ENGLISH VERSION:

CHAPTER 6: ELECTRICITY & MAGNETISM

6.1 GENERATION OF ELECTRICITY

1. Energy sources to generate electricity:

Renewable = can be replaced & never deplete	**Non-renewable** = cannot be replaced & will deplete
Examples: Hydro, wave, solar, tidal, wind, biomass, geothermal	*Examples:* Nuclear, fossil fuel (petroleum, natural gas, coal)

2. How to generate electricity:

- move magnet across the solenoid (or vice versa)
- this will cut the magnetic field
- current will be induced
- use galvanometer & LED lamp to detect induced current

3. Electricty generation at 6 power stations:

a. **Thermal power station:**

- energy change:

Chemical (from fossil fuel)	→	Heat	→	Kinetic	→	Electrical

- *advantages:* large power, cheap
- *disadvantages:* not environmental friendly, non-renewable

b. **Biomass power station:**

- energy change:

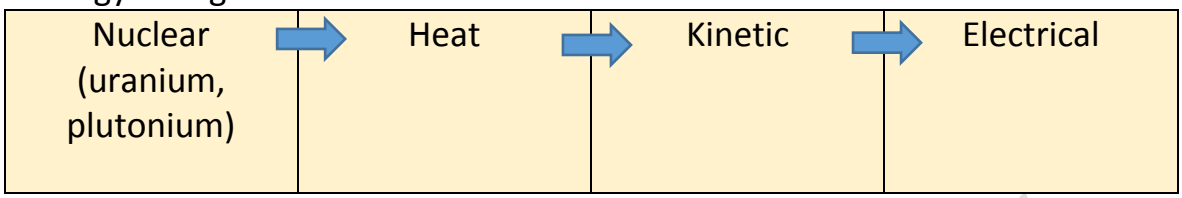
Chemical (from methane)	→	Heat	→	Kinetic	→	Electrical

- *advantages:* renewable

- *disadvantages:* not environmental friendly

c. **Nuclear power station:**

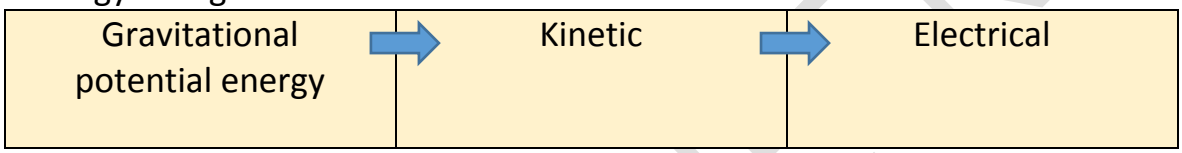
- energy change:



- *advantages:* very large power, no pollution
- *disadvantages:* expensive, risk of nuclear disaster

d. **Hydroelectric power station:**

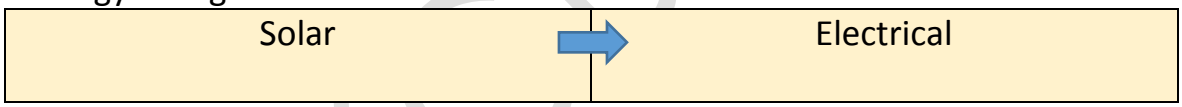
- energy change:



- *advantage*: no air pollution
- *disadvantage*: disturb local ecosystem

e. **Solar panel:**

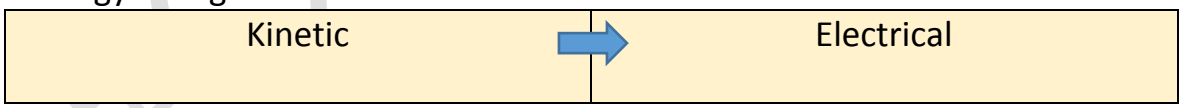
- energy change:



- *advantage:* ecofriendly, renewable, free
- *disadvantage:* not efficient, expensive equipment, need large space

f. **Wind turbine:**

- energy change:



- *advantage:* ecofriendly, renewable, free
- *disadvantage:* not efficient, need flat space

