



CURRICULUM

Microwave Technician

03 Month Program

**NATIONAL TRAINING BUREAU
H-9, ISLAMABAD**

1. Introduction:

This training course provides the student with a strong background in the area of planning telecommunication transmission networks using modern Radio-relay Digital Microwave radio.

The course covers in detail all the important aspects of radio propagation, starting from free-space loss and absorption loss, followed by statistical analysis of various phenomena impairing radio reception process - rain, multipath fading (both flat and selective), K-factor variation and ducting.

The introductory part of the course also reviews basic parameters of the microwave radio systems, antenna, transmission lines and all other auxiliary equipment used during implementation of microwave radio-relay sites.

Classroom discussion of all the above topics will be complemented by interactive student exercises. The course concludes with a guide to several ITU-T/ITU-R references, students can access for additional information.

2. Course Objectives:

At the end of this course the student will understand the essentials of Transmission engineering and will be able to design and manage microwave networks. This course is designed to teach students the essence of microwave path planning.

The students will also learn how to design paths that will not suffer from interference, or disturb other radio systems in the vicinity.

3. Key Benefits:

The person who will attend this course;

- He will understand why a certain link or network is not functioning as per performance specifications and will be able to successfully resolve them.
- He will be able to select the best component for the network.
- He will have the knowledge to optimize and improve the network performance and quality.

4. Curriculum Salient

Entry-level	Matric/F.Sc/DAE
Duration of course	3 Months
Training Hours	360
	30 hours a week
Training Methodology	80% Practical
	20% Theory
Medium of Instructions	Urdu / English

5. Scheme of Studies

Sr.	Module	Theory (Hrs)	Practical (Hrs)	Total (Hrs)
1.	Introduction to Computer	3	40	43
2.	Basic Electricity and Electronics	13	60	73
3.	Telecommunication Fundamentals	5	15	20
4.	Data Communication	4	10	14
5.	Modulation Techniques	5	10	15
6.	Antennas	8	15	23
7.	Multiplexing/De-multiplexing	5	2	7
8.	Microwave Communication Overview	10	6	16
9.	Digital Microwave Communication Equipment	5	30	35
10.	Digital Microwave Networking and Application	8	10	18
11.	Installation Testing & Commissioning Exercises	6	90	96
Total		72	288	360

Sr. No.	Detail of Topics	Theory Hours
1.	<p><u>Introduction to Computer</u></p> <p>1.1. General introduction to computers 1.1.1. Definition of computer 1.1.2. Characteristics of computer 1.1.3. Use of computer</p> <p>1.2. I/O devices 1.2.1. Mouse 1.2.2. Key board 1.2.3. Microphone 1.2.4. Speaker 1.2.5. Printer 1.2.6. Scanner 1.2.7. Monitor</p> <p>1.3. Storage devices 1.3.1. Hard Disk (HDD) 1.3.2. Floppy Disk 1.3.3. Compact Disk (CD) 1.3.4. Universal Serial Bus (USB)</p> <p>1.4. CPU 1.4.1. Power Supply 1.4.2. Mother Board 1.4.3. Processor 1.4.4. Memory 1.4.5. Expansion Board 1.4.6. I/O ports 1.4.7. Network interface card 1.4.8. Hard disk 1.4.9. Floppy disk 1.4.10. CD ROM 1.4.11. DVD ROM</p> <p>1.5. Ms Office 1.5.1. Microsoft Word 1.5.2. Microsoft Excel 1.5.3. Microsoft Visio</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>1</p>

2.	<u>Basic Electricity and Electronics</u>	
	2.1. Electricity 2.1.1. Atom 2.1.2. K, L and M shell 2.1.3. Valence electrons 2.1.4. Conductors, insulators and semiconductors 2.1.5. Electrical Quantities 2.1.5.1. Charge 2.1.5.2. Potential 2.1.5.3. Potential difference 2.1.5.4. Current 2.1.5.5. Resistance 2.1.5.6. Unit of each quantity	2
	2.2. <u>Electrical Measuring Instruments</u> 2.2.1. Ampere Meter 2.2.2. Volt Meter 2.2.3. Digital Multimeter 2.2.4. Clamp-On AC Meter 2.2.5. Oscilloscope	1
	2.3. <u>DC Fundamentals</u> 2.3.1. Ohm's Law 2.3.1.1. Definition of Ohm's law 2.3.1.2. Mathematical formula 2.3.1.3. Calculation on ohm's law 2.3.2. Resistor 2.3.2.1. Construction of resistor 2.3.2.2. Types of resistors 2.3.2.3. Colorcoding of resistors 2.3.3. Series combination of resistors 2.3.4. Parallel combination of resistors	2
	2.4. <u>Batteries</u> 2.4.1. What is a battery? 2.4.2. Working principle of batteries 2.4.3. Type of batteries 2.4.4. Purpose of batteries in telecommunication 2.4.5. Series connection of batteries 2.4.6. Parallel connections of batteries 2.4.7. Charging of a secondary battery	2
	2.5. <u>AC Fundamentals</u> 2.5.1. Sine wave 2.5.2. Cycle 2.5.3. Wavelength and its unit 2.5.4. Frequency ant its unit 2.5.5. Amplitude and its unit 2.5.6. AC sine wave form and its characteristics. 2.5.7. Audio and Radio frequencies 2.5.8. Radio frequency spectrum.	1
	2.6. <u>Transformer</u> 2.6.1. Definition of transformer 2.6.2. Working principle of transformer	1

