GAUTENG DEPARTMENT OF EDUCATION

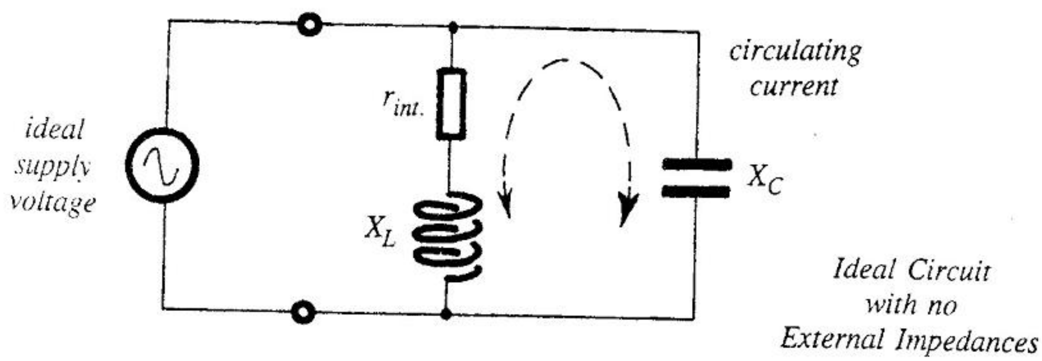
SENIOR CERTIFICATE EXAMINATION

TECHNIKA (ELEKTRONICS) SG

POSSIBLE ANSWERS OCT / NOV 2006

QUESTION 1

1.1



1.2.1. f $= \dfrac{1}{2\pi\sqrt{LC}}$

$= \dfrac{1}{2\pi\sqrt{10x10^{-6}x10x10^{-12}}}$

= 15,9 MHz

1.2.2. It $= \dfrac{Vt}{r}$

$= \dfrac{5}{0,2}$

= 25 Amps

1.2.3 Xl = 2?fl

= 2?x 15,9x10^{-6} x 10 x 10^{-6}

= 1 090,29 Ohms

Q = $\frac{Xl}{r\,\text{int}}$

= $\frac{1090,29}{0,2}$

= 5 451,45

1.2.4. Z = $\sqrt{r^2 + Xl^2}$

= $\sqrt{(0,2)^2 + [1012,85]^2}$

= 1 012,85 Ohms

IL = $\frac{VT}{Z}$

= $\frac{5}{1012,85}$

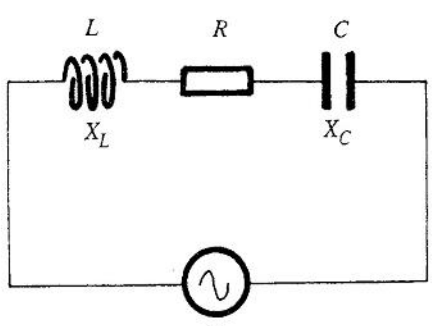
= 0,005 Amps

1.2.5. Ic = $\frac{VT}{Z}$

= $\frac{5}{1012,85}$

= 0,005 Amps

1.3



1.3.1. XL $= 2\pi fL$

$= 2\pi \times 200 \times 0{,}035$

$= 43{,}98$ Ohms

1.3.2. $Xc = \frac{1}{2\pi fc}$

$C = \frac{1}{2 \, x \, \pi \, 43{,}98 x 200}$

$= 1{,}8$ µF

1.3.3. R = Z Resonate
Z = 6 Ohms

1.3.4. $It = \frac{Vt}{R}$

$= \frac{3{,}5}{6}$

$= 0{,}583$ Amps

QUESTION 2

2.1 1. The usual method of turning an SCR on is by forward biasing the anode-cathode terminals and applying a positive voltage to the gate terminal. The size of this gate voltage is quite small even for large power SCRs. A typical gate triggering signal is 2 V at 10 mA.

2. By raising the anode-cathode forward biasing voltage to a large positive level which will force the one reverse biased pn junction to break down. The SCR will then go into immediate conduction without any triggering voltage on the gate. This is not the recommended manner to operate an SCR as it can be permanently damaged.

