higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

COMMUNICATION-ELECTRONICS N5

19 November 2024

This marking guideline consists of 8 pages.

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QUESTION 1

1.1 1.1.1

$$Z_D = \frac{L}{CR}$$

$$= \frac{60 \text{ x } 10^{-3}}{100 \text{ x } 10^{-6} \text{ x } 5} \checkmark$$

$$= 120\ \Omega \checkmark\checkmark \quad (3)$$

1.1.2

$$I_R = \frac{V_T}{R}$$

$$= \frac{120\angle 0°}{5\angle 0°}$$

$$= 24\angle 0° \text{ A} \checkmark\checkmark$$

$$I_L = \frac{V_T}{X_L} \qquad \text{where } X_L = 2\pi fL$$

$$= \frac{120\angle 0°}{18{,}85\angle 90°} \qquad = 2\pi \text{ x } 50 \text{ x } 60 \text{ x } 10^{-3}$$

$$= 6{,}366\angle -90° \text{ A} \checkmark\checkmark \qquad = 18{,}85\ \Omega \checkmark$$

$$Ic = \frac{V_T}{Xc} \qquad \text{where } Xc = \frac{1}{2\pi fC}$$

$$= \frac{120\angle 0°}{31{,}831\angle -90} \qquad = \frac{1}{2\pi \text{ x } 50 \text{ x } 100 \text{ x } 10^{-6}}$$

$$= 3{,}77\angle 90° \text{ A} \checkmark\checkmark \qquad = 31{,}831\ \Omega \checkmark \quad (8)$$

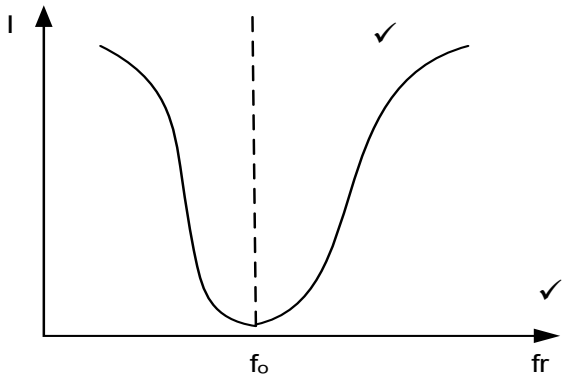
1.1.3

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

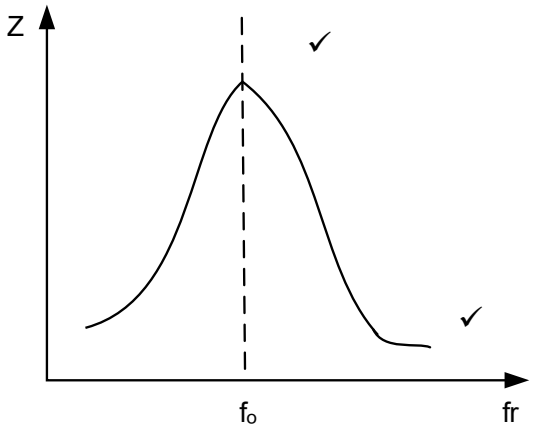
$$= \frac{1}{5}\sqrt{\frac{60 \text{ x } 10^{-3}}{100 \text{ x } 10^{-6}}} \checkmark$$

$$= 4{,}899 \checkmark\checkmark \quad (3)$$

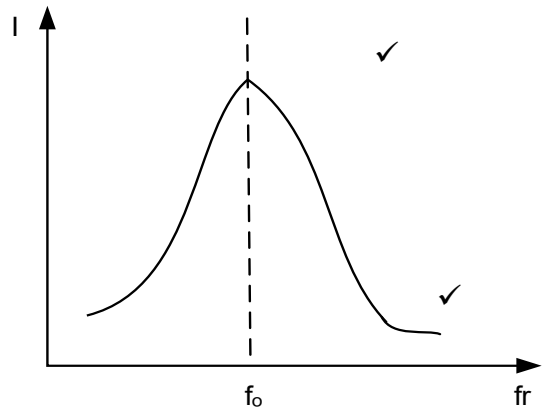
1.2 1.2.1



1.2.2



1.2.3



(3 × 2) (6)

1.3 The quality factor is a measure of the quality of a component or circuit at resonance when carrying an oscillating current at a specific frequency,✓ which is basically the ratio of the two amounts of energy.✓ (2)

[22]

QUESTION 2

2.1 The bridged T-attenuator is the favoured format for variable RF attenuators,✓ especially those using diodes,✓ because it only requires the use of two variable resistors (R_B and R_C) against the three required for both T-type attenuators and π-type attenuators.✓ It also tends to match itself with the characteristic impedance Z_o which is a great advantage compared to the T-type and π-type attenuators.✓ (4)

