Program :	**Diploma in Electronics Engineering / Electronics and Communication Engineering**
Course Code : **5043B**	Course Title: **Microwave Devices and Radar**
Semester : **5**	Credits: **4**
Course Category: **Program Elective**	
Periods per week: **4 (L:4, T:0, P:0)**	Periods per semester: **60**

Course Objectives:

- To provide conceptual knowledge of microwave devices, antennas and RADAR.
- To provide the fundamental ideas of microwave communication, and RADAR navigation.

Course Prerequisites:

Topic	Course code	Course Title	Semester
Electromagnetic theory and antenna		Principles of Electronic Communication	3

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO1	Explain the theory and operation of microwave devices.	14	Understanding
CO2	Explain the working principle of microwave generators and various microwave antennas.	16	Understanding
CO3	Outline the operation of microwave semiconductor devices.	14	Understanding
CO4	Explain the concept of Radar, and its applications.	14	Understanding
	Series Test	2	

CO-PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2						
CO2	2						
CO3	2						
CO4	2						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Explain the theory and operation of microwave devices**.		
M1.01	List microwave frequency ranges	2	Remembering
M1.02	Summarize microwave system	2	Understanding
M1.03	Outline reflection coefficient, transmission coefficient and S-Matrix	3	Understanding
M1.04	Explain microwave waveguides and components	7	Understanding
Contents: **Introduction:** microwave devices, microwave systems. Reflection coefficient, transmission coefficient, S-Matrix. Waveguides and Components - Rectangular waveguides- modes (TEM, TE, TM) concept only, **Directional Couplers:** directivity, coupling factor, S-Matrix. Basic idea and S-matrix of Circulator, Isolator, and Magic Tee.			
CO2	**Explain the working principle of microwave generators and various microwave antennas.**		
M2.01	Explain the working principle of Klystron and Reflex Klystron	4	Understanding
M2.02	Summarize the working principle of Magnetron and TWT	4	Understanding
M2.03	Define basic parameters of antenna- Gain, Directivity, Radiation pattern	4	Remembering
M2.04	Classify different antennas- Dipole antenna, Horn antenna, parabolic reflector antenna.	4	Understanding

	Series Test I	1	
Contents: **Microwave linear beam tubes:** Klystron and Reflex Klystron, magnetron oscillators, Travelling wave tube amplifier. **Basic parameters of antenna:** Gain, Directivity, Radiation pattern **Classify different antennas:** Dipole antenna- Gain, directivity and radiation pattern, Horn antenna, Parabolic reflector antenna- working			
CO3	**Outline the operation of microwave semiconductor devices.**		
M3.01	Explain the working principle of Microwave BJT & Tunnel diode	4	Understanding
M3.02	List the applications of Tunnel diode	2	Remembering
M3.03	Explain the working principle of PIN Diodes	4	Understanding
M3.04	Show the construction of Gunn diode. Explain Gunn effect, List the applications of Gunn diode	4	Understanding
Contents: Principle of Microwave BJTs and TUNNEL Diodes-Principle of operation. PIN Diode - working principle. TEDs-advantages, Gun diode -Gunn Effect.			
CO4	**Explain the concept of Radar, and its applications.**		
M4.01	Explain the block diagram of Radar	2	Understanding
M4.02	Classify the Radar frequency ranges, to list the applications of Radar	2	Understanding
M4.03	Derive Radar range equation	2	Understanding
M4.04	Summarize the operation of pulse RADAR and CW RADAR	4	Understanding
M4.05	Explain the operation and block diagram of FM CW RADAR	4	Understanding
	Series Test II	1	
Contents: Radar - concept - block diagram - operation - applications - range equation - derivation (no problems) - Radar performance factors - Signal to Noise ratio - Radar cross section of targets - transmitter power - pulse repetition frequency. Doppler effect – Block diagram and operation of CW Radar - Block diagram and operation of pulse Radar- Block diagram and operation of FM CW Radar.			

Text / Reference:

T/R	Book Title/Author
T1	Merril I.Skolnik "Introduction to Radar systems" - Tata Mc Graw Hill
T2	Samuel Y.Liao "Microwave Devices and circuits" - Pearson
T3	Kennedy "Electronic Communication Systems" - Tata Mc Graw Hill
R1	Wayne Thomas "Advanced Communication systems" -Pearson
R2	G.S.N.Raju "Microwave Engineering" -I K International

Online resources:

Sl.No	Website Link
1	https://www.microwaves101.com/encyclopedias/s-parameters
2	https://www.iare.ac.in/sites/default/files/lecture_notes/2.%20MWE%20LECTURE%20NOTES.pdf
3	https://www.radartutorial.eu/01.basics/Radar%20Principle.en.html
4	http://www2.eng.ox.ac.uk/communications/research/rf-and-microwave-systems/radar-systems-and-antennas/fm-radar
5	https://www.tutorialspoint.com/radar_systems/radar_systems_range_equation.htm