	<p>2.6.3. Construction of transformer</p> <p>2.6.4. Types of transformer</p> <p>2.6.5. Use of transformer in electronics and telecommunication</p> <p>2.7. <u>Semiconductors</u></p> <p>2.7.1. Definition</p> <p>2.7.2. Intrinsic semiconductors</p> <p>2.7.3. Extrinsic semiconductors</p> <p>2.7.4. Doping</p> <p>2.7.4.1. Trivalent impurities</p> <p>2.7.4.2. Pentavalent impurities</p> <p>2.7.5. N-type semiconductors</p> <p>2.7.6. P-type semiconductors</p> <p>2.8. <u>Diode</u></p> <p>2.8.1. PN Junction diode</p> <p>2.8.2. Depletion region</p> <p>2.8.3. Barrier potential</p> <p>2.8.4. Diode as forward bias</p> <p>2.8.5. Diode as reverse bias</p> <p>2.8.6. Diode as switch</p> <p>2.9. <u>Rectifiers</u></p> <p>2.9.1. What is rectifier?</p> <p>2.9.2. Working Principle of rectifier.</p> <p>2.9.3. Types of rectifier.</p> <p>2.9.3.1. Half wave rectifier</p> <p>2.9.3.2. Full wave centre tapped rectifier</p> <p>2.9.3.3. Full wave bridge rectifier</p> <p>2.9.4. Purpose of rectifier in telecommunication</p>	<p>1</p> <p>1</p> <p>2</p>
3.	<p><u>Telecommunication Fundamentals</u></p> <p>3.1. <u>Definition and concept</u></p> <p>3.1.1. Components of a communication system</p> <p>3.1.1.1. Transmitter</p> <p>3.1.1.2. Medium</p> <p>3.1.1.3. Receiver</p> <p>3.1.2. Definition of Telecom</p> <p>3.1.3. Examples</p> <p>3.2. <u>Major parts of a telecommunication network</u></p> <p>3.2.1. Access network</p> <p>3.2.1.1. Fixed line Access Network</p> <p>3.2.1.2. Wireless Access Network (WLL)</p> <p>3.2.2. Switching network</p> <p>3.2.3. Transmission Network</p> <p>3.2.3.1. Transmission by copper cables (Twisted pair, coaxial cable, wave guide)</p> <p>3.2.3.2. Transmission by satellite</p> <p>3.2.3.3. Transmission by microwave</p> <p>3.2.3.4. Transmission by fiber optic</p>	<p>2</p> <p>3</p>

	10.2.1. Active Relay station 10.2.1.1. Radio Frequency relay station 10.2.1.2. Regenerator relay station 10.2.2. Passive Relay Station 10.2.2.1. Parabolic reflector passive relay station 10.2.2.2. Plane Reflector Passive Relay Station 10.3. <u>Application of Digital Microwave</u>	1
11.	<u>Installation Testing & Commissioning Exercises</u> 11.1. <u>Installation of hardware</u> 11.1.1. Installation method of equipment rack 11.1.2. Installation method of microwave radios 11.1.3. Installation method of signal cables 11.1.4. Installation method of electrical power cables 11.1.5. Installation method of microwave antennas 11.1.6. Installation method of ODU 11.1.7. Installation method of IF cables from ODU to microwave radios 11.1.8. Earthing of microwave transmission system 11.1.9. Installation method of battery bank	6