2.2 2.2.1 A T-type attenuator network is a symmetrical attenuator network that can be used in a transmission line circuit✓ that has either equal or unequal impedances,✓ and it can be connected in either direction making it a bi-directional network.✓ (3)

2.2.2 Attenuation is the loss of power in transmission lines in electrical networks,✓ and it is measured in decibels (dB) and nepers.✓ (2)

2.3
- It must provide the correct input impedance.
- It must provide the correct output impedance.
- It must provide the correct attenuation.
- It must be independent of frequency. (Any 3 × 1) (3)

2.4 $\mathrm{Ra} = \sqrt{\mathrm{R_1}(\mathrm{R_1} - \mathrm{R_2})}$

$(70{,}7)^2 = \left(\sqrt{100(100 - \mathrm{R_2})}\right)^2$✓

$4998{,}49 = 10000 - 100.\mathrm{R_2}$

$4998{,}49 - 10000 = -100.\mathrm{R_2}$✓

$\frac{-5001{,}51}{-100} = \frac{-100.\mathrm{R_2}}{-100}$ ✓

$\therefore \mathrm{R_2} = 50\ \Omega$✓ (4)

2.5 $\mathrm{Attenuation\ (N)} = 20\log\frac{\mathrm{Iin}}{\mathrm{Iout}}$

$= 20\log\frac{5{,}16}{2{,}5}$✓

$= 6{,}294\ \mathrm{dB}$✓✓ (3)

[19]

QUESTION 3

3.1 The characteristic impedance Z_{OT} of a T-type low-pass filter network is real if $\left(\frac{\omega^2 LC}{4} < 1\right)$, ✓✓and the characteristic impedance Z_{OT} is imaginary if $\left(\frac{\omega^2 LC}{4} > 1\right)$ ✓✓. Hence, the module passes frequencies below $\omega = \frac{2}{\sqrt{LC}}$ and attenuates a cut − off frequency given by $\omega c = \frac{2}{\sqrt{LC}}$ or

$fc = \frac{1}{\pi\sqrt{LC}}$. ✓✓ (6)

3.2 $L = \frac{R_o}{\pi fc}$

$= \frac{600}{\pi \text{ x } 4{,}5 \text{ x } 10^3}$

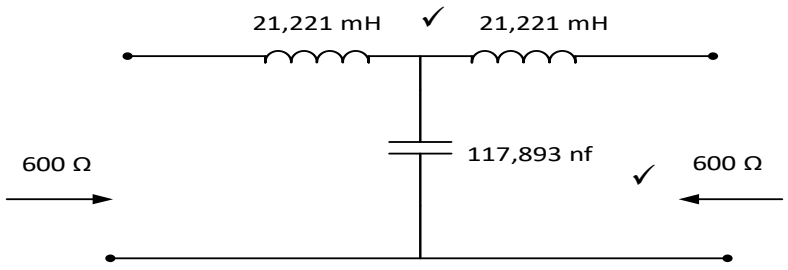
$= 42{,}441 \text{ mH}$✓✓

$C = \frac{1}{\pi R_o fc}$

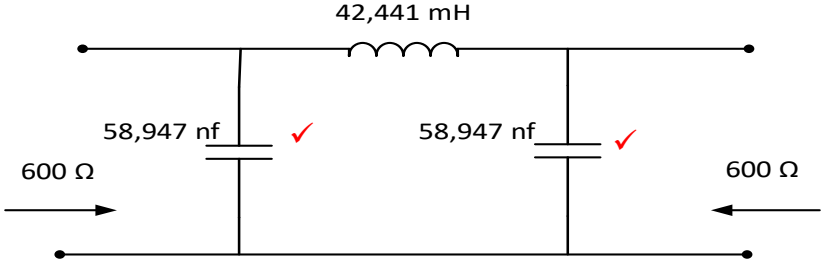
$= \frac{1}{\pi \text{ x } 600 \text{ x } 4{,}5 \text{ x } 10^3}$

$= 117{,}893 \text{ nf}$✓✓

T-type



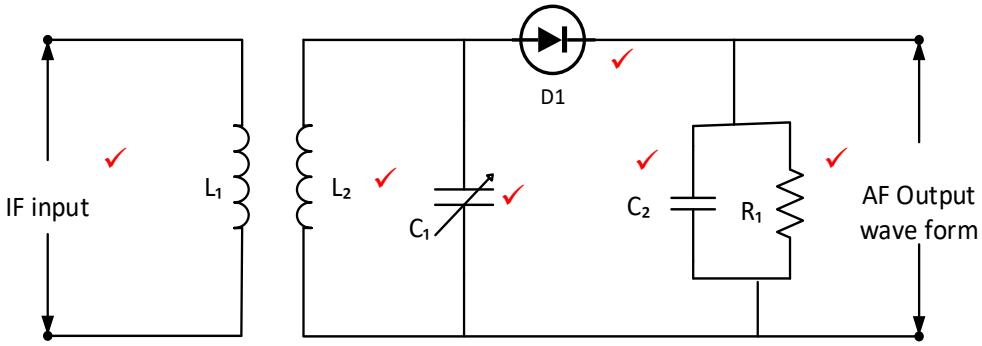
π-type



(8)
[14]

