Cape Peninsula University of Technology

FACULTY OF ENGINEERING & THE BUILT ENVIRONMENT

DEPARTMENT: ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING

QUALIFICATION(S): BET (Electrical and Computer Engineering)

SEMESTER/YEAR: [ ] 1 [ ] 2 [X] Year

ASSESSMENT TYPE:
E.G. MID-TERM TEST TEST (T1) CLOSED BOOK ASSESSMENT

SUBJECT NAME: **ELECTRONIC COMMUNICATIONS 3**	**ANNEXURE(S):**	**PAGES:**	**TIME:** 75 mins
SUBJECT CODE: **COM 371S /COM 372S**	**DATE:** **March 28 2023**	**MARKS** 11 Weight (5%)	14:00 - 15:15

EXAMINER: AA PERIOLA

MODERATOR (INTERNAL): B VIPIN

SPECIAL INSTRUCTIONS:

- Write legibly.
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Graduate Attribute (GA): Indicate which question measures the GA.

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1. What is the gain for an amplifier with an input voltage of 1.14 V and an output voltage of 1.565 V
a. 3.01 dB
b. 2.65 dB
c. 2.75 dB
d. 2.97 dB

2. Which of the following frequency blocks has the highest bandwidth
a. 0.9 GHz – 1.0 GHz
b. 250 MHz – 345 MHz
c. 450 GHz – 450.05 GHz
d. 234 MHz – 350 MHz

3. Which of the following is not a type of internal noise
a. White Noise
b. Thermal Noise
c. Johnson Noise
d. Grey Noise

4. What is the noise ratio and noise figure if the input and output signal-to-noise ratios are 34 and 5, respectively?
a. 7.54, 8.77 dBm
b. 6.62, 8.2 dB
c. 4.14. 3.56 dB
d. 6.8, 8.33dB

5. Which of the following variants of amplitude modulation has the highest power consumption
a. DSBFC
b. DSBSC
c. SSBSC
d. SSBFC

6. Which combination results in overmodulation
a. Modulating signal amplitude of 40V, Carrier signal amplitude of 67 V
b. Carrier signal amplitude of 56 V, Modulating signal amplitude of 32 V
c. Modulating signal amplitude of 56 V, Carrier signal amplitude of 112.5 V
d. Carrier signal amplitude of 54 V, Modulating signal amplitude of 28.5 V.

7. For an SSBSC system what is the sideband power given a transmitter and carrier power of 440W and 230 W, respectively?
a. 220 W.
b. 250 W.
c. 210 W.
d. 200 W.

8. A 100 kHz intelligence signal is modulated by a 3.5MHz carrier, what are the lower and upper sidebands

a. 3.545 MHz, 3.455 MHz
b. 3.6 MHz, 3.48 MHz
c. 3.4 MHz, 3.60 MHz
d. 3.61 MHz, 3.43 MHz.

9. What challenge of Amplitude modulation motivated the design of Frequency modulation

a. High Noise Susceptibility
b. Low transmission distance
c. Complexity
d. Obsolescence

10. What is the specification of the system with the following parameters: permissible frequency shift 450 kHz, intelligence signal frequency 60 kHz?

a. Modulation Index of 0.05, System Type: Narrowband FM, Direct FM
b. Modulation Index 7.74, System Type: Wideband FM, Indirect FM
c. Modulation Index 7.50, System Type: Wideband FM
d. Modulation Index 7.43, System Type: Wideband FM

11. Which variant of FM involves a phase modulation stage

a. Conventional FM
b. Direct FM
c. Indirect FM
d. Carrier Suppressed FM

Formula Sheet

1. Gain in dB = 20*log (output voltage/input voltage)
2. Noise ratio = input signal to noise ratio/output signal to noise ratio.
3. Noise figure = 10*log10(Noise ratio).
4. Transmitter power = sideband power + carrier power
5. Upper side frequency = Carrier frequency + Modulating signal frequency
6. Lower side frequency = Carrier frequency - Modulating signal frequency
7. Modulation index = frequency shift allowable /intelligence signal frequency

