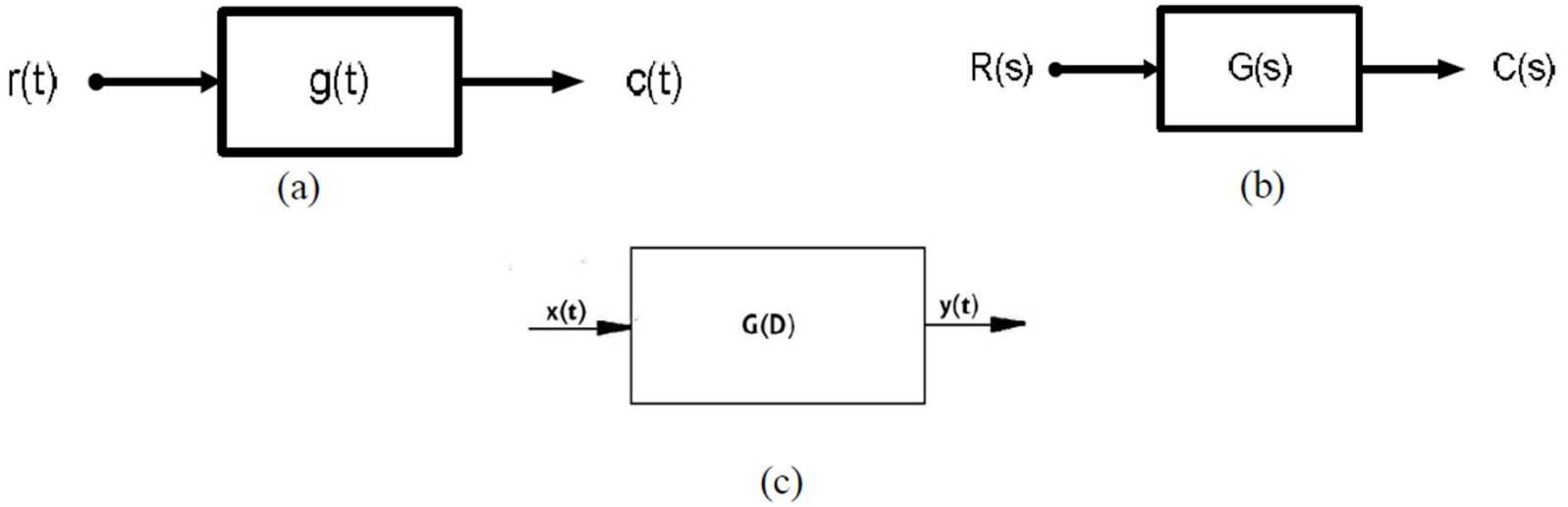
Transfer Function

Definition: It is the ratio of Laplace transform of output signal to Laplace transform of input signal assuming all the initial conditions to be zero, i.e.



(a) A system in time domain, (b) a system in frequency domainand (c) transfer function with differential operator

G(s) is the transfer function of the system. It can be mathematically represented as follows.

$$G(s) = \left.\frac{C(s)}{R(s)}\right|_{zero \quad initial \quad condition}$$

Properties of Transfer function:

Zero initial condition

It is same as Laplace transform of its impulse response

Replacing ‘s’ by *d/dt* in the transfer function, the differential equation can be obtained

Poles and zeros can be obtained from the transfer function

Stability can be known

Can be applicable to linear system only

Advantages of Transfer function:

It is a mathematical model and gain of the system

Replacing ‘s’ by *d/dt* in the transfer function, the differential equation can be obtained

Poles and zeros can be obtained from the transfer function

Stability can be known

Impulse response can be found

Disadvantages of Transfer function:

Applicable only to linear system

Not applicable if initial condition cannot be neglected

It gives no information about the actual structure of a physical system

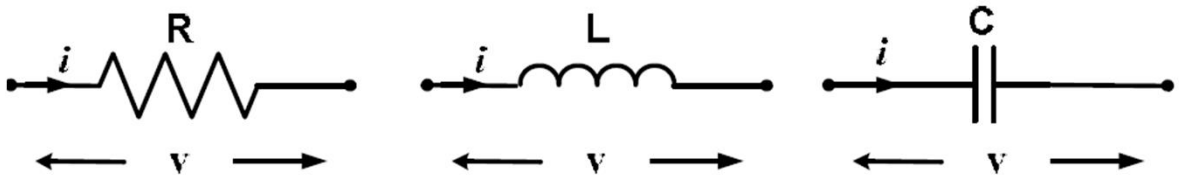
Components of an electrical system: There are three basic elements in an electrical system, i.e. (a) resistor (R), (b) inductor(L) and (c) capacitor (C).

Electrical systems are of two types,
(i) voltage source electrical system and (ii) current source electrical system.

Voltage source electrical system: If i is the current through a resistor(Fig. and v is the voltage drop in it, then $v = Ri$.

If i is the current through an inductor (Fig. and v is the voltage developed in it, then $v = L\frac{di}{dt}$.

If i is the current through a capacitor(Fig. and v is the voltage developed in it, then $v = \frac{1}{C}\int idt$.



Current source electrical system:

If i is the current through a resistor and v is the voltage drop in it, then $i = \frac{v}{R}$.

If i is the current through an inductor and v is the voltage developed in it, then $i = \frac{1}{L}\int v dt$.

If i is the current through a capacitor and v is the voltage developed in it, then $i = C\frac{dv}{dt}$.