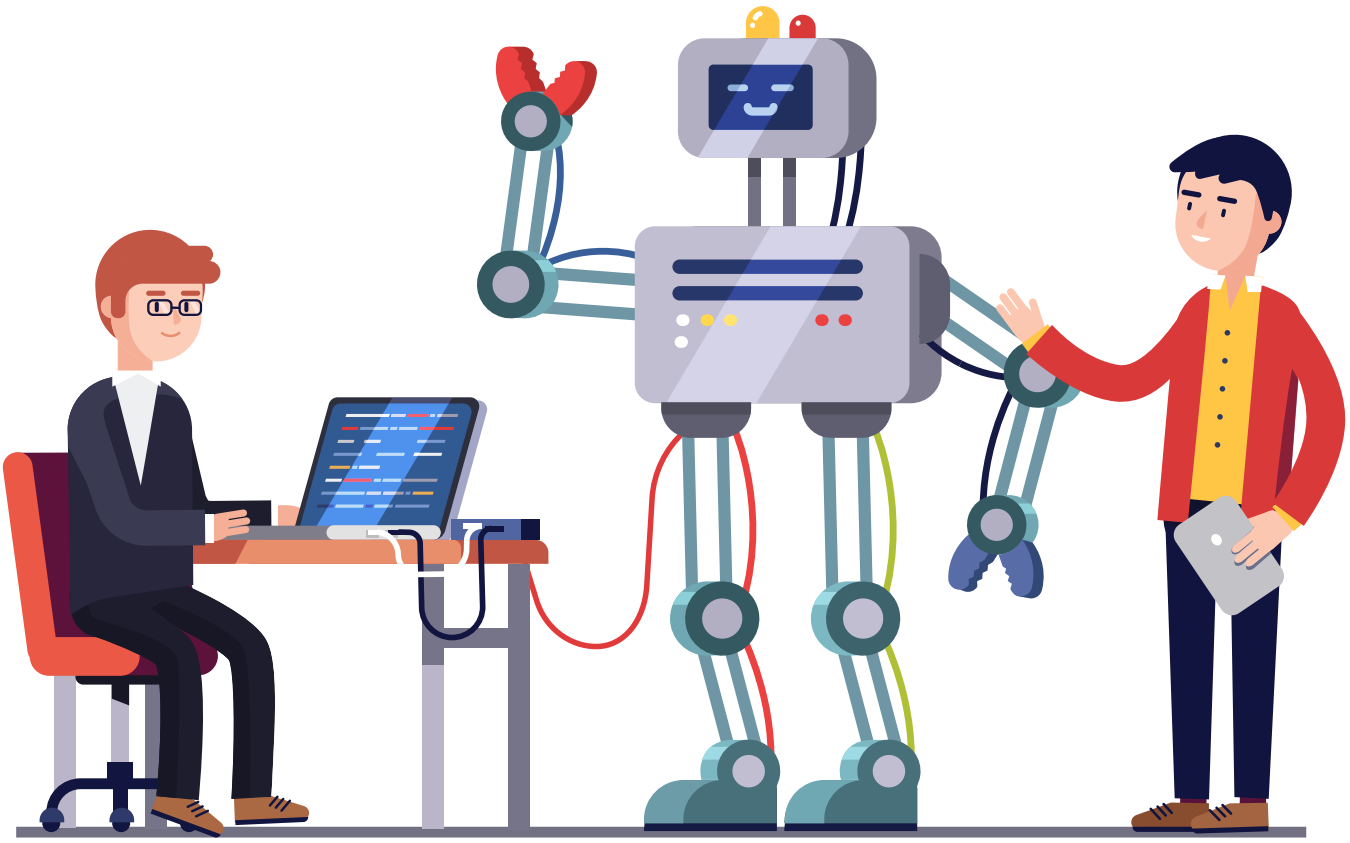
National Curriculum of Pakistan
2022-23

TECHNICAL EDUCATION

AUTOMATION & ROBOTICS TECHNOLOGY

Grades 11-12



NATIONAL CURRICULUM COUNCIL SECRETARIAT
MINISTRY OF FEDERAL EDUCATION AND
PROFESSIONAL TRAINING, ISLAMABAD
GOVERNMENT OF PAKISTAN

بسم الله الرحمن الرحيم

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It is with great pride that we, at the National Curriculum Council Secretariat, present the first core curriculum in Pakistan's 75-year history. Consistent with the right to education guaranteed by Article 25-A of our Constitution, the National Curriculum of Pakistan (2022-23) aspires to equip every child with the necessary tools required to thrive in and adapt to an ever-evolving globalized world.