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Memo

Question	Answer	Question	Answer
1	C	7	C
2	D	8	C
3	D	9	A
4	D	10	C
5	A	11	C
6	C		

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SEMESTER/YEAR: [ ] 1 [ ] 2 [X] Year

ASSESSMENT TYPE:
E.G. MID-TERM TEST TEST (T2) CLOSED BOOK ASSESSMENT

SUBJECT NAME: **ELECTRONIC COMMUNICATIONS 3**	**ANNEXURE(S):**	**PAGES:**	**TIME:** 180 minutes 10:00 - 13:00
SUBJECT CODE: **COM 371S /COM 372S**	**DATE:** **August 01 2023**	**MARKS** 80 Weight (10%)	

EXAMINER: AA PERIOLA

MODERATOR (INTERNAL): B VIPIN

SPECIAL INSTRUCTIONS:

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1. Which of the following statements most describe a frequency selective system
a. A system capable of yielding different outputs for signals having varying frequencies.
b. A system capable of admitting input signals having different frequencies.
c. A system having one or more components whose performance is influenced by signals having different frequencies.
d. A system functioning at the receiver only and capable of exhibiting different behaviours based on signal frequencies.

2. The consideration of the quality factor is inapplicable to which context
a. Component Level Q Factor
b. System Level Q Factor
c. Effective Q Factor
d. Wireless Transmitter – Wireless Receiver Q Factor

3. Which of the following is true for the Quality Q Factor for communication networks.
a. Low values are most desired
b. High values are most desired
c. Medium values are most desired
d. All options are correct

4. A tuned radio frequency has a resonant frequency of 100kHz. What signal frequency will not yield a reasonable output.
a. 450 kHz
b. 100.01 kHz
c. 99.994 kHz
d. 99.9 kHz

5. Which of the following receiver systems has the image frequency problem
a. Tuned Radio Frequency Receiver
b. Superheterodyne Receiver
c. Direct Conversion Receiver
d. Balanced Modulator Receiver

6. Which receiver is unsuitable/challenging to function as a receiver with relation to Frequency Modulation
a. Zero – Intermediate Frequency Receiver
b. Intermediate Frequency Receiver
c. Tuned Radio Frequency Receiver
d. Superheterodyne Receiver

7. Increasing the Quality Factor (Q – Factor)
a. Increases the resonant frequency.
b. Decreases the resonant frequency.
c. Decreases the bandwidth.
d. Increases the bandwidth.

8. Which component is not influenced by the process for Gang Tuning for radio receivers
a. Intermediate Frequency Amplifier
b. Mixer
c. Antenna
d. Local Oscillator

9. Which component selects the mixer input frequency
a. Low Pass Filter
b. Bandpass Filter
c. Discriminator
d. Pre-selector

10. The operational frequency range for Radio Frequency Amplifiers is
a. 100 MHz – 240 GHz
b. 10 MHz – 230 GHz
c. 45 KHz – 400 MHz
d. 30 kHz – 300 GHz

11. Which amplifier class has a wholly linear operation
a. Class B
b. Class D
c. Class A
d. Class C

12. An engineer seeks to design a system in which the utilized amplifier has a reduced power consumption. Which amplifier class is most suitable?
a. Class BC
b. Class AC
c. Class AD
d. Class CD

13. The conduction angle for a class E amplifier can be one of which values
a. 60 degrees – 75 degrees
b. 85 degrees – 105 degrees
c. 40 degrees – 59 degrees
d. 28 degrees – 58 degrees

14. Which of the following is not true for oscillators
a. They are used in transmitters.
b. They are used in receivers.
c. They have a configuration independent resonant frequency.
d. They enable signal frequency conversion.

15. Determine the image frequency given the mixer input frequency of 80 MHz, Oscillator Frequency of 200 MHz, and intermediate amplifier frequency of 95 MHz.
a. 175 MHz.
b. 280 MHz.
c. 295 MHz.
d. 375 MHz.

