Electronic Engineering

Specialization	Aeronautical Communication Engineering
Course Number	20406211
Course Title	Digital and Data Communication
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Brief Course Description:

- Basic communication systems, Introduction to information theory, Digital radio, FSK,PSK, QAM, Digital transmission, Pulse Code Modulation, Error detection and correction, Digital encoding, Multiplexing, OSI protocol architecture, TCP/IP Suite, Local Area Networks, Wide Area Networks.

Course Objectives:

After studying this course the student should

1. Describe basic communication systems and information theory concept.
2. Distinguish between analogue and digital communications.
3. Understand digital radio systems and digital modulation techniques.
4. Understand Digital transmission concept and Pulse Code Modulation.
5. Explain the concepts of error detection and correction and digital encoding.
6. Understand OSI and TCP/IP Protocol stacks and IP addressing.
7. Distinguish between Local Area and Wide Area, networks and services..

Detailed Course Description:

Unit Number	Unit Name	Unit Content	Time Needed
1.	**Basic Communication Systems**	▪ Types of communications: point-to-point, point-to-multipoint, simplex, half-duplex, full-duplex, broadcasting ▪ Transmission Impairments: attenuation distortion, delay distortion, noise ▪ Analogue vs. Digital Communications	
2.	**Digital Communications**	▪ Frequency Shift Keying (FSK): FSK transmitter and FSK receiver ▪ Phase Shift Keying (PSK): Binary PSK, BPSK transmitter and receiver, Quaternary PSK, QPSK transmitter and receiver, Offset QPSK, Eight-PSK, 8PSK transmitter and receiver ▪ Quadrature Amplitude Modulation (QAM): (Eight/Sixteen) QAM transmitter and receiver	
3.	**Digital Transmission**	▪ Pulse modulation: Pulse Width Modu ▪ lation, Pulse Position Modulation, Pulse Amplitude Modulation ▪ Pulse Code Modulation (PCM): Simplified PCM block, Sample-and-Hold circuit, PCM codes, Delta Modulation transmitter and receiver	
4.	**Digital Encoding and Multiplexing**	▪ Error Detection: Parity and Cyclic Redundancy Check ▪ Digital Encoding (NRZ, NRZI, Manchester) ▪ Multiplexing (FDM, ADM, WDM) ▪ Multiple Access: Time Division Multiple Access, Frequency Division Multiple Access	
5.	**Data Communication Protocols and Computer Networking**	▪ ISO/OSI protocol architecture: Overview, OSI reference model ▪ TCP/IP protocol suite: Operation of (TCP, UDP, and IP) ▪ IP addressing and subletting	
6.	**Transmission Media, LAN and WAN**	▪ Transmission media: Coaxial, Twisted pair, Fiber and Wireless communication ▪ Local Area Networks (LAN): Topologies, Media Access Control (MAC), LAN standards ▪ Wide Area Networks (WAN): WAN standards, WAN services	

Evaluation Strategies:

Exams		Percentage	Date
Exams	First Exam	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects		10%	
Discussions and lecture Presentations			

Teaching Methodology:

- Lecture

Text Books & References:

References:

1. "Advanced Electronic Communications Systems, Sixth Edition", Wayne Tomasi, Prentice Hall,2003.
2. "Principles of Digital Communication Systems and Computer Networks", K.V. Prasad, Charles River Media, 2003.

Electronic Engineering

Specialization	**Aeronautical Communication Engineering**
Course Number	**20406252**
Course Title	**Digital And Data Communication Lab**
Credit Hours	**1**
Theoretical Hours	**0**
Practical Hours	**3**

Brief Course Description:

- Introduction to Digital Communications, Pulse Code Modulation, Delta Modulation, Digital encoding and decoding, Time Division Multiplexing, Phase Shift keying, Frequency Shift Keying, Networking Media, Constructing Basic LAN, LAN Meters, Constructing Basic WAN.

