**UNIT-I**

**TWO PORT RF NETWORKS-CIRCUIT REPRESENTATION**

**Session – I: Microwave & Radio Engineering Date:13.7.13 period:3**

Activity: Questionnaires and brainstorming

Questionnaires and brainstorming on radio frequency:

* What is electromagnetic?
* Nature of electrons
* Spectrum of electromagnetic.
* What is radio frequency?
* Need for microwave frequency?
* Where it is used?
* What is radio frequency networks and where it is applicable?

Presentation slides on application:

Thunder: generation, causes and relation to static fields

Flight fuelling: charge discharging mechanism during fuelling

Painting : description of eventual distribution of paints by the application of static fields

Analysis & description of frequency band:

* Frequency band range
* Uses of each range in communication

Activity: Role play by some students

Naming some individuals with frequency bands and services provided by it. Each student is remembered by their frequency band and services.

Ex: Student **Lakshmni** will be assigned with **L** band 1.00 -2.00GHz Audio broadcasting, mobile.

Activity: slides presentation

Topic: Analysis & description on Low frequency parameters:

* Low frequency parameters

Z, Y, h, ABCD parameters.

* Difficulties of low frequency parameters over high frequency

Equipments not availability,

Not possible of s/c, & o/c,

Unstable due to active devices as power amplifier, tunnel diodes

* Matrix form of impedance parameters and its equation derivation
* Matrix form of admittance parameters and its equation derivation

Conclusion &Summary: recall by key words

* Impedance& admittance
* S band range
* Ku band range
* K band range
* X band range

**Session – II**: **Low frequency parameters Date:15.7.13 period:1**

Activity:Questionnaires & discussion

Topic:Questionnaires & discussion on low frequency parameters

* What are low frequency parameters?

Z, h, Y and ABCD parameters

* Low frequency ranges

Less than 3 MHz

* Impact on wavelength

λ=c/f

* Skin effect

Arises with high frequency propagation (ie current flow is more in the rim of the conductor)

Activity: slides presentation

Topic: Analysis & description on Low frequency parameters:

* Matrix form of hybrid parameters
* Equation derivation of hybrid parameters

<http://ux.brookdalecc.edu/fac/engtech/andy/engi242/bjt_models.pdf>

<https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&cad=rja&ved=0CFAQFjAG&url=http%3A%2F%2Fhutchens.okstate.edu%2Fecen3314%2Fsedra42021_appB.ppt&ei=76JxUpWHBoG4rgeu2oHgAg&usg=AFQjCNHskxq5GL967idQ-LQDfoqjuqLDKQ>

* Matrix form of ABCD parameters
* Equation derivation of ABCD parameters

<http://www.egr.uh.edu/courses/Ece/ECE6351-5317/SectionJackson/Class%20Notes/Notes%2014%20-%20Network%20analysis.pptx>

<http://seminarprojects.com/s/abcd-parameters-transmission-line-ppt>

<https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&ved=0CEgQFjAF&url=http%3A%2F%2Fwww.ece.mcmaster.ca%2F~junchen%2Fch16_twoportnetworks.ppt&ei=oqNxUq2ACsmOrQeNi4HADQ&usg=AFQjCNFSUumQea-z0axBOYRev-kSnYP6zg>

Conclusion & summary: recall by key words

* Hybrid parameters
* ABCD parameters
* L band uses
* C band uses

**Session – III:High frequency parameters Date:15.7.13 period:6**

Activity: Questionnaires and brainstorming

Questionnaires and brainstorming on Disadvantages of low frequency parameters:

* Why low frequency components are not same as in high frequency range?
* Which limits the difference?
* Disadvantage of low frequency parameters.

