

## Subject Name & Code:

# BASIC ELECTRICAL ENGINEERING-BE01R00051

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## Assignment – 5: Illumination, Batteries, Measuring Instruments, Electricity Bill

### 1. Explain various types of lamps.

Lamp Type	Working	Efficiency (lm/W)	Life (hours)	Applications
Incandescent	Filament heated to white hot	10–15	1000	Decorative, local lighting
Fluorescent	Mercury vapor UV excites phosphor	50–100	8000	Offices, shops
CFL	Compact fluorescent, similar principle	50–70	8000	Home, replacement for incandescent
LED	Electroluminescence in semiconductor	80–200	25000–50000	General, automotive, street
Sodium vapor (HPS/LPS)	Sodium gas discharge	100–150 (HPS)	24000	Street lighting, highways

### 2. Discuss illumination schemes and recommended lighting levels.

#### Schemes:

- **Direct:** 90% light downward (factory halls).
- **Indirect:** 90% upward (decorative, no glare).
- **Semi-direct:** Both directions (office lighting).
- **General diffusing:** Uniform in all directions (corridors).

#### Recommended levels (lux):

Premises	Lux
Classrooms	300–500
Drawing office	750–1000
Corridors	100–150
Machine shop	300–500
Hospitals	200–500

### 3. Explain construction and characteristics of lead-acid and lithium-ion batteries.

#### Lead-acid:

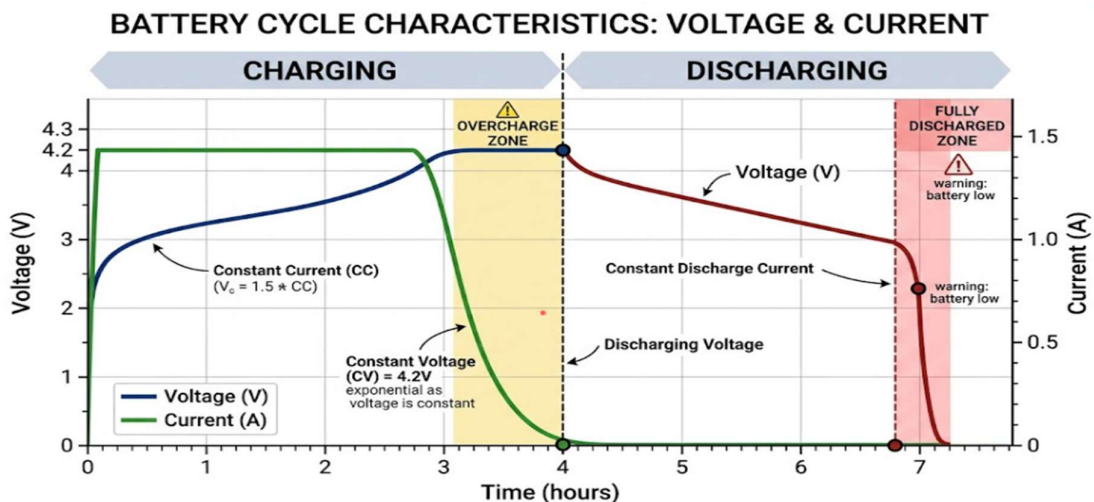
- Construction:  $\text{PbO}_2$  (positive),  $\text{Pb}$  (negative),  $\text{H}_2\text{SO}_4$  electrolyte. Separators between plates.
- Characteristics: Low energy density (30–40 Wh/kg), high current capability, cheap, needs maintenance.

#### Lithium-ion:

- Construction:  $\text{LiCoO}_2/\text{LiFePO}_4$  (cathode), graphite (anode), organic electrolyte, separator.
- Characteristics: High energy density (150–250 Wh/kg), lightweight, long cycle life, no memory effect, expensive, needs protection circuit.

