

# **Gandaki Polytechnique Institute**

## **Teacher Selection Syllabus**

### **For 6th and 7th level**

**Subject: Electrical and electronics**

Full marks:            Subjective: 70  
                                 Objective: 40

Pass marks:    Subjective: 28  
                         Objective: 16

#### **Unit 1. Introduction: [2]**

- 1.1. Importance of electronics in modern society.
- 1.2. Use of electronics in Mechanical Control system and automation.

#### **Unit 2. Introduction to Electronic Passive Components [3]** **Resistive components**

- 2.1. Introduction to Resistor.
- 2.2. Classification of resistors. Fixed Resistors, Variable Resistors, Adjustable Resistors and Special Resistors.
- 2.3. Resistor Color Codes
- 2.4. Resistor Circuits. Series Circuit, Parallel Circuit and Series - Parallel Combined Circuits.
- 2.5. Characteristics, application and demonstration of Thermistors (PTC, NTC), LDR (Light Dependant Resistor).
- 2.6. Characteristics, application and demonstration of Thermistors (PTC, NTC), LDR (Light Dependent Resistor).

#### **Unit 3. Inductive Components [2]**

- 3.1 Introduction to Inductive Components and basic construction.
- 3.2 Types of Inductors used in electronic equipment.
- 3.3 Classification of Inductors in terms of operation frequency.
- 3.4 Inductance Circuits. Series Circuit, Parallel Circuit and Series - Parallel Combined Circuits.
- 3.5 Demonstration of various types of inductive components indicating briefly their application.

#### **Unit 4. Capacitive components [2]**

- 4.1 Introduction of Capacitance, basic construction of capacitor and units.
- 4.4 Range of Capacitances and operating voltages of each type of Capacitor.
- 4.5 Capacitor Circuits. Series Circuit, Parallel Circuit and Series - Parallel Combined Circuits.

#### 4.6 Variable capacitors

4.11 Basic construction and classification of Variable Capacitors based on applications.

### **Unit 5. Principles of semiconductors [2]**

- 5.1 Introduction to Semiconductor. Atomic structure, Semi-conductor Crystals and their characteristics
- 5.2 Adding impurities to semiconductors, Donor and Acceptor impurity in intrinsic Germanium.
- 5.3 N Type and P Type Semiconductor.

### **Unit 6. Semiconductor diode [5]**

- 6.1 PN Junction Diode
- 6.2 Basic construction, Junction barrier & barrier potential.
- 6.3 Forward and Reverse Bias Characteristics of Junction Diode.
- 6.4 Point contact diode (Signal Diode).
- 6.5 Application of Diode. Half Wave Rectifier, Full Wave Center Tapped and Bridge Rectifier circuit.
- 6.6 Rectifier Filter Circuits. Principles of operation of Capacitor filter, RC and LC Filter Circuit
- 6.7 Checking of Diode using Ohm Meter.
- 6.8 Zener Diode
  - 6.8.1 Basic construction and operation of a Zener diode.
  - 6.8.2 Forward and reverse bias Characteristics of a Zener diode.
  - 6.8.3 Application of Zener Diode as a Voltage Regulator.

### **Unit 7 introduction to bi-polar junction transistor (bjt). [2]**

- 7.1 Basic structure of BJT, PNP and NPN type.
- 7.2 Biasing of PNP and NPN Transistor principles of operation.
- 7.3 Voltage and Current Characteristics. Input and Output Characteristics, Collector current as a function of base current (Family of Collector characteristics curve), Cutoff, Saturation and DC Load line.
- 7.4 Basic Configuration of Transistor Circuits. Common Emitter (CE), Common Base (CB) and Common Collector (CC)

### **Unit 8. Special semiconductor devices [5]**

- 8.1 Silicon Controlled Rectifier (SCR)
  - 8.1.1 Basic construction & physical features of SCR

- 8.1.2 Voltage - current characteristics.
- 8.1.3 Application of SCRs
- 8.2 Unijunction Transistor (UJT)
  - 8.2.1 Basic construction & physical features of UJT
  - 8.2.2 Voltage - current characteristics.
  - 8.2.3 Application of UJT. (Relaxation Oscillator and Relay control circuit)
- 8.3 Junction Field Effect Transistor (JFET)
  - 8.3.1 Basic construction & physical features of JFET
  - 8.3.2 Voltage - current characteristics of JFET.
  - 8.3.3 Application of JFET.
- 8.4 Metal Oxide Semiconductor (MOSFET)
  - 8.4.1 Basic construction & physical features of MOSFET
  - 8.4.2 Voltage - current characteristics.
  - 8.4.3 Application of MOSFET.
- 8.5 Photo Diode and Opto Coupler
  - 8.5.1 Basic construction & physical features and operation of Photo diode.
  - 8.5.2 Application of Photo Diode and Opto Coupler.

## **Unit 9 Introduction to integrated circuit [2]**

- 9.1 Introduction to IC,  
basic construction  
of IC chip
- 9.2 Monolithic  
Integrated circuit.  
9.4 Large scale  
Integrated circuit  
(LSI).
- 9.4 General classification of Integrated Circuits based on application.  
(Linear and Digital ICs).
- 9.5 Illustration of some Linear ICs. Voltage regulator IC, Timer IC, OP  
Amplifier etc

## **Unit 10 Digital electronics [4]**

- 10.1 Introduction to Number System.
  - 10.1.1 Decimal Number System
  - 10.1.2 Binary Number System
  - 10.1.3 Octal Number System

- 10.1.4 Hexa -Decimal Number System
- 10.1.5 Conversion of Number system
- 10.2 Introduction to Binary Arithmetic Addition, Subtraction, Multiplication, Division.
- 10.2.1 Signed and Unsigned Binary Numbers.
- 10.2.2 Binary Coded Decimal Numbers and ASCII Codes.

