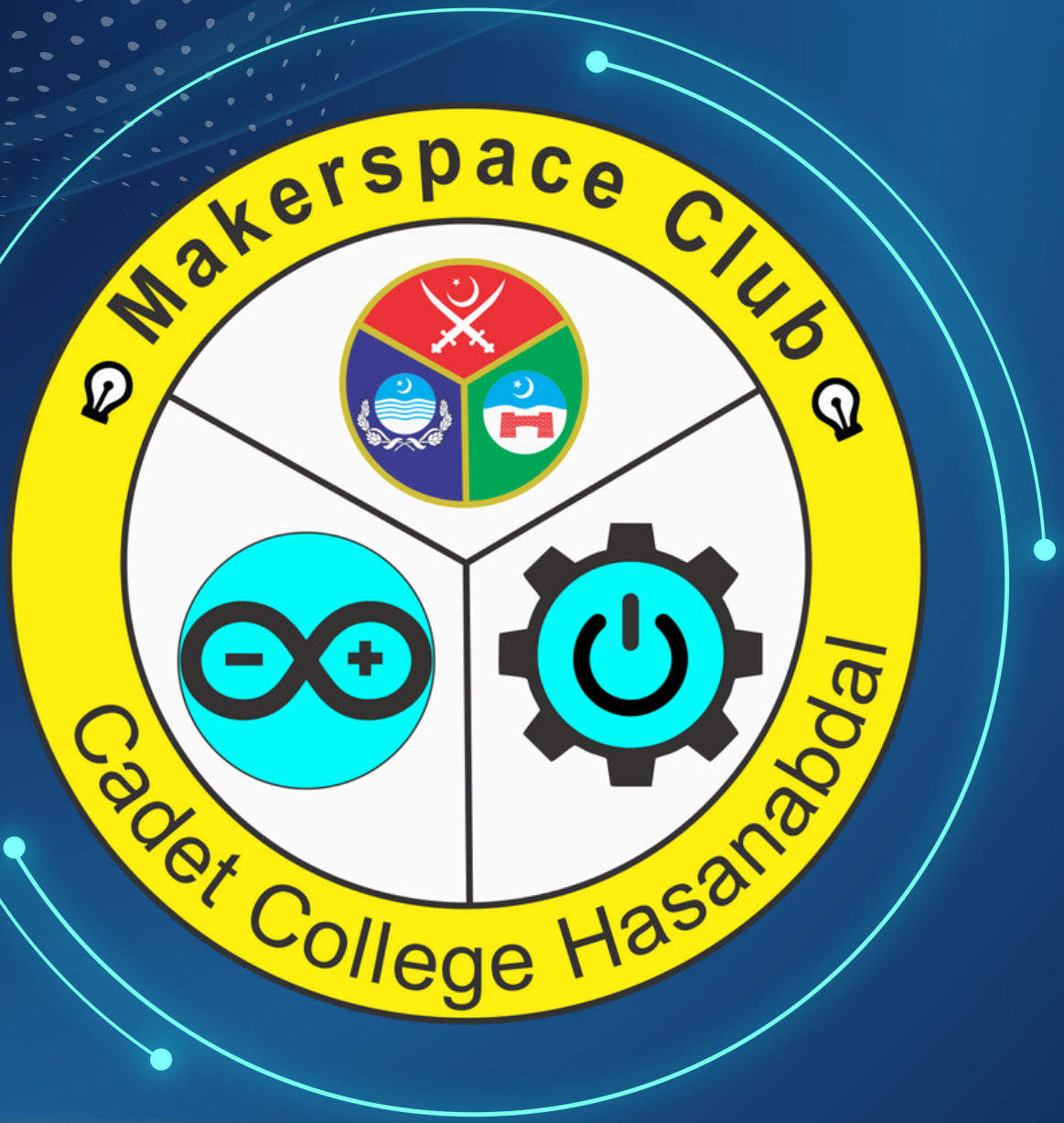

MAKERSPACE CLUB

THE DUKE OF EDINBURGH'S INTERNATIONAL AWARD

CADET COLLEGE HASANABDAL

A Not-for-Profit Boarding High School

Makerspace Club

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INTRODUCTION

A Makerspace is a collaborative workspace within a school, library, or dedicated facility designed for making, learning, exploring, and sharing. It offers access to a range of tools, from high-tech equipment like 3D printers, laser cutters, and CNC machines to basic tools such as soldering irons and sewing machines. However, a Makerspace does not necessarily require all or any of these tools to fulfil its purpose; the essence lies in fostering creativity, innovation, and hands on learning.

