

Pursuant to Article 131 of the Law on Electronic Communications (The Official Gazette of the Republic of Macedonia No. 39/2014) and Article 6 of the Rulebook on the Methods of Taking an Amateur Radio Examination, Radio Amateur Classes, Technical Parameters and Other Requirements for the Use of Amateur Radio Stations and Equipment (The Official Gazette of the Republic of Macedonia No. 180 /2014), the Director of the Agency for Electronic Communications, on 05.11.2014, adopted the following

## **AMATEUR RADIO EXAMINATION PROGRAMME**

### **I. GENERAL PROVISIONS**

#### **Article 1**

- (1) The Amateur Radio Examination Programme defines the mandatory part of the examination programme for:
- a) "A" class, in compliance with the CEPT Recommendation T/R 61-01 (Annex 1);  
and
  - b) "P" class, in compliance with the ERC Report 32 (Annex 2).

### **II. FINAL PROVISIONS**

#### **Article 2**

- (1) This Programme shall enter into force on the day of its publication on the bulletin board of the Agency for Electronic Communications.
- (2) Upon its entry into force, the Amateur Radio Examination Programme shall be published on the web site of the Agency for Electronic Communications.

No. 0201-1302/4

Skopje, 05.11.2014

AGENCY FOR ELECTRONIC COMMUNICATIONS

Director,  
Robert Ordanoski

# **ANNEX 1**

## **“A” CLASS EXAMINATION PROGRAMME**

### **a) TECHNICAL CONTENT**

#### **1. ELECTRICAL, ELECTRO-MAGNETIC AND RADIO THEORY**

- 1.1 Conductivity
- 1.2 Sources of electricity
- 1.3 Electric field
- 1.4 Magnetic field
- 1.5 Electromagnetic field
- 1.6 Sinusoidal signals
- 1.7 Non-sinusoidal signals, noise
- 1.8 Modulated signals
- 1.9 Power and energy
- 1.10 Digital signal processing (DSP)

#### **2. COMPONENTS**

- 2.1 Resistor
- 2.2 Capacitor
- 2.3 Coil (inductivity)
- 2.4 Transformers (application and use)
- 2.5 Diode
- 2.6 Transistor
- 2.7 Heat dissipation
- 2.8 Miscellaneous

#### **3. ELECTRIC CIRCUITS**

- 3.1 Combination of components
- 3.2 Filter
- 3.3 Power supply
- 3.4 Amplifier
- 3.5 Detector
- 3.6 Oscillator

3.7 Phase Locked Loop [PLL]

3.8 Discrete Time Signals and Systems (DSP-systems)

## **4. RECEIVERS**

4.1 Types

4.2 Block diagrams

4.3 Operation and function of the following stages

4.4 Receiver characteristics

## **5. TRANSMITTERS**

5.1 Types

5.2 Block diagrams

5.3 Operation and function of the following stages

5.4 Transmitter characteristics

## **6. ANTENNAS AND TRANSMISSION LINES**

6.1 Types

6.2 Antenna characteristics

6.3 Transmission lines

## **7. PROPAGATION**

## **8. MEASUREMENTS**

8.1 Making measurements

8.2 Measuring instruments

## **9. INTERFERENCE AND IMMUNITY**

9.1 Interference in electronic equipment

9.2 Cause of interference in electronic equipment

9.3 Measures against interference

## **10. SAFETY**

***b) MACEDONIAN AND INTERNATIONAL OPERATING RULES AND PROCEDURES***

1. Phonetic Alphabet
2. Q-Code
3. Operational Abbreviations
4. International Distress Signs, Emergency traffic and natural disaster communication
5. Call signs
6. IARU band plans
7. Social responsibility and operating procedures

