higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

COMMUNICATION-ELECTRONICS N6

17 NOVEMBER 2016

This marking guideline consists of 10 pages.

Copyright reserved

QUESTION 1: ATTENUATORS AND FILTERS

1.1 (a) $S^2 = \frac{R_1}{R_2}$

$= \frac{600}{125}$ ✓✓

$= \xrightarrow{2,191}$ ✓✓ (2)

$40 = 20\log N$

$\log N = 2$

$N = \xrightarrow{200}$ ✓ (1)

(b) $R_A = \frac{R(N^2-1)}{N^2\ 2NS+1}$

$= \frac{600\ (10\ 00-1)}{10\ 00-2\ X\ 100\ X\ 2,191+1}$ ✓

$= \xrightarrow{627,5\ \Omega}$ ✓ (2)

(c) $R_B = \sqrt{\frac{R_1 R_2}{2}}$

$= \sqrt{\frac{600\ X\ 125}{2}}\left(\frac{100^2-1}{100}\right)$ √✓

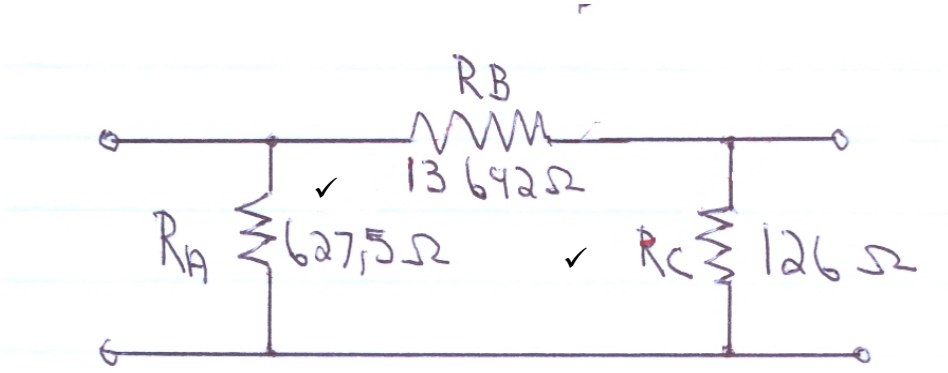
= 13 692 Ω ✓ (2)

(d) $R_C = \frac{R_2(N^2-1)}{(N^2-\frac{2N}{5}+1)}$

$R_C = \frac{125\,(100^2-1)}{(100^2-\frac{2\ X\ 100}{2,191}+1)}$ √

$= \xrightarrow{126\ \Omega}$ ✓ (2)

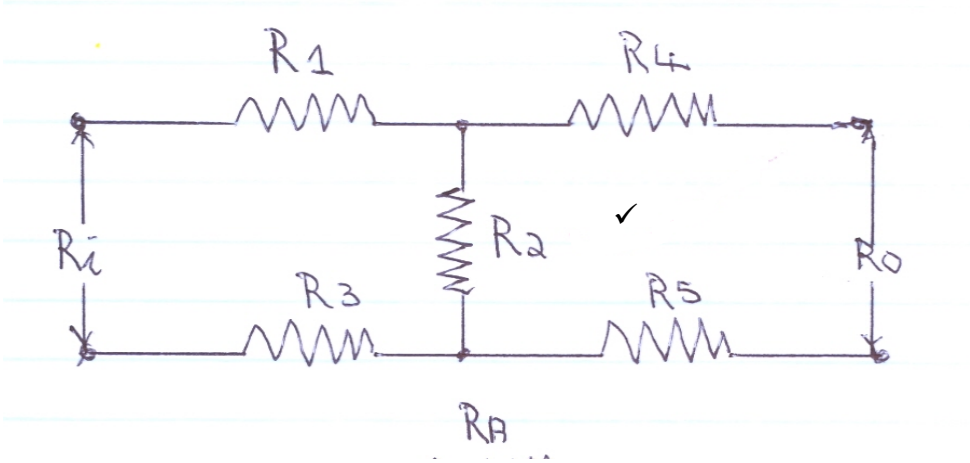
(e)



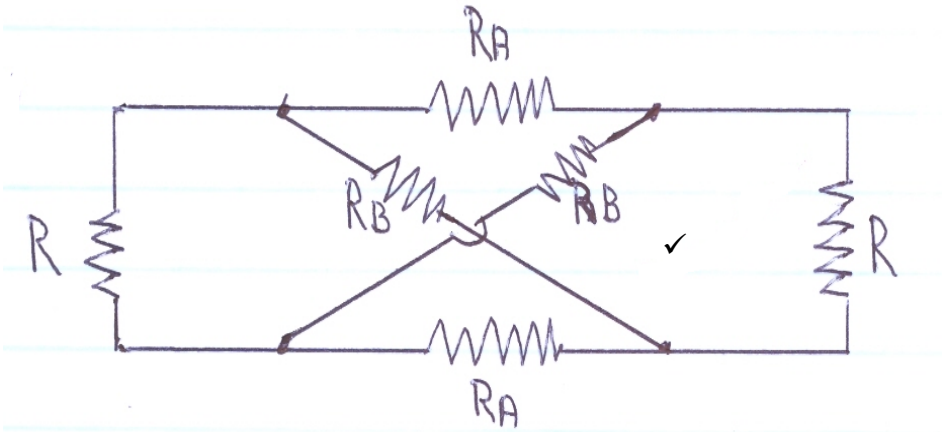
(2)

