higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

COMMUNICATION ELECTRONICS N5

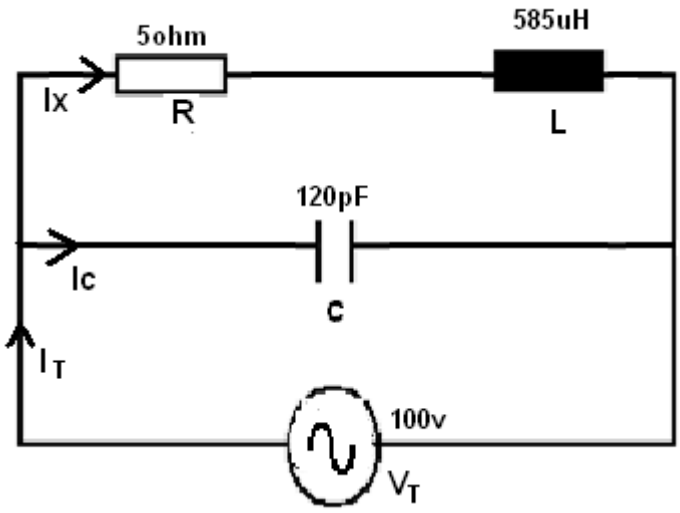
17 NOVEMBER 2016

This marking guideline consists of 8 pages.

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QUESTION 1

1.1 1.1.1



(2)

1.1.2 $Fr = \frac{1}{2\pi\sqrt{LC}}$

$= \frac{1}{2\pi\sqrt{585\times10^{-6}\times120\times10^{-12}}}$

= 601 kHz (2)

1.1.3 $Zd = \frac{L}{CR}$

$= \frac{585\times10^{-6}}{120\times10^{-12}\times5}$

= 975 kΩ (2)

1.1.4 $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

$= \frac{1}{5}\sqrt{\frac{585\times10^{-6}}{120\times10^{-12}}}$

= 442 (5)

1.1.5 $Fr = \frac{1}{2\pi\sqrt{LC}}$

$= \frac{1}{2\pi\sqrt{585\times10^{-6}\times120\times10^{-12}}}$

= <u>601 kHz</u> (2)

1.2 $Q = \frac{XL}{R}$

And $X_L = 2\pi fL$
$= 2\pi \times 601 \times 10^3 \times 585 \times 10^{-6}$
= **2 209,36 Ω**

$\therefore Q = \frac{XL}{R}$
$= \frac{2209,36}{5}$
= 441,81 = 442 (4)

1.3 The coefficient of coupling expresses the degree of coupling between the primary and secondary and is the ratio of mutual inductance to maximum inductance. (3)

1.4 1.4.1 (a) primary
(b) impedance
(c) coupled
(d) reflected (4)

1.4.2 (e) voltage
(f) current
(g) lags (3)

1.4.3 (h) secondary
(i) induced
(j) winding (3)
[30]

QUESTION 2

Looking in from R_1

$$R_1 = R_A + \frac{R_B \times R_2}{R_B + R_2}$$

Multiply by the common denominator $R_B + R_2$

$R_1 (R_B + R_2) = R_A (R_B + R_2) + R_B . R_2$
$R_1R_B + R_1R_2 = R_AR_B + R_AR_2 + R_B . R_2$ ……Eq. 1 (3)

Looking in from R_2

$$R_2 = \frac{R_B(R_1 + R_A)}{R_B + (R_1 + R_A)}$$ (2)

$$R_2 = \frac{R_BR_1 + R_AR_B}{R_B + R_1 + R_A}$$

Multiply by the common denominator $R_B + R_1 + R_A$

$R_2 (R_B + R_1 + R_A) = R_1R_B + R_AR_B$
$R_2 R_B + R_1 R_2 + R_2R_A = R_1R_B + R_AR_B$……Eq. 2 (2)

Adding Eq. 1 and Eq. 2

$R_1R_B + R_1R_2 = R_AR_B + R_AR_2 + R_B . R_2$
$R_2 R_B + R_1 R_2 + R_2R_A = R_1R_B + R_AR_B$
$2 R_1 R_2 + R_1R_B + R_2 R_B + R_2R_A = 2 R_AR_B + R_AR_2 + R_1R_B + R_B .R_2$
$\therefore 2 R_1 R_2 = 2 R_AR_B$ (4)

$$R_1 R_2 = \frac{2R_AR_B}{2}$$
$R_1 R_2 = R_AR_B$
Hence $R_A = \frac{R_1R_2}{R_B}$ (3)

Substituting

$\frac{R_1R_2}{R_B}$ for R_A in Eq. 1

$R_1R_B + R_1R_2 = R_AR_B + R_AR_2 + R_B . R_2$ ……Eq. 1
$\therefore R_1R_2 + R_1R_B = \left(\frac{R_1R_2}{\cancel{R_B}}\right)\cancel{R_B} + \left(\frac{R_1R_2}{R_B}\right)R_2 + R_B . R_2$
$R_1R_2 + R_1R_B = R_1R_2 + \frac{R_1R_2^2}{R_B} + R_B . R_2$ (3)