Course Objectives:

Upon the completion of the course, the student will be able to :

1. Able to use Digital Communication Modulation Kit.
2. Constrict FSK/ PSK generator and detection circuit.
3. Be familiar with PCM, delta modulation.
4. Able to construct LAN cables (crossover, rollover, and straight).
5. Construct basic LAN network.
6. Troubleshoot basic LAN problems.
7. Be familiarized with basic router configuration

Detailed Course Description:

Lab Number	Lab Name	Lab Content	Time Needed
1.	Introduction to Digital Communication, Modulation Kit		
2.	Frequency Shift Keying generation and detection		
3.	Phase Shift Keying generation and detection		
4.	Pulse Code Modulation		
5.	Delta Modulation		
6.	Digital Encoding and Decoding		
7.	Time Division Multiplexing		
8.	Networking Media	▪ Straight, Crossover, and Rollover UTP cables ▪ Coaxial and Fiber cables	
9.	Basic LAN setup 1	▪ TCP/IP protocol, NETBUI protocol, LAN devices	
10.	Basic LAN setup 2	▪ Client/Server and Peer-Peer Networks, File Sharing and Security	
11.	Basic WAN setup 1	▪ Introduction to routers, Basic routing topology	
12.	Basic WAN setup 2	▪ Basic router configurations	

Evaluation Strategies:

Exams		Percentage	Date
Exams	Assignments	30%	--/--/----
	Med – term Exam	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects			
Discussions and lecture Presentations			

Teaching Methodology:

- ❖ Laboratory

Text Books & References:

References:

1. Lab manual.

Electronic Engineering

Specialization	**Aeronautical Communication Engineering**
Course Number	**20406121**
Course Title	**Aeronautical Telecommunication Workshop**
Credit Hours	**1**
Theoretical Hours	**0**
Practical Hours	**3**

Brief Course Description:

- Experiments in different Digital and analogue instruments such as, multi meters, bridges, watt meters, oscilloscopes, signal generators , frequency counter, phase meter, transistor and IC tester,AM/FM Signal Generator,RFvoltmeter,RF power meter,Spectrum analyzer.

Course Objectives:

Upon the completion of the course, the student will be able to :

1. Be familiarized with sub-assemblies and their functions, operations, calibration, precautions and applications
2. Extend their knowledge and skills in an aeronautical communication measurement equipment course
3. Develop their ability to solve practical problems
4. Perform experiments on different equipment sch as multimetres, generators, powermetrs.

Detailed Course Description:

Unit Number	Unit Name	Unit Content	Time Needed
1.	Introduction to instruments in the LAB and care of instruments		
2.	Analog and Digital Multi meters		
3.	The Universal Bridge		
4.	The Transistor and ICs Tester		
5.	The Oscilloscope (one channel)		
6.	The Digital storage Oscilloscope		
7.	A.F signal Generator & Pulse Generator		
8.	Function Generator (sine/square/saw tooth)		
9.	Two-Tone A.F signal Generator & phase Meter		
10.	Frequency Counter and AM/FM Signal generator		
11.	Electronic wattmeter . A.F (O/P power meter) and RF power meter.		
12.	Spectrum analyzer		

Evaluation Strategies:

Exams		Percentage	Date
Exams	Assignments	30%	--/--/----
	Med – term	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects			
Discussions and lecture Presentations			

Teaching Methodology:

- ❖ Laboratory

Text Books & References:

1. Electronic Circuits and Applications
2. Electronic Equipment reliability
3. Electronic Devices and Circuits, David Bell
4. Electronics TEC level DC Green
5. Moto application and maintenance/hand book
6. Manuals of test equipment and measuring equipment used in the lab

Electronic Engineering

Specialization	**Aeronautical Communication Engineering**
Course Number	**20406241**
Course Title	**Radio Wave Transmission**
Credit Hours	**3**
Theoretical Hours	**3**
Practical Hours	**0**

Brief Course Description:

- Types and characteristics of transmission lines , transmission line theory and application, resonant and non- resonant transmission lines , optical fiber theory and application, antenna theory, antenna terminology, antenna types, antenna pairs, electromagnetic waves, wave phenomenon, wave propagation, mobile and satellite propagation

Course Objectives:

Upon the completion of the course, the student will be able to :

1. Be introduced to the basic principles, characteristics and analysis of RF transmission lines
2. Explain the operation of impedance matching and impedance transformation devices
3. Describe the operation of power dividers, and transmission line Bridges
4. Be introduced to the basic concepts of fiber optics
5. Be introduced to the characteristics and radiation patterns of antennas
6. Be introduced to the propagation characteristics of radio waves
7. Acquire an understanding of some of the specific antennae types used in aeronautical radio equipment