16. Given the image frequency of 500 MHz, Desired Signal Frequency of 240 MHz, what is the image rejection (in numerical figure) given a Q factor of 76.

a. 14848
b. 17783
c. 560
d. 4786.3

17. High pass filters:
a. Block signals with frequencies below the cut-off frequency.
b. Yield an attenuated output for signals with frequencies below the cut-off frequency.
c. Have a useful output for signals with frequencies equal to or exceeding the cut-off frequency.
d. Function at the upper cut off frequency associated with bandpass filters.

18. Given a total resistance and inductance of 24 ohms and 23 mH, the circuit bandwidth is:
a. 172 Hz.
b. 180 Hz.
c. 166 Hz.
d. 165 Hz.

19. Signal aliasing arises when
a. Insufficient number of analog signals sampling are taken for reconstruction.
b. Sufficient number of analog signal samples are taken for reconstruction.
c. Signal reconstruction is successful.
d. Analog signal is realized via compute procedures on received digital signals.

20. Analog to Digital Signal conversion results in
a. Enhanced bandwidth efficiency.
b. Improved signal regeneration.
c. Enhanced signal processing capability.
d. All of the above.

21. Digital systems do not solely utilize which of the following component
a. Transducer
b. Encoder
c. Decoder
d. Sampler

22. Which modulation is used in motor speed control
a. PAM
b. PCM
c. PWM
d. PDM

23. The encoder executes how many tasks.
a. 4
b. 2
c. 5
d. 3

24. The commonly used baseband modulation technique for telephony is
a. PPM
b. PMM
c. PAM
d. PCM

25. The suitable sampling frequency for a signal with the highest frequency of 500 MHz is
a. 900 MHz.
b. 1.0 GHz.
c. 2.0 GHz.
d. 980 MHz.

26. How many bits are required for a dynamic range of 79 dB.
a. 12.7
b. 13.0
c. 13.1
d. 18

27. The achieved signal to noise ratio for the case in (26) is:
a. 82 dB
b. 81 dB
c. 85 dB
d. 79 dB

28. In comparison to analog signal, baseband digital signals are used without
a. Data.
b. Transducer functionality.
c. Modulation.
d. Transmission.

29. PPM is derived from which technique?
a. PAM.
b. PCM.
c. PWM.
d. PDM.

30. Which is not true for analog and digital systems
a. Analog signals capture more details than digital signals.
b. Digital signals have a higher level of interoperability than analog signals.
c. Computing needs increase with the continued use of analog signals.
d. More digital data can be stored in a storage medium than corresponding analog data.

31. Which is true from a perspective of noise immunity:
a. PAM < AM < FM
b. PWM>PPM<PAM
c. PAM>PDM>PPM
d. PPM>PWM>PAM

32. A filter's response can be described using how many regions:
a. 3
b. 5
c. 2
d. 4

33. RC Filters are
a. Active Filters
b. Hybrid Filters
c. Passive Filters
d. Band Pass Filters.

34. Sensitivity of a receiver is the
a. Ability to detect signals with high amplitude.
b. 40mV if it can detect a smallest signal of 40mV.
c. -100 dB if it can detect a signal with SNR of - 100dB
d. Filter out noise during audio signal extraction process.

35. Which is not true for the Receiver selectivity:
a. Increases with the Q factor.
b. Decreases with a reduction in the resonant frequency.
c. Is not influenced by the effective system Q factor.
d. Inversely proportional to the Image Rejection Ratio

36. Which of the following is true about content access on the internet?
a. FM technology is predominantly used and deployed.
b. Baseband modulation methods are predominantly used and deployed.
c. Broadband modulation methods are predominantly used and deployed.
d. A, B, and C are correct.

