Experiment – 12

Aim: Introduction To NODE MCU esp8266 and Raspberry pi.

- **Introduction to NodeMCU ESP8266**

Arduino is an Italian open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its hardware products are licensed under a CC BY-SA license, while the software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially from the official website or through authorized distributors.

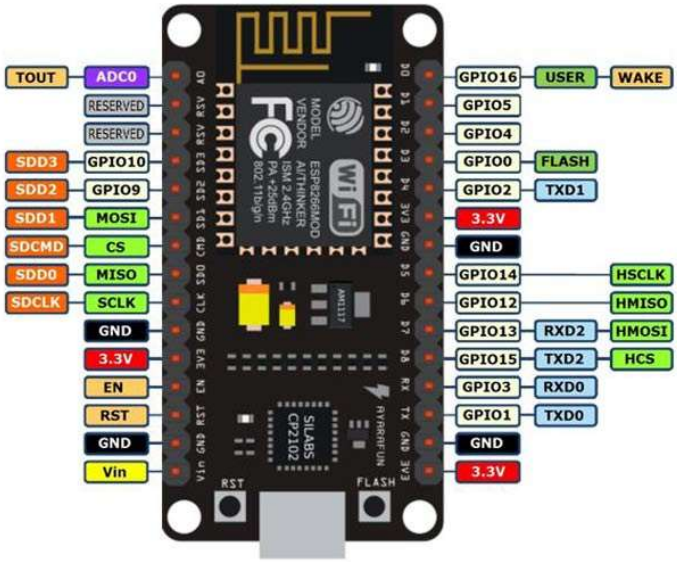
- **Types of Board**

Type	Board Name	Year	Price (INR) (Approx.)
Wi-Fi Enabled	NodeMCU ESP8266	2014	₹250 – ₹400
Compact + Wi-Fi	ESP-01	2014	₹150 – ₹250
Advanced IoT	ESP32 Dev Module	2016	₹300 – ₹500
Low Power	Wemos D1 Mini	2015	₹200 – ₹300
Sensor Focused	NodeMCU ESP8266 + DHT	2015	₹350 – ₹500

- **Components of NodeMCU ESP8266**

Component	**Description**
Microcontroller	ESP8266 (Tensilica Xtensa 32-bit LX106)
Operating Voltage	3.3V
Input Voltage (via USB)	5V (regulated to 3.3V internally)
Digital I/O Pins	11 GPIO (some with dual functions)
Analog Input Pins	1 (ADC0, 10-bit resolution)
Flash Memory	4 MB (varies by board)
Clock Speed	80 MHz (can be overclocked to 160 MHz)
Communication	UART, SPI, I2C
USB Interface	Micro USB for programming and power
Wi-Fi	802.11 b/g/n 2.4GHz Wi-Fi built-in
Dimensions	Approx. 58 mm × 31 mm
Programming Support	Arduino IDE, Lua, MicroPython
Power Connector	Barrel Jack and Vin Pin
LED Indicators	Power (ON), TX/RX, and Pin 13 LED
Reset Button	Yes
Board Dimensions	68.6 mm × 53.4 mm

- **Pin diagram of NodeMCU ESP8266**



- **Introduction to Raspberry Pi**

Raspberry Pi is a small, powerful, and affordable single-board computer developed by the Raspberry Pi Foundation to promote computer science education and DIY innovation. It supports a full operating system (typically Raspberry Pi OS, based on Linux) and offers all essential features of a desktop PC, including USB ports, HDMI output, audio, Ethernet, and wireless connectivity (in newer models). Raspberry Pi can run programming languages like Python, Java, and C++, and is commonly used in automation, robotics, media centers, home servers, and IoT applications. Its GPIO (General Purpose Input Output) pins allow it to interface with sensors, motors, and external devices, making it a flexible platform for hardware and software development.

