



# MANIPAL INSTITUTE OF TECHNOLOGY

## MANIPAL

(A constituent unit of MAHE, Manipal)

### SECOND SEMESTER M.TECH. (DEFENCE TECHNOLOGY)

### END SEMESTER EXAMINATIONS, MAY 2024

### RADAR TECHNOLOGIES (AAE 5280)

REVISED CREDIT SYSTEM

Time: 3 Hours

Date: 5<sup>th</sup> MAY 2024

Max. Marks: 50

#### Instructions to Candidates:

- ❖ Answer **ALL** the questions.
- ❖ Missing data may be suitably assumed.

Q.NO	Questions	Marks	CO	BTL
1A.	Draw the block diagram of radar and explain the function of each block.	(4)	CO 1	3
1B.	List out the effects of atmospheric attenuation on radar performance.	(4)	CO 3	2
1C.	What is a clutter and how it affects the performance of Radar.	(2)	CO 1	3
2A.	For a radar antenna the radiation intensity of an Antenna is $\cos^4\theta$ for the $0 \leq \theta \leq 90^\circ$ with $0 \leq \Phi \leq 360^\circ$ . Find maximum directivity for $f = 10$ GHz.	(4)	CO 3	4
2B.	Explain (i) Radar antenna aperture (ii) RCS	(4)	CO 1	3
2C.	What is the total phase difference of a wave when reflected from the ground surface?	(2)	CO 3	2
3A.	Explain with detailed diagram any one type of high power amplifier used at radar transmitter.	(4)	CO 4	2
3B.	Draw and explain the block diagram of active radar array using T/R modules.	(4)	CO 4	2
3C.	What is a duplexer, what is its use in radar?	(2)	CO 1	3
4A.	Matched filter in radar is implemented by convolving the reflected echo with the time reversed transmit pulse. Show an example using digitized sequence the implementation process of matched filter using convolution process	(4)	CO 3	3
4B.	What is principle concept of imaging radar? How it is similar or different from synthetic aperture radar.	(4)	CO 6	2

<b>4C.</b>	Calculate the range resolution for a pulse having a bandwidth of 1 GHz.	<b>(2)</b>	<b>CO 4</b>	<b>2</b>
<b>5A.</b>	Derive the radar range equation.	<b>(4)</b>	<b>CO 4</b>	<b>2</b>
<b>5B.</b>	Calculate the maximum range of radar for the following specifications. <ul style="list-style-type: none"> <li>• Operating frequency, <math>f = 10</math> GHz</li> <li>• Peak power transmitted by the Radar, <math>P_t = 400</math> KW</li> <li>• Effective aperture of the receiving Antenna, <math>A_e = 5 \text{ m}^2</math></li> <li>• Radar cross section of the target, <math>\sigma = 30 \text{ m}^2</math></li> </ul> Power of minimum detectable signal, $S_{\min} = 10^{-10} \text{ W}$	<b>(4)</b>	<b>CO 3</b>	<b>4</b>
<b>5C.</b>	For a radar, explain the following (i) pulse width (ii) range resolution, (iii) bandwidth and (iv) matched filter.	<b>(2)</b>	<b>CO 4</b>	<b>2</b>