37. How many bits are mapped to realize a symbol in 64 QAM.
a. 5
b. 6
c. 7
d. 4

38. Which of the following statement is not true for communication networks
a. Improved capability to meet user preferences often result in operational challenges.
b. Enhanced operation and efficiency often lead to additional complexity.
c. Ideal performance can be achieved while retaining operational benefits.
d. Filters are used in analog and digital communication systems.

39. Storing information in a *more-bit identity formation* leads to which outcome
I. Increase in number of bits per symbol.
II. Decrease in number of bits per symbol.
III. Increased receiver complexity.

A. I and II.
B. II and III.
C. I, II, and III.
D. No change at all.

40. Packing more bits and symbols during data transmission does not lead to:
a. Increased symbol proximity.
b. More symbol interference.
c. Higher data rate.
d. Reduced receiver complexity.

Formula Sheet

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3. Noise figure = 10*log10(Noise ratio).
4. Transmitter power = sideband power + carrier power
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6. Lower side frequency = Carrier frequency - Modulating signal frequency
7. Modulation index = frequency shift allowable /intelligence signal frequency
8. Bandwidth = Total Circuit Resistance / (2*pi* Total Circuit Inductance)
9. Signal to noise ratio = 1.76 + 6.02*(Number of Quantization Bits) dB
10. Dynamic Range = 6.02 * Number of Quantization Bits in dB.
11. Image rejection (dB) = 20 x log ((image frequency/desired signal frequency) - ((desired signal frequency /image frequency) x Quality Factor)

Memo for Test 2 (T2) Electronic Communications 3

Question	Answer	Question	Answer	Question	Answer	Question	Answer
1	C	11	C	21	A	31	D
2	D	12	C	22	C	32	A
3	B	13	C	23	D	33	C
4	A	14	C	24	D	34	B
5	B	15	C	25	C	35	D
6	A	16	A	26	C	36	C
7	C	17	C	27	B	37	B
8	C	18	C	28	C	38	C
9	D	19	A	29	C	39	B
10	D	20	A	30	C	40	D

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SEMESTER/YEAR: [ ] 1 [ ] 2 [X] Year

ASSESSMENT TYPE:
E.G. MID-TERM TEST TEST (T3) CLOSED BOOK ASSESSMENT

SUBJECT NAME: **ELECTRONIC COMMUNICATIONS 3**	**ANNEXURE(S):**	**PAGES:**	**TIME:** 180 minutes 11:00 - 14:00
SUBJECT CODE: **COM 371S /COM 372S**	**DATE:** **October 03 2023**	**MARKS** 60 Weight (10%)	

EXAMINER: AA PERIOLA

MODERATOR (INTERNAL): B VIPIN

SPECIAL INSTRUCTIONS:

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QUESTION 1

The ionosphere is a region of the atmosphere that is able to reflect non-microwave frequencies thereby radiocommunications. Explain why the ionosphere is not suitable for microwave communications (6 marks) and modification steps that may be taken to address this challenge (6 marks). In addition, explain the challenges associated with considered modification (6 marks).

(18 marks)

QUESTION 2

What is impedance matching and why is it important (3 marks).

Mention and explain two implications of mismatching in a communication system (3 marks each) (6 marks).

Mention a technique that can be used to achieve impedance matching and its concerned matching technique (2 marks each) (4 marks)

Explain the importance of achieving impedance matching in systems like the smartphone (2 marks)

(15 marks)

QUESTION 3

Define an antenna, and the antenna radiation pattern (3 marks each) (6 marks)

Mention, explain and diagrammatically describe three types of antenna radiation pattern (3 marks each) (9 marks)

What is an Antenna Array (2 marks)

Mention two types of scanning that can be used in an antenna array (1 mark each) (2 marks)

(19 marks)

QUESTION 4

Mention four categories of networks based on their coverage level (2 marks each) **(8 marks)**

Formula Sheet

1. Gain in dB = 20*log (output voltage/input voltage)
2. Noise ratio = input signal to noise ratio/output signal to noise ratio.
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10. Dynamic Range = 6.02 * Number of Quantization Bits in dB.
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QUESTION 1

