



**COLLEGE: COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)**

**SCHOOL: SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING**

**PROGRAMME: CERTIFICATE IV IN ELECTRONICS ENGINEERING**

**UNIT CODE: EEE424**

**TITLE: RADIO RECEIVERS AND TRANSMITTERS**

**FINAL EXAMINATION – PENSTER 2, 2014**

**ROOM: AS PER TIMETABLE**

**TIME: 2 HOURS 10 MINUTES**

**INSTRUCTIONS TO STUDENTS**

1. You are allowed 10 minutes extra reading time during which you are NOT to write.
2. Begin each SECTION on a fresh page and use both sides of the sheet.
3. Write your candidate number at the top of each attached sheet.
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with a string.
5. For all sheets of paper on which rough/draft work has been done, cross it through and ATTACH these to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Use of programmable calculator(s) is prohibited.
8. **ANSWER ALL QUESTIONS**
9. Show all working where necessary.
10. **ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE EXAM ROOM.**

**SECTION A****MULTIPLE CHOICE****[20 MARKS]**

Write the *letter* of the *best choice* in the Answer Sheet.

- 1) The difference between the DC power into a transmitter and the RF power coming out:
  - a) Is a measure of efficiency
  - b) Heats the transmitter
  - c) May require water cooling
  - d) All of the above
  
- 2) ALC stands for:
  - a) Amplitude Level Control
  - b) Automatic Level Control
  - c) Accurate Level Control
  - d) None of the above
  
- 3) In an AM transmitter, ALC is used to:
  - a) Keep the modulation close to 100%
  - b) Keep the modulation below 100%
  - c) Maximise transmitted power
  - d) All of the above
  
- 4) Power amplifiers must be linear for any signal that:
  - a) Is complex
  - b) Has variable amplitude
  - c) Has variable frequency
  - d) All of the above
  
- 5) To remove one AM sideband and leave the other, you could use:
  - a) A mechanical filter
  - b) A crystal filter
  - c) Both a and b
  - d) None of the above
  
- 6) An indirect FM modulator:
  - a) Requires a varactor in the carrier oscillator
  - b) Varies the phase of the carrier oscillator
  - c) Both a and b
  - d) None of the above
  
- 7) With mixing:
  - a) The carrier frequency can be raised
  - b) The carrier frequency can be lowered
  - c) The carrier frequency can be changed to any required value
  - d) The deviation is altered

- 8) The superheterodyne receiver was invented by:
- a) Foster
  - b) Seeley
  - c) Armstrong
  - d) Hertz
- 9) The frequency of the local oscillator:
- a) Is above the RF frequency
  - b) Is below the RF frequency
  - c) Can be either above or below the RF frequency
  - d) Is fixed, typically at 455 kHz
- 10) Which stage comes after the mixer stage in an AM receiver?
- a) IF stage
  - b) AGC stage
  - c) Detector stage
  - d) RF amplifier stage
- 11) The frequency stability of a phase locked loop oscillator depends on a:
- a) Well regulated power supply
  - b) Crystal control oscillator
  - c) Voltage control Oscillator
  - d) High L/C ratio final stage
- 12) FM receivers use the standard frequency band of 88 MHz to 108 MHz. What is the usual IF of these receivers?
- a) 10.6 MHz
  - b) 10.7 MHz
  - c) 10.8 MHz
  - d) 10.9 MHz
- 13) A varactor diode is also known as:
- a) A snap-off varactor
  - b) Voltage variable capacitor diode
  - c) Rectifier diode
  - d) Tunnel diode
- 14) Which type of filter is commonly used in the antenna feed to prevent spurious radiation at the VHF base repeater site?
- a) High pass filters
  - b) Band- pass filters
  - c) Band- stop filters
  - d) Low pass filters

- 15) For an AM receiver with an RF frequency of 558 kHz, what will the LO frequency be?
- a) 1012 kHz
  - b) 1.013 MHz
  - c) 11.358 MHz
  - d) None of the above
- 16) Automatic gain and level control is most likely to be found in the
- a) Superhet AM receiver
  - b) Superhet FM receiver
  - c) Superhet AM transmitter
  - d) Superhet FM transmitter
- 17) What is the IF of the AM receiver?
- a) 10.6 MHz
  - b) 10.8 MHz
  - c) 454 kHz
  - d) 455 kHz
- 18) A directive antenna is:
- a) A dipole aerial
  - b) Marconi aerial
  - c) A yagi-uda aerial
  - d) A whip aerial
- 19) SAW devices may be used as:
- a) Transmission media like strip line
  - b) Filters
  - c) UHF amplifiers
  - d) Oscillators
- 20) Choose the appropriate antenna used in all CB radios:
- a) Yagi-uda aerial
  - b) Marconi aerial
  - c) Dipole aerial
  - d) Stingers

