI, Example: ELIZA	<b>136</b>
Section 2	Introduction to AI Domains - Data Sciences, Computer Vision (CV), Natural Language Processing (NLP)	<b>138</b>
Section 3	AI Project Cycle	<b>140</b>
Section 4	Problem Scoping - 4Ws Problem Canvas, Problem Statement Template	<b>142</b>
Section 5	Data Acquisition - What is Data? Data Acquisition, Data Sources	<b>147</b>
Section 6	Data Exploration	<b>148</b>
Section 7	Modelling - Learning Based Approach, Rule Based Approach	<b>152</b>
Section 8	Evaluation	<b>155</b>
Section 9	Neural Network	<b>155</b>

### Part 3: Lab Activities on Python, Robotics and Artificial Intelligence

Lab Activity	Activity Name	Activity Category	Page
Lab Activity 1	First Python Code	Basics of Python Programming	<b>162</b>
Lab Activity 2	Addition Bot with Python	Basics of Python Programming	<b>164</b>
Lab Activity 3	Operators in Python – Part 1	Basics of Python Programming	<b>165</b>

Lab Activity 4	Operators in Python – Part 2	Basics of Python Programming	<b>165</b>
Lab Activity 5	Lists in Python – Part 1	Basics of Python Programming	<b>167</b>
Lab Activity 6	Lists in Python – Part 2	Basics of Python Programming	<b>167</b>
Lab Activity 7	Working with Conditions in Python	Basics of Python Programming	<b>170</b>
Lab Activity 8	Nested Conditional Statements in Python	Basics of Python Programming	<b>172</b>
Lab Activity 9	For Loop in Python	Basics of Python Programming	<b>173</b>
Lab Activity 10	While Loop in Python	Basics of Python Programming	<b>175</b>
Lab Activity 11	Combining Conditional and Loop Programming in Python	Basics of Python Programming	<b>176</b>
Lab Activity 12	Prime Numbers with Python	Basics of Python Programming	<b>177</b>
Lab Activity 13	LED Patterns with Quarky	Robotics with Quarky	<b>185</b>
Lab Activity 14	Exploring LED Animations with Quarky	Robotics with Quarky	<b>187</b>
Lab Activity 15	Creating a Touch Piano with Quarky	Robotics with Quarky	<b>188</b>
Lab Activity 16	Programming the Quarky Robot's Movements	Robotics with Quarky	<b>190</b>
Lab Activity 17	Wirelessly Controlled Robot	Robotics with Quarky	<b>191</b>
Lab Activity 18	Line Following Robot with Quarky – Part 1	Robotics with Quarky	<b>193</b>
Lab Activity 19	Line Following Robot with Quarky – Part 2	Robotics with Quarky	<b>193</b>
Lab Activity 20	Face Detection with Python	AI with PictoBlox	<b>198</b>
Lab Activity 21	Face Recognition with Python	AI with PictoBlox	<b>200</b>
Lab Activity 22	Object Detection with Python – Part 1	AI with PictoBlox	<b>202</b>
Lab Activity 23	Object Detection with Python – Part 2	AI with PictoBlox	<b>202</b>
Lab Activity 24	Human Body Detection with Python	AI with PictoBlox	<b>207</b>
Lab Activity 25	Finger Tracking with Python	AI with PictoBlox	<b>210</b>
Lab Activity 26	Mask Detection with Image Classifier (ML) – Part 1	ML with PictoBlox	<b>212</b>
Lab Activity 27	Mask Detection with Image Classifier (ML) – Part 2	ML with PictoBlox	<b>212</b>
Lab Activity 28	Pneumonia Detection with Image Classifier (ML) – Part 1	ML with PictoBlox	<b>215</b>
Lab Activity 29	Pneumonia Detection with Image Classifier (ML) – Part 2	ML with PictoBlox	<b>215</b>
Lab Activity 30	NLP Based Text Classifier	ML with PictoBlox	<b>217</b>

### Part 4: Project Work and Miscellaneous

#	Lesson Name	Page
1	Capstone Project – Codeavour	<b>220</b>
2	Sample Projects Built by Community	<b>221</b>
3	Answer Keys	<b>222</b>

# Robotics and Artificial Intelligence

Unleashing Creativity Through Technology

SECONDARY STAGE

ALIGNED WITH NEP 2020



## INCLUDES

- Part 1: Robotics
- Part 2: Artificial Intelligence (AI)
- Part 3: Lab Activities on Python, Robotics and AI
- Part 4: Project Work



Code with  
PictoBlox



Robotics with  
Quarky

AUTHORED BY IIT ALUMNI

Get proficient in Robotics and Artificial Intelligence through immersive, hands-on activities, empowering you to effectively apply these cutting-edge technologies in practical, real-world scenarios.

