GOVERNMENT POLYTECHNIC COLLEGE, BHILWARA

CLASS TEST - 2017-18

ELECTRONICS III YEAR

MICROWAVE AND OPTICAL FIBER ENGINEERING - EL 304

Time - 1 Hour

Max. Marks-15

Q.1. What are the advantages and applications of microwave. [3 marks]

Ans. Advantages of Microwave-

(i) Large Bandwidth - BW of microwave is larger than the common low frequency radio waves. Thus more information can be transmitted.

(ii) Better directivity - As wavelength decreases Directivity increases and beam width decreases. So microwave has better directivity. so it is easier to design high gain antenna.

(iii) Low power Consumption - The power required to transmit a high freq. signal is lesser than the power required in transmission of low freq. signals. As microwaves have high freq. thus requires less power.

(iv) Effect of fading - The effect of fading is minimized by using Line of sight propagation technique. while at low freq. signals, the layers around the earth causes fading of the signal.

Applications of Microwave-

(i) Communication - Microwave is used in broadcasting and telecommunication transmissions. It is also used in satellite communication for TV transmission and telephony links.

(ii) Remote Sensing - Microwave is used in free air space traffic control and in RADAR and SONAR. Radiometry is also one of the remote sensing application of microwave.

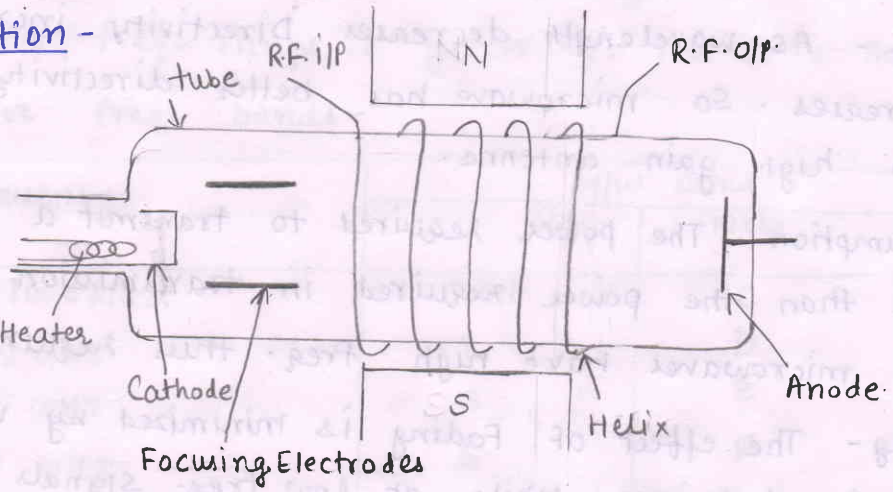
(iii) Heating - We use microwave in microwave oven to bake and cook food. Microwave oven working principle is based on the vibration of the electrons present in the food particles.

(iv) Medical Science - Microwave's heating property is used in medical Science. It is used in diagnosis and various therapies.

Q.2. Write construction and working principle of travelling wave tube (TWT). [6 marks]

Ans. The travelling wave tube can be used as a medium or high power microwave amplifier. The TWT, because of its construction and working principle has enormous bandwidths and low noise. The heated cathode at one end of the tube produced a beam of electrons and is attracted to the collector at the other end of the tube. The i/p signal is fed at one end of the tube and amplified version of the i/p signal is taken from the other end.

Construction -



As shown in fig. the TWT consists of a glass tube or envelope in which heater, cathode, frequency electrons and anode are located. A conducting wire is wound around the glass envelope to which i/p and o/p are connected. A permanent magnet is also kept around the envelope over the helix or conducting spring focussing electrodes are used to keep the electron beam right in the center. The permanent magnet is used to produce the slow speed of electrons. The wire given the shape of spring in order to slow down the speed of e^- emitted from the cathode.

Working

When we switch on the circuit the cathode starts the emission of electrons. The focussing electrodes focus these electrons in a narrow beam at the center of the tube. These electrons travel toward the anode and if no signal is applied at the helix then the emitted

electrons will be collected by the anode without any obstruction. When the R.F. signal is applied at the i/p the positive half cycle will be accelerate the speed of electrons emitted by the cathode and -ve half cycle will de-accelerate the speed of electrons. As a result the electrons will be found in bunches and it will travel towards the anode. The volume of bunch will become stronger and stronger as the electrons approaches towards the anode end. Therefore at the o/p end of the helix, there will be a strong electric field created by the buncher which will result to produce the amplified o/p signal.

The magnet is used around the helix in order to produce the strong magnetic field which causes the e^- beam to remain in the center. The helix is used as a slow structure because if from i/p to o/p we use a straight wire, then the speed of electrons through the straight will be more w.r.t. speed of e^- emitted from cathode hence, no amplification will take place.

In case of helix, the speed of e^- moving in the helix synchronized with the speed of e^- emitted by the cathode, therefore this system is known as slow wave structure.

3. What is acceptance angle and numerical aperture of a optial fibre cable (OFC)? [3 marks]

Ans. Numerical aperature (NA) is the light gathering ability or capacity of an optical fiber. More the numerical aperture, the more efficient will be fiber. It is also known as figure of merit of optical fiber cable.

NA is related to refractive index of core (n_1), cladding (n_2) and outside medium (n_0) as -

$$NA = \frac{\sqrt{n_1^2 - n_2^2}}{n_0}$$

if the medium is air then $n_0 = 1$, then

$$\boxed{NA = \sqrt{n_1^2 - n_2^2}}$$

Acceptance Angle(θ): It is the maximum angle made by the light ray with the fiber axis, so that light can propage through the fiber after total internal reflection. Relation b|w numerical aperture and acceptance angle is given by -

$$NA = \sin\theta$$

$$\theta = \sin^{-1}(NA)$$

Acceptance angle = $\sin^{-1}$ (Numerical aperture)

Q.4. Write down the microwave frequency bands. [3 marks]

Ans. Microwave freq. range is given by 1 GHz to 300 GHz.

Microwave freq. bands -

Frequency	M/w Band	
	old	New
500-1000 MHz	VHF	C
1- 2 GHz	L	D
2-3 GHz	S	E
3-4 GHz	S	F
4-6 GHz	C	G
6-8 GHz	X	H
8-10 GHz	X	I
10-12.4 GHz	X	J
12.4-18 GHz	Ku	J
18-20 GHz	K	J
20-26.5 GHz	K	K
26.5-40 GHz.	Ka	K

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