Detailed Course Description:

Unit Number	Unit Name	Unit Content	Time Needed
1.	**Transmission Line Theory**	▪ Non-mathematical description of Transmission line behavior ▪ The general equations ▪ Standing wave pattern ▪ Impedance and admittance ▪ Losses ▪ Transmission Line components (stub, directional coupler, slotted line)	
2.	**Transmission Line Applications**	▪ Quarter wave transformers ▪ Stub impedance matching ▪ Balance to unbalance transformations ▪ Transmission Line Bridges	
3.	**Optical Fiber Theory and Application**	▪ Introduction to light ▪ Fiber construction and characteristics ▪ Step index single mode fiber ▪ Fiber optic attenuation and dispersion ▪ Couplers, connectors, splices , and switches	
4.	**Antenna Theory**	▪ Electromagnetic radiation ▪ Hertzian dipole ▪ Current and voltage distribution , and radiation pattern . ▪ Resonant and non resonant antenna . ▪ Effects of antenna height ▪ Antenna coupling	
5.	**Antenna Terminology**	▪ Antenna gain and effective radiated power ▪ Radiation measurement and field intensity ▪ Antenna Resistance ▪ Bandwidth, beam width, and polarization ▪ Antenna Length	

6.	**Antenna Types**	▪ General description and characteristics of the following antenna types ▪ Half wave(YAGI), vertical (Quarter Wavelength) , "L", ferrite, "V", Rhombic, Slot, Long wire, Log periodic, parabolic reflector and Loop antenna	
7.	**Antenna Pairs**	▪ Basic concepts and definitions ▪ Basic Antenna pairs with equal antenna currents ▪ Basic Antenna pairs with unequal antenna currents ▪ Specific Antenna pairs	
8.	**Electromagnetic Waves**	▪ The electromagnetic spectrum ▪ Radiation of electromagnetic waves ▪ Waves in free space ▪ Effects of the environment ▪ Reflection, Refraction, ▪ Diffraction , and ▪ Interference . ▪ Linear and nonlinear polarization ▪ Attenuation and absorption ▪ Electromagnetic waves calculations	
9.	**Propagation of Waves**	▪ Ground waves ▪ Standard atmosphere ▪ Sky wave ▪ Space wave ▪ Troposphere scatter propagation	
10.	**Mobile and Satellite Propagation**	▪ General description of cellular system ▪ VHF propagation , fast and flat fading component ▪ UHF and EHF propagation ▪ Adjacent channel, co channel, and nodal point interference. ▪ Satellite propagation	

Evaluation Strategies:

Exams		Percentage	Date
Exams	First Exam	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects		10%	
Discussions and lecture Presentations			

Teaching Methodology:

- Lecture

Text Books & References:

References:

1. Electronic communication system , KENNEDY , 1996.
2. Modern electronic communication ,GARY, 2001.
3. Introduction to Radio propagation , JOHN, 1996

Electronic Engineering

Specialization	**Aeronautical Communication Engineering**
Course Number	**20406242**
Course Title	**Radio Wave Transmission Lab**
Credit Hours	**1**
Theoretical Hours	**0**
Practical Hours	**3**

Brief Course Description:

- Introduction to the transmission lines kit, primary and secondary T. L factors measurement , Behavior of T.L under various load .Polar-diagram of radiation pattern for different antennas types. Short-circuit and open circuit terminal condition.

Course Objectives:

Upon the completion of the course, the student will be able to :

1. Analyze the behavior of transmission line.
2. Distinguish the types of T .L
3. Use the T .L measuring instruments.
4. Distinguish the types of antennas.
5. Use the computer to draw the radiation patterns of antennas.
6. Calculate the approximate gain, measure beam width of different antennas.

