SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution

Coimbatore-35

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

16EC402- MICROWAVE AND OPTICAL ENGINEERING

IV YEAR/ VII SEMESTER

UNIT I-MICROWAVE ACTIVE DEVICES

TOPIC 5-TWO CAVITY KLYSTRON AMPLIFIER

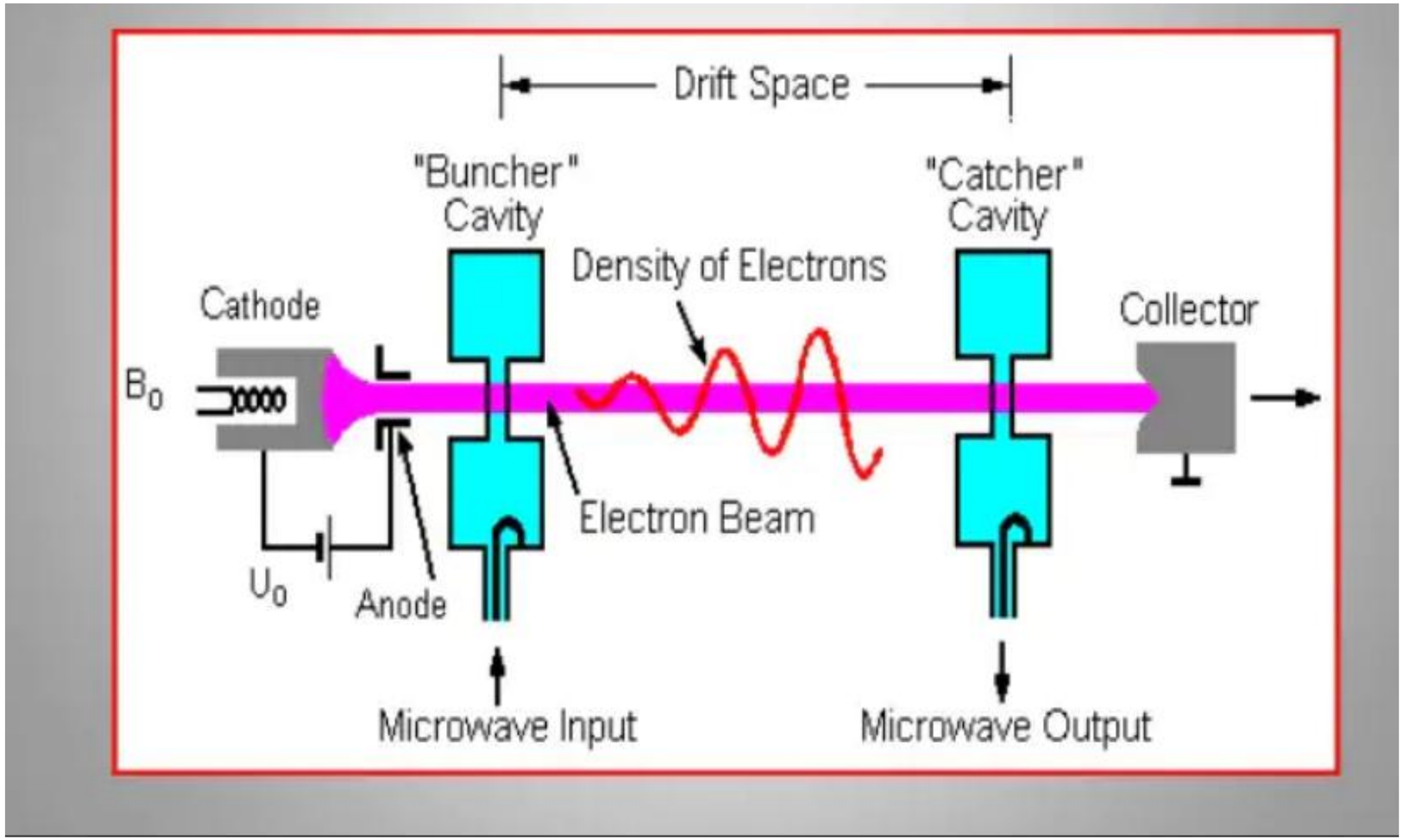
CONTENTS

- Introduction of Two Cavity Klystron
- Construction of Two Cavity Klystron
- Two Cavity Klystron Amplifier
- Performance Characteristics
- Application

