Class Lectures of **ECE-3105 Microwave Engineering** (Section B)

Department of Electronics and Communication Engineering (ECE)

Khulna University of Engineering & Technology (KUET)

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| **Year** | **3rd**  |  **Term** | **1st**  |  **Credit Hour : 3** |
|  **ECE** | **3105** |  |  |  **Microwave Engineering** |
| **Rationale:** This course is designed to get the knowledge about Microwave Devices and its frequency spectrum. Because Microwave is one of the most important part of communication system. This course is useful for the students to know about microwave transmission lines (wave guides), matching techniques and its application. It uses different types of industry, scientific and medical purposes. It also uses as the transmitting source of Satellite and RADAR. The students also can get the knowledge about its harmful effect and it’s protecting technique.  |
| **Course Objectives :*** To provide the students and researchers with an understanding of fundamental principles of microwave transmission lines, its characteristics and matching technique.
* To match the transmission line with stub and to calculate the impedance using the smith chart.
* To measure and calculate the properties of transmission line of wave guides.
* To provide the students with an understanding of fundamental knowledge about Microwave measurements.
* To know the comparative performance analysis of Microwave Tubes, Circuits and its Applications.
* To know about the Microwave Solid State Devices.
* To know the industrial, scientific and medical applications of microwaves.
* To know about the hazards of microwave and protective technique while working in different industry with microwave.
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| **Course Contents** |
| **Section A****Transmission lines**: Microwave Transmission Lines, Transmission Line Analogy, Impedance Matching Techniques, Smith Chart and Its Applications.**Wave Guides:** Waves Propagation in Guided Media; Propagation through Parallel-Plate Wave Guides, Rectangular and Circular Wave Guides, Dominant and degenerate modes, Field patterns, Cavity Resonators.**Section B****Microwave Tubes:** Microwave systems, Classification of microwave tubes, Klystron amplifier, Reentrant cavities, Velocity Modulation, Space Charge wave, Multicavity Klystron Amplifier, Reflex Klystron Oscillator. Magnetron, Travelling Wave Tube (TWT) Amplifier, Backward Wave Oscillator (BWO), Waveguide Components. **Solid State Microwave Devices:** Gunn diode, Energy band structure of Gunn diode, Gunn oscillator, Different modes of Gunn diode oscillator, Application of Gunn diode, PIN diode as modulator, Solid state devices used as microwave amplifier, Applications of solid state microwave devices.Industrial applications of Microwaves, Microwave Heating, Microwave Radiation Hazards. |

**Section B**

 **Lectures: 1st**

1. Fundamentals of Conventional and Microwave Vacuum tubes. Why conventional electronic vacuum tubes fail to operate above the frequency 1 GHz? [A das 9.1]

**Lectures: 2nd**

1. Different types of Microwave Vacuum Tubes. What do you mean by ‘O’ type & ‘M’ type tubes? Classify them. [Das+Liao]

**Lectures: 3rd and 4th**

1. Describe the operation of Reflex Klystron Oscillator/Describe the mechanism of oscillation of Reflex klystron Oscillator.
2. Higher modes occurs at lower repeller voltages and lower modes occurs at higher repeller voltage for RKO. Justify the statement.
3. Draw the circuit Diagram of Reflex klystron oscillator.
4. Explain the mode of oscillation of Reflex klystron oscillation (RKO)

**Lectures: 5th and 6th**

1. Define; beam coupling coefficient, Transit time, Depth of modulation, Density modulation & Beam current.
2. Find out the value of rms output power of RKO. 
3. Find out the value of efficiency of RKO.  = 0.3986/N
4. Application of R.K.O.

**Lectures: 7th and 8th**

1. Block Diagram of Two cavity klystron Amplifier.
2. Draw the Applegate Diagram of Two-cavity klystron amplifier.
3. Describe the operation of two cavity klystron amplifier.
4. Performances and applications - Kennedy\_359
5. What does mean beam loading?
6. How the band width of klystron amplifier can be improved? [9.23]

**Lectures: 9th and 10th**

1. Draw the circuit Diagram of TWTA.
2. Explain the operation of TWTA.
3. Give the analytical Description of TWTA.
4. Classify the TWTA & write down its application. Kennedy\_378-379
5. What are the difference between klystron amplifier & TWTA?

**Lectures: 11th and 12th**

1. Describe the operation of Magnetron.
2. Describe the effect of Electric field & Magnetic field of Magnetron.
3. Find out the value of Hull-cut off Magnetic field of Magnetron.

i.e. Bc=(8Vom/e).-----------

1. Find out the value of cut-off voltage of Magnetron. i.e Vc=.........
2. Classify the Magnetron tube & Give it’s application. Kennedy\_371-373

**Lectures: 13th**

1. Describe the operation of Backward wave oscillation (BWO). Kennedy\_384
2. Applications of BWO.

**Lectures: 14th, 15th and 16th**

1. What are the purposes for Microwave Semiconductor devices? [A Das 10.1]
2. Why microwave solid state devices have replaced the electron beam devices? [A Das 10.1]
3. Classify the microwave diodes and write the applications of different microwave diodes. [A Das 10.2]
4. Write down the short note on i) IMPATT ii)TRAPATT iii)BARITT iv)Tunnel diodes[A Das 10.4-10.5]
5. Compare the characteristics among 3 diodes IMPATT, TRAPATT and BARITT .

**Lectures: 17th**

1. What are the adverse effects of high power Microwave radiations? /What are hazards effects of Electromagnetic Radiation? [A Das 12.1]
2. Describe the hazards of Electromagnetic Radiation to Personnel. [A Das 12.2]
3. Radiation Hazards level for Personnel and its limit. [A Das 12.5- 12.6]
4. How can we protect our self from Electromagnetic Radiation effect? [A Das 12.7]

**Lectures: 18th**

1. What are the advantages of microwave communications over medium/short wave communications? [A Das 11.3]
2. What is terrestrial system? Draw the block diagram of terrestrial microwave communication system. [A Das 11.3.1]
3. What is fading? Classify different types of fading and describe them. [A Das P-431-432]
4. Describe the causes of attenuation for atmospheric multipath fading. [A Das P-431]
5. What is transponder? Draw the block diagram of a transponder. [A Das 11.3.2]
6. What are the applications of Microwaves? [A Das 11.4]
7. Write down the mechanism of microwave heating.
8. Draw the heating system of Microwave Ovens and describe the cooking system of Microwave ovens.

**Lectures: 19th** All Examples (Chpt 9), 11.4 [A Das and S K Das]

 9.2.1, 9.3.1, 9.5.1, 10.1.1, 10.4.1 [Liao]

**References:**

* Microwave Engineering - A K Das and S K Das
* Microwave Devices and Circuits - Lio
* Electronic Communication Systems - Kennedy

**(Prof. Dr. Md. Mostafizur Rahman )**