3. Polarizing Anode positive in respect to Kathode negative.

4. Make use of A/C to ensure that SCR switches of after ½ a cycle.

2.2

NUMBER	COLOUR
0	black
1	brown
2	red
3	oranqe
4	yellow
5	qreen
6	blue
7	violet
8	qrey
9	white

TOLERANCES	
+- 1%	brown
+- 2%	red
+- 5%	gold
+-10%	silver
+-20%	no band

2.3.1

CHARACTERISTICS:

As the input circuit to the transistor appears across the forward biased emitter-base junction the circuit has a very low input resistance. The output circuit is across the reverse biased collector-base junction which gives the circuit a very high output resistance. Any slight voltage change at the input creates the same current changes in both input and output circuits but, as the output current is flowing in a much higher resistance circuit, the voltage changes across the load resistor RI will be much larger than those original changes at the input. Thus the signal voltage has been amplified showing that the circuit has a high voltage gain. There is no current gain in this amplifier configuration as it is almost the same size current that flows through both input and output circuits. In fact there is a slight loss in current gain as some of the emitter current is "lost" as it flows out of the base lead, as has been shown the output voltage is in phase with the input voltage change.

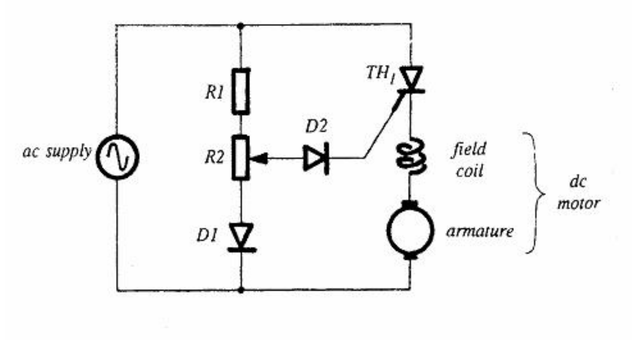
2.3.2

CHARACTERISTICS:

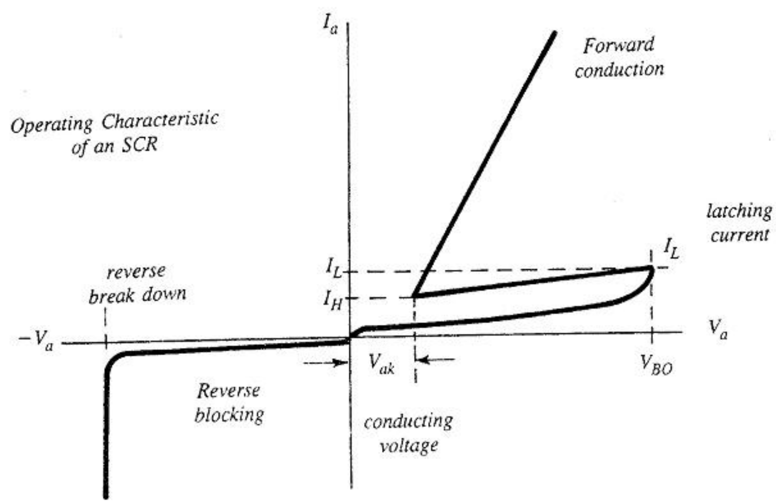
This circuit has a medium input resistance and also a medium output resistance. As the input circuit is driven by the small base current I_B, and the output circuit current consists of the large collector current I_C it shows that this circuit has a medium to high current gain. The input circuit to the transistor appears across the forward biased emitter-base junction which has a very low resistance. Therefore this does not require a large input voltage swing to affect it. The output circuit of the transistor appears across the reverse biased collector-base junction which has a very high resistance. The high current flowing in the high resistance collector circuit leads to a high voltage appearing across the load resistor R_L. Comparing the small voltage swings at the input to the large voltage swings at the output it shows that this circuit develops a medium to high voltage gain. As has been shown the signal voltage is inverted through this circuit.

2.3.3
CHARACTERISTICS:
As the input circuit appears between base and collector the circuit has a very high input resistance. As the output circuit appears across the emitter terminal it creates a very low output resistance. When comparing the sizes of the input current to the output current it shows that this circuit produces a high current gain but at the same time there is no voltage gain. The output voltage swings follow in phase with the input voltage changes.

