higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

COMMUNICATION-ELECTRONICS N5

26 JULY 2019

This marking guideline consists of 7 pages.

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QUESTION 1: GENERAL

1.1 direct✓ oppose✓
1.2 Insertion loss✓ mismatch✓
1.3 prototype✓ networks✓
1.4 microphone✓ electrical✓
1.5 controllers✓ bandwidth✓

(5 × 2) **[10]**

QUESTION 2: AC NETWORKS

2.1 2.1.1 $Z_{total} = (2 + 2) + (j5 - j) = j4 + 4$

In polar form:

$ZT = 5{,}7\angle 45°$✓

$i.e\ \tan\theta = \frac{1}{1} = 45°$

and $ZT = \frac{4}{\sin 45°} = 5{,}65$ or $5{,}7\ \Omega$✓

$I = \frac{V}{Z}$

$I = \frac{100\angle 0°}{5{,}7\angle 45°}$

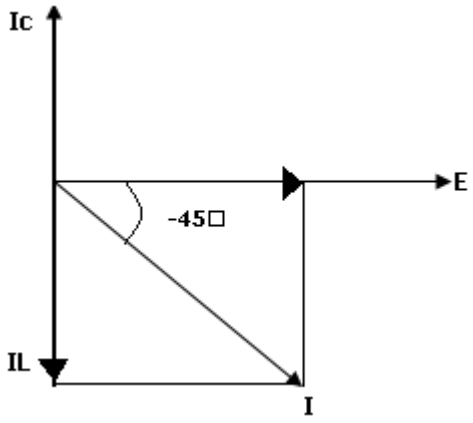
$I = 17{,}5\angle -45°$✓ (3)

2.1.2 $i = Im\sin(\omega t - \theta)$

Where $Im = 17{,}5 - \sqrt{2}$ A
$= 24{,}75$ A✓

Frequency $\omega = 377$ rad/s
$\theta = 45°$
$i = Im\sin(\omega t - \theta)$✓
$= 24(377t - 45°)$✓ (3)

2.1.3



(2)

2.2 $$ZT = \frac{Zc \times ZL}{ZC + ZL}$$

Where $Zc = -jXc$

$ZL = R + jXL$ ✓

Therefore $\acute{Z} = \frac{-jXC \times (R+jXL)}{-jXC+(R+jXL)}$ ✓

At resonance $Xc = XL$ *i.e* $jXc = jXL = 0$ ✓

Hence $\acute{Z} = \frac{-jRXc+XcXL}{R}$ ✓

But $-jRXc$ is negligible

$\therefore Z = \frac{Xc \times XL}{R}$ ✓

$Xc = \frac{1}{wc}$ and $XL = wL$ ✓

i.e $Z = \frac{\frac{1}{wc} \times \frac{wL}{1}}{R}$ ✓

$= \frac{\frac{wL}{wc}}{R} = \frac{wL}{wc \times R}$ ✓✓

Hence $Z = \frac{L}{CR}$ ✓

(10)

2.3 2.3.1 Impedance versus frequency for a parallel-tuned circuit
2.3.2 Current versus frequency for a parallel-tuned circuit
2.3.3 Current versus frequency for a series-tuned circuit
2.3.4 Impedance versus frequency for a series-tuned circuit

(4 × 3) (12)

[30]

QUESTION 3: FOUR-TERMINAL NETWORKS

3.1 A symmetrical two-port network is defined as a symmetrical two-port network that has similar input and output ports which may be interchanged. (3)

3.2 3.2.1 Calculate Z1 and Z2:

$$Z1 = 2\ [Zoc - \sqrt{Zoc(Zoc - Zsc)}\ ]$$

$$= 2\ [800 - \sqrt{800(800 - 600)}\ ] \checkmark$$

$$Z1 = 2\ (800 - 400)$$

$$= 800\ \Omega \checkmark$$

$$\frac{Z1}{2} = 800 \div 2$$

$$= 400\ \Omega \checkmark$$

$$Z2 = \sqrt{Zoc(Zoc - Zsc)}$$

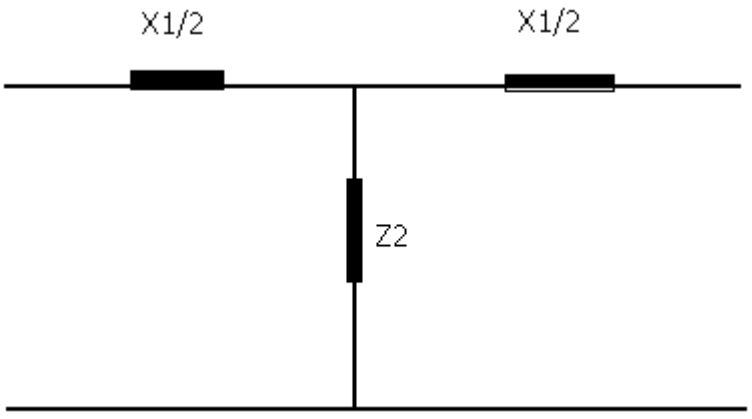
$$= \sqrt{800(800 - 600)}$$

$$= \sqrt{(800\ x\ 600)}\ \checkmark$$

$$= 400\ \Omega \checkmark$$

(5)