At Cadet College Hasanabdal, the Makerspace project was initiated in mid-2019. The vision was set forth by the then Principal, Gen (Retd) Najeeb Tariq, HI(M), who aspired to establish a state-of-the-art facility equipped with modern technological tools that would create a conducive environment for STEM education.

The primary aim was to introduce cadets to the practical applications of science and technology, fostering creativity through hands-on projects aligned with their respective club activities.

This vision became a reality thanks to the generous contributions of our distinguished alumni from the 16th entry, who responded wholeheartedly to the call. Notable among them are Mr. Azmat, Mr. Kamal Ud Din Tipu, and Mr. Zakir Habib, whose philanthropy and commitment played a pivotal role in establishing this unique learning space for the cadets.

These benefactors not only supported the setup but also facilitated essential training sessions for the CCH Makerspace Team. These sessions included training on laser cutting, 3D printing, smart board usage, and the application of electronics kits for various projects, greatly enhancing the technical skills of both staff and students.

A portion of the Biology Laboratory was allocated for the Makerspace by the administration at that time. The responsibility for renovation was entrusted to Mr. Tariq Javed (Head of the Chemistry Department). The renovation work was completed in August 2019, marking the beginning of a new era of hands-on learning and innovation at Cadet College Hasanabdal.

AIM

The aim of the Makerspace Club at Cadet College Hasanabdal is to cultivate innovation, creativity, and leadership among cadets through hands-on engagement with modern technologies. By exploring tools like Arduino, 3D printing, and laser cutting, students are encouraged to think critically, collaborate effectively, and take initiative. The club also aims to instil a strong sense of social responsibility, guiding cadets to apply their skills in meaningful ways that benefit both their personal growth and the wider community.

OBJECTIVES

1. **Develop** students' technical proficiency in Arduino programming, 3D modelling, 3D printing, laser cutting, and basic electronics.
2. **Promote** collaborative, project-based learning that encourages teamwork, communication, and shared innovation.
3. **Encourage** independent thinking and initiative by supporting self-led projects and creative exploration.
4. **Provide** opportunities for leadership and ownership, helping students manage and present their ideas and solutions.
5. **Inspire** students to design community centred solutions, using technology to address real-world challenges and promote social impact.
6. **Foster** a culture of empathy, responsibility, and purposeful innovation, preparing students to become changemakers in society.

MENTORS AND AFFILIATIONS

We are honoured to have Mr. Azmat Mehmood Saqib as the visionary mentor behind the Makerspace Club. With a strong commitment to innovation, experiential learning, and social impact, he brings exceptional expertise in technology integration and student guidance.

His passion for nurturing young talent and promoting a culture of curiosity has empowered students to take initiative, think critically, and apply their skills in meaningful ways. Under his mentorship, the Makerspace has evolved into a dynamic environment where creativity, collaboration, and purposeful innovation thrive.

SAFETY GUIDELINES

1. Always wear appropriate protective gear, such as safety goggles, gloves, or lab coats, when operating machines or handling tools.
2. Use all equipment—including 3D printers, laser cutters, and soldering irons—only under the supervision of an instructor or authorised mentor.
3. Carefully read and follow all operating instructions before using any machine.
4. Do not attempt to repair or modify equipment on your own.
5. Keep your workspace neat and clutter-free. Clean your area after each session to ensure a safe and organised environment for others.
6. Immediately report any damaged or malfunctioning equipment to the supervisor.