### 4. Explain battery charging and discharging process with curve.

#### Diagram:



**Explanation:**

During **charging**, terminal voltage rises; after full charge, voltage increases rapidly if charging continues (overcharge). During **discharging**, voltage drops gradually; after 80% depth of discharge, voltage falls sharply.

**5. Explain calculation of electricity bill for a domestic consumer with example.**

Bill = Energy charge (kWh × tariff) + Fixed charge + Tax.

**Example:**

Consumption = 200 kWh, tariff = ₹5/kWh, fixed = ₹50, tax = 10% of energy charge.

Energy charge =  $200 \times 5 = ₹1000$

Tax =  $1000 \times 0.1 = ₹100$

Total =  $1000 + 50 + 100 = ₹1150$ .

**6. Explain working principle and circuit connections of electrical measuring instruments.**

- **Ammeter:** Low resistance, connected in series. Measures current by magnetic effect (moving coil or iron vane).
- **Voltmeter:** High resistance, connected in parallel. Measures potential difference.
- **Wattmeter:** Two coils – current coil (series), pressure coil (parallel). Measures real power  $P = VI \cos \phi$ .
- **Energy meter:** Induction motor type – rotating disc driven by eddy currents; measures energy (kWh).

**7. Compare ammeter, voltmeter, wattmeter and energy meter.**

Meter	Unit	Connection	Internal resistance	Output
Ammeter	A	Series	Very low	Instantaneous
Voltmeter	V	Parallel	Very high	Instantaneous
Wattmeter	W	Current coil series, voltage coil parallel	–	Instantaneous power
Energy meter	kWh	Series + parallel	–	Integrated over time

**8. Explain importance of proper illumination in industrial and commercial areas.**

- **Productivity:** Proper lighting reduces errors and fatigue.
  - **Safety:** Avoids accidents in machine areas, staircases.
  - **Quality control:** Inspection requires 500–1000 lux.
  - **Energy saving:** LED with daylight harvesting cuts cost.
  - **Compliance:** Electrical codes mandate minimum lux levels.
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**9. Numerical: Household energy consumption.****Given:**

Microwave:  $1000 \text{ W} \times 0.5 \text{ h} = 0.5 \text{ kWh}$

Fan:  $60 \text{ W} \times 8 \text{ h} = 0.48 \text{ kWh}$

5 LEDs:  $5 \times 10 \text{ W} = 50 \text{ W} \times 5 \text{ h} = 0.25 \text{ kWh}$

**Total daily:**  $0.5 + 0.48 + 0.25 = 1.23 \text{ kWh}$

**Monthly bill (30 days):**

Energy =  $1.23 \times 30 = 36.9 \text{ kWh}$

Tariff = ₹0.15/kWh → Bill =  $36.9 \times 0.15 = ₹5.535$

**Final answer:**

$1.23 \text{ kWh}, ₹5.54$

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**10. Numerical: Air conditioner billing.****Given:**

Power = 1.5 kW, daily hours = 6 h, days = 30, pf = 0.8 (not needed for energy, since watt is real power)

**Monthly energy:**

$$1.5 \times 6 \times 30 = 270 \text{ kWh}$$

**Bill:**

Energy charge =  $270 \times 0.12 = ₹32.4$

Add fixed = ₹10

Total = ₹42.4

**Final answer:**

$270 \text{ kWh}, ₹42.4$

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**11. Numerical: Series circuit with ammeter and voltmeter.****Given:**

$I = 5 \text{ A}, V_{load} = 220 \text{ V}, V_{supply} = 230 \text{ V}$  (supply voltage not directly needed for load resistance)

**To find:**

Circuit resistance  $R_{load}$  and power  $P$

**Formula:**

$$R = \frac{V_{load}}{I}, P = V_{load} \times I$$

**Solution:**

$$R = \frac{220}{5} = 44\Omega$$

$$P = 220 \times 5 = 1100 W = 1.1 kW$$

**Final answer:**

$$\boxed{44\Omega, 1100 W}$$

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