higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

COMMUNICATION-ELECTRONICS N5

APRIL 2016

This marking guideline consists of 7 pages.

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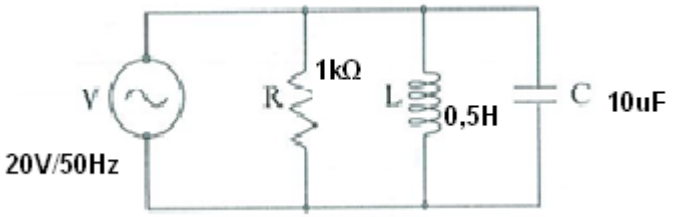
QUESTION 1: AC NETWORKS

1.1 1.1.1 Series:
(Z = R = Minimum
$X_L = X_C$
Current = Maximum

1.1.2 Parallel:
Z = L/RC = Maximum
XL= XC
Current = Minimum (3 x 2) (6)

1.2 1.2.1



✓✓ (2)

1.2.2 (a) $I_R = \frac{100}{100}$
= 0,1 A✓ (1)

$I_L = \frac{V}{XL}$
$= \frac{100}{2\pi \times 50 \times 0,5}$ ✓
= 0, 673 A ✓ (2)

$I_C = \frac{V}{Xc}$
$= \frac{100 \times 2\pi \times 50 \times 10}{10^6}$ ✓
= 0, 314 A ✓ (2)

$I_x = I_L - I_C$
= 0, 673 - 0, 314 ✓
= 0, 323 A ✓ (2)

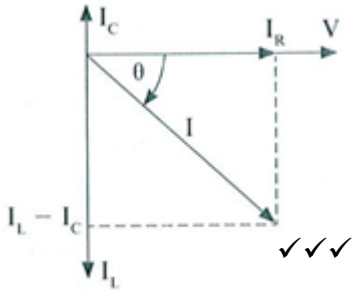
$I_T = \sqrt{I_R^2 + I_x^2}$
$= \sqrt{0,1^2 + 0,323^2}$
= 0,338 A ✓ (1)

(b) $\Theta = \tan^{-1}\frac{Ix}{IR}$

$= \tan^{-1}\frac{0,323}{0,1}$ ✓

= 72°46 ✓ (2)

1.3



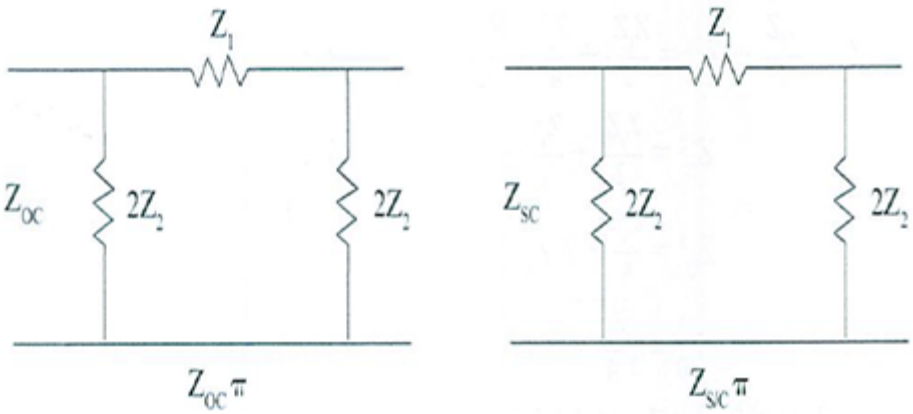
✓✓✓

(5)
[23]

QUESTION 2: FOUR-TERMINAL NETWORKS

2.1 An insertion loss of a symmetrical two-port network is defined as the total loss of the mismatch losses combined with the attenuation losses when a network is inserted. (5)

2.2



Z- open circuit (Zoc)

$$Z_{OC} = \frac{2Z_2(Z_1 + 2Z_2)}{2Z_2 + Z_1 + 2Z_2}$$

$$= \frac{2Z_2(Z_1 + 2Z_2)}{(Z_1 + 4Z_2)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

Z- short circuit (Zsc)

$$Z_{SC} = \frac{2Z_2Z_1}{Z_1 + 2Z_2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