4. Direct current & alternating current:

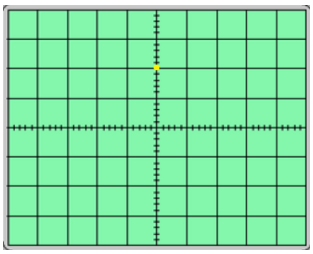
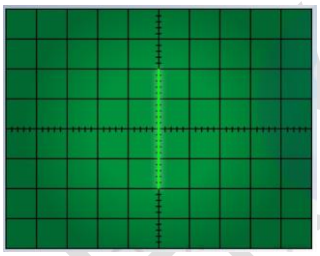
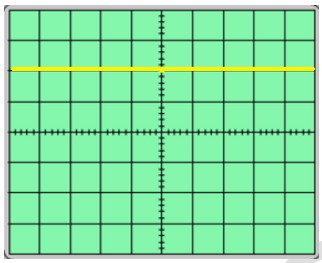
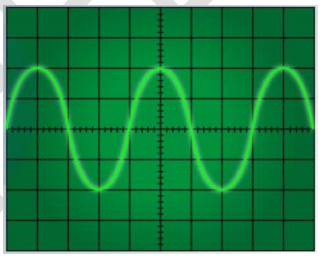
a. **Direct current (DC)**

- electric current moves in one direction
- used in dry cells, batteries, solar panel

b. **Alternating current (AC)**

- electric current moves alternatingly
- used in many home appliances (charger, oven, refrigerator)

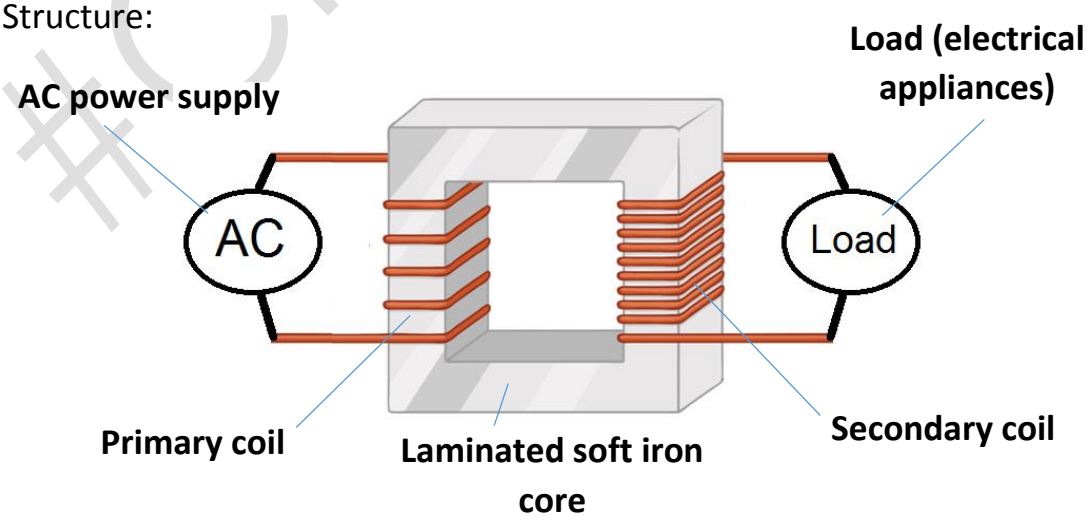
5. Use **cathode ray oscilloscope (CRO)** to detect AC or DC:
- current pattern:

DC	AC
Time-base off 	Time-base off 
Time-base on 	Time-base on 

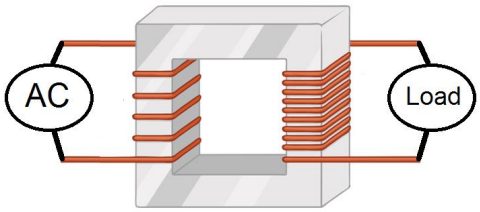
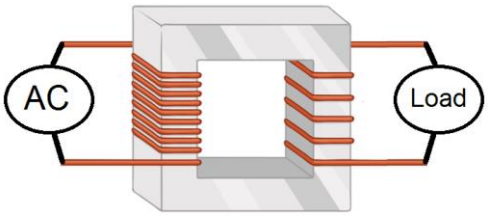
6.2 TRANSFORMER

1. Function = change voltage of alternating current

2. Structure:



3. Type of transformers:

STEP-UP	STEP DOWN
- increase voltage - has more wire turns in sec. coil - used in **high-energy appliances** (microwave oven, camera flashlight, generators)	- reduce voltage - has less wire turns in sec. coil - used in **low-energy appliances** (TV, radio, chargers)
	