***c) MACEDONIAN AND INTERNATIONAL REGULATIONS RELEVANT TO THE AMATEUR SERVICE AND AMATEUR SATELLITE SERVICE***

1. ITU Radio Regulations
2. CEPT Regulations
3. Macedonian Laws, Regulations and Authorisation conditions

# **“A” CLASS DETAILED EXAMINATION PROGRAMME**

## **a) TECHNICAL CONTENT**

### **PART 1**

#### **1. ELECTRICAL, ELECTRO-MAGNETIC AND RADIO THEORY**

##### **1.1 Conductivity**

- Conductor, semiconductor and insulator
- Current, voltage and resistance
- Ohm's Law [ $E = I \cdot R$ ]
- Kirchhoff's Laws
- Electric power [ $P = E \cdot I$ ]
- The unit watt
- Electric energy [ $W = P \cdot t$ ]
- The capacity of a battery [ampere-hour]

##### **1.2 Sources of electricity**

- Voltage source, source voltage [EMF], short circuit current, internal resistance and terminal voltage
- Series and parallel connection of voltage sources

##### **1.3 Electric field**

- Electric field strength
- The unit volt/meter
- Shielding of electric fields

##### **1.4 Magnetic field**

- Magnetic field surrounding live conductor
- Shielding of magnetic fields

##### **1.5 Electromagnetic field**

- Radio waves as electromagnetic waves
- Propagation velocity and its relation with frequency and wavelength [ $v = f \cdot \lambda$ ]

- Polarisation

## 1.6 Sinusoidal signals

- The graphic representation in time
- Instantaneous value [ $U_{\max}$ ], amplitude [ $E_{\max}$ ], effective [RMS] value and average value  $\left[ U_{\text{eff}} = \frac{U_{\max}}{\sqrt{2}} \right]$
- Period and duration of period
- Frequency
- The unit hertz
- Phase difference

## 1.7 Non-sinusoidal signals

- Audio signals
- Square wave
- The graphic representation in time
- D.C. voltage component, fundamental wave and higher harmonics
- Noise [ $P_N = kTB$ ] (receiver thermal noise, band noise, noise density, noise power in receiver bandwidth)

## 1.8 Modulated signals

- CW
- Amplitude modulation
- Phase modulation, frequency modulation and single-sideband modulation

- Frequency deviation and modulation index  $\left[ m = \frac{\Delta F}{f_{\text{mod}}} \right]$
- Carrier, sidebands and bandwidth
- Spectrum of CW, AM, SSB and FM signals (graphical presentation)
- Digital modulations: FSK, 2-PSK, 4-PSK, QAM
- Digital modulation: bit rate, symbol rate (Baud rate) and bandwidth
- CRC and retransmissions, packet radio, forward error correction

## 1.9 Power and energy

- The power of sinusoidal signals  $\left[ P = i^2 \cdot R; P = \frac{u^2}{R}; u = U_{\text{eff}}; i = I_{\text{eff}} \right]$

- Power/ decibel ratios corresponding to the following dB values: 0 dB, 3 dB, 6 dB, 10 dB and 20 dB [both positive and negative]
- The input/output power ratio in dB of series-connected amplifiers and/or attenuators
- Matching [maximum power transfer]
- The relation between power input and output and efficiency  $\left[ \eta = \frac{P_{out}}{P_{in}} \cdot 100\% \right]$
- Peak envelope power [p.e.p.]

### 1.10 Digital signal processing (DSP)

- Sampling and quantization
- Minimum sampling rate (Nyquist frequency)
- Convolution (time domain / frequency domain, graphical presentation)
- Anti-aliasing filtering, reconstruction filtering
- ADC / DAC

## PART 2

### 2. COMPONENTS

#### 2.1 Resistor

- The unit ohm
- Resistance
- Current/voltage characteristic
- Power dissipation

#### 2.2 Capacitor

- Capacitance
- The unit farad
- The relation between capacitance, dimensions and dielectric. (Qualitative treatment only)
- The reactance

$$\left[ X_c = \frac{1}{2\pi f \cdot C} \right]$$

- Phase relation between voltage and current

#### 2.3 Coil

- Self-inductance
- The unit henry
- The effect of number of turns, diameter, length and core material on inductance. (Qualitative treatment only)
- The reactance
- $[X_L = 2\pi f \cdot L]$
- Phase relation between voltage and current
- Q-factor

