



UNIVERSITY OF HILLA
College of Engineering Technologies
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Fundamental of Electrical Engineering(DC)

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First Stage

Lecture1

symbols and abbreviation, electric circuit & its elements

The system of units used in engineering and science is the (International system of units), usually abbreviated to SI units, and is based on the metric system.

Quantity	Quantity Symbol	Unit	Unit Symbol
Length	l	Metre	M
Mass	m	Kilogram	Kg
Time	T	Second	S
Force	F	Newton	N
Electrical charge or quantity	Q	Coulomb	C
Electrical current	I	Ampere	A
Resistance	R	Ohm	Ω
Energy	E or W	Joule	J
Work	W	Joule	J
Power	P	Watt	W
Conductance	G	Siemen	S
Electromotive force	E	Volt	V
Potential difference	V	Volt	V
Velocity	V	Metres per second	m/s
Acceleration	a	Metres per second	m/s

Tab. (1)

SI units may be made larger or smaller by using prefixes which denote multiplication or division by a particular amount.

prefix	Name	Meaning
M	mega	Multiply by 1000 000 (i.e. $\times 10^6$)
k	kilo	Multiply by 1000 (i.e. $\times 10^3$)
m	milli	Divide by 1000 (i.e. $\times 10^{-3}$)
μ	Micro	Divide by 1000 000 (i.e. $\times 10^{-6}$)
n	nano	Divide by 1000 000 000 (i.e. $\times 10^{-9}$)
p	pico	Divide by 1000 000 000 000 (i.e. $\times 10^{-12}$)

Tab. (2)

Charge: The unit of charge is the coulomb (C) where one coulomb is one ampere second. ($1 \text{ coulomb} = 6.24 \times 10^{18} \text{ electrons}$).

Thus, charge, in coulombs $Q = It$ where I is the current in amperes and t is the time in seconds.

Example 1: - if a current of (5 A) flows for (2 minutes), find the quantity of electricity transferred?

Solution:

Quantity of electricity $Q = It$ coulombs

$I = 5A, t = 2 \times 60 = 120s, \text{ hence } Q = 5 \times 120 = 600C$

Example 2: A current of 3 A flows for 5 minutes. What charge is transferred?

Solution:

$Q = It$

$t = 5 \times 60 = 300 \text{ s}, Q = 3 \times 300$

$Q = 900C$.

Force: The unit of forces the Newton (N) where one newton is one-kilogram meter per second squared. Thus, force, in Newton's $F = ma$

Where m is the **mass** in kilograms and a is the acceleration in meters per second squared.

Gravitational force, or weight, is mg , where $g = 9.81 \text{ m/s}^2$.

For example: A mass of 5000 g is accelerated at 2 m/s^2 by a force. Determine the force needed.

Solution:

Force = mass x acceleration

$$5\text{kg} \times 2\text{m/s}^2 = 10 \text{ kg m/s}^2 = 10 \text{ N.}$$

Work: The unit of work or energy is the joule (**J**) where one joule is one Newton meter. Thus

work done on a body, in joules, $W=Fs$ where F is the force in Newton's and s is the distance in meters moved by the body in the direction of the force.

Power: The unit of power is the watt (W) where one watt is one joule per second. Power is defined as the rate of doing work or transferring energy. Thus, power, in watts, $P = W/t$, where W is the work done or energy transferred, in joules, and t is the time, in seconds. Thus, energy, in joules, $W=Pt$

$$p = \frac{w}{t} = \frac{\text{total work done (J)}}{\text{total time taken (s)}} = \frac{J}{s}$$

$$\frac{J}{s} = 1 \text{ watt} = 1\text{N.m/s}$$

$$\text{But } V = \frac{w}{q} \text{ and } I = \frac{q}{t}$$

$$\therefore p = \frac{w}{t} = \frac{v \cdot q}{t} = V \cdot I \text{ (watt).}$$

But $V = I \cdot R$ (ohm's law).

$$P = V \cdot I = I^2 \cdot R = \frac{V^2}{R} \text{ Watt}$$

Example: A mass of 1000 kg is raised through a height of 10 m in 20 s.

What is

- (a) the work done and
- (b) the power developed.

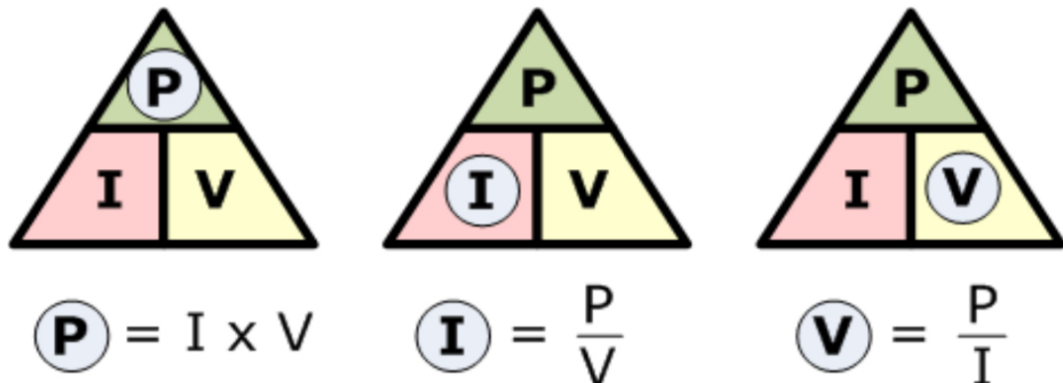
Solution:

(a) Work done = force $\times$ distance

and force = mass $\times$ acceleration

$$\begin{aligned}\text{Hence, work done} &= (1000 \text{ kg} \times 9.81 \text{ m/s}^2) \times (10 \text{ m}) \\ &= 98\,100 \text{ Nm} \\ &= \mathbf{98.1 \text{ kNm} \text{ or } 98.1 \text{ kJ}}\end{aligned}$$

$$\begin{aligned}\text{(b) Power} &= \frac{\text{work done}}{\text{time taken}} = \frac{98100 \text{ J}}{20 \text{ s}} \\ &= 4905 \text{ J/s} = \mathbf{4905 \text{ W} \text{ or } 4.905 \text{ kW}}\end{aligned}$$



Example: An electric heater consumes 1.8 M/J when connected to a 250 V supply for 30 minutes. Find the power rating of the heater and the current taken from the supply.