4. Formula:

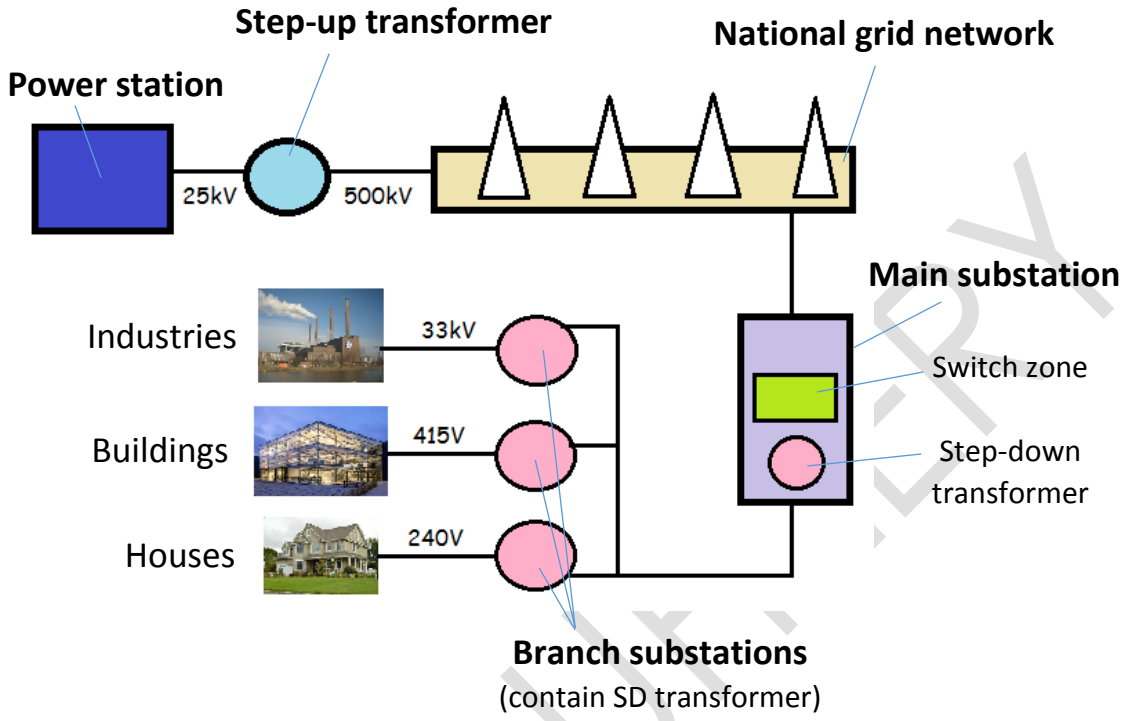
$$V_p/V_s = N_p/N_s$$

V_p = voltage at primary coil
V_s = voltage at secondary coil
N_p = number of wire turns at primary coil
N_s = number of wire turns at secondary coil

6.3 TRANSMISSION & DISTRIBUTION OF ELECTRICITY

A. The system:

1. Diagram:



2. **National grid network** requires large voltage to send current at a distance

3. **Main substation** contains switch zone & step down transformer:
- **Switch zone** – send electricity to branch substations
- **Step-down transformer** – reduce large voltage received from NGN

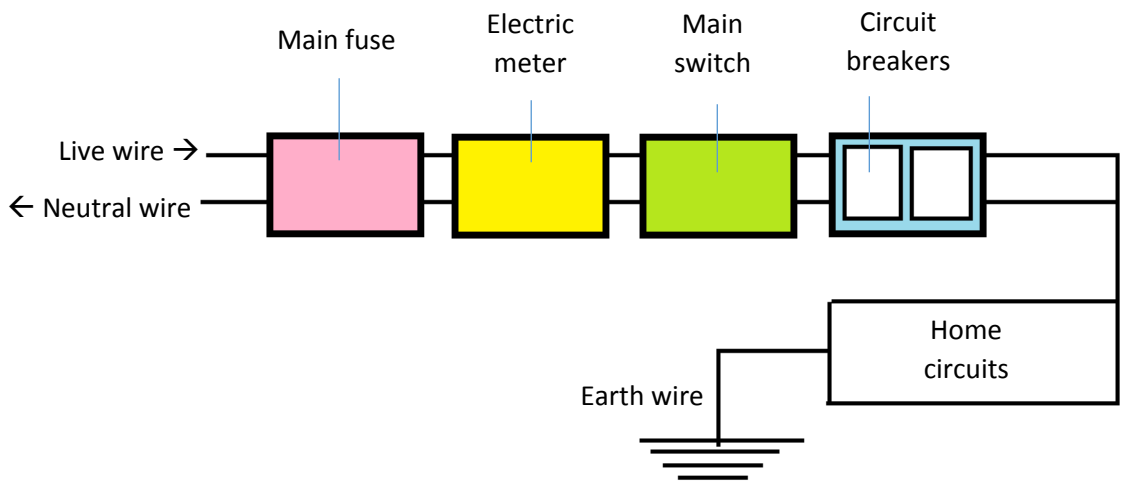
4. **Branch substations** contain step-down transformers that further reduce voltage according to areas (industries, commercial buildings, residential areas)