2.4



2.5

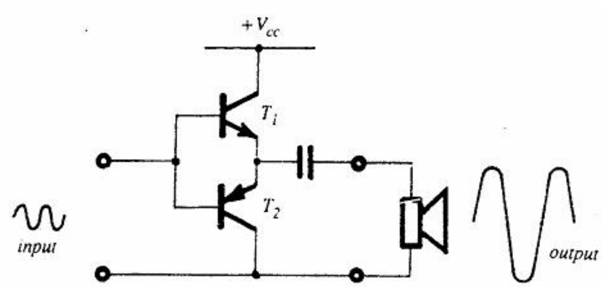


QUESTION 3

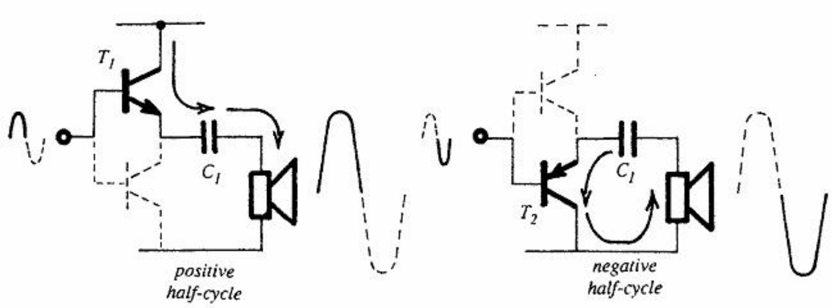
3.1
To eliminate the bulky and expensive transformers from the circuit, a matched (symmetrical) pair of opposite NPN and PNP transistors are used. This is known as a complementary NPN and PNP pair as they compliment each other in operation. (The only difference in operation of a PNP from that of an NPN transistor is that all its terminal voltages are reversed causing its currents to flow in the opposite direction. This leads to a PNP transistor being viewed as a "mirror image" of an NPN transistor).

The transistors are a complimentary opposite npn-pnp pair which are chosen to have identical but, opposite characteristics which are symmetrical, leading to this circuit being called a complementary-symmetry push-pull pair.

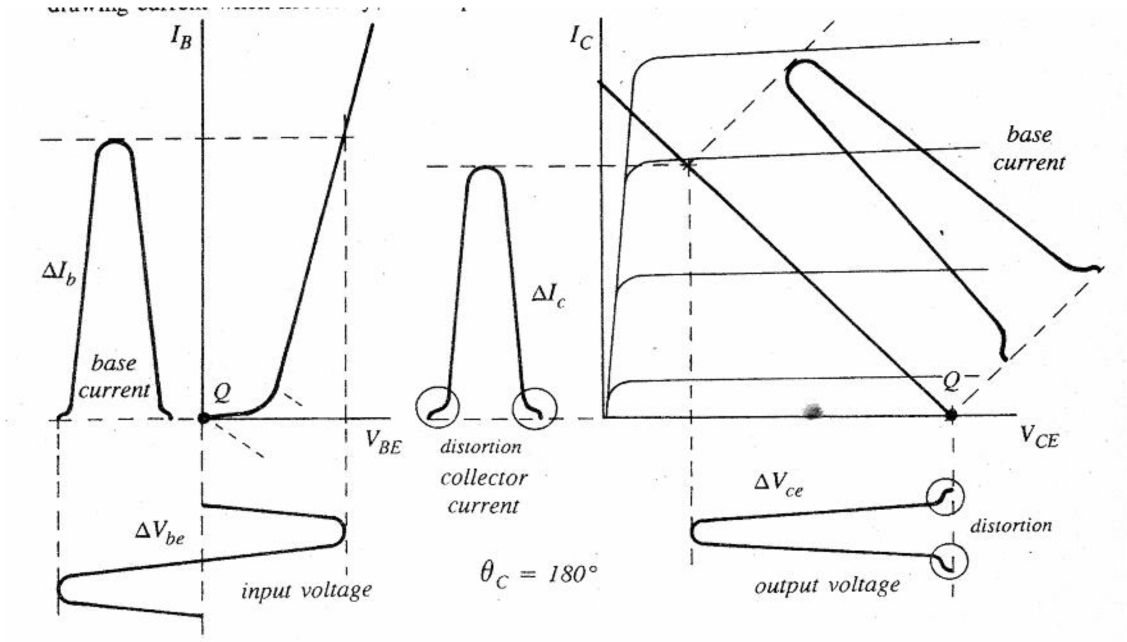
A rising positive signal on the base of the NPN transistor will turn it on, while at the same time the same signal on the base of the PNP transistor turns it off. Likewise in the second half cycle the negative signal turns the NPN transistor off and the PNP transistor on. The capacitor C1 coupling the circuit with the speaker acts as a short term "power supply" for the PNP transistor, each second half cycle. Each time T_1 conducts, T_2 is off. At this time a pulse of current flows through the capacitor and down through the speaker. charging up the capacitor. During the second half cycle T_1 is off and T_2 goes on providing a discharge path for the capacitor to send a current pulse anti-clockwise through T_2 and up through the speaker. Therefore during each complete cycle of input waveform the speaker will experience two opposite half wave signal current pulses which combine to appear as one continuous output signal. However as both transistors are biased in Class B mode they still have the problem of causing the cross-over distortion effect.