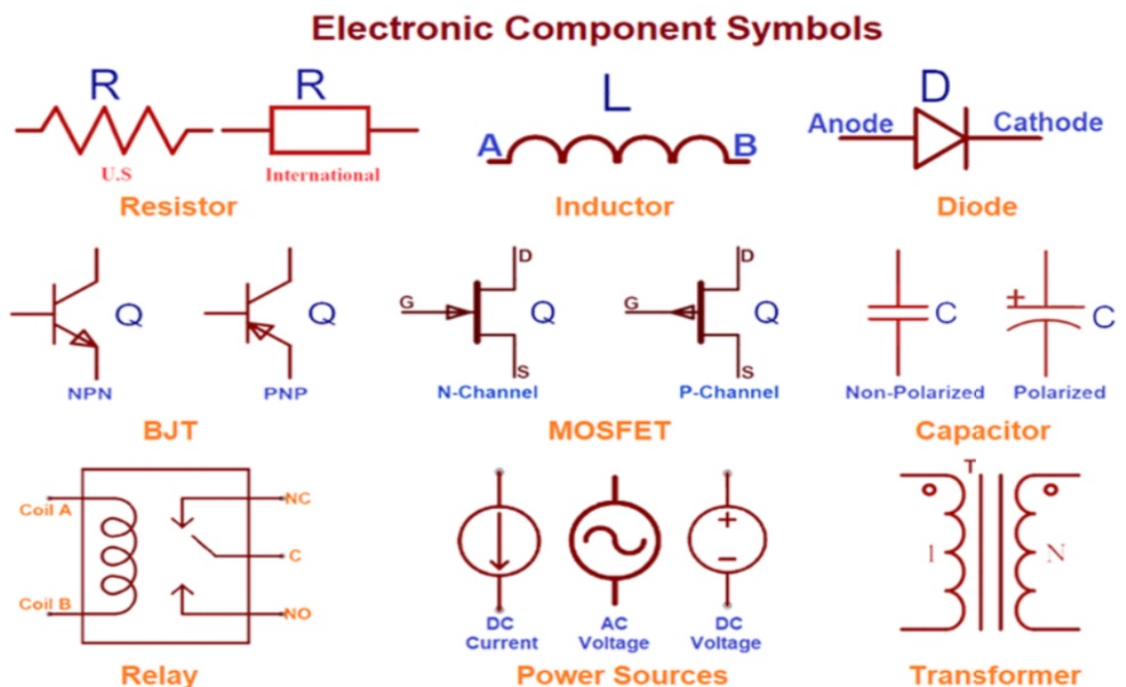
Solution:

$$\text{Power} = \frac{\text{energy}}{\text{time}} = \frac{1.8 \times 10^6 \text{ J}}{30 \times 60 \text{ s}} \\ = 1000 \text{ J/s} = 1000 \text{ W}$$

i.e. power rating of heater = 1 kW

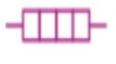
$$\text{Power } P = VI, \text{ thus } I = \frac{P}{V} = \frac{1000}{250} = 4 \text{ A}$$

Hence the current taken from the supply is 4 A.



some of important electrical circuit symbols

Electronic Circuit Symbols

	Lamp		Voltmeter		Zener diode		Resistor
	Wall light		Ammeter		Diode		Variable resistor
	Light globe		Galvanometer		Photo diode		Transformer
	Switch		Potentiometer		LED		Antenna unbalanced
	Locking switch		Galvanometer		Diode pin		Antenna balanced
	Push button switch		Capacitor		Cell		Speaker
	wire		Polarized capacitor		Battery		Microphone
	Connected		Variable capacitor		Ground		Heating element
	Not connected		Crystal		Fuse		Motor
					dc supply		Electric Bell
					ac supply		

Most Important Electrical Symbols

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Resistor Symbol



Inductor Symbol



Capacitor Symbol



Diode Symbol



Switch Symbol



Fuse Symbol



Alternating Current Symbol



Direct Current Symbol



Ammeter Symbol



Voltmeter Symbol



Wattmeter Symbol



Grounding Symbol



Transformer Symbol



Circuit Breaker Symbol



Cell Symbol



Battery Symbol



Electric lamp Symbol



Electric Motor Symbol



Relay Symbol



Electric Line or Wire Symbol

Tutorials:

Q1/ what quantity of electricity is carried by (6.24×10^{21}) electrons?
{sol :1000C}

Q2/ what time would a current of 1A transfer a charge of 30C?
{30S}

Q3/ A force of 40 N accelerates a mass at 5m/S^2 . Determine the mass.
{8kg}

Q4/ How long must a current of 0.1 A flow so as to transfer a charge of 30 C?
{5min}

Q5/ Find the accelerating force when a car having a mass of 1.7 Mg increases its speed with a constant acceleration of 3m/S^2
{5.1 kN}

Q6/ What force is required to give a mass of 20kg an acceleration of 30m/s^2 ?
{600N}