5. Type of wiring system in Malaysia:

ONE-PHASE	THREE-PHASE
- less stable - use small power & current - used in rural & residential areas	- more stable - use large power & current - used in commercial & industrial areas

B. Electrical Supply & Wiring System in Homes

1. Diagram:



2. Components & their functions:

a. **Live wire** = channel current into the home circuit
b. **Neutral wire** = channel current out of home
c. **Main fuse** = cut off current if current is too much
d. **Electric meter** = measure power usage
e. **Main switch** = turn circuit on or off

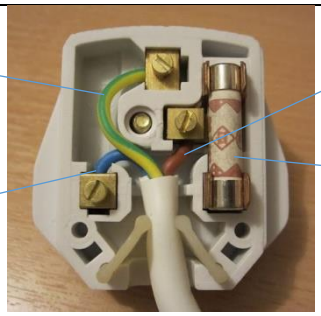
f. Circuit breakers:
- **Earth leakage circuit breaker** = cut off current if current is too much
- **Miniature circuit breaker** = separate circuit to different home appliances

g. **Earth wire** = channel excessive current into the earth

3. Plugs:

a. **2-pin plug** = for appliances that use small current

b. **3-pin plug**
- for appliances that use large current (electric kettle, washing machine, refrigerator)
- has earth wire to channel excessive current into the earth
- diagram:



4. Fuse value should be <u>higher a bit</u> that the current supply (top up a bit!)
- if current supply is 10A, the fuse value should be around 11A-15A

5. Safety in using electrical appliances:

- We should not use too many appliances in one socket:

- this could cause **power overload** which leads to **short circuit**
- short circuit can cause fire

6.4 Calculate the Cost of Electricity Consumption

5 formulas are discussed:

1) Energy efficiency
2) Electric power
3) Electric current
4) Voltage
5) Cost of electrical energy

1. **Energy efficiency** = percentage of energy output over input

$$\text{Efficiency} = \frac{\text{Useful energy output}}{\text{Energy input supplied}} \times 100\%$$

- Comparing high & low efficiency (identified with label):

High efficiency (High rating (more star))	Low efficiency (Low rating (less star))
- Save energy & good for environment - Low energy cost but appliance is expensive - Example: LED lamp	- Waste energy & not so good for environment - High energy cost but appliance is cheap - Example: Filament lamp

2. 2 formula for **power**, P (W):

$= \frac{\text{Energy, E (J)}}{\text{time, t (s)}}$	P = Current, I (A) x Voltage, V (V) P = IV

3. Electric **current & voltage:**

Electric current, I (A)	Voltage, V (V)
$= \frac{\text{Electric charge (Q (C)}}{\text{time, t (s)}}$	$= \frac{\text{Energy, E (J)}}{\text{Charge, Q(C)}}$

4. **Cost of electrical energy:**

= Power (kW) x time (h) cost per unit

- How to save electricity cost?

a. Use high efficiency appliance
b. Use high-power appliance sparingly

c. Apply the concept of **green building:**
- ventilation system & plants to reduce the use of fan & air conditioner
- glass panel to allow natural lighting to reduce the use of lamps
- solar panel as alternative energy source

#FINISH_CHAPTER_6

VERSI BAHASA MELAYU:

BAB 6: ELEKTRIK & KEMAGNETAN

6.1 PENJANAAN TENAGA ELEKTRIK

1. Sumber tenaga utk menjana elektrik:

Boleh baharu: = dapat diganti & tidak akan habis	**Tidak boleh baharu:** = tidak dapat diganti & akan habis
Contoh: Hidro, ombak, suria, pasang surut, angin biojisim, geoterma	*Contoh:* Nuklear, bahanapi fosil (petroleum, gas asli, arang batu)