**SECTION B****MATCHING****[30 MARKS]****Instruction:***Write the corresponding alphabet for each question:*

1)	Frequency Counter	A	A process or means by which gain is automatically adjusted in a specified manner as a function of a specified parameter, such as received signal level
2)	Automatic Level Control	B	Detects the transmitted frequency
3)	Sensitivity	C	Uses a p-n junction in reverse bias and has a structure such that the capacitance of the diode varies with reverse voltage
4)	De-emphasis stage	D	Found in the detector stage of the radio receiver
5)	Yagi-uda antenna	E	Ability to receive weak signals with an acceptable signal to noise ratio
6)	RF amplifier	F	Measures the forward and reflected transmitted power
7)	Frequency multiplier	G	Found in FM receivers
8)	Automatic Gain Control	H	Used for AM reception
9)	Over-modulation	I	Transformer coupling is used for the impedance matching
10)	Pre-emphasis stage	J	Requires a non-linear circuit
11)	Selectivity	K	A filter that passes most frequencies unaltered, but attenuates those in a specific range to very low levels
12)	Demodulation	L	Distortion
13)	Foster-Seeley Discriminator	M	Used in communication transmitters that keeps the modulation at a level approaching but never exceeds 100%
14)	Whip Antenna	N	Found in FM transmitters
15)	Band-Stop Filter	O	Contains a dipole, reflector plus one or more directors

16)	Balun	P	In this system, a voltage controlled oscillator (VCO) is phase locked by a feedback loop into following the deviation of the incoming FM signal. The low frequency error voltage that forces the VCO to track is the demodulated output
17)	Class D	Q	Ability to discriminate against interfering signals
18)	Modulator	R	The recovery, from a modulated carrier, of a signal having substantially the same characteristics as the original modulating signal
19)	Phase Locked Loop Detector	S	Used in CB radios
20)	High-Pass Filter	T	Found in the RF and LO stages
21)	Band-Pass Filter	U	A device or circuit that maintains the frequency of an oscillator within the specified limits with respect to a reference frequency
22)	Aerial Coupling Unit	V	Normally found between an AM transmitter and the Marconi antenna
23)	Long Wire Antenna	W	A device that imposes a signal on a carrier
24)	Varactor	X	Found with the FM transmitter and the antenna
25)	Ganged Capacitors	Y	Balanced to unbalanced and is found near a TV yagi-uda antenna
26)	Automatic Frequency Control	Z	A filter that passes high frequencies well, but attenuates (or reduces) frequencies lower than the cut-off frequency
27)	Crystal Oscillator	AA	Power amplifier of modern AM solid state transmitters
28)	Feeders	AB	Is a common type of FM detector circuit
29)	Power Meter	AC	Coaxial cable in the transmitter sites
30)	Low Pass Filter	AD	Uses piezoelectric effect

**SECTION C      CALCULATIONS & OPERATIONS      [50 MARKS]**

1) Explain the meaning of the following :

- [a] Notch Filter (2marks)
- [b] Comb Filter (2marks)
- [c] Yagi Antenna (2marks)
- [d] AM Waveform (2marks)
- [e] FM Waveform (2marks)
- [f] Modulator (2marks)
- [g] Matching (2marks)
- [h] CB Radio (2marks)

2) Draw a block diagram of an AM transmitter and:

- [a] label each block. (5 marks)
- [b] label and describe the functions of the two transducers used. (2 marks)
- [c] write down the possible frequency of the signal at the antenna compared to the crystal frequency. (2 marks)
- [d] Clearly with the aid of diagrams describe how would you find the depth of modulation of a the transmitter you have drawn using CRO. (3 marks)

3) Draw a block diagram of an FM transmitter and clearly label each block? (5 marks)

4) Draw a block diagram of an AM receiver:

- [a] label each block (5 marks)
- [b] explain the two transducers functions used in the system. (2 marks)

5) A PLL FM generator as shown below with  $f_{ref} = 100 \text{ kHz}$ ,  $N = 200$  and

$k_f = 50 \text{ kHz/V}$ .

[a] Calculate the carrier frequency of the output signal. (3 marks)

[b] What r.m.s. modulated voltage will be required for a deviation of 10 kHz at the carrier frequency? (3 marks)

6) A PLL FM detector uses a VCO with  $k_f = 100 \text{ kHz/V}$ . If it receives an FM signal with a deviation of 75 kHz and sine wave modulation, what is the RMS output voltage from the detector? (2 marks)

7) A receiver has a sensitivity of  $0.5 \mu\text{V}$  and a blocking dynamic range of 70 dB. What is the strongest signal that can be present along with a  $0.5 \mu\text{V}$  signal without blocking taking place? (2 marks)

**THE END**