NIELIT O-LEVEL (IT) | REVISION 5.1 | MODULE 4

M4-R5.1

Internet of Things and its Applications

Complete Syllabus | Exam Scheme | Practical Assignments | Study Resources

120 hrs	48 hrs	72 hrs	100 + 100
Total learning	Theory	Practical	Theory + Practical marks

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M4 Notes
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01

Module Overview

This module equips learners with the fundamentals of the connected world, the **Internet of Things (IoT)**, and its applications across industrial control, retail, energy, agriculture and more. It covers both the theory and the hands-on practice of interfacing sensors and actuators with a microcontroller, the communication modes and models used by IoT devices, and the software and tools needed to build working IoT applications.

Learning Objectives

After completing the module, the learner will be able to:

1. Understand how connected devices work together to update other applications.
2. Interface sensors and actuators with the microcontroller-based Arduino platform.
3. Write C programs in the Arduino IDE.
4. Communicate between a microcontroller and a PC using serial communication.
5. Build IoT-based applications and understand how data flows between things.
6. Understand how electronic devices control electrical appliances working at 220V AC.
7. Understand the security aspects of IoT devices.
8. Enhance their skill set towards better personality development.

Outline of Module

Unit	Module Unit	Theory (hrs)	Practical (hrs)	Marks
1	Introduction to IoT – Applications/Devices, Protocols and Communication Model	4	6	10
2	Things and Connections	4	6	10
3	Sensors, Actuators and Microcontrollers	8	12	15
4	Building IoT Applications	20	30	40
5	Security and Future of IoT Ecosystem	4	6	5
6	Soft Skills – Personality Development	8	12	20
	Total	**48**	**72**	**100**

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Examination Scheme

Exam	Mode	Time	Pattern	Marks	Pass	Weight
Theory	Online / OMR	2 hours	100 MCQs, 1 mark each	100	33%	60%
Practical	Lab session	3 hours	Practical 80 + Viva 20	100	33%	40%

- **Module result** = 60% of Theory marks + 40% of Practical marks. A minimum of **50%** is required to pass the module, with at least 33% in Theory and 33% in Practical separately.
- There is **no negative marking** in the theory examination.
- Separate admit cards are issued for the Theory and Practical examinations.

Grading

S	A	B	C	D	F
85 – 100%	75% – 84.99%	65% – 74.99%	55% – 64.99%	50% – 54.99%	Below 50%

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Detailed Syllabus

Unit 1 Introduction to IoT – Applications/Devices, Protocols and Communication Model

Theory 4 h | Practical 6 h | 10 marks

Introduction	Overview of Internet of Things (IoT), characteristics of devices and applications in the IoT ecosystem, building blocks of IoT, technologies making up the IoT ecosystem, IoT levels, IoT design methodology, Physical Design / Logical Design of IoT, functional blocks of IoT and communication models, development tools used in IoT.

Unit 2 Things and Connections

Theory 4 h | Practical 6 h | 10 marks

Controlled Systems	Working of controlled systems; real-time systems with feedback loop, e.g. thermostat in refrigerator, AC, etc.
Connectivity	Connectivity models – TCP/IP versus OSI model; wired and wireless modes; process flow of an IoT application.

Unit 3 Sensors, Actuators and Microcontrollers

Theory 8 h | Practical 12 h | 15 marks

Sensor	Measuring physical quantities in the digital world, e.g. light, moisture and temperature sensors.
Actuator	Moving or controlling systems, e.g. DC motor; different types of actuators.
Controller	Microcontroller as gateway for interfacing sensors and actuators; microcontroller vs microprocessor; types of microcontrollers in the embedded ecosystem.

Unit 4 Building IoT Applications

Theory 20 h | Practical 30 h | 40 marks

Arduino IDE	Writing code in a sketch, compiling and debugging, uploading to the Arduino board, role of the Serial Monitor.
Embedded C Basics	Variables and identifiers, built-in data types, arithmetic operators and expressions, constants and literals, assignment.
Conditions & Loops	Relational operators, logical connectives, if-else; while, do-while and for loops; nested and infinite loops; switch statement.
Arrays	Declaring and manipulating single-dimension arrays.
Functions	Standard C library functions in Arduino IDE; function prototype: formal parameter list, return type, function call.
Interfacing Sensors	Digital vs analog pins on Arduino; interfacing LED, button, DHT, LDR, MQ135 and IR sensors; displaying data on LCD; interfacing keypad.
Serial Communication	Interfacing HC-05 Bluetooth module.
220V AC Control	Controlling 220V AC supply by interfacing a relay module.

Unit 5 Security and Future of IoT Ecosystem

Theory 4 h | Practical 6 h | 5 marks

Need of Security	Why security; privacy for IoT-enabled devices; IoT security for consumer devices; security levels; protecting IoT devices.
Future IoT Ecosystem	Need of powerful cores for secure algorithms; new trends – AI and ML in IoT.

Unit 6 Soft Skills – Personality Development

Theory 8 h | Practical 12 h | 20 marks

Personality	Determinants of personality – self-awareness, motivation, self-discipline; building a positive personality; gestures.
Self-esteem	Self-efficacy, self-motivation, time management, stress management, etiquette and manners.
Communication	Objective, attributes and categories of communication; writing a resume, letters, reports and presentations; interview skills and body language.