2. Bagaimana tenaga elektrik dijana?

- gerakkan magnet merentasi solenoid (atau sebaliknya)
- ini memotong medan magnet
- ini menyebabkan arus teraruh
- guna galvanometer & lampu LED utk mengesan arus teraruh

3. Penjanaan elektrik di 6 stesen jana kuasa:

a. **Penjana elektrik terma:**
- perubahan tenaga:

Kimia (bahan bahanapi fosil)	→	Haba	→	Kinetik	→	Elektrik

- *kelebihan:* kuasa elektrik besar, murah
- *keburukan:* tidak mesra alam, tidak boleh diperbaharui

b. **Penjana elektrik biomas:**
- perubahan tenaga:

Bahan kimia (drpd metana)	→	Haba	→	Kinetik	→	Elektrik

- *kelebihan:* boleh diperbaharui
- *keburukan:* tidak mesra alam

c. **Penjana elektrik nuklear:**
- perubahan tenaga:

Nuklear (uranium, plutonium) →	Haba →	Kinetik →	Elektrik

- *kelebihan*: kuasa elektrik sgt besar, mesra alam
- *keburukan*: mahal, risiko bencana nuklear

d. **Penjana elektrik hidro:**
- perubahan tenaga:

Tenaga keupayaan graviti (air di lokasi tinggi) →	Kinetik →	Elektrik

- *kelebihan:* tiada asap (tiada pencemaran udara)
- *keburukan:* mengganggu ekosistem tempatan

e. **Panel solar:**
- perubahan tenaga:

Suria →	Elektrik

- *kelebihan:* mesra alam, boleh diperbaharui, percuma
- *keburukan*: tidak cekap, peralatan mahal, memerlukan ruang yang luas

f. **Turbin angin:**
- perubahan tenaga:

Kinetik →	Elektrik

- *kelebihan*: mesra alam, boleh diperbaharui, percuma
- *keburukan*: tidak cekap, memerlukan tempat yg rata

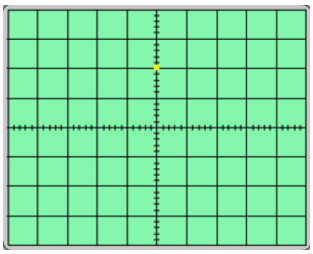
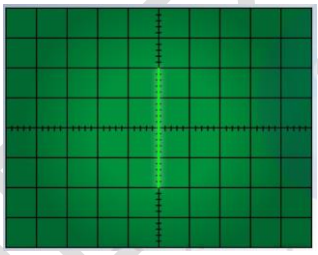
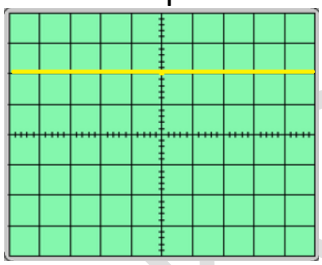
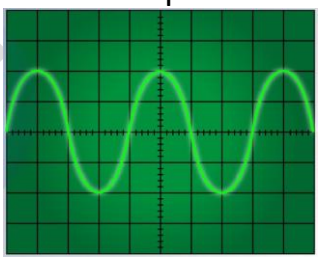
4. Arus terus & arus ulang alik:

a. **Arus terus (AT)**
- arus elektrik bergerak dalam satu arah

- digunakan dalam sel kering, bateri, panel solar

b. **Arus ulang alik (AU)**
- arus elektrik bergerak secara ulang alik
- digunakan dlm banyak peralatan rumah (pengecas, ketuhar, peti sejuk)