1.2 An attenuator is a resistance network that is used to reduce voltage, current or power in controllable and known amounts that are independent of frequency.✓✓ (2)

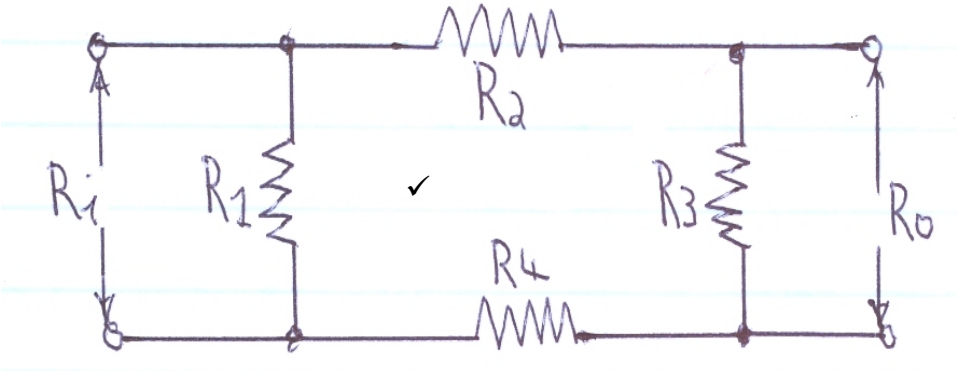
1.3 1.3.1



1.3.2



1.3.1



(3 × 1) (3)

1.4 Older design theory: in the older theory, a filter was designed according to the theory and its characteristics were accepted as final.

Modern approach: In the modern approach, the filter is built up or synthesized bit by bit to provide the required characterises as closely as possible. (2 × 1) (2)

1.5 The negative-impedance converter(NIC)
The gyrator (2)

1.6 (a) $L_1 = \frac{Z_o}{\pi (F_2 - F_1)}$

$= \frac{600}{\pi(4000-1000)}$

$= \frac{600}{\pi X\, 3000}$ ✓

$= \xrightarrow{63{,}65\ mH}$ ✓ (2)

(b) $L_2 = \frac{Zo}{4\pi}(\frac{1}{F_1} - \frac{1}{F_2})$

$= \frac{600}{4\pi}(\frac{1}{1000} - \frac{1}{4\,000})$ ✓

$= \xrightarrow{35{,}81\ mH}$ ✓ (2)

(c) $C_1 = \frac{1}{4\pi Zo}(\frac{1}{F1} - \frac{1}{F2})$

$C_1 = \frac{1}{4\pi\, X\, 600}(\frac{1}{1000} - \frac{1}{4\,000})$√

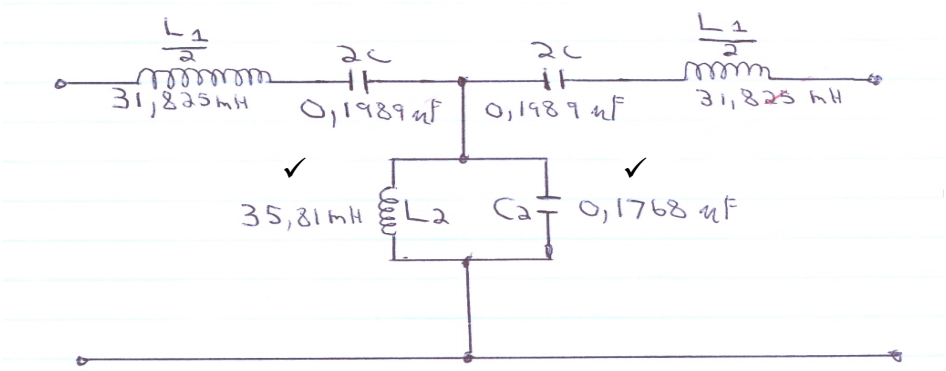
$= \xrightarrow{0{,}09946uF}$ √ (2)

(d) $C_2 = \frac{1}{\pi Zo(F_2 - F_1)}$

$= \frac{1}{\pi\, X\, 600\, X\, 3000}$√

$= \xrightarrow{0{,}1768uF}$ ✓ (2)

