ELECTRICAL SCIENCE-II (15B11EC211)

Jaypee Institute of Information & Technology, Sector 62
Dr Rachna Singh

ELECRTICAL SCIENCE-2 (15B11EC211)

At the end of the course, students will be able to:

S.No.	Course Outcomes	Cognitive levels/Blooms taxonomy
CO1	Study and analyze the complete response of the first order and second order circuits with energy storage and/or non-storage elements.	Analyzing (C4)
CO2	Understand two-port network parameters and study first order, second order passive filters.	Understanding (C2)
CO3	Study the properties of different types of semiconductors, PN junction diode, zener diode and analyze diode applications.	Analyzing (C4)
CO4	Study the characteristics, operation of bipolar junction transistor (BJT) and its biasing, stability aspects.	Understanding (C2)

Course Description

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1	Transient Analysis	First order network analysis, sequential switching, Differential equation approach for DC and Non constant source, second order network analysis using differential equation approach for DC and non-constant source	8
2	Two Port Network Parameters	Definition of Z, Y, h and transmission parameters and their conversions	7
3	Introduction to filters	First order and Second order (Low pass, High pass, Band pass and Band Stop) RLC Filters	4
4	Introduction to Semiconductor	Semiconductor Physics - Energy Band Model, Carrier Statistics, Intrinsic Semiconductors, Extrinsic Semiconductors, Fermi Level, Charge densities in a semiconductor Carrier Mobility and Drift Current, Hall Effect, Recombination of charges, diffusion and conductivity equation.	5
5	Diodes & Applications	PN Junction, Biasing the PN Junction, Current–Voltage Characteristics of a PN Junction, PN Junction Diodes, Half Wave Rectifier & Full Wave Rectifier, Clipper & Clamping Circuits, Zener Diodes and applications, Line and load regulations	8
6	Bipolar Junction Transistor	Transistor Construction and Basic Transistor Operation, Transistor Characteristics (CE, CB, CC), Transistor Biasing & Stability,	10

Evaluation Criteria and Recommended Books

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25
Total	100

Recommended Reading material: (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)	
1.	R.C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 9th ed, John Wiley & Sons, 2013.
2.	Charles K. Alexander (Author), Matthew N.O Sadiku, "Fundamentals of Electric Circuits", 6th ed, Tata Mc Graw Hill, 2019.
3.	Oppenheim, A.V., Willsky, A.S. and Nawab, S.H., Signals and Systems. Prentice-Hall.
4.	Abhijit Chakrabarti, Circuit Theory Analysis and Synthesis, 7th ed, Dhanpat Rai & Co. 2018.
5.	Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th ed, Prentice Hall of India, 2014.
5.	Jacob Millman, Millman's Electronic Devices and Circuits (SIE), 4th ed, McGraw Hill Education, 2015.

- If a circuit has one C or L then ***circuit becomes dynamic*** **means**
  - Its behaviour is a function of time.
    - Its behaviour is described by a (set of) differential equation(s).
    - It has a transient response as well as a steady state.
- Resistive circuits have no transient
  - When the switch is turned on, the voltage across R becomes V **immediately (in zero time).**

RL and RC circuits are called first-order circuits

Capacitor

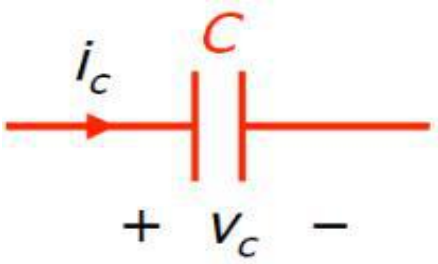
- C = □A/d

Where

□ = dielectric constant

A = Area of plates

d= Distance between plates



- Q = CV

Capacitor voltage deposits a charge Q.

C = Constant of proportionality, it is capacitance of capacitor

- Current

$$\frac{1}{C}\int_{-\infty}^{t} i(t)dt$$

- Voltage

$$i_C = C\frac{dv_c}{dt}$$

- Energy in capacitor

$$w_c(t) = \int_{-\infty}^{t} vi\ dt$$

$$w_c(t) = \int_{-\infty}^{t} vC\frac{dv}{dt}\ dt$$

- $w_c(t) = \int_{-\infty}^{t} vC\,dv$

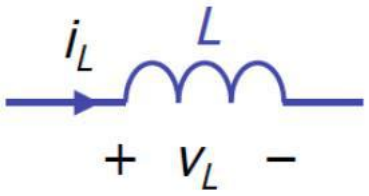
- $w_c(t) = \frac{1}{2}cv^2$

Capacitor was uncharged at t=-∞, v(-∞)=0

- Unit of C is Farad

Inductor

- $L = \frac{\mu N^2 A}{l}$



- N = No of turns
- A = Cross-sectional area of core
- l= length of winding
- μ= permeability

Voltage = $v_L = L\frac{di_L}{dt}$

- Current $\frac{1}{L}\int_{-\infty}^{t} v(t)dt$

- Energy in inductor

$$w_L(t) = \int_{-\infty}^{t} vi\, dt$$

$$w_L(t) = \int_{-\infty}^{t} iL\frac{di}{dt}\, dt$$

$$w_L(t) = \int_{-\infty}^{t} iL\, di$$

- $w_L(t) = \frac{1}{2} L i^2$

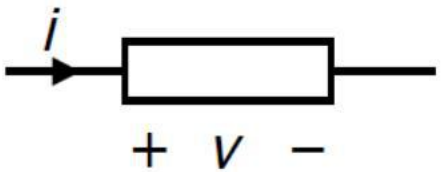
Capacitor was uncharged at t=-∞, i(-∞)=0

- Unit of L is Henry

Resistor

- Resistance

$$R = \frac{\rho l}{A}$$



- A = Cross-sectional area
- l= length of conductor
- ρ = resistivity

- Ohms law

$$v = i\,R$$

Initial Condition of Switched circuit

- Circuit include more than one switch that opens or closes at time t_0
- $t_o^- = \ time\ immediately\ before\ the\ switch\ opens\ or\ closes$
- $t_o^+ = time\ immediately\ after\ the\ switch\ opens\ or\ closes$

Steady State:

- When the circuit have been in a position for long time at t = t_0
- Circuit that contains only one constant source and is at steady state is called DC circuit.
- In DC circuit
  - Capacitor acts like open circuit
  - Inductor acts like short circuit
- Series and parallel capacitors, inductors and resistors can be reduced to equivalent values