Detailed Course Description:

Lab Number	Lab Name	Lab Content	Time Needed
1.	Introduction to the transmission lines circuit board and cables		
2.	Velocity of propagation		
3.	Behavior of transmission line under various load	-short circuit /open circuit condition	
4.	Attenuation and distortion		
5.	Reflection coefficient at the load and generator		
6.	standing waves and standing wave ratio		
7.	polar diagram plotting for rombic antenna		
8.	plotting diagram for yogi and horn antennas		
9.	wave pattern for yogi(vertical polarization & horizontal polarization)		
10.	wave pattern for rombic (vertical and horizontal polarization)		

Evaluation Strategies:

Exams		Percentage	Date
Exams	Assignment	30%	--/--/----
	Med-term Exam	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects			
Discussions and lecture Presentations			

Teaching Methodology:

- ❖ Laboratory

Text Books & References:

References:

1. Manuals of test equipment and measuring equipment used in lab.
2. Manuals of T L circuit board.

Electronic Engineering

Specialization	**Aeronautical Communication Engineering**
Course Number	**20406243**
Course Title	**Aeronautical Radio**
Credit Hours	**2**
Theoretical Hours	**2**
Practical Hours	**0**

Brief Course Description:

- ❖ General classification of radio transmission .ICAO standard specification ,Aeronautical radio transmitter and receiver, micro wave system ,voice com. system , fiber optic system

Course Objectives:

1. The student shall be introduced to :
   - VHF and UHF communication in civil aviation in Jordan.
   - ICOA standards and specifications.
2. Describe the operation of :
   - Aeronautical radio transmitter and receiver.
   - Ground -air- ground communications.
   - Ground to ground communications.
   - Digital millimeter wave radio system.
   - Voice communication system (VSC)
   - Fiber optical system.

Detailed Course Description:

Unit Number	Unit Name	Unit Content	Time Needed
1.	**Introduction to Aeronautical Radio**	▪ General classification of radio transmissions and utilization of frequency bands ▪ VHF and UHF transmission in civil Aviation (state) ▪ Organization of VHF comm. In civil aviation (state) ▪ General block diagram of ground –air – ground voice communication system (describe) ▪ Ground frequency ,tower and area frequencies,and emergency frequency.(define) ▪ Ground-ground UHF system characteristics (state)	
2.	**Aeronautical Radio Transmitter**	▪ General description of VHF transmitter ▪ VHF transmitter performance specifications (explain) ▪ VHF –TX . block diagram ,function of each block ▪ Explain in detail the operation of VHF –TX ,with the aid of circuit –diagram ▪ Explain how the main parameters of VHF-TX are checked	
3.	**Aeronautical Radio Receivers**	▪ Block diagram of VHF receivers (describe) ▪ Performance specifications of VHF-RX(explain) ▪ Describe the operation of VHF-RX , with the aid of circuit diagram ▪ Describe tuning techniques for RF and IF stages ▪ Describe adjusting techniques for squelch and S/N ratio	
4.	**Optical Communication Systems**	▪ Introduction ▪ Transmitter ▪ Receiver ▪ Wavelength Division Multiplexing ▪ Optical Time Division Multiplexing ▪ Local Area Network	
5.	**Digital Microwave System**	▪ Microwave fundamentals (define) frequency band ,LOS ,micro wave channel ,basic MW system	

		▪ comparison of FDM and TDM equipment , long ,and short haul ▪ Basic two way digital MW system (block ,describe) ▪ Digital radio path (block ,describe) ▪ Fade margin (define ,solve problem) ▪ Multi-path fading (explain) ▪ Diversity and protection switch techniques . space ,and freq diversity,protection switching and hot stand by ,switching and combining techniques ▪ Radio telemetry system ▪ VHF extended range using microwave link	
6.	**Digital Millimeter Wave Radio System**	▪ Introduction. ▪ Product structure (explain) ▪ Specifications of system (state) ▪ Theory of operation (explain) Out door, and Indoor unit ,signal flow –transmit and receiver direction ▪ Channel plans (describe) ▪ Service channels (describe) ▪ PCM multiplexing system	
7.	**VOICE COMMUNICATIO N SYSTEM**	▪ Network organization ▪ Centralized switching ▪ Switching system ▪ Description of (QUMRAN) system ▪ VCS external interfaces. ▪ VCS functional architecture ▪ OWP components and connections ▪ Emergency radio VSC	

Evaluation Strategies:

Exams		Percentage	Date
Exams	First Exam	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects		10%	
Discussions and lecture Presentations			

Teaching Methodology:

- ❖ Lecture

Text Books & References:

References:

1. Digital communication,KAMILO FEHER, 1997.
2. P-COM manual, 1997.
3. Modern electronic communication , GARY, 2001.
4. QUMRAN manual,2003.
5. Fibre optic communication , DC AGARWAL, 1998.