Sr. No.	Detail of Topics	Practical Hours
1	<p><u>Introduction to Computer</u></p> <ul style="list-style-type: none"> 1.1. Installation of I/O devices <ul style="list-style-type: none"> 1.1.1. Mouse 1.1.2. Key board 1.1.3. Microphone 1.1.4. Speaker 1.1.5. Printer 1.1.6. Scanner 1.1.7. Monitor 1.2. Installation and working of Storage devices <ul style="list-style-type: none"> 1.2.1. Hard Disk (HDD) 1.2.2. Floppy Disk 1.2.3. Compact Disk (CD) 1.2.4. Universal Serial Bus (USB) 1.3. Working and Operation of CPU <ul style="list-style-type: none"> 1.3.1. Power Supply 1.3.2. Mother Board 1.3.3. Processor 1.3.4. Memory 1.3.5. Expansion Board 1.3.6. I/O ports 1.3.7. Network interface card 1.3.8. Hard disk 1.3.9. Floppy disk 1.3.10. CD ROM 1.3.11. DVD ROM 1.4. Practice of Ms Office <ul style="list-style-type: none"> 1.4.1. Microsoft Word 1.4.2. Microsoft Excel 1.4.3. Microsoft Visio 1.5. Internet Browsing and surfing 	40

2	<p><u>Basic Electricity and electronics</u></p> <ul style="list-style-type: none"> 2.1. Function and application of measuring instruments <ul style="list-style-type: none"> 2.1.1. Ampere Meter 2.1.2. Volt Meter 2.1.3. Digital Multimeter 2.1.4. Clamp-On AC Meter 2.1.5. Oscilloscope 2.2. Measurement of current, voltage and resistance using Ammeter, voltmeter and multimeter 2.3. Verification of ohm law by <ul style="list-style-type: none"> 2.3.1. Keeping the voltage constant 2.3.2. Keeping the Resistance constant 2.4. Practice of resistor color coding 2.5. Verify the laws of series combination of resistors 2.6. Verify the laws of parallel combination of resistors 2.7. Series connection of batteries 2.8. Parallel connections of batteries 2.9. Charging of a secondary battery 2.10. Installation of battery banks 2.11. Diode as switch 2.12. Diode as rectifier 2.13. Assemble a half wave rectifier and verify its output wave form with the help of oscilloscope 2.14. Assemble a full wave rectifier with centre taped transformer and verify its output wave form with the help of oscilloscope 2.15. Assemble a full wave bridge rectifier and verify its output wave form with the help of oscilloscope. 2.16. Installation practice of rectifiers for microwave communication systems 	60
3	<p><u>Telecommunication Fundamentals</u></p> <ul style="list-style-type: none"> 4.1. Function and applications of components <ul style="list-style-type: none"> 6.1.1. Transmitter 6.1.2. Receiver 6.1.3. Medium 6.1.4. Transducer 6.1.5. Transceiver 4.2. More about the medium <ul style="list-style-type: none"> 6.2.1. Shielded Twisted pair 6.2.2. Unshielded twisted pair 6.2.3. Coaxial cable 	15

	6.2.4. Wave guide 6.2.5. Drop wire 6.2.6. Single mode optical fiber cable 6.2.7. Multimode optical fiber cable 4.3. Working of transmission system 6.3.1. Copper based transmission 6.3.2. Optical fiber transmission 6.3.3. Microwave transmission 6.3.4. Voice and data transmission systems	
	<u>Data Communication</u> 5.1. Function and application of DTE 5.2. Configuration of DCE 5.3. Connecting a DCE with DTE 5.4. Types of medium according to DCE and DTE interface 5.5. Different types of interfaces like RJ-11, RJ-45, BNC, RS-232 etc. 5.6. Function and working of an NTU. 5.7. Create a link between two DTEs using DCE, medium, interface and NTU. 5.8. Function of dialup and leased line	10
	<u>Modulation Techniques</u> 6.1. Construct an FM transmitter 6.2. Implement an FM transmitter 6.3. Construct FM receiver 6.4. Implement FM receiver 6.5. Observe modulated signal on oscilloscope	10
	<u>Antennas</u> 7.1. Working of different types of antennas like 7.1.1. Sector antenna 7.1.2. Omni-directional antenna 7.1.3. Directional antenna 7.1.4. LOS antenna 7.2. Construct a simple antenna 7.3. Measurement the intensity of radiation of antenna 7.4. Adjustment and alignment of antenna 7.5. Antenna gain calculation	15
	<u>Multiplexing/De-multiplexing</u> 8.1. Multiplexing of telephone lines 8.2. De-multiplexing of telephone lines 8.3. Time division multiplexing procedure with the help of PCM multiplexer	2
	<u>Microwave Communication Overview</u> 9.1. Selection of frequencies according to propagation distance 9.2. Channel configuration of microwave equipment 9.3. Modulation and de-modulation of microwave signals 9.4. Multiplexing and de-multiplexing of communication signal	6
	<u>Digital Microwave Communication Equipment</u> 10.1. Trunk microwave radios and its accessories	30