7. Do not use faulty tools under any circumstances.
8. Avoid wearing loose clothing, long jewellery, or keeping long hair untied while operating machines to prevent accidents.
9. Do not bring food or drinks into the Makerspace to avoid spills, electrical hazards, and equipment contamination.
10. Use each tool only for its intended purpose. Misuse of tools may lead to injury and may result in limited access to the facility.
11. Stay focused and avoid distractions while working. Refrain from using mobile phones or engaging in casual conversation when handling tools.
12. Familiarise yourself with the location of emergency exits, fire extinguishers, and the first aid kit. In case of an emergency, follow all safety procedures promptly and responsibly.

CURRICULUM
GRADE 8 – MEMBERS

Students in Grade 8 are introduced to the fundamentals of electronics, programming, and digital fabrication. This foundational level is designed to spark curiosity and provide hands-on exposure to basic tools and concepts used in the Makerspace.

Introduction to Arduino

1. Understand the basics of Arduino Uno, Nano, and Micro boards and their components.
2. Learn to write simple code for controlling outputs such as LED blinking.
3. Explore basic coding structures using guided online platforms.

Basic Electronics Projects

1. Build simple circuits using jumper wires, LEDs, and resistors.
2. Learn the function and use of LCDs in basic electronic setups.
3. Get introduced to sensor-based systems, including fingerprint sensors.

Foundations of Robotics

1. Assemble beginner-level car kits to understand movement and power flow.
2. Explore robotic arm kits to grasp basic mechanical movement and control.

Introduction to 3D Printing and Laser Cutting

1. Observe the operation of 3D printers and laser cutters under supervision.
2. Learn about safety protocols and basic principles of machine operation.

GRADE 9 – PARTICIPANTS

In Grade 9, students build on foundational knowledge by engaging in more interactive and skill-based learning. This level emphasizes hands-on practice, guided experimentation, and collaboration with senior students.

Arduino Programming :

1. Intermediate coding structures and functions using Arduino Uno and Nano.
2. Intermediate projects incorporating LCDs and sensors.
3. Introduction to serial communication and data logging.

Advanced Electronics Projects

1. Creating more complex circuits with sensors and actuators.
2. Understanding and implementing basic soldering techniques.
3. Introduction to more advanced sensor integration.

Advanced Robotics Concepts:

1. Advanced programming for robotic kits' movement and interaction.
2. Exploring manoeuvrability and manipulation with robotic arms.

3D Printing & Laser Cutting

1. Participate in basic printing and cutting projects with close supervision.
2. Reinforce machine safety protocols and proper handling techniques.

This level encourages students to take greater responsibility for their learning, develop precision in technical work, and begin contributing meaningfully to collaborative Makerspace projects.

GRADE 10 – CONTRIBUTORS

At this stage, students take on a more active role as contributors, applying their knowledge to design-focused, problem-solving projects. Emphasis is placed on independence, technical skill development, and integration of digital tools.

Advanced Arduino Applications

1. Advanced coding and libraries for diverse functionalities.
2. Advanced sensor integration for complex projects.
3. Project-based learning with a focus on problem-solving using Arduino.

3D Printing (Hands-On Learning)

1. Introduction to Flash Forge 3D printer software.
2. Basic 3D modelling and printing exercises.
3. Understanding the principles of 3D printing.

Laser Cutting Basics

1. Use CorelDraw to create vector designs for laser cutting and engraving.
2. Understand material properties and cutting techniques for wood, acrylic, and paper.
3. Complete supervised projects such as personalized keychains, plaques, or stencils.

Grade 10 students begin to bridge the gap between learning and application, contributing to club projects, mentoring junior members, and demonstrating growing confidence in both creative design and technical execution

GRADE 11 – ASSOCIATES

In Grade 11, students transition from guided learning to independent problem-solving and innovation. They are encouraged to lead projects, explore complex applications, and mentor junior members, deepening both their technical expertise and leadership capacity.

Complex Arduino Projects

1. Integrate multiple sensors and actuators to build multifunctional systems.
2. Apply data logging, wireless communication (e.g., Bluetooth, IR), and control logic in advanced applications.
3. Prototype projects such as smart security systems, automated lighting, or environmental monitoring tools.

Advanced 3D Printing

1. Move beyond basic models to intermediate-level 3D design using tools like Fusion 360 or SketchUp.
2. Adjust print settings based on object complexity, infill, and material type.
3. Diagnose common print issues and perform basic maintenance and calibration of printers.