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Use-cases for Building IoT Applications

Reference use-cases with Arduino, sensors and actuators, as given in the syllabus:

No.	Use-case	What it teaches
1	**Blinking LED**	GPIO peripheral of the ATmega microcontroller in output mode.
2	**Button and LED – LED glows when button is pressed**	GPIO in input mode (button) and output mode (LED).
3	**LDR and LED – automatic night lamp**	ADC peripheral; reading analog data from sensors.
4	**Temperature (LM35) and/or humidity (DHT11) sensor**	Environmental monitoring sensors with suitable libraries.
5	**LCD – display sensor data**	Providing a local display unit for the Arduino.
6	**Air quality sensor (MQ135) with LCD and LED**	LED switches on above a set value – a smart-city application.
7	**Bluetooth module (HC-05) – phone to LCD**	Receiving data from a mobile phone and displaying it on LCD.
8	**Relay with Bluetooth – home automation**	Controlling an actuator remotely from a Bluetooth serial app.

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Practical Assignments

Official sample practical list for M4-R5.1. Practise every program on hardware or on the Zed-King Arduino Simulator before the practical exam.

No.	Practical	Component
1	Blink the default LED on the Arduino board with a delay of 2 seconds.	LED
2	Interface LEDs on pins 10, 11, 12, 13 and blink them alternately with a delay of 1 second.	LED
3	Run patterns on LEDs at pins 10–13, e.g. one LED glowing at a time from left to right (1000, 0100, 0010, 0001) and two LEDs glowing together and shifting (1100, 0110, 0011).	LED
4	Interface a buzzer to buzz on/off with a delay of 1 second.	Buzzer
5	Interface LED and buzzer so the buzzer is on whenever the LED is on, and off when the LED is off.	Buzzer

No.	Practical	Component
6	Interface button and LED so the LED blinks/glows when the button is pressed.	Button
7	Interface button, buzzer and LED: each press gives a 100 ms beep and toggles the LED.	Button
8	LEDs at pins 10–13, buttons at pins 7 and 8: pin 7 (increment) switches LEDs on one by one; pin 8 (decrement) switches them off one by one.	Button
9	LEDs at pins 10–13 and a button at pin 7: each press changes the LED pattern (four patterns).	Button
10	Interface an LDR and print its values on the Serial Monitor every 2 seconds.	LDR
11	Interface LDR and LED: LED off in sufficient light, LED on in darkness.	LDR
12	Interface LEDs at any two PWM pins and show LED fading.	PWM
13	LED on a PWM pin with an LDR: LED dims as light increases and turns off beyond a threshold (smart street light).	PWM
14	Interface LEDs at two PWM pins and a button to show LED fading on a button click.	PWM
15	Interface any analog (pollution) sensor and print its values on the Serial Monitor.	Sensor
16	Interface an LCD and display “Hello world”.	LCD
17	Interface a keypad and display the key pressed on the Serial Monitor.	Keypad
18	Interface LCD and keypad and display the key pressed on the LCD.	Keypad
19	Interface LCD and 4×4 keypad to build a basic calculator (0–9, +, -, ×, ÷, Clear, Enter).	Keypad
20	Password-based security lock with LCD, LEDs, buzzer and keypad: correct 4-digit password turns on buzzer and green LED; wrong password turns on red LED; after three wrong attempts the red LED and buzzer blink continuously.	Keypad
21	Interface LCD and DHT11 and display the sensor values on the LCD.	DHT11
22	Interface DHT11 (or any temperature sensor) and a DC motor: the motor (fan) starts above a threshold temperature and stops below it.	DHT11
23	Interface LCD and Bluetooth module to display values received from a mobile phone.	Bluetooth
24	Interface LED and Bluetooth module: LED on when 1 is received, off when 0 is received.	Bluetooth
25	Interface relay and Bluetooth module to switch an AC load (5W LED bulb, table lamp) on with 1 and off with 0.	Relay

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Lab Projects & Working Models

Interfacing projects practised in the Zed-King IoT lab

Project	Concept
LED Blinking with Arduino	Digital output, delay()
Traffic Light System	Sequencing multiple LEDs with timing
LDR Interfacing	Analog input and thresholds
Ultrasonic Sensor Interfacing	Distance measurement
MQ-2 Gas Sensor Interfacing	Gas detection with alert LED
LED with Buzzer Interfacing	Combined outputs for alerts
Servo Motor Interfacing	PWM control of angle

Working model samples

Model	Description
Smart Home	Automatic gate, lights and appliances controlled with servo, relay and Bluetooth.
Smart City	Smart street lights, traffic signals and display board using LDR, LEDs and LCD.
Automatic Dustbin	Lid opens automatically when a hand comes near (ultrasonic sensor + servo).
Water Quality Detector	Measures turbidity of water and shows the result on LCD.
Food Spoilage Detector	Gas sensor detects spoiled food and shows the status on LCD.

Lab kit

Arduino UNO, breadboard, jumper wires, LEDs, resistors, buzzer, push buttons, 16×2 LCD, 4×4 keypad, LDR, DHT11 / LM35, MQ-series gas sensor, ultrasonic sensor, servo and DC motor, HC-05 Bluetooth module, relay module. Software: Arduino IDE.

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Study Resources by Zed-King

All M4 study material is prepared by Zed-King faculty. Here is where to find each type of material:

What you need	Where	What is available
Notes	Website zedking.in	Unit-wise M4 notes, practical programs (PR4), online M4 mock test and Arduino simulator.
Video Lectures	YouTube M4 IoT playlist	Video lectures covering the M4-R5.1 syllabus.
Complete Courses	Zed-King App Android & iPhone	**Theory Exam Targeted Course** – focused preparation for the M4 theory exam. **Practical Exam Targeted Course** – focused preparation for the M4 practical exam. **Complete IoT Course** – the full IoT course from basics to projects.

Need the complete course?

Download the **Zed-King App** on Android (Google Play Store) or iPhone (App Store). Choose the **Theory Exam Targeted Course**, the **Practical Exam Targeted Course**, or the **Complete IoT Course** as per your need.

Notes zedking.in	**Video Lectures** YouTube playlist	**App – Android** Google Play Store	**App – iPhone** App Store

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