

**PM SHRI / ATL FACILITATOR SYLLABUS**

Unit	Unit Title	Detailed Syllabus / Bullet Topics	Hands-on / Lab Activities	Suggested Projects
Unit 1	ATL Introduction, Innovation & Safety	- Atal Tinkering Lab (ATL) purpose and innovation ecosystem - Atal Innovation Mission (AIM) and culture of innovation - Curiosity, creativity, imagination and entrepreneurship - Design mindset, computational thinking and physical computing - Role of ATL facilitator, teacher support and student mentoring - ATL lab equipment, inventory awareness and responsible utilization - Lab discipline, electrical safety, tool safety and emergency response - ESD awareness, battery/power-supply precautions and safe prototyping - Scientific method: observation → hypothesis → experiment → analysis → conclusion - Technical documentation, activity register and project records	- ATL lab orientation and equipment identification - Safety drill and emergency-response demonstration - Identify components/tools from a sample ATL kit - Prepare a basic lab-safety poster - Maintain a sample experiment log	- ATL Innovation Wall - School/Community Problem Map - Safety Awareness Model
Unit 2	Basics of Electronics, Breadboard & PCB	- Voltage, current, resistance and electrical power - Ohm's Law and basic circuit calculations - AC/DC awareness and polarity - Series and parallel circuits - Resistors, capacitors, diodes, LEDs and transistors - Relay, switch, buzzer and basic power modules - Semiconductor basics and transistor as a switch - Breadboard structure, power rails and jumper wiring - Continuity testing and multimeter operation - PCB concept: tracks, pads, components and soldering awareness - Through-hole vs SMD awareness - Schematic → breadboard → PCB workflow - Basic tool identification: screwdriver, plier, wire stripper, soldering iron	- Build LED/resistor circuit - Test voltage, resistance and continuity using multimeter - Build transistor/relay switching circuit - Breadboard a simple sensor circuit - Demonstrate safe soldering and desoldering (under supervision)	- Automatic Night Lamp - Electronic Doorbell - Transistor-Controlled Relay - Mini Emergency Light
Unit 3	Sensors & Actuators	- Sensor vs actuator: input sensing and physical output - Analog vs digital sensors - Sensor range, threshold, sensitivity and calibration - LDR/light sensor - IR obstacle/proximity sensor - PIR motion sensor - Ultrasonic HC-SR04 distance sensor - Temperature sensors: LM35 / DS18B20 awareness - Humidity/temperature: DHT11/DHT22 awareness - Sound/microphone sensor - MQ gas sensor awareness - Touch sensor and Hall-effect/magnetic sensor awareness - Actuators: LED, buzzer, DC motor, gear motor, servo and stepper motor - Relay as an electrically controlled switch - Sensor-actuator control loop	- Measure light/distance/temperature - Calibrate sensor thresholds - Control LED/buzzer from sensor input - Servo positioning exercise - DC motor and relay demonstration	- Automatic Street Light - Smart Dustbin - Motion Security Alarm - Digital Distance Meter - Temperature & Humidity Monitor
Unit 4	Computational Thinking & Programming	- Computational thinking: decomposition, pattern recognition, abstraction and algorithms - Flowcharts and pseudocode - Problem definition and step-by-step logic - Scratch/block-based programming awareness - C programming fundamentals: variables, data types, operators, conditions and loops - Functions, arrays and basic modular programming - C++ awareness: classes, objects and reusable code concepts - Python fundamentals: input/output, conditions, loops, functions and lists - Debugging and error identification - Basic data handling and visualization awareness - Programming logic for physical computing	- Create flowcharts for real-life problems - Scratch logic activity - Write simple C/C++ programs - Python mini programs - Debug deliberately broken code	- Calculator Program - Unit Converter - Quiz Game - Sensor Data Analyzer - Simple Attendance Program
Unit 5	Arduino & Physical Computing	- What is a microcontroller and embedded system? - CPU, ALU, RAM, ROM, EEPROM and clock basics - Arduino ecosystem and Arduino IDE - Arduino Uno, Nano and Mega: basic comparison and applications - Digital pins, analog inputs and PWM pins - GPIO, ADC and serial communication concepts - setup() and loop() structure - digitalRead(), digitalWrite(), analogRead(), analogWrite() - Variables, functions, libraries and modular sketches - Serial Monitor for debugging - Button, LED, buzzer and relay interfacing - Sensor + actuator integration - Interrupt concept awareness - I2C/SPI/UART communication awareness - Power and current considerations	- Install/configure Arduino IDE - Blink LED and LED patterns - Push-button input - Traffic-light controller - PWM LED dimming - Serial sensor monitoring - Multi-sensor integration	- Smart Traffic Light - Reaction Timer - Automatic Classroom Bell - Digital Thermometer - Smart Parking Indicator