## ICSE Robotics and Artificial Intelligence for Class 10 - Subject Code 66

Total Marks: 100 (Theory – 50 + Practical 50)

The ICSE Robotics and AI curriculum for Class 10 is an innovative educational programme designed to equip students with foundational knowledge and practical skills in Robotics and Artificial Intelligence (AI). This curriculum is motivated by the growing significance of AI and robotics in our modern world. It aims to prepare students for the future by providing them with the tools and understanding necessary to navigate and contribute to a rapidly evolving technological landscape.

Key aims of the course include:

- **Developing Fundamental Knowledge:** Equip students with essential Robotics and AI concepts and applications.
- **Building Expertise:** Use a blend of classroom teaching, lab work, and projects for comprehensive subject understanding.
- **Hands-on Engagement:** Provide active learning with cutting-edge technologies in Robotics and AI.
- **AI-Readiness Preparation:** Introduce key AI concepts such as Data Analysis, Computer Vision, and Natural Language Processing.
- **AI-Robotics Project and Python Programming:** Familiarize students with AI project processes and advance Python programming and libraries.
- **Ethical AI Understanding:** Highlight the ethical aspects and responsibilities in AI technology.

### Salient Features of the Book

This comprehensive book is segregated into four parts:

- **Part 1: Robotics** - Explores the evolution and impact of New Age Robotic Systems (NARS) across various industries, the transition from robots to cobots, components of robotic systems, and practical assembly and programming of different types of robots.
- **Part 2: Artificial Intelligence (AI)** - Covers decision-making in machines, machine vs human intelligence, cybersecurity, the AI project framework, and an introduction to data and programming with Python.
- **Part 3: Lab Activities on Python, Robotics, and Artificial Intelligence** - Offers a series of lab activities encompassing advanced Python programming, robotics with Quarky, AI with PictoBlox, and machine learning applications.
- **Part 4: Project Work and Miscellaneous** - Includes a capstone project, examples of community-built projects, and an answer key for the exercises covered in the book.

### Role of PictoBlox and Quarky in Enhancing Practical Learning

- **PictoBlox:** PictoBlox is an intuitive and engaging Python platform that simplifies complex AI concepts for students. It uses interactive activities such as image classification, object detection, and natural language processing to make learning AI accessible and enjoyable.
- **Quarky:** Quarky is a robotic tool that offers students a hands-on experience in robotics. It allows students to explore robotic movements, sensor usage, and control systems in a practical setting, thus deepening their understanding of robotics.

### Chapter Specific Features

- **Modern Technological Content:** Tailored to match the technological interests of today's students.
- **Activity-Based Learning:** Focus on practical activities for interactive concept understanding.
- **Step-by-Step Guidance:** Detailed instructions for easy understanding of lessons and projects.
- **Challenging Exercises:** MCQ, answered short answer type questions, and higher-order questions to test and enhance topic comprehension.

Our goal is to develop technologically adept and innovative future leaders through this book. We welcome suggestions for its enhancement.