The ionosphere is a region of the atmosphere that is able to reflect non-microwave frequencies thereby radiocommunications. Explain why the ionosphere is not suitable for microwave communications (6 marks) and modification steps that may be taken to address this challenge (6 marks). In addition, explain the challenges associated with considered modification (6 marks). **(18 marks)**

The ionosphere is unsuitable for microwave communications because of the significant reduction in the wavelength associated with microwave frequencies. This wavelength is small in comparison to the ionosphere's dimensions. **(6 marks)**

The ionosphere can be modified by changing its total electron count (2 marks), electron density (2 marks) in a manner that synchronizes with transmitter and receiver location (2 marks) **(6 marks)**

The challenges associated with this modification approach is ensuring non-disastrous changes to the climate, and weather (3 marks) ; and determining the suitable synchronization of the transmitter, receiver, and ionosphere conditions (3 marks) **(6 marks)**

(18 marks)

QUESTION 2

What is impedance matching and why is it important (3 marks).

Mention and explain two implications of mismatching in a communication system (3 marks each) (6 marks).

Mention a technique that can be used to achieve impedance matching and its concerned matching technique (2 marks each) (4 marks)

Explain the importance of achieving impedance matching in systems like the smartphone (2 marks)

(15 marks)

Impedance Matching is the process of ensuring that the impedances associated with interacting interfaces in communication networks are equal (1.5 marks), It is important to ensure maximum power transfer (1.5 marks) **(3 marks)**

Poor power efficiency : The non–realization of maximum power transfer results in the occurrence of poor power efficiency as all power arising from the generator is not transferred to the load.

(3 marks)

Damage to Network Components: A build of standing waves results in network components being subjected. to high voltage levels that exceed their expected capability thereby leading to damage **(3 marks)**

Smith Chart (2 marks) ; and Quarter Wave Matching Section (2 marks) **(4 marks)**

It is important to achieve impedance matching between microwave components used in the smartphone to ensure its functionality across multiple networks having different operational frequencies (2 marks)

(15 marks)

QUESTION 3

Define an antenna, and the antenna radiation pattern (3 marks each) **(6 marks)**

Mention, explain and diagrammatically describe three types of antenna radiation pattern (3 marks each)

(9 marks)

What is an Antenna Array **(2 marks)**

Mention two types of scanning that can be used in an antenna array (1 mark each) **(2 marks)**

(19 marks)

An antenna is a component of a communication system that converts electrical energy to electromagnetic energy ; and also converts electromagnetic energy into electrical energy (3 marks)

The antenna radiation pattern is a radial plot of the electric field strength associated with an antenna at different angular position and orientation (3 marks)

Isotropic Radiation Antenna (1 mark) – Insertion of Diagram showing radiation of electric field strength of equal values in all directions (1 mark). An isotropic radiation pattern is one where the concerned antenna radiates an electric field of equal values in all its angular positions (1 mark) (3 marks)

Omnidirectional Radiation Antenna (1 mark) – Insertion of Diagram showing radiation electric field strength of values in all directions. However, all values are not equal (1 mark). An omnidirectional radiation pattern is one where all the concerned antenna radiates an inequal electric field in all its angular position (1 mark) (3 marks)

Directional Radiation Antenna (1 mark) – Insertion of Diagram showing radiation pattern associated with the main lobes and minor lobes (1 mark). A directional radiation pattern is one where the significant focus of the antenna radiation is in the main lobe (1 mark) (3 marks)

An Antenna Array is a collection of multiple types of antennas used in radiocommunication applications. (2 marks)

Electronic Scanning (1 mark), and Mechanical Scanning (1 mark) (2 marks)

QUESTION 4

Mention four categories of wireless networks based on their coverage level (2 marks each) **(8 marks)**

Wireless Wide Area Networks ; Wireless Metropolitan Area Networks ; Wireless Local Area Networks ; and Wireless Personal Area Networks (2 marks each) **(8 marks)**