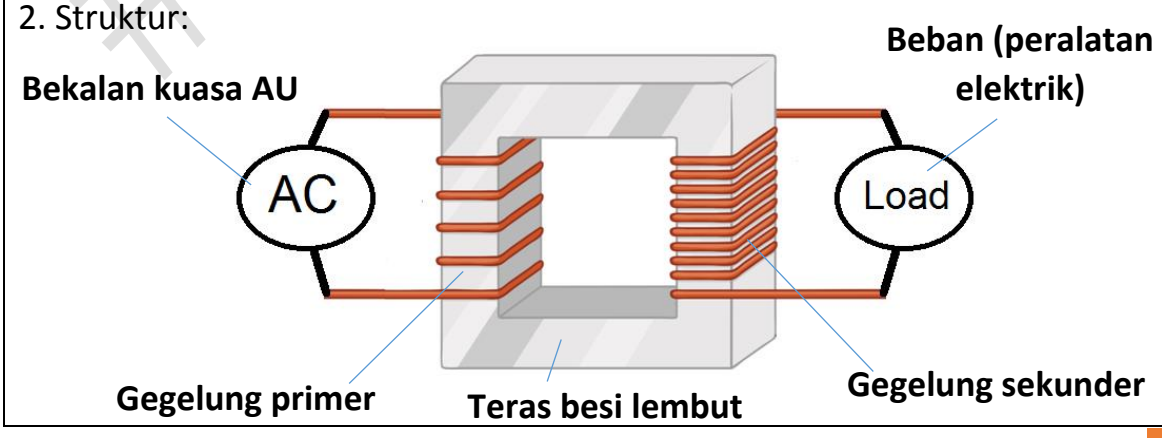
5. Gunakan **osiloskop sinar katod (OSK)** untuk mengesan AT atau AU:
- corak arus:

AT	AU
Dasar-masa dimatikan 	Dasar-masa dimatikan 
Dasar-masa dihidupkan 	Dasar-masa dihidupkan 

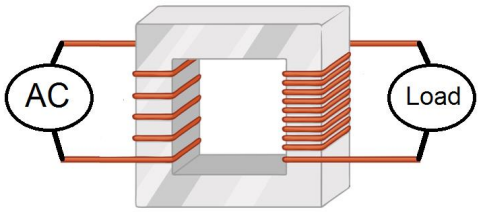
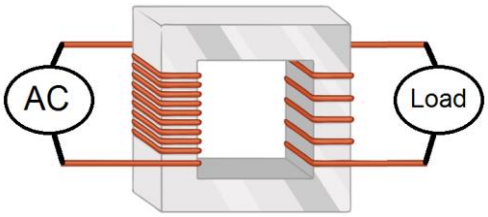
6.2 TRANSFORMER

1. Fungsi = menukar voltan arus ulang-alik (au)

2. Struktur:



3. Jenis transformer:

INJAK NAIK	INJAK TURUN
- meningkatkan voltan - lebih banyak lilitan gegelung pada g. sekunder - digunakan dalam alat bertenaga tinggi (ketuhar gelombang mikro, lampu kamera, penjana elektrik)	- menurunkan voltan - kurang lilitan gegelung pada g. sekunder - digunakan dalam alat yg guna tenaga rendah (TV, radio, pengecas)
	