#### 2.4 Transformers (application and use)

- Ideal transformer [ $P_{\text{prim}} = P_{\text{sec}}$ ]
- The relation between turn ratio and:

○ voltage ratio  $\left[ \frac{u_{\text{sec}}}{u_{\text{prim}}} = \frac{n_{\text{sec}}}{n_{\text{prim}}} \right]$

- current ratio [  $\frac{i_{sec}}{i_{prim}} = \frac{n_{sec}}{n_{prim}}$  ]
- Impedance ratio
- Transformers

## 2.5 Diode

- Use and application of diodes
- Rectifier diode, zener diode, LED [light-emitting diode], voltage-variable and capacitor [varicap]
- Reverse voltage and leakage current

## 2.6 Transistor

- PNP- and NPN-transistor
- Amplification factor
- Field effect vs. bipolar transistor (voltage vs. current driven)
- The transistor in the:
  - common emitter [source] circuit
  - common base [gate] circuit
  - common collector [drain] circuit
  - input and output impedances of the above circuits

## 2.7 Miscellaneous

- Simple thermionic device [valve]
- Voltages and impedances in high power valve stages, impedance transformation
- Simple integrated circuits

## PART 3

### 3. ELECTRIC CIRCUITS

#### 3.1 Combination of components

- Series and parallel circuits of resistors, coils, capacitors, transformers and diodes
- Current and voltage in these circuits
- Behaviour of real (non-ideal) resistor, capacitor and inductors at high frequencies

#### 3.2 Filter

- Series-tuned and parallel-tuned circuit
- Impedance
- Frequency characteristic

$$\left[ f = \frac{1}{2\pi\sqrt{LC}} \right]$$

- Resonance frequency

$$\left[ Q = \frac{2\pi f \cdot L}{R_s}; Q = \frac{R_p}{2\pi f \cdot L}; Q = \frac{f_{res}}{B} \right]$$

- Quality factor of a tuned circuit
- Bandwidth
- Band-pass filter
- Low-pass, high-pass, band-pass and band-stop filters composed of passive elements
- Frequency response (frequency bandwidth)
- Pi-filter and T-filter
- Quartz crystal
- Effects due to real (non-ideal) components
- Digital filters (see sections 1.10 and 3.8)

#### 3.3 Power supply

- Circuits for half-wave and full-wave rectification and the Bridge rectifier
- Smoothing circuits
- Stabilisation circuits in low voltage supplies
- Switching mode power supplies, isolation and EMC

#### 3.4 Amplifier

- LF and HF amplifiers
- Gain
- Amplifier factor
- Amplitude/frequency characteristic and bandwidth (broadband vs. tuned stages)
- Class A, A/B, B and C biasing
- Harmonic and intermodulation distortion, overdriving amplifier stages

### **3.5 Detector**

- AM detectors (envelope detectors)
- Diode detector
- Product detectors and beat oscillators
- FM detectors

### **3.6 Oscillator**

- Feedback (intentional and unintentional oscillations)
- Factors affecting frequency and frequency stability conditions necessary for oscillation
- LC oscillator
- Crystal oscillator, overtone oscillator
- Voltage controlled oscillator (VCO)
- Phase noise

### **3.7 Phase Locked Loop [PLL]**

- Control loop with phase comparator circuit
- Frequency synthesis with a programmable divider in the feedback loop

### **3.8 Digital signal processing (DSP systems)**

- FIR and IIR filter topologies
- Fourier Transformation (DFT, FFT, graphical presentation)
- Direct Digital Synthesis

## PART 4

### 4. RECEIVERS

#### 4.1 Receiver types

- Single and double superheterodyne receiver
- Direct conversion receivers

#### 4.2 Block diagrams

- CW receiver [A1A]
- AM receiver [A3E]
- SSB receiver for suppressed carrier telephony [J3E]
- FM receiver [F3E]

#### 4.3 Operation and function of the following stages (Block diagram treatment only)

- HF amplifier [with tuned or fixed band pass]
- Oscillator [fixed and variable]
- Mixer
- Intermediate frequency amplifier
- Limiter
- Detector, including product detector
- Audio amplifier
- Automatic gain control
- S meter
- Squelch