Laser Cutting Applications

1. Create more intricate and functional designs using layering, engraving, and precision cutting.
2. Apply design principles to fabricate custom enclosures, educational models, or signage.
3. Explore creative integration of laser-cut parts with electronics and robotics projects.

Grade 11 students take greater ownership of their learning journey, often working on interdisciplinary projects and preparing for capstone-level work in their final year.

GRADE 12 – FELLOWS

Grade 12 students function as leaders, innovators, and mentors, applying their cumulative learning to develop independent, high-impact projects. At this stage, they are expected to demonstrate mastery, creativity, and initiative while guiding junior members and contributing to the Makerspace community.

Capstone Arduino Projects

1. Design and execute advanced, self-conceived projects integrating multiple technologies.
2. Combine sensors, actuators, displays, and communication modules to create fully functional prototypes.
3. Document and present the stages, outcomes, and real-world relevance of project development.

3D Printing Innovation

1. Design complex, customised 3D models involving multiple components and functional moving parts.
2. Use prototyping to solve practical problems or support other club initiatives.
3. Present final projects that demonstrate innovation, design logic, and effective use of materials.

Laser Cutting Mastery

1. Execute intricate laser cutting projects that require precision and layered design thinking.
2. Integrate laser-cut parts with electronics, mechanics, or decorative elements.
3. Independently plan and deliver final showcase projects reflecting originality and advanced skill.

ASSESSMENT

The Makerspace Club follows a holistic and skill-based assessment approach to evaluate students' growth, engagement, and innovation. Assessment is continuous and based on participation, creativity, technical skills, and collaborative contributions.

Project-Based Evaluation

1. Students are assessed on the creativity, functionality, and complexity of their completed projects.
2. Emphasis is placed on real-world application, originality, and problem-solving.

Skills Demonstration

1. Practical skills such as coding, circuit design, 3D modelling, printing, and laser cutting are observed and evaluated during hands-on activities.
2. Students may also be given tasks or challenges to complete individually or in teams.

Documentation and Reflection

1. Each student maintains a project log or portfolio to document their design process, challenges, and solutions.
2. Self-reflection is encouraged to help students assess their learning and progress.

Peer Review and Presentation

1. Students present their projects to peers and mentors for feedback and evaluation.
2. Peer-to-peer reviews help promote constructive criticism, collaboration, and confidence.

Written or Online Assessments

1. Periodic quizzes or written tasks may be used to evaluate theoretical understanding of tools, components, safety protocols, and design principles.

Mentorship and Leadership

Active mentoring of junior students and leadership in group projects are recognised and contribute positively to the student's overall evaluation.

Attendance and Participation

Regular attendance and consistent engagement in club activities are essential criteria for a fair and complete assessment.

This multidimensional assessment model ensures that students are recognised not only for their technical abilities, but also for their creativity, leadership, collaboration, and commitment to the Makerspace learning journey.

COMPETETIONS

Participation in competitions is a key aspect of the Makerspace experience. It motivates students to apply their skills, showcase their creativity, and engage with peers on local, national, and international platforms. Competitions also help students build confidence, resilience, and real-world problem-solving abilities.

International Competitions

HackMIT (USA): Prestigious hackathon encouraging innovation and collaboration.

Google Science Fair: Online global competition promoting scientific research and creativity.

Odyssey of the Mind: A challenge-based competition focusing on teamwork and imaginative problem-solving.

Red Bull Basement: Encourages students to develop tech-based solutions for social change.

IEEE Xtreme: A 24-hour global coding competition for teams of university and high school students.

RoboCup: International robotics competition involving soccer and technical challenges.

Shell Eco-Marathon: Design energy-efficient vehicles with real-world applications.

Hult Prize: Global social entrepreneurship challenge for solving pressing issues.

Imagine Cup: Microsoft-hosted innovation contest for tech-based projects.

FIRST Robotics Competition: Large-scale robotics tournament emphasising engineering and teamwork.

National Competitions (Pakistan)

Pakistan Science Club Competitions: Various science and innovation events, including robotics and STEM fairs.