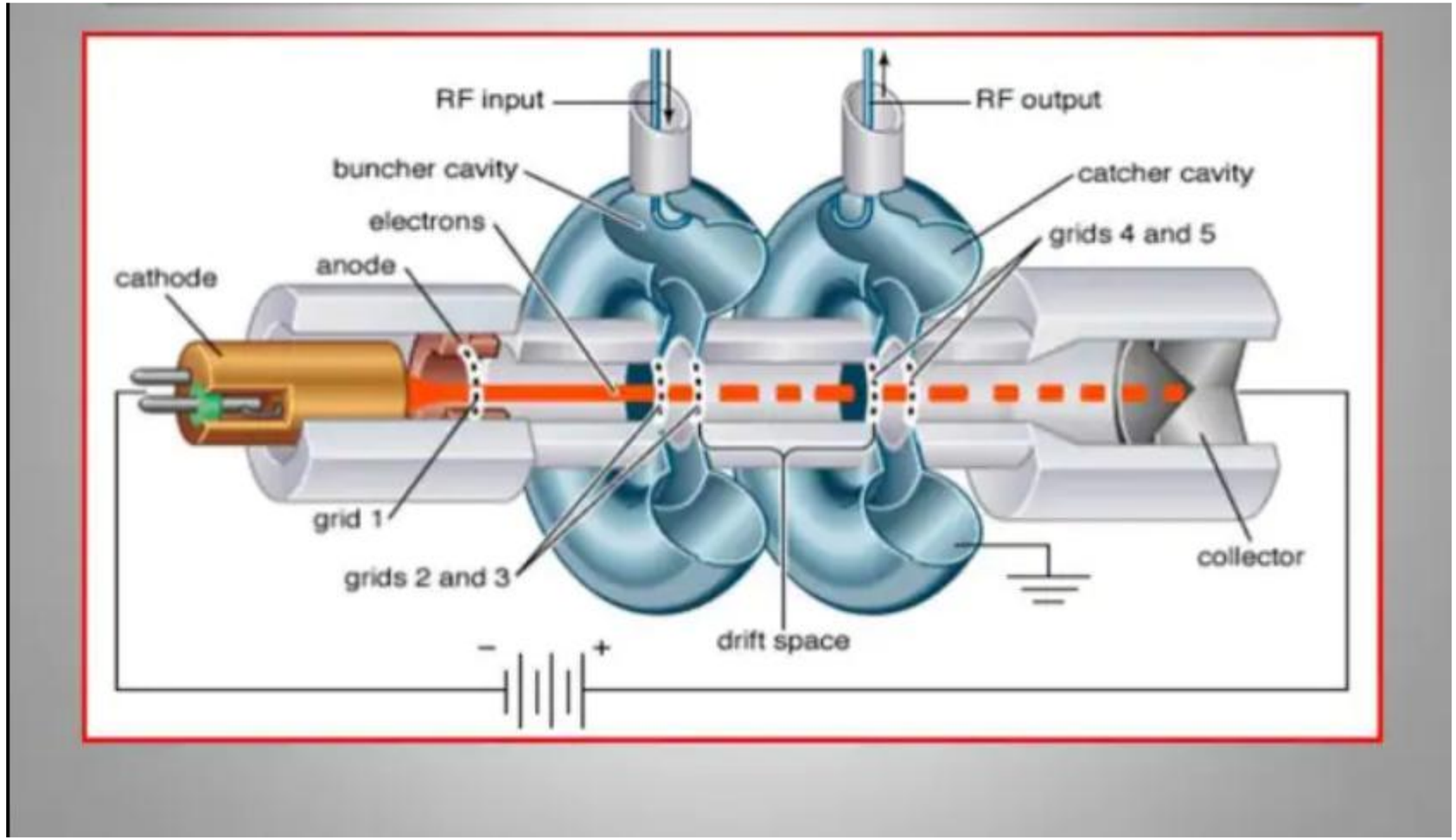
INTRODUCTION

- A Klystron is a vacuum tube that can be used either as a generator or as an amplifier or as an oscillator, at microwave frequencies.
- The Klystron is a linear beam device; that is, the electron flow is in a straight line focused by an axial magnetic field.
- The velocities of electrons emitted from the cathode are modulated to produce a density-modulated electron beam.

Construction of Two cavity Klystron



Two cavity klystron Amplifier



WORKING

- The first grid next to the cathode controls the number of electrons in the electron beam and focuses the beam.
- The voltage accelerates the DC electron beam to a high velocity before injecting it into the grids of the buncher cavity.
- The grids of the cavity enable the electrons to pass through, but they confine the magnetic fields within the cavity
- Electrons traversing the interaction space when the RF potential on grid 3 is positive with respect to grid 2 are accelerated by the field.
- The decelerated electrons give up energy to the fields inside the buncher cavity, while those that have been accelerated absorb energy from its fields.