Electronic Engineering

Specialization	**Aeronautical Communication Engineering**
Course Number	**20406244**
Course Title	**Aeronautical Radio Lab**
Credit Hours	**1**
Theoretical Hours	**0**
Practical Hours	**3**

Brief Course Description:

- RF electronic voltmeter, RF signal generators, RF wattmeter , Identification and analysis and trouble shooting of AM/FM transmitter and receiver circuits, VHF aeronautical transmitter and receiver (testing and tuning and fault finding) , VHF transceiver (performance and fault finding) .

Course Objectives:

Upon the completion of the course, the student will be able to.

1.Be familiarized with RF measuring and test instrument.
2.Analysis the AM/FM transmitter and receiver circuits.
3.Identify and test the VHF aeronautical transmitter and receiver.
4.Trouble shooting AM/FM , TX and RX.
5.Trouble shooting VHF , TX and RX.

Detailed Course Description:

Lab Number	Lab Name	Lab Content	Time Needed
1.	**RF electronic voltmeter, and RF signal generators and RF wattmeter**		
2.	**Identification and analysis of AM transmitter circuits**	1.Trouble-shooting AM ,TX circuit.	
3.	**Identification and analysis of FM transmitter circuits**	1.Trouble-shooting FM,TX circuit.	
4.	**Identification and analysis of AM/FM ,receiver circuits**	**1. Trouble-shooting AM/FM, RX circuits**	
5.	**Trouble shooting of AM/FM radio receiver**		
6.	**Identification of VHF aeronautical transmitter**		
7.	**Testing and tuning of VHF aeronautical transmitter**		
8.	**Fault finding of VHF aeronautical transmitter**		
9.	**Identification of VHF aeronautical Receiver**		
10.	**Testing and tuning of VHF aeronautical Receiver**		
11.	**Identification of VHF transceiver**		
12.	**Trouble shooting of VHF transceiver**		

Evaluation Strategies:

Exams		Percentage	Date
Exams	Assignments	30%	--/--/----
	Med-term Exam	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects			
Discussions and lecture Presentations			

Teaching Methodology:

- ❖ Laboratory

Text Books & References:

References:

1. Comprehensive laboratory course materials.
2. VHF aeronautical transmitter and receiver manuals.

Electronic Engineering

Specialization	**Aeronautical Communication Engineering**
Course Number	**20406251**
Course Title	**Air Traffic Control Radar**
Credit Hours	**3**
Theoretical Hours	**3**
Practical Hours	**0**

Brief Course Description:

- Common concepts to primary and secondary radar, radar wave guide (W/G) theory, radar wave guide components, radar microwave sources, primary surveillance radar, radar transmitters and receiver, radar signal processing and plot extraction , conventional & Mono pulse secondary surveillance radar , radar displays and antennas.

Course Objectives:

Upon the completion of the course, the student will be able to :

1. Describe the common concepts of primary and secondary radar .
2. Explain the wave guide theory .
3. Describe the radar wave guide components.
4. Recognize the different stages of primary and secondary radar .
5. Analysis the circuits of primary and secondary radar .
6. Distinguish between the codes and modes of the radar.

Detailed Course Description:

Unit Number	Unit Name	Unit Content	Time Needed
1.	**Concepts Common To Primary and Secondary RADAR**	▪ Basic principles of Radar Theory ▪ RF signal Parameters ▪ Synchronization ▪ Coherence ▪ Radio Wave characteristics ▪ Wave polarization (linear and circular) ▪ Spectrum and bandwidth ▪ Signal delectability ▪ Noise	
2.	**Radar Wave guide (W/G) theory**	▪ Advantages and disadvantages of W/G ▪ Shapes of W/G ▪ W/G transmission (rectangular modes, and circular modes) ▪ Phase and group velocities ▪ W/G equation ▪ W/G attenuation ▪ W/G coupling ▪ W/G termination ▪ W/G impedance matching	
3.	**Radar Wave guide (W/G) devices**	▪ Cavity resonator fundamentals ▪ Directional coupler ▪ W/G junctions ▪ Isolators and Circulators ▪ Joints (choke joint , rotary joint) ▪ Duplexer ▪ Switches ▪ Bends , Twists , Corners , Stubs	
4.	**RADAR Microwave Sources**	▪ Magnetron (theory and application) ▪ Klystron (theory and application) ▪ Traveling wave tube(TWT) (theory and application)	
5.	**Primary Surveillance RADAR (PSR)**	▪ PSR concepts ▪ Radar equation , Radar echo, Radar reference coordinates , Ranges ▪ Pulse repetition frequency(PRF),	