#### 4.4 Receiver characteristics (Simple description treatment)

- Adjacent-channel
- Selectivity
- Sensitivity, receiver noise, noise figure
- Stability
- Image frequency
- Desensitization / Blocking
- Intermodulation; cross modulation
- Reciprocal mixing [phase noise]

## PART 5

### 5. TRANSMITTERS

#### 5.1 Transmitter types

- Transmitter with or without frequency translation

#### 5.2 Block diagrams

- CW transmitter [A1A]
- SSB transmitter with suppressed carrier telephony [J3E]
- FM transmitter with the audio signal modulating the VCO of the PLL [F3E]

#### 5.3 Operation and function of the following stages (Block diagram treatment only)

- Mixer
- Oscillator
- Buffer
- Driver
- Frequency multiplier
- Output matching
- Output filter
- Frequency modulator
- SSB modulator
- Phase modulator
- Crystal filter

#### 5.4 Transmitter characteristics

- Frequency stability
- RF Bandwidth
- Sidebands
- Audio-frequency range
- Non-linearity [harmonic and intermodulation distortion]
- Output impedance
- Output power
- Efficiency
- Frequency deviation
- Modulation index

- CW key clicks and chirps
- SSB overmodulation and splatter
- Spurious RF radiations
- Cabinet radiations
- Phase noise

## PART 6

### 6. ANTENNAS AND TRANSMISSION LINES

#### 6.1 Antenna types

- Centre fed half-wave antenna
- End fed half-wave antenna
- Folded dipole
- Quarter-wave vertical antenna [ground plane]
- Antenna with parasitic elements [Yagi]
- Aperture antennas (Parabolic reflector, horn)
- Trap dipole

#### 6.2 Antenna characteristics

- Distribution of the current and voltage
- Impedance at the feed point
- Capacitive or inductive impedance of a non-resonant antenna
- Polarisation
- Antenna directivity, efficiency and gain
- Capture area
- Effective radiated power (ERP, EIRP)
- Front-to-back ratio
- Horizontal and vertical radiation patterns

#### 6.3 Transmission lines

- Parallel conductor line
- Coaxial cable
- Waveguide
- Characteristic impedance [ $Z_0$ ]
- Velocity factor
- Standing-wave ratio
- Losses
- Balun transformer
- Quarter-wave impedance transformer
- Antenna tuning units (Pi and T configurations only)

## PART 7

### 7. PROPAGATION

- Signal attenuation, signal to noise ratio
- Line of sight propagation (free space propagation, inverse square law)
- Ionospheric layers
- Critical frequency
- Influence of the sun on the ionosphere
- Maximum Usable Frequency
- Ground wave and sky wave, angle of radiation and skip distance
- Multipath in ionospheric propagation
- Fading
- Troposphere (ducting, scattering)
- Temperature inversion
- Sporadic E-reflection
- Auroral scattering
- Meteor scatter
- Reflections from the moon
- Atmospheric noise [distant thunderstorms]
- Galactic noise
- Ground (thermal) noise
- Propagation prediction basics (link budget):
  - o dominant noise source (band noise vs. receiver noise)
  - o minimum signal to noise ratio
  - o minimum received signal power
  - o path loss
  - o antenna gains, transmission line losses
  - o maximum transmitter power

## PART 8

### 8. MEASUREMENTS

#### 8.1 Measurement of:

- DC and AC voltages and currents
- Measuring errors:
  - o influence of frequency
  - o influence of waveform
  - o influence of internal resistance of meters
- Resistance
- DC and RF power [average power, Peak Envelope Power]
- Voltage standing-wave ratio
- Waveform of the envelope of an RF signal
- Frequency
- Resonance frequency

#### 8.2 Measuring instruments

- Making measurements using:
  - o Multi range meter (digital and analogue)
  - o Rf-power meter
  - o Reflectometer bridge (SWR meter)
  - o Signal generator
  - o Frequency counter
  - o Oscilloscope
  - o Spectrum analyser