Unit 6	Tools, Prototyping, 3D Design & 3D Printing	• ATL hand tools and safe tool selection • Measuring, cutting, drilling and fastening awareness • CAD/3D modelling concept • 2D sketch to 3D model workflow • Tinkercad/e-CollabCAD style beginner modelling • STL file concept • Slicing and G-code awareness • FDM 3D printing process • Filament awareness: PLA and other common materials • Layer height, infill, supports and print orientation • Bed adhesion and basic print troubleshooting • Post-processing and safe handling • Rapid prototyping and iterative design	• Design a simple keychain/bracket/enclosure • Export STL • Slice a model • Demonstrate supervised print setup • Inspect and improve a printed part	• Custom Keychain • Arduino Sensor Enclosure • Mini Robot Chassis Part • Cable/Tool Organizer • Prototype Mechanical Mount
Unit 7	Raspberry Pi, IoT & Smart Systems	• Raspberry Pi as a small single-board computer • Hardware: SoC/CPU, GPIO, RAM, microSD, USB, HDMI and power • Raspberry Pi OS setup awareness • Basic Linux/terminal concepts • GPIO input/output and Python-based control • Arduino vs Raspberry Pi: microcontroller vs computer • Internet of Things (IoT) architecture • Sensors → controller/gateway → network → cloud/dashboard • Wi-Fi and Bluetooth awareness • ESP8266/NodeMCU as IoT controllers • MQTT/HTTP protocol awareness • Edge vs cloud computing • Blynk/IoT dashboard concept • Remote monitoring and smart automation • Smart home, smart classroom and smart agriculture use cases	• Boot Raspberry Pi and identify hardware • GPIO LED/button demo • Python GPIO awareness activity • NodeMCU Wi-Fi connection • Send/display sensor data on a dashboard • Smart relay demonstration	• Smart Classroom Monitor • IoT Weather Station • Smart Home Automation • Remote Water-Level Monitor • Smart Irrigation System
Unit 8	Design Thinking, Innovation & Project Development	• Human-centered problem solving • Empathize: observation, interviews and user needs • Define: problem statement and need statement • Ideate: brainstorming, reverse brainstorming and idea prioritization • Prototype: low-fidelity and functional prototypes • Test: feedback, iteration and redesign • Root-cause analysis and 5-Why awareness • Feasibility: uniqueness, ease of use, durability, design feasibility and cost • Requirement analysis and component selection • Bill of Materials (BOM) and basic costing • Risk identification and testing plan • Project documentation and evidence collection • Intellectual property/patent awareness • Business pitch: problem, solution, users, value proposition, prototype and future scope	• Empathy map • Problem statement workshop • Brainstorming/dot voting • Prototype sprint • User feedback and redesign • Prepare 3-minute pitch	• School Water-Saving Solution • Assistive Device Prototype • Smart Energy Saver • Community Safety Solution • Agriculture Innovation Prototype
Unit 9	Advanced Robotics, Automation & Emerging Technology	• Robotics system architecture • Sensors, actuators, controller and power system • DC/gear motors and motor drivers • H-bridge and PWM control • Servo and stepper motor awareness • Obstacle avoidance and line following • State-machine and basic autonomous navigation • PID concept awareness • Robotic arm and pick-and-place concepts • Industrial robotics: conveyor, welding, assembly and cobots • PLC and CNC awareness • Drone/UAV components and applications • Defence robotics and surveillance awareness • Radar fundamentals and ultrasonic radar simulation • Satellite/space technology awareness: communication, weather and remote sensing • GPS/NavIC awareness • Smart agriculture, precision farming and agricultural IoT • Artificial Intelligence and computer-vision awareness • Industry 4.0 and smart manufacturing	• Motor driver test • Obstacle-avoiding robot • Line follower • Servo robotic arm • Mini conveyor automation • Arduino radar demonstration • Smart agriculture sensor demonstration	• Obstacle Avoiding Robot • Line Follower Robot • Mini Robotic Arm • Automated Conveyor • Arduino Radar • Smart Agriculture System

Unit 10	Project Showcase, Entrepreneurship, Assessment & ATL Management	• Project selection and milestone planning • Prototype validation and testing • Technical report: abstract, objective, methodology, components, circuit/block diagram, results and future scope • Project demonstration and viva preparation • Business pitch structure: problem → solution → users → uniqueness → feasibility → impact → future scope • Entrepreneurship and innovation ecosystem awareness • Team roles, leadership and peer mentoring • ATL exhibition and judging preparation • Assessment rubric and student feedback • Attendance, activity and project records • Equipment utilization and inventory awareness • Photo/video evidence and monthly/periodic reporting • Collaboration with teachers, mentors and external institutions • Continuous improvement and next-project planning	• Final prototype testing • Technical report preparation • Poster/presentation creation • Mock viva • Innovation exhibition • Peer review and feedback	• Capstone ATL Innovation Project • Student Innovation Exhibition • 3-Minute Business/Innovation Pitch • Project Portfolio
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