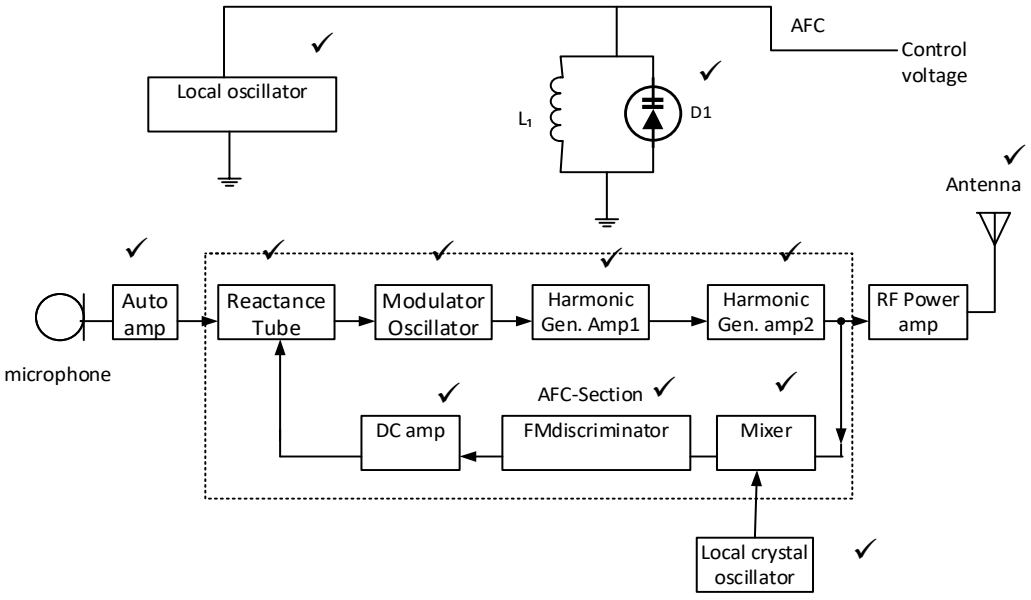
QUESTION 4

4.1



The IF signal is inductively coupled to the tuned circuit of L_2 and C_1 (455 kHz).✓ D_1 rectifies the RF currents and C_2 filters off the RF signals.✓ During the positive portion of the input wave, C_2 charges to the peak voltage value.✓ During the negative portion of the input wave, D_1 is now conducting and C_2 discharges across R_1, developing the audio frequency signal output voltage.✓ (10)

4.2



(12)

4.3

$$P_o = Pc\left(1 + \frac{m^2}{2}\right)$$

$$10 \times 10^3 = Pc\left(1 + \frac{0{,}85^2}{2}\right) ✓$$

$$Pc = \frac{10 \times 10^3}{1.36125} ✓$$

$$\therefore Pc = 7{,}346\ \text{kW} ✓$$

Power left in one sideband:

$$\text{Mean SSB output Power} = \frac{1}{2} \times \frac{\text{m}^2\text{Pc}}{2}$$

$$= \frac{0{,}15^2}{4} \times 7{,}346 \times 10^3 \checkmark$$

$$= 41{,}321 \text{ watts} \checkmark \quad (5)$$

[27]

QUESTION 5

5.1 Antennas play a major role in wireless communication systems as they effectively convert electromagnetic waves✓ to electronic signals (frequency),✓ or electronic signals to electromagnetic waves which are radiated through space by antennas.✓ (3)

5.2 A rhombic antenna is used in commercial point-to-point high-frequency (HF) communication.

OR

A rhombic antenna is used in commercial point-to-point shortwave band communication as a broadband directional antenna. (2)

5.3 5.3.1 An isotropic antenna is a hypothetical antenna that radiates the same intensity of radio waves in all directions.

5.3.2 An effective aperture is where the power received by an antenna can be associated with the collecting area;✓ every antenna may be considered to have such a collecting area.✓

5.3.3 Power transfer is when maximum power is transferred from a receiving antenna to its receiver's antenna✓ where the impedance of such antenna should be matched to the input impedance of the receiver.✓

(3 × 2) (6)

[11]

QUESTION 6

6.1
- If the zero and pole appear on the left, the Bode plot will be for an ordinary stable network.
- If the zero and pole are on the right, the Bode plot will indicate an unstable network. (2)

6.2
- The first point where $\omega \rightarrow 0$.
- The second point is where $\omega \rightarrow \infty$.
- The third point is where ω is the break frequency. (3)

6.3
- RC integrating circuit
- RC differentiating circuit (2)

[7]

TOTAL: 100

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