## Table of Contents for Class 10 – Robotics and AI Book | ICSE

### Part 1: Robotics

#	Lesson Name	Page
<b>Unit 1</b>	<b>New Age Robotic Systems</b>	<b>1</b>
Section 1	<b>Introduction to New Age Robotic Systems (NARS)</b> - Historical Evolution of Robotics leading to NARS, Comparison Between Traditional Robotics and NARS, The Impact of NARS on Modern Society and Industry	<b>1</b>
Section 2	<b>Warehouse Robots</b> - Case Studies: Robotics in Logistics and Supply Chain Management, Future Trends in Warehouse Automation	<b>4</b>
Section 3	<b>Assistant Robots</b> - Examples of Assistant Robots in Everyday Life, Ethical Considerations and Human-Robot Interaction	<b>5</b>
Section 4	<b>Smart Environments</b> - Smart Homes, Smart Schools, Smart Mobility	<b>6</b>
Section 5	<b>Autonomous Drones</b> - Applications of Drones in Various Industries	<b>7</b>
Section 6	<b>Robotics in Medicine and Healthcare</b> - Surgical Robots and their Advancements, Future of Robotics in Healthcare Systems	<b>8</b>
Section 7	<b>Robotics in Agriculture, Construction, and Other Industries</b> - Modern Elevator Systems	<b>9</b>
Section 8	<b>Relevance and Possibility of NARS</b> - Why NARS are Becoming Increasingly Relevant, Technological, Economic, and Social Drivers of NARS, Future Prospects and Challenges of NARS	<b>11</b>
<b>Unit 2</b>	<b>From Robots to Cobots</b>	<b>17</b>
Section 1	<b>Difference Between a Machine and a Robot</b> - Defining Machines and Robots, Evolution of Machines into Robots, Characteristics of a Robot, Illustrations and Comparisons: Case Studies of Machines and Robots	<b>18</b>
Section 2	<b>Cobots</b> - Definition and Evolution, Key Features Distinguishing Cobots from Traditional Robots, Human-Robot Collaboration, Safety, Efficiency, and Ergonomics in Cobot Design, Differences Between Cobots and Robots, Case Studies Highlighting Differences and Applications, Importance of Cobots, Impact on Workforce and Productivity, Progress from Robots to Cobots, Future Trends and Potential Developments	<b>22</b>
<b>Unit 3</b>	<b>Components of Robots as a System</b>	<b>35</b>
Section 1	<b>Introduction to Gears</b> - What is a Gear? Role of Gears in Robotics, Importance of Gears in Force Transmission and Amplification, Basic Principles of Gear Operation, How to Calculate Gear Ratio? Types of Gears and Their Applications in Robotics, Practical Examples Illustrating Gear Ratio in Robotic Systems	<b>35</b>
Section 2	<b>Sensors in Robotics</b> - Common Sensors, Classification of Sensors in Robotics (Internal and External Sensors), Functions of Sensors in Robotic Systems	<b>41</b>
Section 3	<b>Actuators in Robotics</b> - Basic Concept of Actuators, Types of Energy Sources, Application of Actuators in Robotics, Types of Actuators in Robotics, Real Life Examples of Actuator Applications in Robotics	<b>45</b>
Section 4	<b>Controller for a Robotic System</b> - Everyday Examples of Control Systems, Control Systems in Robotics, Manual vs. Automatic Control Systems, Illustration through Block Diagrams	<b>47</b>
Section 5	<b>Integrating Sensors, Actuators, and Controller in a Robotic System</b>	<b>49</b>
<b>Unit 4</b>	<b>Visualization, Design and Creation of Components</b>	<b>57</b>

Section 1	<b>Introduction to Quarky Ultimate Kit</b> - Quarky Prototyping Board, Quarky Board Features, 10+ Possible Robotics Configurations, What's Inside the Kit? Programming Quarky with Python, Connecting Quarky to PictoBlox, Understanding Modes of Programming Quarky	<b>58</b>
Section 2	<b>Identification of Quarky Robot Parts</b> - Quarky ESP32 Controller, Quarky RGB LED Display, Quarky Speaker, Quarky Tactile Switches, Quarky Touch Sensors, Quarky IR (Infrared) Sensors, How IR Sensor Works? Quarky Robot Control: Two-Wheel Drive Configuration	<b>62</b>
Section 3	<b>TinkerCAD</b> - Key Features of TinkerCAD, TinkerCAD Tutorials	<b>70</b>
<b>Unit 4</b>	<b>Integrating Robots as a System</b>	<b>73</b>
Section 1	<b>2 Wheel Drive Robot</b> - Assembling the 2 Wheel Drive Robot, Logic for Wirelessly Control Robot, Moving in Circle	<b>73</b>
Section 2	<b>Line Follower Robot</b> - Why Line Following Robots? Logic for Line Follower Robot	<b>76</b>
Section 3	<b>Obstacle Avoidance Robot</b> - Assembling the Quarky Obstacle Avoidance Robot, Connecting Ultrasonic Sensor, The Logic of Obstacle Avoidance Robot	<b>78</b>
Section 4	<b>Edge Detection Robot</b> - Assembling the Edge Detection Robot, The Logic of the Robot	<b>83</b>
Section 5	<b>Quarky Gripper Robot</b> - Assembling the Gripper Robot	<b>86</b>
Section 6	<b>Pick and Place Robot</b> - Assembling the Pick and Place Robot	<b>88</b>