A Complimentary-Symmetry Push-Pull Pair



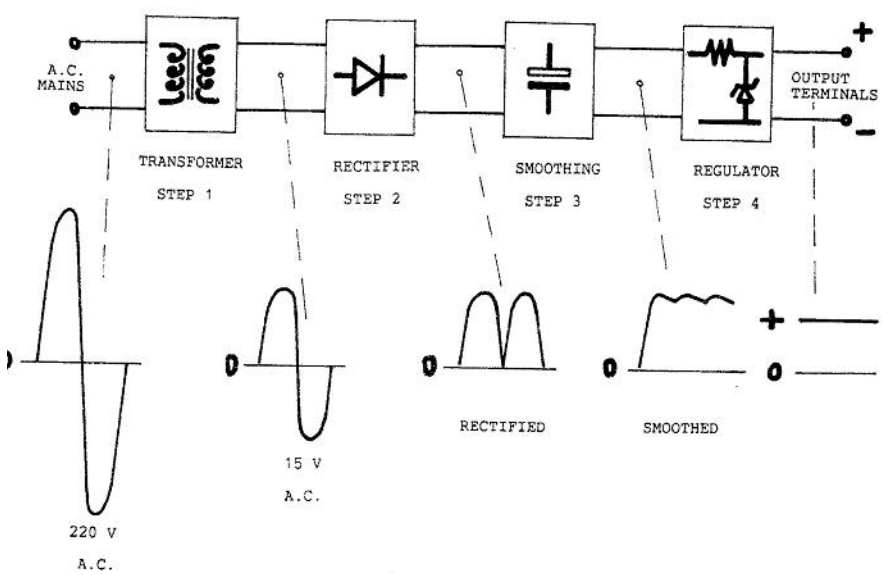
3.2



A Pure Class B Biased Transistor

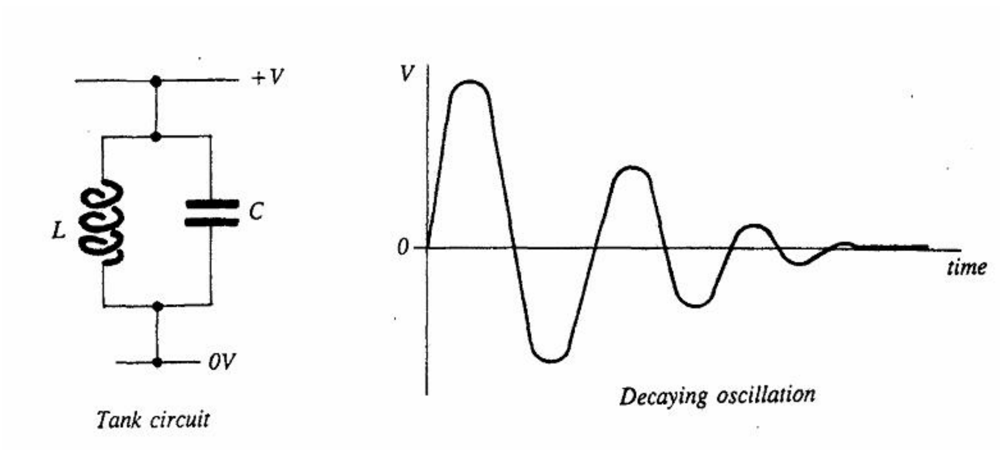
QUESTION 4

4.1



QUESTION 5

5.1.1
These circuits rely on the resonant properties of a parallel connected inductor, capacitor combination commonly called a tank circuit.



When connected to a dc supply the tank circuit will rapidly begin oscillating sinusoidally, drawing a charge from the supply and transferring it back and forth between the two components.

As dc power is applied to the circuit the capacitor will immediately charge up. Upon removing the dc supply the capacitor discharges through the inductor. As it does the capacitor transfers the electro-static charge stored between its plates to the inductor which, in turn, stores it in its magnetic field as an electro-magnetic charge. As the inductor cannot save the charge it immediately releases it back into the circuit as a current which re-charges the capacitor. This transferring of energy continues in a regular sinusoidal manner but, with each change of energy (electro-static .to electro-mechanical) some is lost into the system. This can be seen as a slowly decaying sinusoidal waveform.