National Engineering Robotics Contest (NERC): Prestigious university-hosted robotics competition.

Startup Weekend Pakistan: Platform for pitching startup ideas and forming teams.

National STEM School Olympiad: Academic and technical challenges across STEM disciplines.

Tech Valley Abbottabad Robo Race: Competitive robotics event featuring obstacle races and innovation challenges.

Students are encouraged to take part in these competitions based on their interest, skill level, and project readiness. Club mentors and faculty guide and support participants throughout the preparation and submission process.

COMPETETIONS CALENDER

Tentative Month	Competition/Event	Type	Focus Area	Mode
August	National STEM School Olympiad	National (Free)	STEM Challenges	Onsite/ Hybrid
September	Red Bull Basement	International (Free)	Tech for Social Change	Online
October	Pakistan Science Club Innovation Challenge	National (Free)	Science & Innovation	Onsite
November	IEEE Xtreme Programming Competition	International (Free)	Programming & Coding	Online
December	Tech Valley Abbottabad Robo Race	National (Free)	Robotics & Engineering	Onsite
January	Imagine Cup (Microsoft)	International (Paid)	Innovation & Technology	Online
February	National Engineering Robotics Contest (NERC)	National (Paid)	Robotics	Onsite
March	Startup Weekend Pakistan	National (Paid)	Entrepreneurship	Onsite
April	Google Science Fair	International (Free)	Scientific Projects	Online
May	Hult Prize – Regionals	International (Paid)	Social Entrepreneurship	Onsite/ Online
June	RoboCup (International Event)	International (Paid)	Robotics & AI	Onsite
July	HackMIT	International (Free)	Programming & Problem Solving	Online/ Hybrid

RESOURCES AND WEBSITES

To support hands-on learning and skill development, the following curated resources are recommended for students in the Makerspace Club. These tools, websites, and platforms offer tutorials, project ideas, and free access to cutting-edge technology knowledge.

1. Arduino and Electronics:

Arduino Official Website:

https://www.arduino.cc/

Comprehensive tutorials, code examples, and board documentation.

Circuito.io:

https://www.circuito.io/

A circuit design tool for building and simulating Arduino projects.

Adafruit Learning System:

https://learn.adafruit.com/

Beginner to advanced guides on sensors, coding, and electronics.

SparkFun Learn:

https://learn.sparkfun.com/

Excellent tutorials on microcontrollers and DIY electronics.

2. 3D Modelling and Printing:

Tinkercad:

https://www.tinkercad.com/

A beginner-friendly, web-based platform for 3D modelling and electronics.

Fusion 360:

https://www.autodesk.com/products/fusion-360/overview

Professional 3D design software for advanced modelling.

Thingiverse:

https://www.thingiverse.com/

A vast library of free 3D printable designs.

Ultimaker Academy:

https://academy.ultimaker.com/

Free online courses on 3D printing principles and best practices.

3. Laser Cutting and Engraving

CorelDRAW Tutorials:

https://www.coreldraw.com/en/learn/

Learn how to design files for laser cutting.

Instructables:

https://www.instructables.com/howto/laser+cut/

Laser Cutting – Community projects, templates, and ideas.

Epilog Laser

https://www.epiloglaser.com/resources/sample-club.htm

Free downloadable laser cutting designs.

4. Robotics and STEM Platforms

MIT OpenCourseWare:

https://ocw.mit.edu/

Introduction to Robotics – University-level robotics lectures and notes.

Make: Magazine:

https://makezine.com/

STEM projects, DIY ideas, and maker movement resources.

Robotics for Beginners (YouTube):

https://www.youtube.com/results?search_query=robotics+for+beginners

Great video tutorials on building and coding robots.

5. General DIY and Project Sharing

Instructables:

https://www.instructables.com/

Step-by-step DIY project guides across all skill areas.

Hackster.io:

https://www.hackster.io/

A large community of makers sharing projects involving Arduino, Raspberry Pi, and more.

These resources are recommended for students at different learning levels—from beginners to advanced makers. Club mentors may also assign specific platforms as part of the curriculum or projects.

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