The product of $Z_{OC} \cdot Z_{SC}$

$$Z_{OC} \cdot Z_{SC} = \left[\frac{2Z_2(Z_1 + 2Z_2)}{(Z_1 + 4Z_2)}\right] \times \left[\frac{2Z_2Z_1}{Z_1 + 2Z2}\right]$$

$$= \frac{4Z_1Z_2^2}{Z_1 + 4Z_2}$$

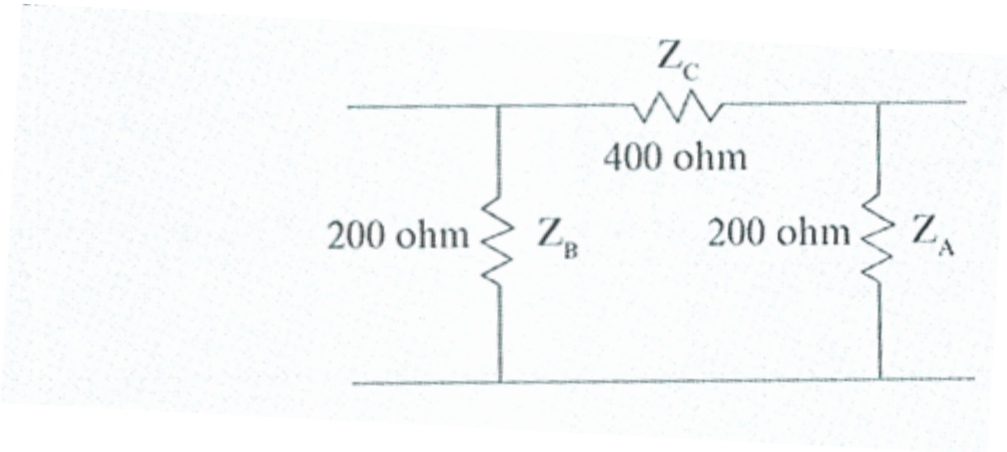
$$= \frac{Z_1^2 \cdot Z_2^2}{Z_1^2 + Z_1Z_2}$$

$$= Z_O^2$$

Then $Z_O = \sqrt{Z_{OC} \cdot Z_{SC}}$

(10)

2.3



$$Z_1 = \frac{Z_B Z_C}{Z_A + Z_B Z_C}$$

$$= \frac{200 \times 400}{200 + 200 + 400}$$

$$= 100 \text{ ohm}$$

$$Z_2 = \frac{Z_C Z_A}{Z_A + Z_B Z_C}$$

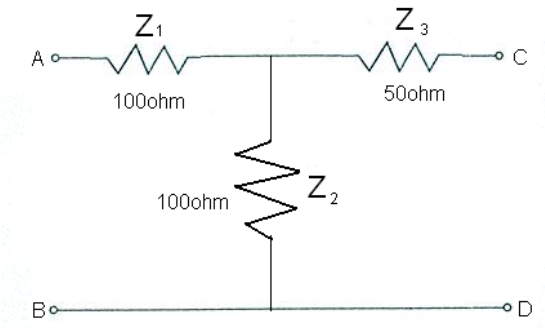
$$= \frac{400 \times 200}{200 + 200 + 400}$$

$$= 100 \text{ ohm}$$

$$Z_3 = \frac{Z_A Z_B}{Z_A + Z_B Z_C}$$

$$= \frac{200 \times 200}{200 + 200 + 400}$$

$$= 50 \text{ ohm}$$



(10)
[25]

QUESTION 3: FILTERS

3.1

$\frac{C}{2} = 1\ \mu F$

$L = 100\ mH$

Solution

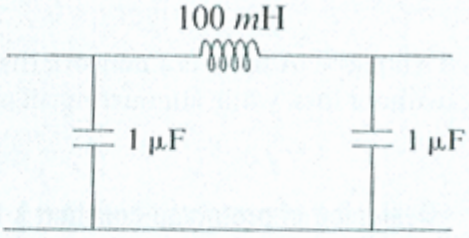
$C = 2\ \mu F$

$\therefore f_C = \frac{1}{\pi\sqrt{LC}}$

$= \frac{1}{\pi\sqrt{100 \times 10^{-3} \times 2 \times 10^{-6}}}$

$= 711{,}76\ Hz$

$C_T = 2\ \mu F$



(5)

3.2

$Z = 600$

$f_C = 10\ kHz$

$Z_1 = \frac{1}{j\omega c}$

$Z_2 = j\omega L$

$\therefore Z_O = \sqrt{\frac{j\omega L}{j\omega c} - \frac{1}{4\omega^2 C^2}}$

$= \sqrt{\frac{L}{C}} \times \sqrt{1 - \frac{1}{4\omega^2 LC}}$

Multiplying 1 × 2:

$$Z_O \times f_C = \sqrt{\frac{L}{C}} \times \frac{1}{4\pi\sqrt{LC}}$$

$$= \frac{1}{4\pi C}$$

$$C = \frac{1}{4\pi Z_O f_C}$$

Dividing 2 by 1:

