KUMARAGURU
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Register Number:……

M.TECH DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Second Semester

DEFENCE TECHNOLOGY

P18DTT2017: Radar Technologies

COURSE OUTCOMES

CO1: Understand the design of radar systems, solve range equations.

CO2: Apply appropriate mathematical and computer models relevant to radar systems to calculate system performance, and assess the limitations of particular cases

CO3: Understand the major components of a modern radar system

CO4: Learn basic radar signal processing techniques.

CO5: Understand advanced radar techniques.

CO6: Know the major functions and applications of a modern radar system.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Assertion (A): Rain attenuation increases at higher radar frequencies. CO2 [K_2]
   Reason (R): Shorter wavelengths are more affected by scattering and absorption in rain.
   a) Both A and R are true, and R is the correct explanation of A
   b) Both A and R are true, but R is not the correct explanation of A
   c) A is true, but R is false
   d) A is false, but R is true

2. What is the major source of clutter in airborne radar systems? CO1 [K_2]
   a) Atmospheric absorption
   b) Reflections from stationary objects like terrain
   c) Signal attenuation
   d) Target motion

3. What is the function of a duplexer in a radar system? CO3 [K_2]
   a) Amplify the received signal
   b) Allow a single antenna to transmit and receive
   c) Filter out noise from the received signal
   d) Adjust the frequency of the radar wave

4. Matching type item with multiple choice code CO5 [K_2]

List I	List II
A. Synthetic Aperture	i. Surface mapping
B. Phased Array	ii. Multiple target tracking
C. Inverse SAR	iii. Imaging moving targets
D. X-band	iv. Weather monitoring

	A	B	C	D
a)	i	ii	iii	iv
b)	ii	iii	i	iv
c)	iii	ii	i	iv
d)	i	iii	ii	iv

5. Assertion (A): Micro-Doppler processing can identify the motion of target components. CO4 [K_2]
Reason (R): Micro-Doppler shifts occur due to small, rapid motions within a target.

a) Both A and R are true, and R is the correct explanation of A
b) Both A and R are true, but R is not the correct explanation of A
c) A is true, but R is false
d) A is false, but R is true

6. Which of the following is NOT an advanced radar technique? CO5 [K_2]

a) Pulse compression
b) Beam steering
c) Frequency modulation
d) Image sharpening

7. What is the primary goal of pulse compression in radar systems? CO4 [K_2]

a) Increase the range
b) Improve resolution
c) Reduce noise
d) Enhance power output

8. Assertion (A): Phased array radar is suitable for tracking fast-moving targets. CO6 [K_2]
Reason (R): Phased array radar can dynamically steer its beam without mechanical movement.

a) Both A and R are true, and R is the correct explanation of A
b) Both A and R are true, but R is not the correct explanation of A
c) A is true, but R is false
d) A is false, but R is true

9. Which atmospheric condition causes ducting in radar signals? CO2 [K_2]

a) High humidity
b) Temperature inversion
c) Low pressure
d) Heavy precipitation

10. Sequence the following radar signal processing steps: CO4 [K_2]

1. Clutter suppression

2. Pulse compression
3. Signal detection

a) a) 2 → 3 → 1
b) b) 3 → 2 → 1
c) c) 1 → 2 → 3
d) d) 2 → 1 → 3

PART B (10 x 2 = 20 Marks)

11.	Evaluate the evolution of radar systems from basic pulse radars to modern digital radars.	CO1	[K_2]
12.	Define radar cross-section (RCS) and explain its significance.	CO2	[K_2]
13.	Describe how atmospheric conditions affect radar signal propagation.	CO3	[K_2]
14.	Summarize the functions of a radar duplexer?	CO4	[K_3]
15.	Explain the concept of pulse compression in radar signal processing.	CO5	[K_3]
16.	How does a phased array radar achieve beam steering without moving parts?	CO6	[K_2]
17.	Outline the primary functions of radar?	CO1	[K_2]
18.	What is clutter in radar systems, and how is it mitigated?	CO2	[K_2]
19.	Compare surveillance radar and tracking radar?	CO3	[K_2]
20.	What is Synthetic Aperture Radar (SAR) and its application?	CO5	[K_2]

PART C (10 x 5 = 50 Marks)

21.	Explain the working principles and design considerations of radar antennas.	CO3	[K_3]
22.	Discuss the effects of ducting and rain attenuation on radar performance.	CO2	[K_2]
23.	Explain the concept of the signal-to-noise ratio (SNR) and how it affects radar detection performance.	CO1	[K_3]
24.	Describe the function and implementation of Doppler filtering in radar systems.	CO4	[K_2]
25.	Compare conventional radar and phased array radar in terms of functionality and applications.	CO5	[K_4]
26.	Enumerate the limitations of radar systems and methods to overcome them.	CO1	[K_2]
27.	Describe the Neyman-Pearson criterion for radar detection.	CO2	[K_2]
28.	Explain how mono pulse radar improves angular accuracy in target tracking.	CO3	[K_2]
29.	Illustrate the concept of micro-Doppler processing and its applications	CO4	[K_2]
30.	Compare adaptive beamforming techniques used in phased array radars. Discuss their applications in tracking and imaging.	CO6	[K_4]

c

31.	Derive the radar range equation considering the impact of system losses and discuss its application to calculate radar system performance in realistic environments.	10	CO1	[K_4]
32.	Explain the design and operational principles of a radar transmitter. Identify and discuss how advancements in solid-state transmitters have improved modern radar systems.		CO3	[K_3]
33.	Explain the working principle of the Kalman Filter in radar tracking and analyze its strengths and limitations in real-world radar systems.		CO4	[K_4]

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