3.2.2

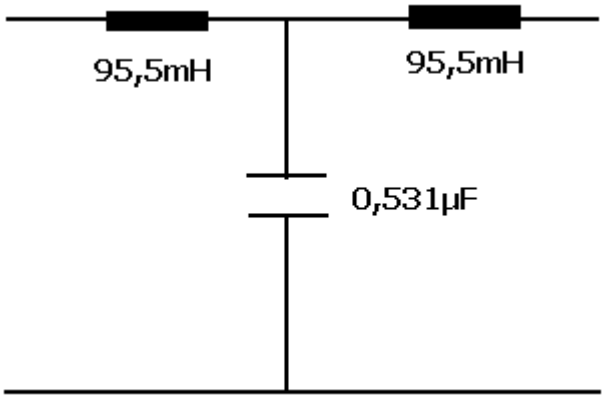


(2)
[10]

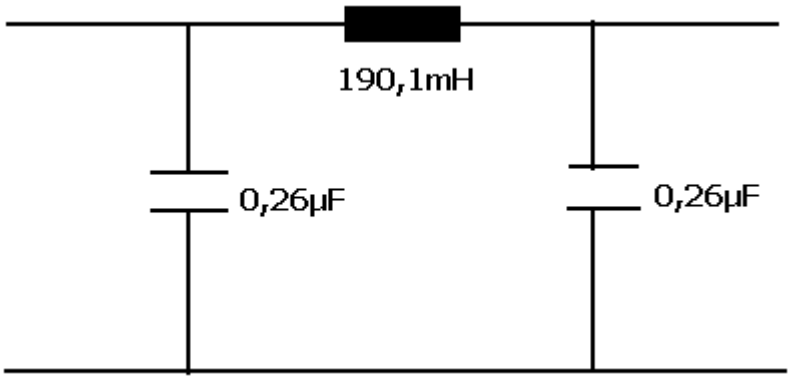
QUESTION 4: FILTERS

4.1 A constant K-filter is a simple-filter known prototype because of its characteristic that the product of the series and shunt impedances is constant at all frequencies. The impedance of this filter varies with frequency and the cut-off frequency is not sharply defined. (4)

4.2 $$L = \frac{Ro}{\pi Fc}$$
$$= \frac{600}{\pi \times 1\,000}\checkmark$$
$$= 190{,}1\ \text{mH}\checkmark$$
$$C = \frac{1}{\pi RoFc}$$
$$= \frac{1}{\pi \times 600 \times 1\,000}\checkmark$$
$$= 0{,}531\ \mu\text{H}\checkmark$$



T-type filter✓



π-type filter✓

(6)
[10]

QUESTION 5: RECEIVERS AND TRANSMITTERS

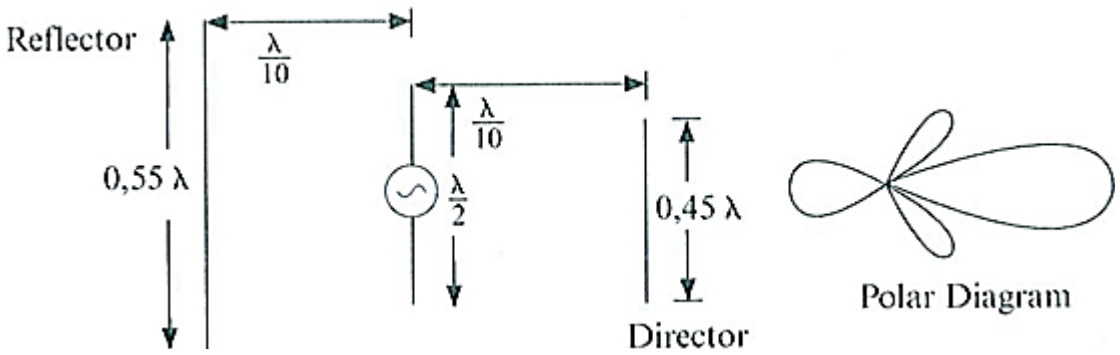
5.1
- The RF oscillator generates the RF which has constant amplitude to be modulated and transmitted.
- The buffer amplifier isolates the oscillator from load variations in other parts of the transmitter and provides stability to the oscillator.
- The frequency multiplier multiplies the output frequency of the oscillator to the required carrier frequency for transmission.
- The modulator places the audio signal on the RF carrier wave.
- The microphone converts mechanical sound waves to electrical currents for amplification by the audio amplifier.
- The audio amplifier amplifies the signal from the microphone to the required value for superimposing the radio frequency by the modulator.
- The RF power amplifier sufficiently amplifies the RF modulated carrier wave to a value enough to drive the antenna circuits.
- The antenna converts electrical energy into electromagnetic energy radiated into free space. (8 × 2) (16)

5.2
- Upper sideband
- Lower sideband
- Carrier frequency (3)

[19]

QUESTION 6: ANTENNAE

6.1



(4)

6.2 6.2.1 Directive gain is the ratio of the power density radiated in a particular direction by the antenna to the power density that would be radiated by an isotropic antenna.

6.2.2 Radiation resistance is the ratio of the power radiated by antenna to the square of the current at the feed point.

6.2.3 Polarisation is the direction in space of the electric vector of the electromagnetic wave radiated from an antenna and is parallel to the antenna itself.

(3 × 3) (9)

[13]

QUESTION 7: BODE PLOTS

7.1 Bode diagrams are an approximation of the frequency and phase response of RC circuits. (2)

7.2 7.2.1 Integrating circuit
7.2.2 Differentiating circuit

(2 × 3) (6)
[8]

TOTAL: 100

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