$$\frac{Z_O}{f_C} = \sqrt{\frac{L}{C}} \times 4\pi\sqrt{LC}$$

$$= 4\pi L$$

$$L = \frac{Z_O}{4\pi f_C}$$

$$C = \frac{1}{4\pi Z_O f_C}$$

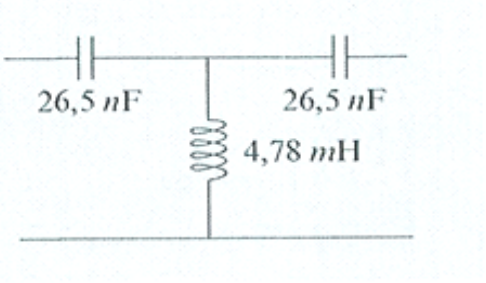
$$= \frac{1}{4 \times \pi \times 600 \times 10 \times 10^3}$$

$$= 13{,}27\ nF$$

$$L = \frac{Z_O}{4\pi f_C}$$

$$= \frac{600}{4 \times \pi \times 10 \times 10^3}$$

$$= 4{,}78\ mH$$



(15)
[20]

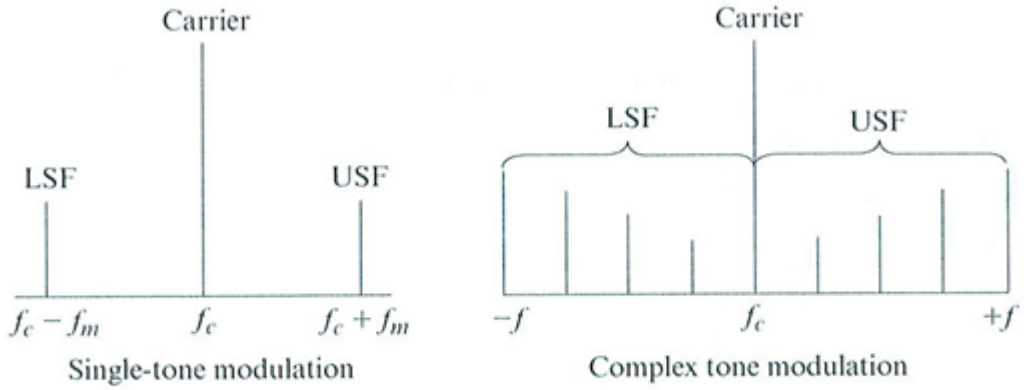
QUESTION 4: RECEIVERS AND TRANSMITTERS

4.1 4.1.1 Automatic Frequency Control (AFC) for a typical FM transmitter. (1)

4.1.2
A Reactance Tube
B Modulator Oscillator
C Harmonic Gen. Amp. 1
D Harmonic Gen. Amp. 2
E Mixer
F Mixer FM Discriminator
G DC Amplifier (7 x 1) (7)

4.2 4.2.1 Single-tone modulation
Complex-tone modulation (2 x 1) (2)

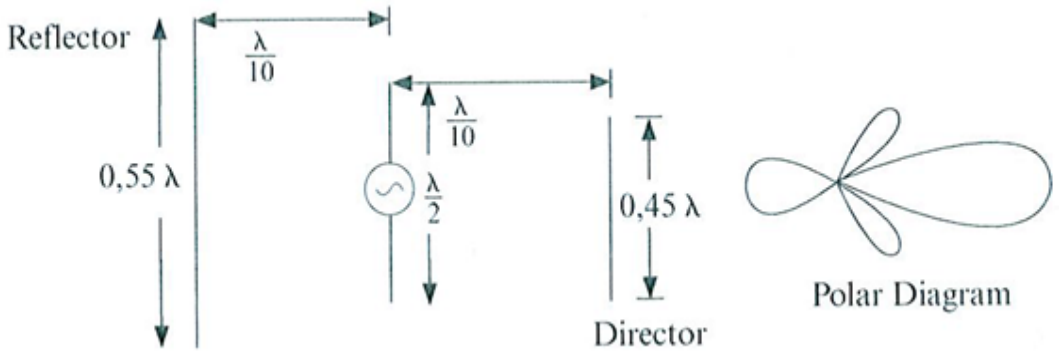
4.2.2



(6)
[16]

QUESTION 5: ANTENNAS

5.1 Yagi-Uda antenna is an array consisting of a driven element and one or more parasitic elements which are arranged collinearly and close together. (6)



(4)

5.2 5.2.1 **Directive gain:** Is defined as 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.

5.2.2 **Radiation resistance:** Is defined as the ratio of the power radiated by an antenna to the square of the current at the feed point.

5.2.3 **Polarisation:** Is defined as the direction in space of the electric vector of the electromagnetic wave radiated from an antenna, and is parallel to the antenna itself. (3 x 2) (6)
[16]

TOTAL: 100

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