The National Curriculum is in line with international benchmarks, yet sensitive to the economic, religious, and social needs of young scholars across Pakistan. As such, the National Curriculum aims to shift classroom instruction from rote learning to concept-based learning.

Concept-based learning permeates all aspects of the National Curriculum, aligning textbooks, teaching, classroom practice, and assessments to ensure compliance with contemplated student learning outcomes. Drawing on a rich tapestry of critical thinking exercises, students will acquire the confidence to embark on a journey of lifelong learning. They will further be able to acknowledge their weaknesses and develop an eagerness to build upon their strengths.

The National Curriculum was developed through a nationwide consultative process involving a wide range of stakeholders, including curriculum experts from the public, private, and non-governmental sectors. Representatives from provincial education departments, textbook boards, assessment departments, teacher training departments, *deeni madaris*, public and private publishers, private schools, and private school associations all contributed their expertise to ensure that the National Curriculum could meet the needs of all Pakistani students.

The experiences and collective wisdom of these diverse stakeholders enrich the National Curriculum, fostering the core, nation-building values of inclusion, harmony, and peace, making the National Curriculum truly representative of our nation's educational aspirations and diversity.

I take this opportunity to thank all stakeholders, including students, teachers, and parents who contributed to developing the National Curriculum of Pakistan (2022-23)

Dr. Mariam Chughtai
Director
National Curriculum Council Secretariat
Ministry of Federal Education and Professional Training

Automation & Robotics Technology

Grades 11-12

Progression Grid

Domain A: Fundamental of Automation and Robotics

Standard: Students will be able to describe fundamentals and application of automation and robotics.

Grade 11	**Grade 12**
Benchmark I: Students will be able to discuss the importance of automation and robotics and **Benchmark II:** Students will be able to discuss various applications robotics and automations in industry.	
Students Learning Outcomes	
[SLO:ART-11-A-01]: Define robotics with some examples [real-life examples, animations, DIY] [SLO:ART-11-A-02]: Explain the role of Robotics in automation [SLO:ART-11-A-03]: Identify the different subsystems of robotics	[SLO:ART-12-A-01]: Explain the principles of digital and analog electronics for developing proficiency in designing circuits. [SLO:ART-12-A-02]: Design basic circuits using digital and analog components integral to automation technology. [for example, capacitor, inductor, diode, transistor and OPAM (Lab required) [SLO:ART-12-A-03]:

[SLO:ART-11-A-04]: Explain the significance of automation and robotics in various industries, [SLO:ART-11-A-05]: Explore and identify applications of automation and robotics [SLO:ART-11-A-06]: Discuss the role of robotics in enhancing the operational efficiency of industries. [SLO:ART-11-A-07]: Identify and list safety protocols in automation and robotics, prioritizing secure technological integration by recognizing potential risks.	Develop circuits based on sensors for data acquisition [Sensors: temperature, motion, strain, IR, Ultrasonic sensors] (Arduino Lab required) [SLO:ART-12-A-04]: Discuss to explore the functionalities of microcontrollers and microprocessors [SLO:ART-12-A-05]: Design hands-on projects and simulations that simulate real-world scenarios (computer lab) [SLO:ART-12-A-06]: Explore industrial data acquisition methods by internships/visits to sites. [SLO:ART-12-A-07]: Discuss entrepreneurial aspects of automation and robotics [SLO:ART-12-A-08]: Analyze case studies of successful professionals in the field robotics locally and internationally

Benchmark II: **History and evolution of automation and robotics**	
[SLO:ART-11-A-08]: Discuss the historical developments and important developmental milestones in automation and robotics vis-a-vis: 1.1. [Ancient times] 1.2. [Pre-Industrial Revolution (17th to 18th centuries)] 1.3. [Industrial Revolution (18th to 19th centuries)] 1.4. [Early to Mid-20th Century] 1.5. [Late 20th to Early 21st Century] 1.6. [Current Era (21st Century)]	
Benchmark III: Apply electronics fundamentals to analyze robotics systems. **Benchmark IV**: Discuss diverse robotics applications, the integration of ethics into projects, and a commitment to continuous learning prepares for responsible innovation and various career paths in the dynamic field of automation and robotics.	
[SLO:ART-11-A-09]: Define basics of electrical circuits,	

[SLO:ART-11-A-10]: Analyze and design basic circuits essentials for automation and robotics systems. (Lab) [SLO:ART-11-A-11]: Explain the working principles and their possible application of sensors and transducers in robotics [SLO:ART-11-A-12]: Explore diverse career paths in robotics, introducing roles such as robotics technician, automation engineer, and industrial designer [SLO:ART-11-A-13]: Identify the essential skills and qualifications for different career path [SLO:ART-11-A-14]: Discuss Industry Trends and Emerging Technologies in Pakistan and world	

Domain B: Mechatronics

Standard: Students will be able to describe and apply mechanics, kinematics, dynamics of robots.

