

ASSIGNMENT NO 1 [LO4] - (100 Marks Total)

Instructions

- Answer all ten questions clearly and analytically, following final-year undergraduate standards.
- Use relevant technical concepts from ECM and radar systems to support your explanations, adding diagrams where useful.
- Write answers in your own words, presenting well-structured arguments with proper organization.
- The design-type question must include a logically developed and justified ECM strategy.
- Submit the assignment neatly formatted and on time, following departmental submission guidelines.

1. Explain how range resolution and pulse width are related in radar systems. Using examples from the document, discuss why pulsewidth becomes a critical parameter for threat radar identification. **(10 marks)**
2. Describe the concept of range gating and range gate tracking. Discuss how these techniques contribute to improved tracking accuracy in target tracking radars (TTR). **(10 marks)**
3. Compare and contrast noise jamming and deceptive range jamming, explaining their operational principles and impacts on radar performance. **(10 marks)**
4. Radar tracking accuracy is fundamentally dependent on beamwidth and antenna characteristics. Analyse how beamwidth, side lobes, and polarization affect target detection and susceptibility to ECM. **(10 marks)**
5. Discuss the strengths and vulnerabilities of Conical Scan (Con Scan) and Track-While-Scan (TWS) radars when subjected to Electronic Countermeasures. Provide real-world implications for aircraft survivability. **(10 marks)**
6. Explain how pulse repetition frequency (PRF), stagger, and jitter contribute to reducing ECM susceptibility. Evaluate how these PRF patterns complicate the function of repeater jammers **(10 marks)**

7. Compare the three missile guidance methods described—Command Guidance, Homing Guidance, and Beam Rider Guidance. Evaluate the ECM vulnerabilities associated with each method. **(10 marks)**

8. Electronic Counter-Countermeasures (ECCM) ensure continued radar performance under jamming. Discuss the roles of AGC, IAGC, MTI, and LORO as ECCM techniques, highlighting their operational value and limitations. **(10 marks)**

9. Radar Warning Receivers (RWRs) rely on “fingerprints” to identify and classify threats. Describe the RWR identity word structure and explain how parameters such as frequency band, pulse width band, PRF patterns, scan, and missile guidance correlation collectively improve threat recognition. **(10 marks)**

10. Assume you are tasked with designing an integrated ECM response strategy for a modern fighter aircraft operating in an air defence zone containing Con-Scan AAA radars, TWS SAM radars, and CW missile illuminators. Using the principles presented in the document, develop a comprehensive ECM strategy that includes:

- Noise and deceptive jamming approaches
- Cooperative ECM tactics (if applicable)
- Techniques to counter CW-based homing missiles
- RWR-assisted situational awareness and pilot decision-making
- Limitations and potential risks of your design

Provide a structured and technically justified design. **(10 marks)**