4. Formula:

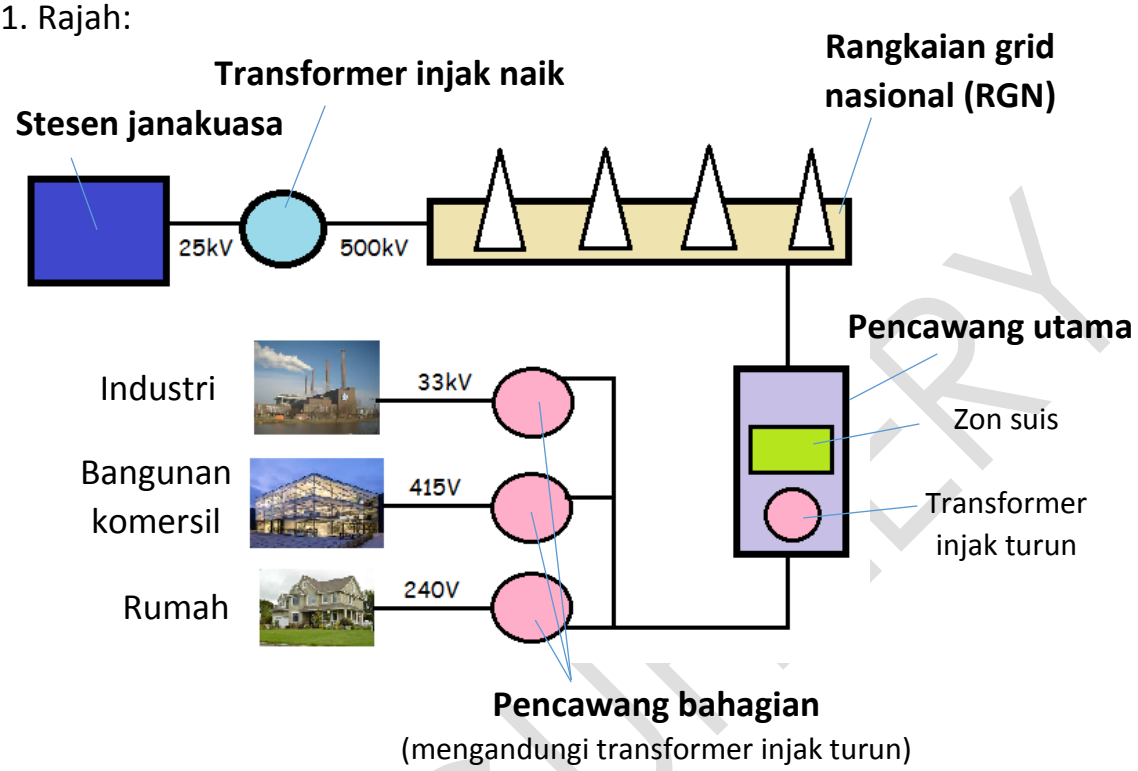
$$Vp / Vs = Np / Ns$$

Vp = voltan pada gegelung primer
Vs = voltan pada gegelung sekunder
Np = bilangan lilitan pada gegelung primer
Ns = bilangan lilitan pada gegelung sekunder

6.3 PENGHANTARAN & PENGAGIHAN TENAGA ELEKTRIK

A. Sistem:

1. Rajah:



2.**Rangkaian grid nasional** memerlukan voltan yang besar untuk menghantar tenaga elektrik pada jarak jauh

3. **Pencawang utama** mengandungi zon suis & transformer injak turun:
- **Zon suis** - menghantar elektrik ke pencawang bahagian
- **Transformer injak turun** - turunkan voltan besar yang diterima dari RGN

4. **Pencawang bahagian** mengandungi transformer injak turun yang mengurangkan voltan mengikut kawasan (industri, bangunan komersial, kawasan kediaman)

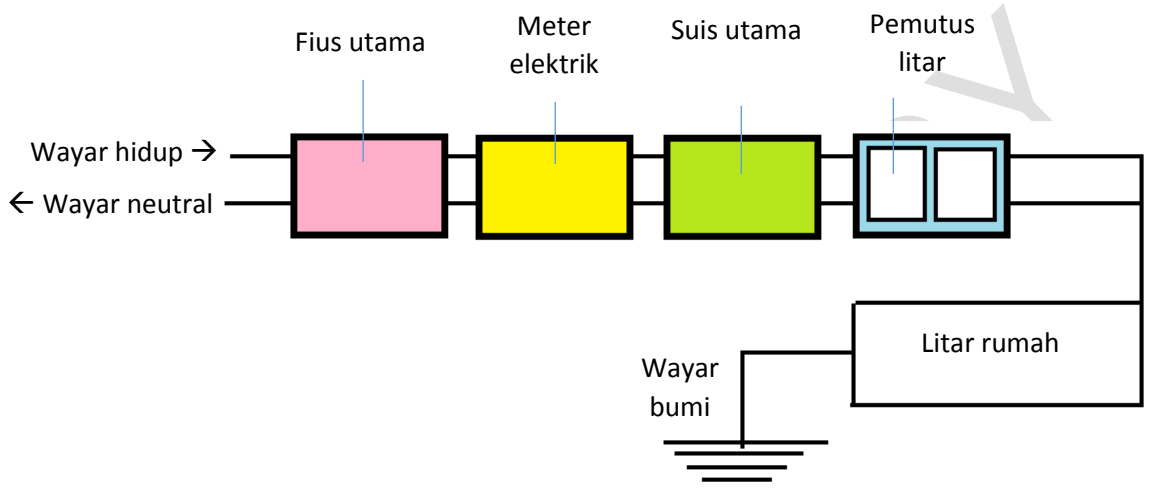
5. Jenis sistem pendawaian di Malaysia:

SATU FASA	TIGA FASA
- kurang stabil - guna kuasa & arus kecil	- lebih stabil - guna kuasa & arus yang besar

- digunakan di kawasan luar bandar & perumahan	- digunakan di kawasan komersial & perindustrian