The frequency of the transfer of charge in a tank circuit, called the resonant frequency, is determined by the size of the inductor and capacitor. This is given by the equation:

$$f_r = \frac{1}{2\pi\sqrt{LC}} \ Hz$$

The tank circuit is therefore very frequency selective.

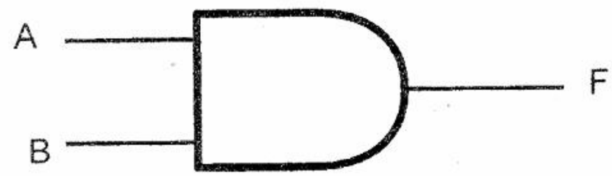
To prevent the oscillations of a tank circuit from dying away the circuit must be kept oscillating. This is done through a circuit which will "top-up" the charge each time some is lost through energy loss. The simplest "top-up" circuit uses a class C biased transistor which only conducts for a very brief time period during each cycle (see chapter 3.2.5).

5.2. a) Phase shifting
b) Electronic switch

QUESTION 6

6.1.1

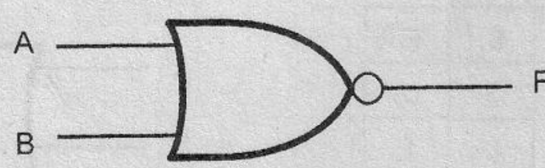
A	B	F
0	0	0
0	1	0
1	0	0
1	1	1



$$F = A \cdot B$$

6.1.2 NOR Gate

A	B	F
0	0	1
1	0	0
0	1	0
1	1	0

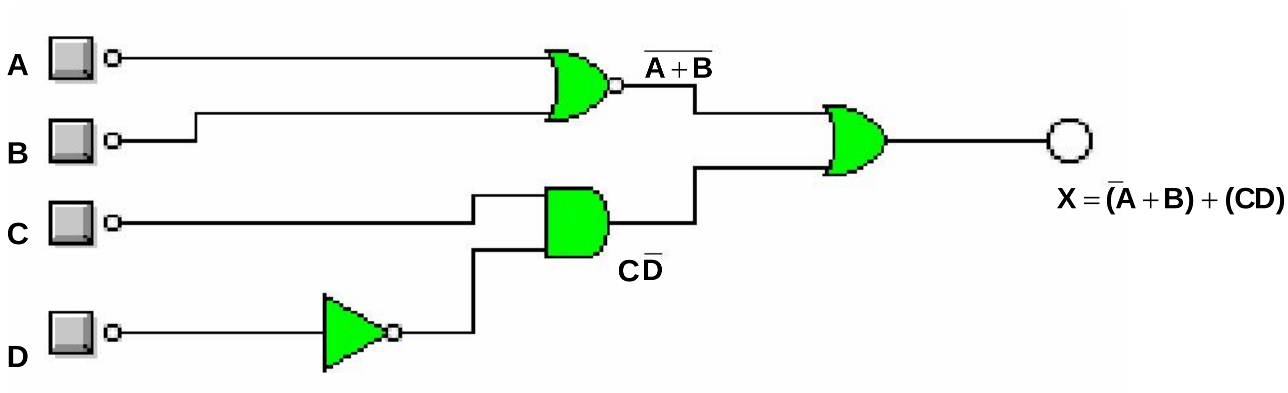


$$F = \overline{A + B}$$

6.2 F = $A. + B + C$

F = $A.B + C$

6.3



QUESTION 7

7.1.1 1µS/cm x 4 cm = 4 µS

$F = \frac{1}{T}$

$= \frac{1}{4\mu S}$

= 250 KHz

7.1.2 Emaks = 2V x 4 cm
= 8 v

7.1.3 Epeak = 2V x 8 cm
= 16 v

7.1.4 Erms = Emaks x 0.707
= 8 V x 0,707
= 5,65 v

7.1.5 Eave = Emaks x 0,637
= 8V x 0,637
= 5,096 v

QUESTION 8

8.1.1	False
8.1.2	False
8.1.3	False
8.1.4	True
8.1.5	False
8.1.6	False

8.2. Wear protective clothes.
Never touch the wound with bare hands.
Apply pressure to stop bleeding.
Clean the wound from the inside out.
Record all accidents in the register maintained in the shop
Any acceptable answer

8.3. Sexual transmission
Contact with blood that is infected with the HI virus
Body fluids
Any acceptable answer