## PART 9

### 9. INTERFERENCE AND IMMUNITY

#### 9.1 Interference in electronic equipment

- Blocking
- Interference with the desired signal
- Intermodulation
- Detection in audio circuits

#### 9.2 Cause of interference in electronic equipment

- Electromagnetic field in the transmitter
- Spurious radiation of the transmitter [parasitic radiation, harmonics]
- Undesired influence on the equipment:
  - o via the antenna input [aerial voltage, input selectivity]
  - o via other connected lines
  - o by direct radiation

#### 9.3 Measures against interference

- Measures to prevent and eliminate interference effects:
  - o Filtering
  - o Decoupling
  - o Shielding

## **PART 10**

### **10. SAFETY**

- The human body
- Main power supply
- High voltages
- Lightning

## **b) MACEDONIAN AND INTERNATIONAL OPERATING RULES AND PROCEDURES**

### **PART 1**

#### **1. PHONETIC ALPHABET**

A = Alpha	J = Juliet	S = Sierra
B = Bravo	K = Kilo	T = Tango
C = Charlie	L = Lima	U = Uniform
D = Delta	M = Mike	V = Victor
E = Echo	N = November	W = Whiskey
F = Foxtrot	O = Oscar	X = X-ray
G = Golf	P = Papa	Y = Yankee
H = Hotel	Q = Quebec	Z = Zulu
I = India	R = Romeo	

### **PART 2**

#### **2. Q-CODE (abbreviations)**

<u>Code</u>	<u>Question</u>	<u>Answer</u>
QRK	What is the readability of my signals?	The readability of your signals is ...
QRM	Are you being interfered with?	I am being interfered with ...
QRN	Are you troubled by static?	I am troubled by static
QRO	Shall I increase transmitter power?	Increase transmitter power
QRP	Shall I decrease transmitter power?	Decrease transmitter power
QRT	Shall I stop sending?	Stop sending
QRZ	Who is calling me?	You are being called by ...
QRV	Are you ready?	I am ready
QSB	Are my signals fading?	Your signals are fading
QSL	Can you acknowledge receipt?	I am acknowledging receipt
QSO	Can you communicate with ... direct?	I can communicate ... direct
QSY	Shall I change to transmission on another frequency?	Change transmission to another frequency
QRX	When will you call again?	I will call you again at ... hours on ... kHz (or MHz)
QTH	What is your position in ... latitude and longitude or in another way?	My position is ... latitude, ... longitude ...

## **PART 3**

### **3. ABBREVIATIONS USED IN AMATEUR SERVICE**

BK	Signal used to interrupt a transmission in progress
CQ	General call to all stations
CW	Continuous wave
DE	From, used to separate the call sign of the station called from that of the calling station
K	Invitation to transmit
MSG	Message
PSE	Please
RST	Readability, signal-strength, tone-report
R	Received
RX	Receiver
TX	Transmitter
UR	Your

## **PART 4**

### **4. INTERNATIONAL DISTRESS SIGNS, EMERGENCY TRAFFIC AND NATURAL DISASTER COMMUNICATION**

- Distress signs:
  - o Radiotelegraphy ...---... [SOS]
  - o Radiotelephony "MAYDAY"
- International use of the amateur station in the event of national disasters
- Frequency bands allocated to the amateur service and amateur satellite service

## **PART 5**

### **5. CALL SIGNS**

- Identification of the amateur station
- Use of the call signs
- Composition of call signs
- National prefixes

## **PART 6**

### **6. IARU BAND PLANS**

- IARU band plans
- Purposes

## **PART 7**

### **7.1 SOCIAL RESPONSIBILITY OF RADIO AMATEUR OPERATION**

### **7.2 OPERATING PROCEDURES**

**c) MACEDONIAN AND INTERNATIONAL REGULATIONS RELEVANT TO THE AMATEUR SERVICE AND AMATEUR SATELLITE SERVICE**

**PART 1**

**1. ITU RADIO REGULATIONS**

- Definition Amateur Service and Amateur Satellite Service
- Definition Amateur station
- Article 25 Radio Regulations (RR)
- Status Amateur Service and Amateur Satellite Service
- ITU Radio Regions