## Part 2: Artificial Intelligence (AI)

#	Lesson Name	Page
<b>Unit 1</b>	<b>Decision making in Machines/ Computers</b>	<b>93</b>
Section 1	<b>Automated versus Autonomous Systems</b> - Roles in Technological Contexts, System Types: Deterministic, Probabilistic, and Versus Systems	<b>93</b>
Section 2	<b>Decision Making in Machines</b> - Features of Human Decision Making, Features of Machine Decision Making, Comparative Analysis, Object Classification: Humans vs Computers, Comparative Case Studies	<b>96</b>
Section 3	<b>Introduction to Machine Learning (ML)</b> - Fundamentals of Machine Learning, Importance of Data and Information in ML, Steps in Machine Learning, Practical Application: Fruit Sorting Example, Other Machine Learning Modes in PictoBlox	<b>99</b>
<b>Unit 2</b>	<b>Machine Intelligence and Cybersecurity in Computing</b>	<b>115</b>
Section 1	<b>Human and Machine Intelligence</b> - Introduction to Machine Intelligence, Human Intelligence vs Machine Intelligence, Comparative Analysis	<b>115</b>
Section 2	<b>The Turing Test</b> - Significance of Turing Test in AI Development, Criteria, and Implications	<b>117</b>
Section 3	<b>Connectivity Between Human and Machine Intelligence</b> - Collaborative Potential, Future Prospects and Challenges	<b>118</b>
Section 4	<b>Cybersecurity</b> - Ethical and Security Issues in Computing, Cyber Threats and Countermeasures, Viruses and Other Forms of Sabotage, Legal and Social Responsibilities in Computing, The Human Impact, Cybersecurity Best Practices	<b>119</b>
<b>Unit 3</b>	<b>Components of AI Project Framework</b>	<b>128</b>
Section 1	<b>AI Project Cycle</b>	<b>128</b>
Section 2	<b>Problem Scoping</b> - Sustainable Development Goals, 4Ws Problem Canvas, Problem Statement Template	<b>129</b>
Section 3	<b>Data Acquisition</b> - Data Sources, Data Features, Datasets, Data Acquisition	<b>133</b>

Section 4	<b>Data Exploration</b>	<b>135</b>
Section 5	<b>Modelling</b> - Rule Based Approach, Learning Based Approach, Supervised Learning (Classification, Regression), Unsupervised Learning (Clustering)	<b>137</b>
Section 6	<b>Evaluation</b>	<b>141</b>
<b>Unit 4</b>	<b>Introduction to Data and Programming with Python</b>	<b>146</b>
Section 1	<b>PictoBlox Python</b> - PictoBlox Python Interface	<b>146</b>
Section 2	<b>Recap of Python Programming</b> - Applications of Python, Python Basics - Printing Statements, Python Statements and Comments, Keywords, Identifiers, Variables and Datatypes, Python Inputs, Python Operators, Conditional Statements, Looping	<b>148</b>
Section 3	<b>Python Packages</b> - Installing Python Packages in PictoBlox Python, Importing Installed Packages, Key Python Libraries (NumPy, Matplotlib, Pandas, SciPy)	<b>149</b>
Section 4	<b>Lists in Python</b> - Creating a List, Accessing List Elements, Adding Elements to a List, Removing Elements from a List, Slicing in Lists, List Methods	<b>154</b>
Section 5	<b>Tuples in Python</b> - Creation of Tuple, Accessing Tuples, Deleting a Tuple, Converting List to Tuple and Vice-Versa	<b>156</b>
Section 6	String in Python - Traversing a String, Multiline Strings, Concatenating Strings, Escape Sequences, String Slicing	<b>161</b>

