ش ت ب/ش ت/ (ط-٤٦)
**Military Technical College**
**Branch of Educational and Research Affairs**
**Educational Affairs**

**Branch** : Electrical Engineering **Department** : Radar
**Course Code: ERD402** **Course Name:** Radar Electronic Warfare

| | |
|---|---|
| Year: 4th | Specialization: RA&GU |
| Term: Winter | Duration (weeks): 16 |
| Type of the course : A | Type of the Exam. : W |

| *Number of Hours* | *Week Hours* | | | *Total Hours* | | |
|---|---|---|---|---|---|---|
| | *Lec.* | *Ex.* | *Lab.* | *Lec.* | *Ex.* | *Lab.* |
| | *3* | *1* | *-* | *48* | *16* | *-* |
| *Total Number of Hours* | *4* | | | *64* | | |

## Course Description:

Electronic counter measures, basic definitions, concepts, missions. Main radar ECM techniques, active & passive jamming techniques and active& passive deception techniques. Radar range performance under jamming. Main radar ECCM techniques for enhancement of security, survivability, immunity, and interference suppression. ECM receivers, classification, parameters measured, and IFM receiver as an example.

## Course Objectives:

After completing this course, the student will be able to:

1- Evaluate the ECCM capabilities of different radar, or guidance systems.
2- To differentiate between different hostile ECM technique.
3- To calculate the effect of jamming on radar performance (maximum detection range.
4- To understand the mutual effects and the different links between ECM, ECCM and ESM measures.

## Instructional Materials:

Lecture notes

## References:

Electronic Warfare Fundamentals, November 2000.

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**Year** : *4th*
**Specialization** : Radar & Guidance

## Course Plan

| Item No. | Theme | Hours | | | | Remarks |
|---|---|---|---|---|---|---|
| | | *Tot* | *Lec* | *Ex* | *Lab* | |
| *1* | Introduction | **6** | **6** | **-** | **-** | |
| *2* | Electronic Counter measures | **6** | **4** | **2** | **-** | |
| *3* | ECM Techniques | **12** | **10** | **2** | **-** | |
| *4* | Radar Performance under jamming | **10** | **6** | **4** | **-** | |
| *5* | ECCM techniques | **14** | **10** | **4** | **-** | |
| *6* | Ew receivers | **8** | **6** | **2** | **-** | |
| *7* | Control tests | **8** | **6** | **2** | **-** | |
| Total | | **64** | **48** | **16** | **-** | |

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# Course Outlines

| Week | Lec | Lecture | Hrs | Exercise | Hrs | Lab | Hrs |
|---|---|---|---|---|---|---|---|
| 1 | 1 | Introduction & Electronic counter measure | 2 | | | | |
| | 2 | Introduction & Electronic counter measure | 2 | | | | |
| 2 | 3 | Introduction & Electronic counter measure | 2 | | | | |
| 3 | 4 | Introduction & Electronic counter measure | 2 | Assignment #1Active jamming | 2 | | |
| | 5 | Introduction & Electronic counter measure | 2 | | | | |
| 4 | 6 | ECM Techniques | 2 | | | | |
| 5 | 7 | ECM Techniques | 2 | Assignment #2 Radar performance under jamming | 2 | | |
| | 8 | ECM Techniques | 2 | | | | |
| 6 | 9 | 1st Control Test | 2 | 1st Control Test | | | |
| 7 | 10 | ECM Techniques | 2 | Assignment #3 Performance under jamming conditions | 2 | | |
| | 11 | ECM Techniques | 2 | | | | |
| 8 | 12 | Radar Performance under jamming | 2 | | | | |
| 9 | 13 | Radar Performance under jamming | 2 | Assignment #3 Performance under jamming conditions | 2 | | |
| | 14 | Radar Performance under jamming | 2 | | | | |
| 10 | 15 | Basic ECCM Techniques | 2 | | | | |
| 11 | 16 | 2nd Control Test | 2 | 2nd Control Test | | | |
| | 17 | 2nd Control Test | 2 | | | | |
| 12 | 18 | Basic ECCM Techniques | 2 | Assignment #4 Interference suppression and noise standardization technique | 2 | | |
| 13 | 19 | Basic ECCM Techniques | 2 | Assignment #4 Interference suppression and noise standardization technique | 2 | | |
| | 20 | Basic ECCM Techniques | 2 | | | | |
| 14 | 21 | Basic ECCM Techniques | 2 | | | | |
| | | EW Receivers | 2 | Assignment #5 IFM receiver | 2 | | |
| 15 | 22 | EW Receivers | 2 | | | | |
| | 23 | EW Receivers | 2 | | | | |
| 16 | 24 | Revision | - | Revision | | | |

## Grading System:

| | | | |
|---|---|---|---|
| Control Test 1 | 15 % | Control Test2 | 15 % |
| Teacher Opinion | 10 % | Final Exam | 60 % |

**Total** **100 %**

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| **Year** | : 4th | **Specialization** | : Radar& Guidance |

## Course Contents

**Chapter1**: **Electronic Counter Measures [ECM]**

1-1 Basic definition
1-2 Components of defiance system affected by ECM.
1-3 ECM concepts.
1-4 ECM missions
- stand off mission
- stand forward mission
- self screening (protection) mission
- Escort mission
-Mutual support mission

1-5 ECM Priorities

**Chapter2: ECM Techniques**

2-1 Active jamming techniques
- CW jamming
- Impulse jamming
- Spot noise jamming
- Barrage noise jamming
- Swept-spot noise jamming
- Smart noise jamming

2-2 Passive jamming
- Chaff
- Low flying
- Evasive maneuvers

2-3 Active Deception
- False target generation
- Range-gate stealer
- Velocity gate stealer
- Inverse gain
- Cross-eye angle deception
- Formation angle deception
- Blinking angle deception
- Cross- polarization

2-4 Passive deception
- Chaff
- Decoys
-Low observable

**Chapter 3: Radar range performance under jamming**
- The effective radiated jamming power(ERP)
- The effective radiated spectral density (ERD)
- The radar range equation in the presence of jamming (the burn through range considering different conditions of jamming)

**Chapter 4: Survey of basic ECCM Techniques**

4-1 Introduction

4-2 Security enhancement techniques
- Frequency camouflage
- Confusion techniques
- Deception techniques
- Masking techniques

4-3 Survivability enhancement techniques
- Burn through technique
- Prevention of receivers overloading
  - Feedback AGC
  - Feed forward AGC
  - Programmed AGC [STC]
  - Logarithmic reception

4-4 Interference immunity enhancement techniques
- Signal discrimination techniques
  - Spatial discrimination
  - Polarization discrimination
  - Frequency discrimination
  - Tracking techniques
  - Pulse width discrimination
  - Pulse reception frequency
- Identification techniques
- Optimization of signal processing
- System enhancement due to redundancy
  - Reliability and availability
  - Frequency divers radars
  - Frequency agile radar

4-5 Interference suppression and noise standardization techniques:

- CFAR processing
- Dicke-Fix
- MTI processing
- Doppler processing
- Side-lobe blanking
- Side-lobe cancellation

4-6 Techniques of mathematical game theory

**Chapter 5: EW receivers**

5-1 Introduction

5-2 Classification of intercept receivers

5-3 Parameters measurably EW receivers

5-4 Instantaneous Frequency Measurement receiver [IFM]

- Principle of operation
- Basic components
- The limiting amplifier
- Capture effect
- IFM receiver with multiple correlation
- Frequency digitizing window