**PART 2**

**2. CEPT REGULATIONS**

- Recommendation T/R 61-01
- Temporary use of amateur stations in CEPT countries
- Temporary use of amateur stations in NON-CEPT countries which participate in the T/R 61-01 system

**PART 3**

**3. MACEDONIAN LAWS, REGULATIONS AND AUTHORISATION CONDITIONS**

- Macedonian laws
- Regulations and authorisation conditions
- Demonstrate knowledge of maintaining a log:
  - o log keeping
  - o purpose
  - o recording data

## **ANNEX 2**

### **“P” CLASS EXAMINATION PROGRAMME**

#### **a) TECHNICAL CONTENT**

#### **1. ELECTRICAL, ELECTRO-MAGNETIC AND RADIO THEORY**

- 1.1 Conductivity
- 1.2 Sources of electricity
- 1.3 Radio waves
- 1.4 Audio and digital signals
- 1.5 Modulated signals
- 1.6 Power

#### **2. COMPONENTS**

- 2.1 Resistor
- 2.2 Capacitor
- 2.3 Coil
- 2.4 Transformers (application and use)
- 2.5 Diode
- 2.6 Transistor
- 2.7 Tuned circuits

#### **3. ELECTRIC CIRCUITS**

- 3.1 Filtering

#### **4. RECEIVERS**

- 4.1 Types
- 4.2 Block diagrams
- 4.3 Application and use

#### **5. TRANSMITTERS**

- 5.1 Block diagrams
- 5.2 Application and use
- 5.3 Transmitter characteristics

## **6. ANTENNAS AND TRANSMISSION LINES**

6.1 Antenna types (physical construction, directivity and polarisation)

6.2 Antenna power supply

6.3 Matching

## **7. FREQUENCY SPECTRUM AND PROPAGATION**

## **8. MEASUREMENTS**

8.1 Making measurements

8.2 Measuring instruments

## **9. INTERFERENCE AND IMMUNITY**

9.1 Interference in electronic equipment

9.2 Cause of interference in electronic equipment

9.3 Measures against interference

## **10. SAFETY**

10.1 The human body

10.2 Electric network supply

10.3 Dangers

10.4 Thunders

***b) MACEDONIAN AND INTERNATIONAL OPERATING RULES AND PROCEDURES***

1. Phonetic Alphabet
2. Q-Code
3. Operational abbreviations used in amateur service
4. Call signs

***c) MACEDONIAN AND INTERNATIONAL REGULATIONS RELEVANT TO THE AMATEUR SERVICE AND AMATEUR SATELLITE SERVICE***

1. ITU radio regulations
2. CEPT regulations
3. Macedonian laws, regulations and authorisation conditions

# **“P” CLASS DETAILED EXAMINATION PROGRAMME**

## **a) TECHNICAL CONTENT**

### **PART 1**

#### **1. ELECTRICAL, ELECTRO-MAGNETIC AND RADIO THEORY**

##### **1.1 Conductivity**

- Conductor, semiconductor and insulator
- Current, voltage and resistance
- The unit ampere, volt and ohm
- Ohm's Law [ $E = I \cdot R$ ]
- Electric power [ $P = E \cdot I$ ]
- The unit watt

##### **1.2 Sources of electricity**

- Battery and electric network supply

##### **1.3 Radio waves**

- Radio waves as electromagnetic waves
- Propagation velocity and its relation with frequency and wavelength
- Polarisation
- Frequency
- The unit hertz

##### **1.4 Audio and digital signals**

- Audio signals
- Digital signals

##### **1.5 Modulated signals**

- Advantages and disadvantages of:
  - o amplitude modulation
  - o single sideband modulation
  - o frequency modulation
- Carrier, sidebands and bandwidth

## **1.6 Power**

- Direct input power and output radio frequency power

## **PART 2**

## **2. COMPONENTS**

### **2.1 Resistor**

- Resistance
- The unit ohm
- Power dissipation
- Colour designation
- Resistors in series and parallel connection