Performance Characteristics

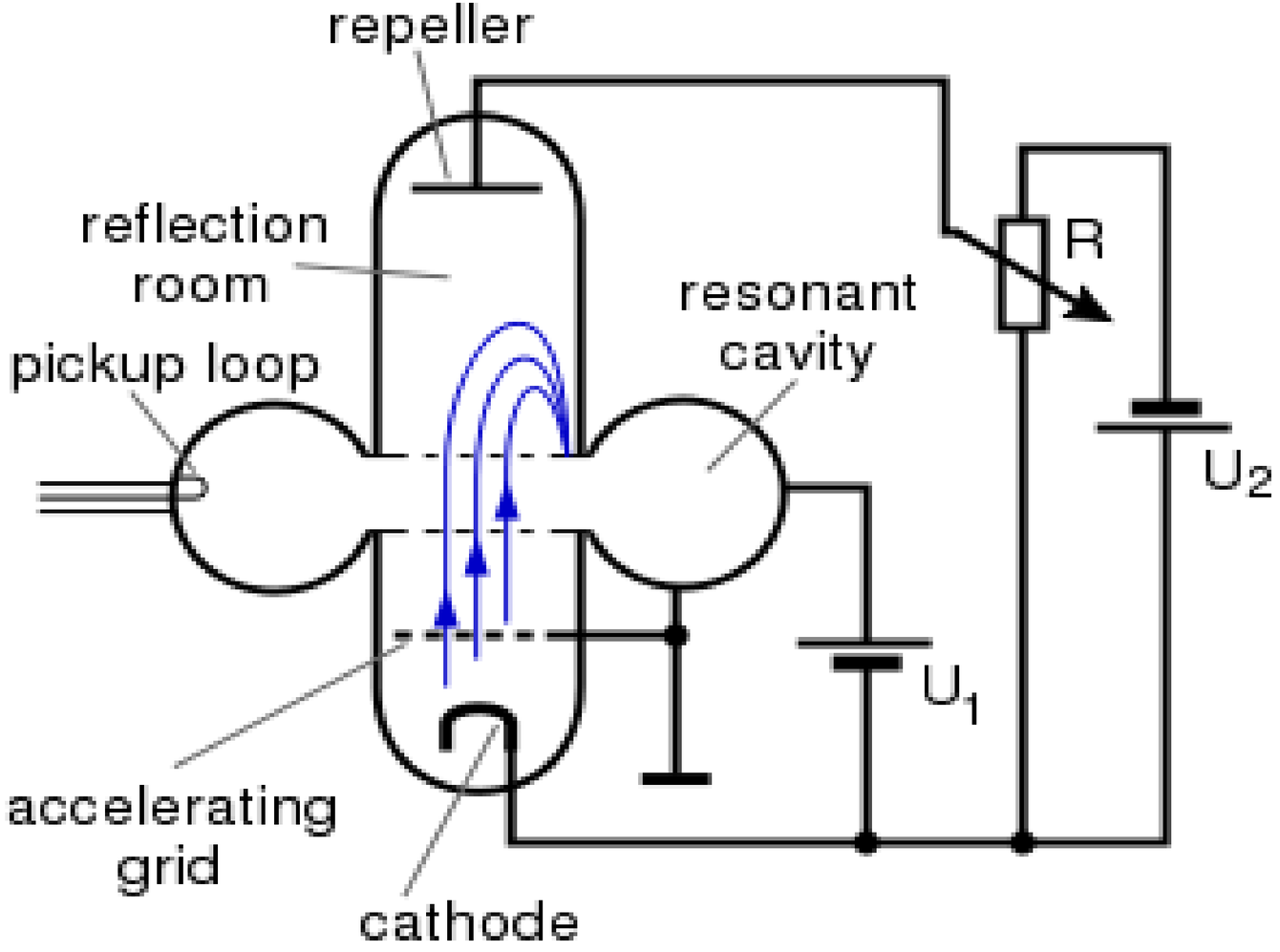
- Frequency : 250 MHz to 100 GHz (60 GHz nominal).
- Power : 10 kW – 500 kW (CW) 30 MW (pulsed).
- Power Gain : 15 dB – 70 dB (60 dB nominal).
- Bandwidth : Limited 10 – 60 MHz Generally used in fixed Freq. application.
- Noise Figure : 15 – 20 dB
- Theoretical Efficiency : 58 % (30 – 40 % nominal).

Application

- **As power output tubes**
  1. in UHF TV transmitters
  2. in troposphere scatter transmitters
  3. Satellite communication ground station
  4. Radar transmitters
- **As power oscillator** (5 – 50 GHz), if used as a klystron oscillator

There are two basic configurations of klystron tubes

1. **Reflex Klystron** used as a low-power Microwave oscillator
2. **Multi cavity klystron** used as low-power microwave amplifier



Modes of oscillation

- The electrons should return after 1¾, 2 ¾ or 3 ¾ cycles – most optimum departure time.
- If **T is the time period at the resonant frequency**, t_o is the time taken by the reference electron to travel in the repeller space between entering the repeller space and returning to the cavity at positive peak voltage on formation of the bunch

Then, $t_o = (n + ¾)T = NT$

Where $N = n + ¾$, $n = 0,1,2,3$…….

N – mode of oscillation.

Applications

1. Radar receivers
2. Local oscillator in microwave receivers
3. Signal source in microwave generator of variable frequency
4. Portable microwave links
5. Pump oscillator in parametric amplifier

THANK YOU