### **Unit 11 Fundamentals of digital electronics [8]**

- 11.1 Principles of operations of two state operation and its advantages.
- 11.2 Operation of Transistor as a Switch and Relay Control.
- 11.3 Introduction to Logic Gates (NOT, AND, OR, NAND, NOR XOR). Symbols, Truth Tables, Boolean algebra and Associate Rules.
- 11.4 De-Morgan's Theorem.
- 11.5 Universal Gates
- 11.6 Minimization of Logical Expressions using Boolean algebra.
- 11.7 Application of Karnuf's Map (K-Map) for minimization of Logical expressions.

### **Unit 12 Combinational logic devices [4]**

- 12.1 Encoder / Decoder – Decimal to Binary, Binary to Gray Code, Priority Encoder.
- 12.2 Multiplexer and De-Multiplexer.
- 12.3 Parity Generator and Checker.
- 12.4 Half Adder, Full Adder and Subtractor.

### **Unit 13 Analog and digital conversion [2]**

- 13.1 Introduction
  - Analogue to Digital Conversion.
  - Digital to Analogue Conversion.

### **Unit 14. Memory [2]**

- 14.1 Functions of Flip-flop as Memory.
- 14.2 Types of Memory: ROM, RAM, PROM, EPROM, EEROM, UVPROM. Static and dynamic Memory

### **Unit 15. Introduction**

- 15.1 Brief history of the generation of electricity in Nepal
- 15.2 Energy sources and production
- 15.3 Application of electrical energy in the field of mechanical engineering.

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| <b>Unit 16. Fundamentals of electricity</b>                                                                                                      | <b>[2]</b> |
| 16.1 Concept of atomic structure and electric charge                                                                                             |            |
| 16.2 Concept of electric voltage and current                                                                                                     |            |
| 16.3 Concept of resistor, inductor and capacitor                                                                                                 |            |
| <b>Unit 17. Electric Laws and d.c. circuit</b>                                                                                                   | <b>[6]</b> |
| 17.1 Electric circuit.                                                                                                                           |            |
| 17.2 Ohm's law                                                                                                                                   |            |
| 17.3 Kirchoffs laws.                                                                                                                             |            |
| 17.4 Network analysis                                                                                                                            |            |
| 17.5 Electrical work, energy and power                                                                                                           |            |
| <b>Unit 18 Electric and magnetic field</b>                                                                                                       | <b>[6]</b> |
| 18.1 Fundamental concept of electric field                                                                                                       |            |
| 18.2 Laws of electric field and electrostatic induction                                                                                          |            |
| 18.3 Fundamental concept of magnetic field                                                                                                       |            |
| 18.4 Electro-magnetism and electro-magnetic induction.                                                                                           |            |
| 18.5 Magnetic material, magnetic circuit and application                                                                                         |            |
| <b>Unit 19. Chemical effect of electricity</b>                                                                                                   | <b>[2]</b> |
| 19.1 Basic concept                                                                                                                               |            |
| 19.2 Faradays laws of electrolysis                                                                                                               |            |
| 19.3 Electro chemical voltage generation                                                                                                         |            |
| <b>Unit 20. Single &amp; three phase a.c. circuit analysis</b>                                                                                   | <b>[8]</b> |
| 20.1 Generation of an alternating voltage                                                                                                        |            |
| 20.2 A.C. quantities                                                                                                                             |            |
| 20.3 Loads in a.c. circuit                                                                                                                       |            |
| 20.4 Power in a.c. circuit                                                                                                                       |            |
| 20.5 Three phase a.c. circuit                                                                                                                    |            |
| <b>Unit 21. Electrical Machine</b>                                                                                                               | <b>[8]</b> |
| 21.1 Transformer: types, construction, working principle, loaded and no-load operation of transformer                                            |            |
| 21.2 D.C. machine: types, construction, working principle of motor and generator, methods of excitation, armature reaction, back emf in dc motor |            |
| 21.3 A.C. machine: types, construction, working principle of motor and generator.                                                                |            |
| 21.4 Selection of electric motor.                                                                                                                |            |

**Unit 22. Electrical measurement, supply and installation [6]**

- 22.1 General concept of supply and distribution of electric system.
- 22.2 Basic concept of electrical installation, control and protection
- 22.3 Electrical measuring units, instruments and measurement method.

**Unit 23. Electrical maintenance and safety [4]**

- 23.1 Concept of preventive maintenance and routine check
- 23.2 Basic maintenance of electric system
- 23.3 Concept of safety rules and regulation
- 23.4 First aid steps to be taken in electrical accident

**Unit 24. Basic industrial electronics [5]**

- 24.1 Introduction to semiconductor material, diodes, transistors, thyristors, electronic valves and IC chips and their simple working principle, construction and application.
- 24.2 Simple electronics circuits of transistor, rectifying, amplifying, control etc.

**Unit 25 Teaching Methods and Teaching Skills**