Multiply by denominator R_B

$$R_B(R_1R_2 + R_1R_B) = R_B(R_1R_2) + \frac{RB}{1}\left(\frac{R1R2^2}{RB}\right) + (R_B.\ R_2)\ R_B$$

$$\cancel{R_B\,R_1R_2} + R_1R_B^{\,2} = \cancel{R_B\,R_1R_2} + R_1R_2^{\,2} + R_2\,R_B^{\,2}$$

$$R_1R_B^{\,2} = R_1R_2^{\,2} + R_2\,R_B^{\,2}$$

$$R_1R_B^{\,2} - R_2\,R_B^{\,2} = R_1R_2^{\,2} \qquad (4)$$

Taking the common factor $R_B^{\,2}$

$$R_B^{\,2}(R_1 - R_2) = R_1R_2^{\,2}$$

$$\therefore R_B^{\,2} = \frac{R1R2^2}{R1-R2}$$

Then $R_B = \sqrt{\frac{R1R2^2}{R1-R2}}$ (3)

To find R_A divide: $R_A = \frac{R1R2}{RB}$ (3)

$$\therefore R_A = \frac{R1-R2}{\sqrt{\frac{R1R2^2}{R1-R2}}}$$

$$= \frac{R1\ R2}{\sqrt{R1R2^2}} \div \frac{1}{\sqrt{R1-R2}}$$

$$= \frac{R1\ R2}{\sqrt{R1R2^2}} \times \frac{\sqrt{R1-R2}}{1}$$

$$= \frac{R1\ \cancel{R2}}{\cancel{R2}\sqrt{R1}} \times \frac{\sqrt{R1-R2}}{1}$$

$$= \frac{R1}{\sqrt{R1}} \times \frac{\sqrt{R1-R2}}{1}$$

$$= \frac{\sqrt{R1}\ .\sqrt{R1}}{\sqrt{R1}} \times \frac{\sqrt{R1-R2}}{1}$$

$$= \frac{(\sqrt{R1}\ .\cancel{\sqrt{R1}})}{\cancel{\sqrt{R1}}} \times \frac{\sqrt{R1-R2}}{1}$$

$$= \sqrt{R1} \times \sqrt{R1-R2}$$

$$R_A = \sqrt{R1(R1-R2)}$$ (3)

[30]

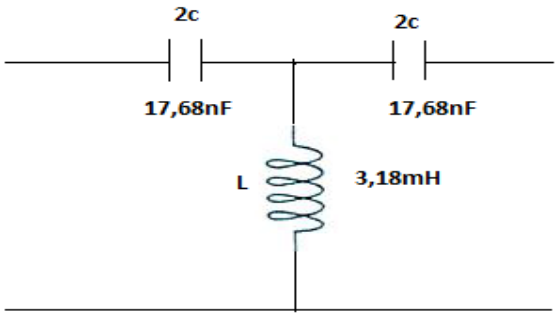
QUESTION 3

3.1

$$L = \frac{Ro}{4\pi Fc}$$

$$= \frac{600}{4\pi \times 15\,000}$$

$$= 3{,}18 \text{ mH}$$

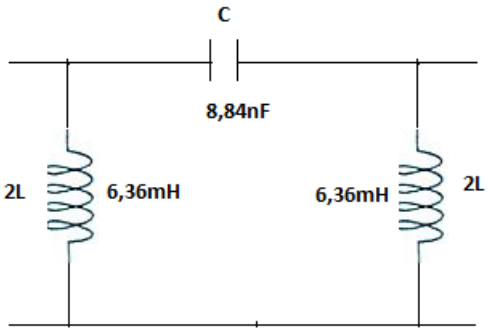


(4)

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

$$= \frac{1}{4\pi \times 600 \times 15\,000}$$

$$= \underline{8{,}84 \text{ nF}}$$



(4)

3.2

$$Fc = \frac{1}{\pi\sqrt{LC}}$$

$$= \frac{1}{\pi\sqrt{0{,}5 \times 40 \times 10^{-6}}}$$

$$= \underline{71{,}17 \text{ Hz}}$$

(2)
[10]

QUESTION 4

4.1 (a) Carrier rotation
(b) Carrier stationary (2)

A Vc
B USF
C LSF
D Wc + Wm
E Wc – Wm
F Wm
G Wm
H Vc (8)

4.2 4.2.1
- It simplifies the equipment of the transmitter and the receiver.
- It reduces the cost of the receiver.
- It uses a simple envelope detector in the receiver.

4.2.2
- It uses expensive and sophisticated equipment.
- It uses less transmission power.
- It uses a narrow bandwidth.

(2 × 3) (6)

4.3 $$mF = \frac{Maximum\ Deviation\ (\Delta)}{Modulation\ Frequency (Fm)}$$
$$= \frac{15}{5}$$
$$= \underline{3}$$

On the Bessel Functions Table the reading is as follows:
mf = 3 = ¿6 = 0,01

Therefore: Bandwidth = modulation frequency × number of sidebands × 2
= 5 × 6 × 2
= <u>60 kHz</u> (4)
[20]

QUESTION 5

5.1
- The half-wave dipole is very unstable for HF, VHF and UHF.
- At lower frequencies the physical dimension of the aerial of the half-wave dipole is too large. (2)

5.2 Effective aperture is the physical dimensions of the antenna which determines the power received by the antenna and is directly proportional to the collecting area of the antenna. (3)
[5]

QUESTION 6

6.1 (a) Integrator
(b) Differentiator
(2 × 2) (4)

6.2 Used to determine an approximation of the frequency and phase response of RC circuits (1)
[5]

TOTAL: 100

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