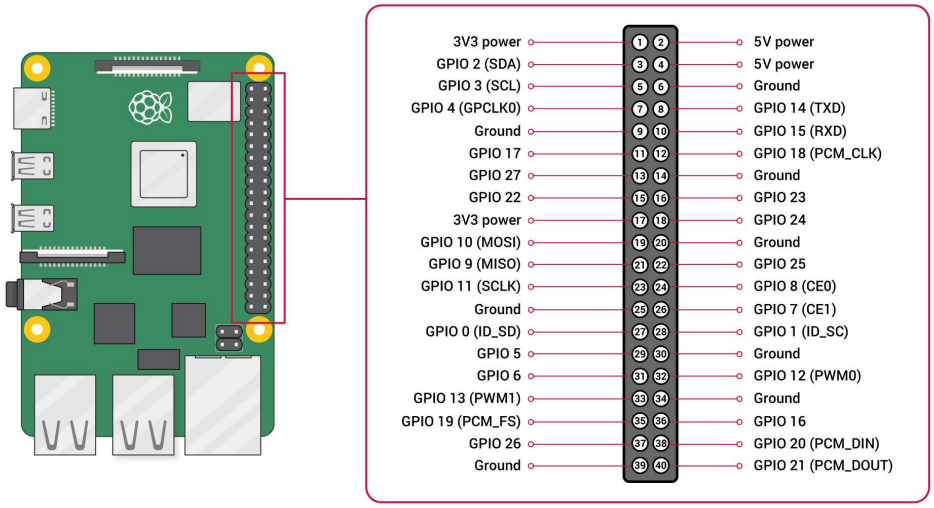
- **Types of Board**

Type	Board Name	Year	Price (INR) (Approx.)
Entry-Level	Raspberry Pi Zero W	2017	₹1,000 – ₹1,200
General Purpose	Raspberry Pi 3 Model B+	2018	₹3,000 – ₹4,000
Advanced	Raspberry Pi 4 Model B	2019	₹4,000 – ₹8,000
High Performance	Raspberry Pi 5	2023	₹6,000 – ₹10,000+
Compact + Basic	Raspberry Pi Pico	2021	₹300 – ₹500
Industrial/CM	Compute Module 4	2020	₹3,500 – ₹7,000

- **Components of Raspberry Pi 4 Model B**

Component	Description
CPU	Quad-core Cortex-A72 (64-bit) @ 1.5 GHz
RAM Options	2GB, 4GB, 8GB LPDDR4
GPU	Broadcom VideoCore VI
Operating System	Raspberry Pi OS (Linux-based), also supports Ubuntu, Windows IoT
GPIO Pins	40-pin GPIO header with I2C, SPI, UART, PWM support
USB Ports	2 × USB 2.0, 2 × USB 3.0
Video Output	2 × micro-HDMI (up to 4K output)
Audio	HDMI and 3.5 mm audio jack
Storage	microSD card slot for OS and file storage
Connectivity	Wi-Fi 802.11ac, Bluetooth 5.0, Gigabit Ethernet
Power Supply	5V/3A via USB-C port
Camera Support	CSI Camera port for Raspberry Pi Camera Module
Display Support	DSI Display port for touchscreens
Dimensions	85.6 mm × 56.5 mm

- **Pin Diagram of Raspberry Pi GPIO (40-pin header)**



- **Application and use – cases**

5. Applications and Use-Cases

- Home Automation: Control lights, fans, door locks, and other appliances using smart interfaces.
- IoT Projects: Collect sensor data and upload to cloud platforms like AWS, Azure, or ThingsBoard.
- Media Center: Run Kodi or Plex to turn Raspberry Pi into a home media server.
- Web Server: Host your own website or web-based application on Apache/Nginx server.
- Robotics: Interface with sensors, motors, and cameras to build autonomous robots.
- Educational Tool: Learn Linux commands, programming, electronics, and networking.
- Security & Surveillance: Use Pi with a camera module for CCTV or motion detection systems.
- AI & ML: Run lightweight models for image processing or voice recognition.