B. Sistem Bekalan & Pendawaian Elektrik di Rumah

1. Rajah:



2. Komponen & fungsinya:

a. **Wayar hidup** = menyalurkan arus ke litar rumah
b. **Wayar neutral** = menyalurkan arus keluar dari rumah
c. **Fius utama** = memotong arus jika arus terlalu besar
d. **Meter elektrik** = mengukur penggunaan kuasa elektrik
e. **Suis utama** = menghidupkan atau mematikan litar

f. Pemutus litar:
- **Pemutus litar bocor ke bumi** = memotong arus jika arus terlalu besar
- **Pemutus litar miniatur** = mengasingkan litar ke peralatan rumah yg berbeza

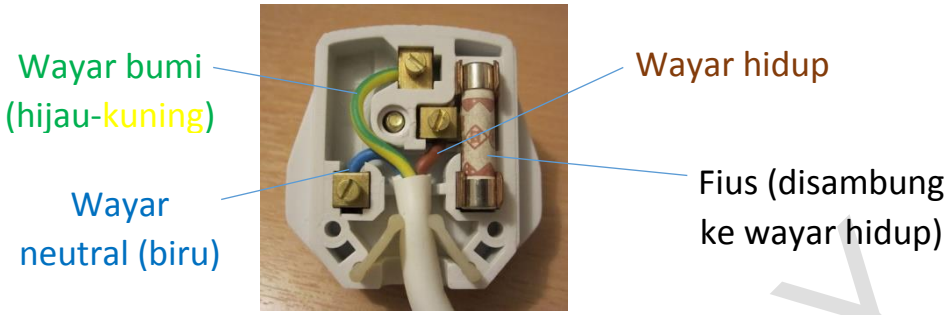
g. **Wayar bumi** = menyalurkan arus berlebihan ke bumi

3. Palam:

a. **Palam 2 pin** = untuk peralatan yang menggunakan arus kecil

b. **Palam 3 pin**
- untuk peralatan yang menggunakan arus besar (cerek elektrik, mesin basuh, peti sejuk)

- mempunyai dawai bumi untuk menyalurkan arus berlebihan ke bumi
- rajah:



4. Nilai fius <u>harus lebih tinggi sedikit</u> daripada bekalan semasa (tambah sedikit!)
- jika bekalan arus adalah 10A, nilai fius hendaklah sekitar 11A-15A

5. Keselamatan dalam penggunaan peralatan elektrik:

- Kita tidak boleh menggunakan terlalu banyak peralatan dalam satu soket:

- ini boleh menyebabkan **bebanan kuasa** yang menyebabkan **litar pintas**
- litar pintas boleh menyebabkan kebakaran

6.4 PENGIRAAN KOS PENGGUNAAN ELEKTRIK

5 formula dibincangkan:

1) Kecekapan tenaga
2) Kuasa elektrik
3) Arus elektrik
4) Voltan
5) Kos penggunaan tenaga elektrik

1. **Kecekapan tenaga** = peratusan output tenaga berbanding input

$$\text{Kecekapan} = \frac{\text{Output tenaga berguna}}{\text{Input tenaga dibekalkan}} \times 100\%$$

- Membandingkan kecekapan tinggi & rendah (dikenal pasti dengan label kecekapan tenaga):

Kecekapan tinggi (banyak bintang)	Kecekapan rendah (kurang bintang)
- Jimat tenaga, mesra alam - Kos tenaga rendah - Perkakas mahal tapi lebih selamat - Contoh: lampu LED	- Bazir tenaga, tidak mesra alam - Kos tenaga tinggi - Perkakas murah & kurang selamat - Contoh: Lampu filamen

2. 2 formula untuk **kuasa**, P (W):

$= \frac{\text{Tenaga, E (J)}}{\text{masa, t}}$	P = Arus, I (A) x Voltan, V (V) P = IV

3. **Arus elektrik & voltan:**

Arus elektrik, I (A)	Voltan, V (V)

= Cas elektrik, Q (C) masa, t (s)	= Tenaga, E (J) Cas, Q (C)

4. Kos penggunaan tenaga elektrik:

= Kuasa (kW) x masa (j) x kos seunit

- Bagaimana menjimatkan kos elektrik?

a. Gunakan perkakas kecekapan tinggi
b. Kurangkan penggunaan perkakas berkuasa tinggi

c. Aplikasikan konsep **bangunan hijau:**
- sistem pengudaraan & tumbuhan untuk mengurangkan penggunaan kipas & penghawa dingin
- panel kaca untuk membolehkan pencahayaan semula jadi & mengurangkan penggunaan lampu
- panel solar sebagai sumber tenaga alternatif

#FINISH_CHAPTER_6