Grade 11	**Grade 12**
Benchmark I: Describe the translatory and rotational motion of robots in a plane through a graphical manipulator. **Benchmark II**: Apply forward and inverse kinematics to the basic manipulators in a plane. **Benchmark III**: interpret dynamic phenomena in various robotic systems, showcasing the ability to connect theoretical concepts with observable behaviors in real-world scenarios. **Benchmark IV:** Explain control system fundamentals, including the key components such as sensors, actuators, and controllers.	
Students Learning Outcomes	
Students will be able to: [SLO:ART-11-B-01]: Define and explain force, motion, and Newton's laws of motion [SLO:ART-11-B-02]:	Students will be able to: [SLO:ART-12-B-01]: Define Motion of robot in One Dimension [SLO:ART-12-B-02]:

Identify scalar & vector quantities with their examples [SLO:ART-11-B-03]: Define robotic systems in equilibrium [SLO:ART-11-B-04]: Explain projectile motion (angle of actuation…) [SLO:ART-11-B-05]: Understand the concepts of energy and work [SLO:ART-11-B-06]: Identify the laws of motion and their applications in robotics? [SLO:ART-11-B-07]: Apply these laws in robotics with help of daily life examples	Explain Motion of robot in Two and Three Dimensions. For example: Rotational Motion, Uniform Circular Motion [SLO:ART-12-B-03]: Explain the concept of the control system and its part. [SLO:ART-12-B-04]: Define the role of feedback in the control system. [SLO:ART-12-B-05]: Explain the working of PID controller

Domain C: Programming

Standard: Students will be able to design Robots using hardware, sensors, principles of AI, pythons

Grade 11	**Grade 12**
Benchmark I: Apply the basics of coding, sensors interfacing, and basic decision making in robots using Artificial Intelligence in their final projects.	
Student Learning Outcomes	
[SLO:ART-11-C-01]: Define the importance of programming language with specific examples for robotics. [SLO:ART-11-C-02]: Enlist the types of programming used for robotics in particular. [SLO:ART-11-C-03]: Apply python language to develop basic programs, for example: mathematical equations, calculator, common daily life problems. [SLO:ART-11-C-04]:	[SLO:ART-12-C-01]: Demonstrate the ability to select and employ appropriate data acquisition techniques for a given scenario [SLO:ART-12-C-02]: Design an obstacle-avoiding robot, integrating principles of robotics and sensors in the laboratory. [SLO:ART-12-C-03]: Analyze and implement line-following algorithms to develop a functioning Line Following Robot (LFR) with precise path tracking. [SLO:ART-12-C-04]:

Identify the data types of variables used in python language. [SLO:ART-11-C-05]: Explain Artificial Intelligence and its role in robotics. [SLO:ART-11-C-06]: Define the robotic simulator in general and its benefits in understanding the field of robotics. [SLO:ART-11-C-07]: Design basic robotic manipulators using the CoppeliaSim, for example RRR, PPP, PRP, PRR etc. [SLO:ART-11-C-08]: Apply pythons programming skills in CoppeliaSim platform [SLO:ART-11-C-09]: Apply basic concepts of motion and control within CoppeliaSim [SLO:ART-11-C-10]:	Designing a SUMO robot, incorporating mechanical and programming elements for Sumo wrestling. [SLO:ART-12-C-05]: Develop a fire-fighting robot capable of autonomously detecting and extinguishing fires by integrating sensors. [SLO:ART-12-C-06]: Assemble a gripper robot, demonstrating ability in mechanical assembly. [SLO:ART-12-C-07]: Design and program a gripper robot to perform specified tasks, showcasing expertise in coding for robotic manipulation. [SLO:ART-12-C-08]: Apply basic AI models to enhance the functionality of a gripper robot, showcasing practical applications in automation. [SLO:ART-12-C-09]: Design a project by synthesizing knowledge and skills acquired throughout the program to address a real-world challenge, demonstrating mastery of the subject matter.

Apply different types of sensors within CoppeliaSim in computer lab [SLO:ART-11-C11]: Design a robotic system with virtual industrial environment	

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