### **2.2 Capacitor**

- Capacitance
- The unit farad
- The use of constant and variable capacitors: air, mica, plastic, ceramic and electrolytic capacitors
- Capacitors in parallel connection

### **2.3 Coil**

- The unit henry

### **2.4 Transformers (application and use)**

- Transformers (function)

### **2.5 Diode**

- Application and use of diodes
- Rectifier diode, zener diode

### **2.6 Transistor**

- Awareness that transistors may be used as amplifiers or oscillators

### **2.7 Tuned circuits**

- Application of series and parallel tuned circuits

## **PART 3**

### **3. ELECTRIC CIRCUITS**

#### **3.1 Filtering**

- Low-pass, high-pass, band-pass and band-stop filters (application and use)

## **PART 4**

### **4. RECEIVERS**

#### **4.1 Receiver types**

- Single and double superheterodyne receiver
- Direct conversion receivers

#### **4.2 Block diagrams**

- CW receiver [A1A]
- AM receiver [A3E]
- SSB receiver [J3E]
- FM receiver [F3E]

#### **4.3 Operation and function of the following stages (Block diagram treatment only)**

- High Frequency (HF) amplifier
- Oscillator [fixed and variable]
- Mixer
- Intermediate frequency amplifier
- Detector
- Beat-frequency oscillator (BFO)
- Low frequency (LF) amplifier
- Power supply
- Squelch (application only)

## PART 5

### 5. TRANSMITTERS

#### 5.1 Block diagrams

- CW transmitter [A1A]
- SSB transmitter [J3E]
- FM transmitter [F3E]

#### 5.2 Operation and function of the following stages (Block diagram treatment only)

- Mixer
- Oscillator (crystal and VFO)
- Buffer
- Driver
- Frequency multiplier
- Output matching
- Output filtering (Pi filter)
- Frequency modulator
- Frequency modulator
- SSB modulator
- Power supply

#### 5.3 Transmitter characters (Simple description)

- Frequency stability
- RF Bandwidth
- Sidebands
- Output power
- Spurious emission and harmonics

## PART 6

### 6. ANTENNAS AND TRANSMISSION LINES

#### 6.1 Antenna types (physical construction, directivity and polarisation)

- Centre fed half-wave antenna
- End fed half-wave antenna

- Quarter-wave vertical antenna [ground plane]
- Antenna with parasitic elements [Yagi]
- Radiated power [ERP, EIRP]

## **6.2 Antenna power supply methods**

- Coaxial cable and parallel conductor line
- Advantages and disadvantages
- Construction and use

## **6.3 Matching**

- Antenna tuning units (application only)

## **PART 7**

### **7. FREQUENCY SPECTRUM AND PROPAGATION**

- Ionospheric layers
- Influence of the ionospheric layers on HF propagation
- Fading
- Troposphere
- Influence of weather conditions on VHF/UHF propagation
- Solar cycles and influence on communications
- HF, VHF, UHF bands
- Relation between frequency and wavelength

## **PART 8**

### **8. MEASUREMENTS**

#### **8.1 Making measurements**

- Measurement of:
  - o direct and alternating voltage
  - o direct and alternating current
  - o resistance
  - o frequency

## **8.2 Measuring instruments**

- Making measurements using:
  - AVO meter (digital and analogue)
  - SWR meter (reflectometer bridge)
  - Wave absorption meter
  - Dummy load

## **PART 9**

## **9. INTERFERENCE AND IMMUNITY**

### **9.1 Interference in electronic equipment**

- Interference with desired signal (TV, VHF and broadcasting)
- Interference with audio system

### **9.2 Cause of interference in electronic equipment**

- Spurious radiation of the transmitter [parasitic radiation, harmonics]
- Undesired influence on the equipment:
  - via the antenna input
  - via other connected lines (electric network, loudspeakers and cables)
  - by direct radiation