		Power calculation (peak & average), Antenna height and speed ▪ Bearing (Azimuth), Altitude, Target resolutions, Radar accuracy and pulse shaping , Scanning Radar transmission methods, search radar, tracking radar	
6.	**Radar Transmitters and Receivers**	▪ Transmitter block diagram ▪ Modulators . ▪ Power amplifier transmitter ▪ Diversity operation (frequency , space, and polarization diversity) ▪ Radar receiver components ▪ Radar special receivers: - moving target indicator - system (MTI) - logarithmic receiver - mono pulse receiver	
7.	**Radar signal processing & plot extraction**	▪ First steps in removing clutter ▪ Threshold techniques ▪ Logarithmic amplification and STC ▪ Phase sensitive detector (PSD) characteristics ▪ Cancellation techniques ▪ Plot extraction techniques : - plot start azimuth - plot finish azimuth - plot range (resolution cell position) - plot presence	
8.	**Radar displays and antennas**	▪ The A-scope ▪ Range height display (RHD) ▪ Plane Position indicator(PPI) ▪ PPI block diagram ▪ Sweep rotation ▪ CRT screen persistence ▪ plot extracted displays ▪ Parabolic reflectors antenna ▪ Cylindrical parabolic antenna ▪ Broad side array	

		▪ Horn radiators	
9.	**Electronic Counter-Countermeasures (ECM & ECCM)**	▪ Introduction ▪ ECM methods ▪ Jamming ▪ ECCM ▪ ECCM implementations ▪ ECCM techniques	
10.	**Conventional secondary surveillance RADAR**	▪ Introduction to CSSR ▪ comparison between PSR and SSR ▪ modes of interrogation and usage ▪ Transponder code reply and usage ▪ Codes reply (real time decoding, automatic decoding and data extraction) ▪ Mode interlace ▪ Interrogator functions ▪ Aircraft transponder functions ▪ SSR system performance ▪ Probability of detection ▪ Aircraft Transponder dead time ▪ Antenna patterns	
11.	**Mono pulse Secondary Surveillance RADAR (MSSR)**	▪ Basic principles of MSSR ▪ Horizontal characteristics of the antenna ▪ Vertical characteristics of the antenna ▪ Antenna back lobes ▪ Improving the azimuth by mono pulse techniques ▪ Phase comparison mono pulse ▪ Amplitude comparison mono pulse ▪ Mono pulse technique (amplitude/ amplitude mono pulse) ▪ Traffic advisory and collision avoidance system	

Evaluation Strategies:

Exams		Percentage	Date
Exams	First Exam	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects		10%	
Discussions and lecture Presentations			

Teaching Methodology:

- Lecture

Text Books & References:

References:

1. Radar system design and analysis ; S.A HOVANESSIAN.
2. Introduction to radar system ; M.I. SKOLNIK , 2000.
3. Radar handbook ; M.I.SKOLNIK , 1999 .

Electronic Engineering

Specialization	**Aeronautical Communication Engineering**
Course Number	**20406261**
Course Title	**Radio Navigation Aids**
Credit Hours	**2**
Theoretical Hours	**2**
Practical Hours	**0**

Brief Course Description:

- Instrument Landing System (ILS). Space Modulation and ILS Waveforms. Difference in depth of Modulation (DDM).Glide Slope Antenna-Array. Glide Slope DDM & path width. Localizer Radiation Patterns. Localizer DDM& course width . Marker. VOR principles , VOR Antenna & Radiation Pattern ,RF Phasing , VOR Block diagram , Doppler VOR, DME Principles ,DME Terminology and Parameters ,DME Block Diagram, DGPS , PAPI precision approach path indicator .