### Part 3: Lab Activities on Python, Robotics and Artificial Intelligence

Lab Activity	Activity Name	Activity Category	Page
Lab Activity 1	Sorting a List of Classmates	Advance Python	<b>166</b>
Lab Activity 2	Finding a Specific Word in a Sentence	Advance Python	<b>167</b>
Lab Activity 3	Dictionary of Indian Cities	Advance Python	<b>168</b>
Lab Activity 4	Exploring NumPy Arrays – Part 1	Advance Python	<b>169</b>
Lab Activity 5	Exploring NumPy Arrays – Part 2	Advance Python	<b>169</b>
Lab Activity 6	Displaying an Image and Its NumPy Array Representation	Advance Python	<b>174</b>
Lab Activity 7	Pandas Basics and Reading a CSV File	Advance Python	<b>175</b>
Lab Activity 8	Reading JSON Data into a Pandas DataFrame	Advance Python	<b>177</b>
Lab Activity 9	Basic Pandas Operations	Advance Python	<b>180</b>
Lab Activity 10	Plotting X and Y Point Arrays using Matplotlib	Advance Python	<b>182</b>
Lab Activity 11	Plotting with Matplotlib - Markers, Line Styles, & Axis Labels	Advance Python	<b>183</b>
Lab Activity 12	Plotting Bar Graphs with Bestselling Book Data	Advance Python	<b>185</b>
Lab Activity 13	Plotting Histograms with Top YouTubers' Data	Advance Python	<b>187</b>
Lab Activity 14	Regression - Predicting Future Temperatures	Advance Python	<b>190</b>
Lab Activity 15	Creating and Analysing a Normal Distribution	Advance Python	<b>192</b>
Lab Activity 16	Calculating Electricity Bill	Advance Python	<b>193</b>
Lab Activity 17	Calculating Employee Bonus	Advance Python	<b>194</b>
Lab Activity 18	LED Patterns with Quarky	Robotics with Quarky	<b>195</b>
Lab Activity 19	Creating a Touch Piano with Quarky	Robotics with Quarky	<b>198</b>
Lab Activity 20	Programming the Quarky Robot's Movements	Robotics with Quarky	<b>199</b>
Lab Activity 21	Wirelessly Controlled Robot	Robotics with Quarky	<b>201</b>

Lab Activity 22	Calibrating and Programming a Line-Following Robot – Part 1	Robotics with Quarky	<b>202</b>
Lab Activity 23	Calibrating and Programming a Line-Following Robot – Part 2	Robotics with Quarky	<b>202</b>
Lab Activity 24	Programming Quarky Obstacle Avoidance Robot	Robotics with Quarky	<b>204</b>
Lab Activity 25	Programming Quarky for Edge Avoidance	Robotics with Quarky	<b>206</b>
Lab Activity 26	Programming Quarky Gripper Robot	Robotics with Quarky	<b>208</b>
Lab Activity 27	Programming Pick and Place Robot	Robotics with Quarky	<b>209</b>
Lab Activity 28	Face Detection with Python	AI with PictoBlox	<b>211</b>
Lab Activity 29	Finger Tracking with Python	AI with PictoBlox	<b>212</b>
Lab Activity 30	Mask Detection with Image Classifier (ML) – Part 1	ML with PictoBlox	<b>215</b>
Lab Activity 31	Mask Detection with Image Classifier (ML) – Part 2	ML with PictoBlox	<b>215</b>
Lab Activity 32	Fruit Detection with Image Classifier (ML) – Part 1	ML with PictoBlox	<b>218</b>
Lab Activity 33	Fruit Detection with Image Classifier (ML) – Part 2	ML with PictoBlox	<b>218</b>
Lab Activity 34	NLP Based Text Classifier	ML with PictoBlox	<b>220</b>
Lab Activity 35	Gesture-Controlled Beetle in the Maze Game – Part 1	ML with PictoBlox	<b>222</b>
Lab Activity 36	Gesture-Controlled Beetle in the Maze Game – Part 2	ML with PictoBlox	<b>222</b>
Lab Activity 37	Gesture-Controlled Beetle in the Maze Game – Part 3	ML with PictoBlox	<b>222</b>
Lab Activity 38	Yoga Pose Detector with Pose Classifier – Part 1	ML with PictoBlox	<b>227</b>
Lab Activity 39	Yoga Pose Detector with Pose Classifier – Part 2	ML with PictoBlox	<b>227</b>
Lab Activity 40	Self-Driving Car with Quarky	AI and Robotics	<b>229</b>

#### Part 4: Project Work and Miscellaneous

#	Lesson Name	Page
1	Capstone Project – Codeavour	<b>231</b>
2	Sample Projects Built by Community	<b>232</b>
3	Answer Keys	<b>233</b>