### **9.3 Measures against interference**

- Measures to prevent and eliminate interference effects:
  - Filtering of the amateur station
  - Filtering of the interfered equipment
  - Decoupling
  - Shielding
  - Separation of transmission and TV antennas
  - Avoiding to use the end fed antenna
  - Minimum power
  - Good RF grounding
  - Social effects (good relation with the neighbours)

## **PART 10**

### **10. SAFETY**

#### **10.1 The human body**

- Power surge
- Cautions against power surge

#### **10.2 Electric network supply**

- Difference between lines, zero and grounding (colour designation)
- Importance of good grounding connections
- Fast and slow fuses, value of fuses

#### **10.3 Dangers**

- High voltages
- Voltage capacitors

#### **10.4 Thunders**

- Dangers
- Protection
- Grounding of equipment

## **b) MACEDONIAN AND INTERNATIONAL OPERATING RULES AND PROCEDURES**

### **PART 1**

#### **1. PHONETIC ALPHABET**

A = Alpha	J = Juliet	S = Sierra
B = Bravo	K = Kilo	T = Tango
C = Charlie	L = Lima	U = Uniform
D = Delta	M = Mike	V = Victor
E = Echo	N = November	W = Whiskey
F = Foxtrot	O = Oscar	X = X-ray
G = Golf	P = Papa	Y = Yankee
H = Hotel	Q = Quebec	Z = Zulu
I = India	R = Romeo	

### **PART 2**

#### **2. Q-CODE (abbreviations)**

<u>Code</u>	<u>Question</u>	<u>Answer</u>
QRK	What is the readability of my signals?	The readability of your signals is ...
QRM	Are you being interfered with?	I am being interfered with ...
QRN	Are you troubled by static?	I am troubled by static
QRO	Shall I increase transmitter power?	Increase transmitter power
QRP	Shall I decrease transmitter power?	Decrease transmitter power
QRT	Shall I stop sending?	Stop sending
QRZ	Who is calling me?	You are being called by ...
QRV	Are you ready?	I am ready
QSB	Are my signals fading?	Your signals are fading
QSL	Can you acknowledge receipt?	I am acknowledging receipt
QSO	Can you communicate with ... direct?	I can communicate ... direct
QSY	Shall I change to transmission on another frequency?	Change transmission to another frequency
QRX	When will you call again?	I will call you again at ... hours on ... kHz (or MHz)
QTH	What is your position in ... latitude and longitude or in another way?	My position is ... latitude, ... longitude ...

## **PART 3**

### **3. ABBREVIATIONS USED IN AMATEUR SERVICE**

BK	Signal used to interrupt a transmission in progress
CQ	General call to all stations
CW	Continuous wave
DE	From, used to separate the call sign of the station called from that of the calling station
K	Invitation to transmit
MSG	Message
PSE	Please
RST	Readability, signal-strength, tone-report
R	Received
RX	Receiver
TX	Transmitter
UR	Your

## **PART 4**

### **4. CALL SIGNS**

- Identification of the amateur station
- Use of the call signs
- Composition of call signs
- National prefixes

## **c) MACEDONIAN AND INTERNATIONAL REGULATIONS RELEVANT TO THE AMATEUR SERVICE AND AMATEUR SATELLITE SERVICE**

### **PART 1**

#### **1. ITU RADIO REGULATIONS**

- Definition Amateur Service and Amateur Satellite Service
- Definition Amateur station
- Article 25 of the Radio Regulation (RR)
- Status Amateur Service and Amateur Satellite Service
- ITU Radio Regions

### **PART 2**

#### **2. CEPT REGULATIONS**

- ECC Recommendation (05)06
- Temporary use of amateur stations in CEPT countries
- Temporary use of amateur stations in NON-CEPT countries which participate in the CEPT Novice Radio Amateur Licensing system

### **PART 3**

#### **3. MACEDONIAN LAWS, REGULATIONS AND AUTHORISATION CONDITIONS**

- Macedonian laws
- Regulations and authorisation conditions
- Demonstrate knowledge of maintaining a log:
  - o log keeping
  - o application of the log
  - o information recorded in the log