(e)

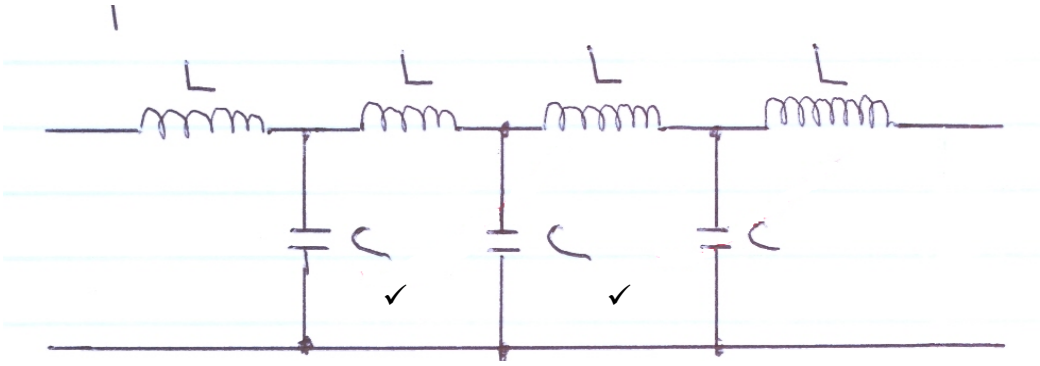


(2)
[30]

QUESTION 2: TRANSMISSION LINES

2.1 A transmission line provides a means of conveying signals or power from one point to another. (2)

2.2



(2)

2.3
- The size of the conductors
- The spacing of the conductors
- The dielectric constant of the insulator (3 × 1) (3)

2.4

$$Zo = \sqrt{\frac{L}{C}}$$

$$L = Zo^2C$$
$$= 75^2 \, X \, 64 \, X \, 10^{-12}\sqrt{}$$

$$= 3{,}6 \text{ x } 10^{-7}\sqrt{}$$

$$= \xrightarrow{0{,}36uH/m}\sqrt{} \quad (3)$$

$$Zo = \frac{138}{\sqrt{K}} \log \frac{D}{d} \quad (2)$$

$$\log\frac{D}{d} = \frac{Zo}{138/\sqrt{K}}$$

$$= \frac{75}{138/\sqrt{2.23}}\sqrt{}$$

$$= 0.81 \checkmark$$

$$D = d \, X \, antilog \, 0{,}81$$

$$= 0{,}584 \, X \, 6.457 \checkmark$$

$$= \xrightarrow{3{,}77\ mm}\sqrt{} \quad (2)$$

2.5 A stub is defined as a short-circuited transmission line which is more often used than lumped components at very high frequencies. (2)
[16]

QUESTION 3: ANTENNAS

3.1 The point source radiator on an isotrophic antenna is a theoretical antenna that radiates equal amounts of energy in all directions which is used as a basis for comparison between antennas. (2)

3.2 3.2.1 The vertically polarised antenna is described as an antenna which has an electric field radiated vertically causing the radiated wave to be vertically polarised.

3.2.2 The horisontally polarised antenna is described as an antenna which has an electric field radiated horisontally causing the radiated wave to be horizontally polarised.

(2 × 2) (4)

3.3 3.3.1

$$Es = \sqrt{\frac{(30\ Pt)(Gt)}{di}}$$

$$= \sqrt{\frac{30X10X10^3\ X\ 316{,}227}{5000\ X\ 10^3}}\surd$$

$$= 1{,}948\ X\ 10^{-3}\ Volts/m\ \checkmark$$ (2)

$$dB = 10 \log Gr$$

$$Gr = Antilog\ \frac{db}{10}$$

$$Antilog = \frac{25}{10}\surd$$

$$Gr \xrightarrow{316{,}227} \surd$$ (2)

3.3.2

$$P'd = \frac{Es^2}{120\pi}$$

$$= \frac{(1{,}948\ X\ 10^{-3})^2}{120\pi}\surd$$

$$= \xrightarrow{1{,}0066\ X\ 10^{-8}\ Watt/m^2}\surd$$ (2)

3.3.3 $\Pr = \frac{10Pt\ X\ Gt}{\pi d^2}$

$= \frac{10X10X10^3\ X\ 316{,}227}{4\pi\ X\ (5\ 000\ X\ 10^3)^2}$ √

$= \xrightarrow{1{,}00658\ X10^{-7}\ Watt/m^2}$ √ (2)

3.3.4 $Er = \sqrt{\frac{30Pr}{d}}$

$= \sqrt{\frac{30X1{,}00658X10^{-7}}{5000X10^3}}$ √

$= \xrightarrow{3{,}475X10^{-10}\ Volts/m}$ √ (2)