	10.2. All outdoor microwave radios and its accessories 10.3. Split mount microwave radios and its accessories 10.4. Installation of IDU 10.5. Installation of ODU 10.6. Installation of IF cables 10.7. Installation of E1 cables 10.8. Installation of Ethernet cables 10.9. Microwave antennal installation 10.10. Antenna alignment 10.11. Antenna adjustment 10.12. Horizontal and Vertical polarization	
	<u>Digital Microwave Networking and Application</u> 11.1. Combination of microwave equipment in star topology 11.2. Combination of microwave equipment in mesh topology 11.3. Combination of microwave equipment in ring topology 11.4. Combination of microwave equipment in chain topology 11.5. Working and function of terminal station 11.6. Working and function of relay station 11.7. Working and function of add/drop station	10
	<u>Installation Testing & Commissioning Exercises</u> 12.1. Site Survey 12.2. Selection of site 12.3. Selection of route for transmission 12.4. Clearance of route 12.5. Path profile using software 12.6. Path profile using web 12.7. Link Budgeting 12.8. Calculation of free space transmission loss 12.9. Selection of frequency band 12.10. Selection of channel width 12.11. Antenna Installation 12.12. Alignment of microwave antennas 12.13. Adjustment of antenna 12.14. Measurement of signal strength 12.15. Checking of alignment 12.16. ODU Installation 12.17. IDU Installation 12.18. IF cable installation 12.19. IF cable grounding 12.20. Equipment Grounding 12.21. Installation of E1 cables 12.22. Installation of Electrical power cables 12.23. Installation of battery bank for power backup 12.24. IDU Configuration 12.25. ODU configuration 12.26. Protection modes of microwave communication 12.27. Link Testing 12.27.1. RSSI (Receive Signal Strength Indication) 12.27.2. BERT analysis	90

	12.27.3. IP , Ethernet over Microwave 12.28. Hard loop back test with E1 tester 12.29. Digital loop back with the help of software 12.30. Remote loop back with the help of software 12.31. Baseband loop back with the help of software 12.32. RF loop back with the help of software 12.33. Commissioning of Microwave transmission link 12.34. Transportation of E1 traffic on microwave link 12.35. Transportation of IP traffic on microwave link	
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Reference Book:

- Training Manual

6. Tools / Equipment Detail

Sr.	Description of Tools and Equipment	Quantity
1.	DDF Rack	10 Nos.
2.	E1 Patch Panel	15 Nos.
3.	E1 Testers	02 Nos.
4.	Telecom Rectifiers	05 Nos.
5.	RJ-11 Crimping Tools	05 Nos.
6.	RJ-45 Crimping Tools	05 Nos.
7.	Wire Strippers	03 Nos.
8.	DC Power Backup (Batteries)	12 Nos.
9.	AC Power Backup (Gen Set)	01 Nos.
10.	Desktop PC	20 Nos.
11.	KRONE Puncher	10 Nos.
12.	Microwave Towers	02 Nos.
13.	Microwave Radios	10 Nos.
14.	Microwave Parabolic Antenna	04 Nos.
15.	Sector Antennas	01 Nos.
16.	Omni Directional Antennas	02 Nos.
17.	IF Cables	04 Nos.
18.	Path Profiling Software	01 Nos. Each
19.	E1 Traffic Interface Cable	10 Nos.
20.	Management interface cable	10 Nos.
21.	Ethernet Cables	10 Nos.
22.	Multimeter	10 Nos.
23.	Compass	05 Nos.
24.	Loop back cables	10 Nos.
25.	BNC connector (Balun)	10 Nos.

EMPLOYABILITY OF PASS-OUTS

The pass outs of this course may find job / employment opportunities in the following areas / sectors:

- In industries Can be select as a Microwave technician
- Telecom solution/service providers
- Mobile Network companies
- IT Solution providers
- ISPs and DSL network provider
- Assembler / technician in Telecom product companies.
- Salesman/Technician in shops dealing with telecomequipment.
- Huge market is available outside the Pakistan especially in **Gulf**.

Reference Books:

1. Microwave communication
2. System Manuals

Qualification Of teacher:

DAE electronics with 2years' Experience in relevant Field.