Activity: slide presentation

Description in needs for high frequency parameters:

* Necessary of reflection coefficient
* Matching networks
* Power balance
* VSWR

Activity: broad activity

Description inFormulation of Scattering matrix (S) parameter:

* Formation of scattering matrix presentation- two port network
* Insertion lossin S-parameters
* Attenuation loss in S-parameters
* Reflection & return loss in S-parameters

Conclusion & summary: List by key words

* S11 or S22
* S21 or S12
* Reflection coefficient
* Standing wave ratio
* Transmission coefficient

**Session – IV: Properties of S-matrix Date:16.7.13 period:2**

Activity: Brainstorming & Discussion

Brainstorming & Discussion on S-parameters:

* Formation of S-parameter
* Need for it
* Factor representing it

Activity: slides presentation

Analysis & Description

* Properties of S matrix: zero diagonal

for an ideal n-port n/w with matched termination Sii = 0 (no reflection from any port) under perfect matched condition diagonal elements of [S] are zero

* Properties of S matrix: Reciprocal network

The two-port network is reciprocal if the transmission characteristics are the same in both directions (i.e. S21 = S12). A network is reciprocal if it is equal to its transpose. Stated mathematically, for a reciprocal network

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Conclusion & summary: recall by key words:

* Reciprocal network
* Diagonal element
* Unitary element
* Condition for reciprocal network
* Lossless network

**Session –V:Properties of S-matrix Date:16.7.13 period:8**

Activity: Brainstorming & Discussion

Brainstorming & Discussion on S-parameters:

* Formation of S-parameter
* Need for it
* Factor representing it
* Unitary elements
* Diagonal elements
* Reciprocal networks

Activity: presentation

Analysis & Description

* Properties of S matrix:

Phase shift and its effect in change of reference planes

* Properties of S matrix: Lossless network

**** In terms of scattering parameters, a network is lossless if

where [*U*] is the unitary matrix



Conclusion & summary: recall by key words:

* Condition for lossless network
* Phase shift matrix
* Diagonal element
* Unitary element
* Transpose matrix

**Session –VI Date:18.7.13 period:3**

Activity: Brainstorming &discussion

Brainstorming & discussion on

* Low frequency parameters

Z, Y, h, ABCD parameters

* High frequency parameters

S-matrix

Activity: slides presentation

Analysis & Derivation:

* Transmission matrix

<https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&ved=0CDYQFjAC&url=http%3A%2F%2Fwww.me.utexas.edu%2F~jensen%2FORMM%2Finstruction%2Fpowerpoint%2For_models_09%2F12_dtmc1.ppt&ei=QKpxUvKcN82Srgfek4CoBw&usg=AFQjCNEOD24aszscwvdUXWVdulLW56DXcA>

* Relation to impedance Matrix



* Equivalent circuit for two port n/w

Circuits, formation, incident & reflected waves

Conclusion & summary: recall by key words:

* Low frequency hybrid equation
* Low frequency ABCD equation
* Low frequency admittance equation
* High frequency S matrix equation

**Session –VII**

Recap:

* Passive components:
* wire & resister at low frequency range
* separate for high frequency parameter

Activity: slides presentation

* RF components: wire
* Wire equivalent circuit

Images view:

<http://www.google.co.in/search?q=images+of+RF+WIRES&biw=1366&bih=667&tbm=isch&tbo=u&source=univ&sa=X&ei=7DHkUfrcJcr5rAedlIGgDw&ved=0CDIQsAQ>

Activity: slides presentation

* RF components: Resistor

its equivalent circuit & types

* Images view of RF wire and resistor types

Image :

<http://www.google.co.in/search?q=images+of+RF+WIRES&biw=1366&bih=667&tbm=isch&tbo=u&source=univ&sa=X&ei=7DHkUfrcJcr5rAedlIGgDw&ved=0CDIQsAQ#tbm=isch&sa=1&q=images+of+RF+resistors&oq=images+of+RF+resistors&gs_l=img.3...301778.308116.0.309454.14.14.0.0.0.0.0.0..0.0...0.0.0..1c.1.17.img.RGICJWayxGI&bav=on.2,or.r_qf.&bvm=bv.48705608,d.bmk&fp=ccb0357be71b2467&biw=1366&bih=667>