3.3.5 $Pd = \frac{Es^2}{120\pi}$

$= \frac{(3{,}475X10^{-10})^2}{120\pi}$ √

$\xrightarrow{3{,}204X10^{-22}\ Watt/m^2}$ √ (2)

3.3.6 $Si = PdXA$

$= Gr\ X\ \frac{\gamma^2}{4\pi}$

$= 316{,}227\ X\ \frac{0{,}62^2}{4\pi}$ √

$= \xrightarrow{9{,}059\ m^2}$ √ (2)

$\gamma = \frac{3X10^8}{F}$

$= \frac{3X10^8}{500X10^3}$ √

$= \xrightarrow{0{,}6m}$ ✓ (2)

$\therefore Si = Pd\ X\ A$
$= 3{,}204\ X\ 10^{-22}\ X\ 9{,}059$ ✓
$= 2{,}9026\ X\ 10^{-21}\ Watts$ ✓ (2)

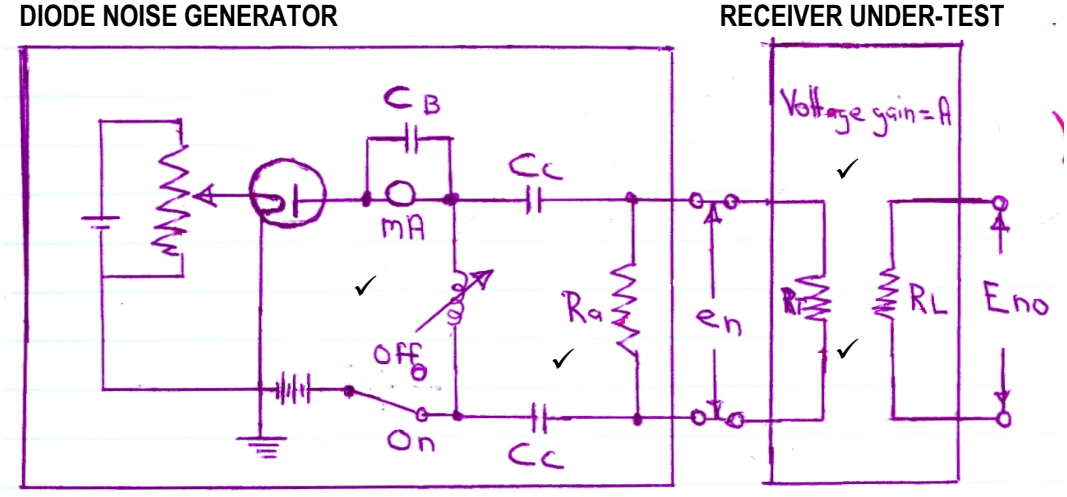
[24]

QUESTION 4: NOISE

4.1 Thermal agitation noise is generated in a receiver by the rapid and random motion of the molecules, atoms and electrons, which increase with temperature according to simplified atomic theory, in all types of materials used to construct such resistors. (5)

4.2 The equivalent noise resistance of an amplifier or receiver is the sum of the input terminating resistance and the equivalent noise resistance of the first stage, together with the noise resistance of the previous stages referred to the input. (3)

4.3



NOISE FIGURE MEASUREMENT (5)

4.4 $$F = 1 + \frac{Req}{Ra}$$

$$= 1 + \frac{30}{50}\surd$$

$$= 1{,}6\surd$$

$$10Log1{,}6 \quad 10\,X\,0{,}204 = 2{,}04\,db\surd$$

$$Teq = To(F-1) = 290(1{,}6-1)\surd$$

$$= 290\,X\,0{,}6\surd$$

$$= \xrightarrow{174K}\surd$$

(6)

[19]

QUESTION 5: MODULATION AND DEMODULATION

5.1 Angle modulation is defined as a modulation whereby the instantaneous angle of the carrier wave is varied which leads to two forms of modulation known as frequency modulation and phase modulation. (2)

5.2 5.2.1 In pulse amplitude modulation (PAM), the amplitude of a train of digital pulses is varied in proportion to the amplitude of the modulating signal. (1)

5.2.2 In pulse position modulation (PPM), the amplitude and width of the pulses is kept constant, while the position of each pulse, in relation to the position of a recurrent reference pulse, is varied by each instantaneous sampled value of the modulating wave. (2)

5.3 ADVANTAGES

- It has superior $\frac{S}{N}$ characteristics for a given bandwidth.
- It is well suited to long distance communication without loss of $\frac{S}{N}$ ration due to pulse generation.
- It fits in with other digital systems such as data transmission.

DISADVANTAGES

- It requires a very large bandwidth.
- It uses costly, sophisticated circuits, which have to be duplicated several times if many repeaters are used.
- It is generally uneconomical for short distances. (3 × 2) (6)

[11]

TOTAL: 100

Copyright reserved