Course Objectives:

Upon the completion of the course, the student will be able to :

1. Explain the Instrument Landing System (ILS) concepts
2. Describe Very high frequency Omni Range (VOR) equipment concepts
3. Explain Distance Measuring Equipment (DME) concepts
4. Define DGPS ,and PAPI system

Detailed Course Description:

Unit Number	Unit Name	Unit Content	Time Needed
1.	Concepts of Navigational Aids	▪ Introduction to the navigational aids systems ▪ Non Directional Beacon (NDB) principles ▪ Description of ILS equipment ,Frequencies , Function , site location , categories , and guidance information ▪ PAPI system	
2.	Navigational Aids Modulation	▪ Transmitter and space modulation ▪ RF phase relationship , and its effect on the space modulation parameters ▪ ILS major radiated signals and ILS waveforms	
3.	DDM & DSM	▪ Difference Depth of Modulation (DDM) ▪ Sum Depth of Modulation (SDM) ▪ ILS receiver characteristic ▪ ILS (LOC.&GP) radiation characteristic	
4.	NRGS, and Navigational Aids Antenna	▪ Specific antenna pairs radiation (SIP,SOP,and the image antenna) ▪ Null reference Glide slope (NRGS) concepts ▪ NRGS antenna array ▪ antenna positioning and height ratios ▪ Carrier(CSB) and side band only (SBO) radiated signals ▪ Formation of the GS ▪ GS DDM and path width	
5.	Capture Effect Glide Slope (CEGS)	▪ Uneven Terrain and GS structure ▪ Capture effect principle ▪ M antenna array and composite CEGS radiated signal (course & Clearance) ▪ Antenna heights and ratios ▪ CEGS DDM structure ▪ proximity phase error and antenna offset ▪ Typical CEGS transmitter block diagram	
6.	Localizer	▪ ILS localizer radiated signals,patterns, and RF phase relationship ▪ LOC.DDM and path width ▪ Front and back course ▪ LOC. Antenna system ▪ Uneven terrain and LOC. Structure ▪ Capture Effect Loclizer (CELOC) ▪ Typical CELOC. Transmitter block diagram	
7.	ILS markers	▪ Types ,guidance information ,and site locations ▪ Radiation , frequencies ,and modulation ▪ Typical marker block diagram	

8.	**VOR**	▪ Introduction to VOR (frequency range, guidance information ,and general concepts) ▪ General theory of VOR operation ▪ VOR antenna system ▪ Carrier radiation pattern (Reference signal) ▪ Composite side band radiation patter (variable signal) ▪ Rotating figure of eight and limacon concept ▪ VOR functional block diagram ▪ Audio phasing ▪ R.F. phasing ▪ Field detector positioning	
9.	**Doppler VOR**	▪ Deference between DVOR and CVOR ▪ Principles of DVOR ▪ DVOR system over view ▪ Phase angle in various direction ▪ Frequency spectrum of a DVOR ▪ Generation of direction ▪ Switch of sideband antennas in the DVOR	
10.	**DME principles**	▪ Purpose of DME ▪ General theory of DME ▪ DME specifications (frequency and distance range) ▪ DME Terminology : High and low level interrogation , Reply pulses, search mode and track mode, major and minor faults, and elapse time and Squatter pulses (ARRC1&ARRC2) ▪ DME parameters : pulse spacing , system delay , pulse count , identification , reply efficiency , and power output . ▪ General DME block diagrams : Transponder , monitor, and DME antenna system	
11.	**Differential Global Positioning System (DGPS)**	▪ Fundamentals of satellite Navigation ▪ Introduction to GPS ▪ GPS satellite Constellation ▪ GPS-segments ▪ GSP-Ground Reference station ▪ GSP-Ground Monitor station ▪ Code Based Techniques ▪ Carrier Based Techniques	

Evaluation Strategies:

Exams		Percentage	Date
Exams	First Exam	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects		10%	
Discussions and lecture Presentations			

Teaching Methodology:

- ❖ Lecture

Text Books & References:

References:

1. FAA Academy training manual; (Instrument Landing System) , 1998.
2. Aeronautical telecommunication ICAO Annex 10 , 2000.
3. Under standing GPS; D. KAPLAN, 1996.