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**B.Tech. DEGREE EXAMINATION, JUNE 2023**  
Sixth and Seventh Semester

**18ECE221T – RADAR AND NAVIGATIONAL AIDS**

*(For the candidates admitted from the academic year 2018-2019 to 2021-2022)*

Note:

- (i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40<sup>th</sup> minute.
- (ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours

Max. Marks: 100

**PART – A (20 × 1 = 20 Marks)**

Answer **ALL** Questions

- |   | Marks | BL | CO | PO |
|---|-------|----|----|----|
| 1. Calculate the peak power of a radar that operates at a PFR of 1000 Hz with a pulse width of 2 $\mu$ s and at an average power of 100 W.<br>(A) 50 kW (B) 500 kW<br>(C) 1000 kW (D) 100 kW  | 1     | 2  | 1  | 2  |
| 2. Duplexer isolates<br>(A) Transmitter while transmitting (B) Receiver while receiving<br>(C) Receiver while transmitting (D) Display unit   | 1     | 1  | 1  | 1  |
| 3. Select the factor on which the maximum range of radar depends<br>(A) Pulse duration (B) Pulse energy<br>(C) Pulse frequency (D) Doppler frequency  | 1     | 1  | 1  | 1  |
| 4. Choose the two-way transmission loss for ground based radome<br>(A) 8 dB (B) 5 dB<br>(C) 2.4 dB (D) 1.2 dB   | 1     | 1  | 1  | 1  |
| 5. The parabolic antenna feed designed to maintain the plane of polarization as it rotates above the axis is called<br>(A) Nutating feed (B) Rotating feed<br>(C) Axial feed (D) Gain control | 1     | 1  | 2  | 1  |
| 6. The clutter spectrum at zero frequency is<br>(A) Not a delta function (B) A Gaussian function<br>(C) A delta function (D) Not a Gaussian function  | 1     | 1  | 2  | 1  |
| 7. Non-coherent MTI radar uses _____ as the reference signal.<br>(A) Local oscillator signal (B) Intermediate frequency signal<br>(C) Doppler frequency (D) Clutter echo signals              | 1     | 1  | 2  | 1  |
| 8. For precise, target location and tracking, radars operate in<br>(A) S band (B) X band<br>(C) C band (D) K band   | 1     | 1  | 2  | 1  |



9. Pick the factor that determines the resolution of cell in the range dimension at low grazing angle 1 1 3 1  
 (A) Radar pulse width (B) Elevation beam width  
 (C) Azimuth beam width (D) Signal power
10. Mention the phenomena that occurs when the refractive gradient of atmosphere is in the range of 0 to -79 1 1 3 1  
 (A) Sub refraction (B) No refraction  
 (C) Normal refraction (D) Ducting
11. Target's radial profile can be obtained if the following condition is satisfied 1 2 3 1  
 (A)  $\frac{f}{2} \ll D$  (B)  $\frac{c\tau}{2} \ll D$   
 (C)  $2c\tau \ll D$  (D)  $\frac{c\tau}{4} \ll D$
12. The maximal length sequence generated from an 4-stage shift register before repeating the sequence is 1 2 3 2  
 (A) 16 (B) 18  
 (C) 15 (D) 1
13. TACAN operates in 1 2 5 1  
 (A) VLF band (B) UHF band  
 (C) HF band (D) Microwave band
14. \_\_\_\_\_ antenna is used for direction finding at low and medium frequencies. 1 1 5 1  
 (A) Horn (B) Patch  
 (C) Loop (D) Slot
15. Choose the angle of inclination of the glide slope with respect to the moving flight deck 1 2 5 2  
 (A) 3° (B) 8°  
 (C) 3.5° (D) 4°
16. The marker beacons operate at frequency of 1 2 5 1  
 (A) 1 kHz (B) 75 mHz  
 (C) 1 kHz (D) 100 Hz
17. Matched filter is 1 1 4 1  
 (A) A low pass filter (B) A high pass filter  
 (C) A band pass filter (D) An SNR optimizing circuit
18. Slow wave structure is present in 1 1 4 1  
 (A) Klystron (B) Magnetron  
 (C) Dematron (D) TWT
19. Balanced mixer 1 1 4 1  
 (A) Contains one local oscillator (B) Does not contain local oscillator  
 (C) Contains two local oscillator (D) Contains three local oscillators



20. The preferred magnetron mode of operation is

(A)  $\frac{\pi}{2}$  mode

(B)  $\frac{\pi}{4}$  mode

(C)  $\pi$  mode

(D)  $\frac{3\pi}{2}$  mode

1 1 4 1

**PART – B (5 × 4 = 20 Marks)**

Answer ANY FIVE Questions

Marks BL CO PO

21. Discuss the Swerling Target model to represent the target fluctuations.

4 3 1 1

22. An MTI radar receives indicated a Doppler shift from an automobile as 1.0KHz. The radar is operating at a frequency of 10GHz with a PFR of 1KHz. Find the speed of the automobile.

4 4 2 2

23. Enumerate in detail the process involved in automatic detection.

4 3 3 1

24. The noise figure of the individual stages of a two – stage amplifier is 2.03 and 1.54, respectively. The available power gain of the first stage is 62. Find the overall noise figure.

4 4 4 2

25. Describe TACAN System.

4 3 5 1

26. The unambiguous range of a radar is 200km. It has a bandwidth of 1MHz. Find the required, pulse repetition frequency, Pulse repetition time, range resolution and pulse width.

4 4 1 2

27. Draw the block diagram of non-coherent MTI Radar.

4 3 2 1

**PART – C (5 × 12 = 60 Marks)**

Answer ALL Questions

Marks BL CO PO

28. a. i. The Radar is fitted with an antenna and it has a radius of 0.5m. The operating frequency of the Radar is 8GHz with a bandwidth of 0.5MHz. The radar cross section is 5m<sup>2</sup> at a maximum distance of 12km. Find peak transmitter power if the noise figure is 4.77dB.

6 4 1 2

ii. Illustrate with suitable diagram the determination of correct range with changing pulse repetition frequency.

6 4 1 1

(OR)

b. Analyze the effect of various system losses in the detection of correct target range with respect to range equation.

12 4 1 1

29. a. With neat block diagram, explain the different types of delay line cancellers.

12 3 2 1

(OR)

b. i. Explain the principle of operation of Conical Scan tracking radar.

8 3 2 1

ii. MTI radar operates at 5GHz with a pulse repetition frequency of 1KHz. Calculate the first, second and third lower blind speeds of the radar.

4 4 2 2



30. a. Explain the various pulse compression techniques in detail. 12 3 3 1

(OR)

b. i. Derive the frequency response of matched filter. 6 3 3 1

ii. Derive the surface clutter Radar range equation. 6 3 3 1

31. a. Explain the VHF phase comparison automatic direction finder. 12 3 5 1

(OR)

b. Describe the operation of Instrument Landing System. 12 3 5 1

32. a. With the help of a neat sketch, explain the operation of Klystron Power Amplifier. 12 3 4 1

(OR)

b. Explain the role of mixer in super heterodyne receiver. Discuss in detail the different types of mixers. 12 3 4 1

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