Conclusion & summary: recall by key words

* Skin effect
* Materials used as wire, resistor, inductor, capacitor
* Carbon composition resistor
* Wire wound resistor
* Thin-film chip resistor
* Impedance curve

**Session –VIII**

Recap:

* Passive components:
* wire & resister at low frequency range
* separate for high frequency parameter
* Passive components: capacitor & Inductor at low frequency range

Activity: slides Presentation

* RF components: Capacitor
* its equivalent circuit
* Images view

Images :

[http://www.google.co.in/search?q=images+of+RF+WIRES&biw=1366&bih=667&tbm=isch&tbo=u&source=univ&sa=X&ei=7DHkUfrcJcr5rAedlIGgDw&ved=0CDIQsAQ#tbm=isch&sa=1&q=images+of+RF+capacitors&oq=images+of+RF+capacitors&gs\_l=img.12...122198.135957.4.140092.25.24.0.0.0.0.3069.28650.3j4-3j1j6j3j3j5.24.0...0.0.0..1c.1.17.img.9Z1SKw-uGt8&bav=on.2,or.r\_qf.&bvm=bv.48705608,d.bmk&fp=ccb0357be71b2467&biw=1366&bih=667](http://www.google.co.in/search?q=images+of+RF+WIRES&biw=1366&bih=667&tbm=isch&tbo=u&source=univ&sa=X&ei=7DHkUfrcJcr5rAedlIGgDw&ved=0CDIQsAQ#tbm=isch&sa=1&q=images+of+RF+capacitors&oq=images+of+RF+capacitors&gs_l=img.12...122198.135957.4.140092.25.24.0.0.0.0.3069.28650.3j4-3j1j6j3j3j5.24.0...0.0.0..1c.1.17.img.9Z1SKw-uGt8&bav=on.2,or.r_qf.&bvm=bv.48705608,d.bmk&fp=ccb0357be71b2467&biw=1366&bih)

Activity : slides Presentation:

* RF components: RF components: Inductor
* its equivalent circuit & types
* Images view

<http://www.google.co.in/search?q=images+of+RF+WIRES&biw=1366&bih=667&tbm=isch&tbo=u&source=univ&sa=X&ei=7DHkUfrcJcr5rAedlIGgDw&ved=0CDIQsAQ#tbm=isch&sa=1&q=images+of+RF+inductors&oq=images+of+RF+inductors&gs_l=img.12...7129.7129.10.9338.1.1.0.0.0.0.0.0..0.0...0.0.0..1c.1.17.img.7-6hKaX5fyo&bav=on.2,or.r_qf.&bvm=bv.48705608,d.bmk&fp=ccb0357be71b2467&biw=1366&bih=667>

Conclusion & summary: recall by key words

* ESR- Effective Series Resistance
* DF- Dissipation factor
* Power factor
* Insulation resistance
* Types of capacitor
* Quality factor in inductor
* Advantages of magnetic core materials used in inductor design

**Session – IX**: Application of radio frequency

Activity: Brainstorming:

* Limitation of S-parameters
* Why S-parameters used
* Advantages of S-parmeters

Activity: slides Presentation & Discussion

* Application of radio frequency at
* Industries
* Consumer applications
* Communications

Video Presentation on working of RF Micro oven:

Link:

* [www.youtube.com/watch?v=kp33ZprO0Ck](http://www.youtube.com/watch?v=kp33ZprO0Ck)
* [www.youtube.com/watch?v=FGdwEPEU61U](http://www.youtube.com/watch?v=FGdwEPEU61U)
* [www.wimp.com/microwaveoven/](http://www.wimp.com/microwaveoven/)
* <http://www.youtube.com/watch?v=JcbPxBnyUVQ&feature=related>

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