THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF NATURAL SCIENCES
B. SC. DEGREE PROGRAMME 2012//2013
DEPARTMENT OF PHYSICS
FINAL EXAMNINATION PHU2143/PHE4143- CIRCUIT THEORY AND ELECTRONICS
DURATION: - 2 HOURS

DATE:- 14-12-2013 FROM 1.30 P.M. TO 3.30 P.M.

ANSWER ANY 04 QUESTIONS

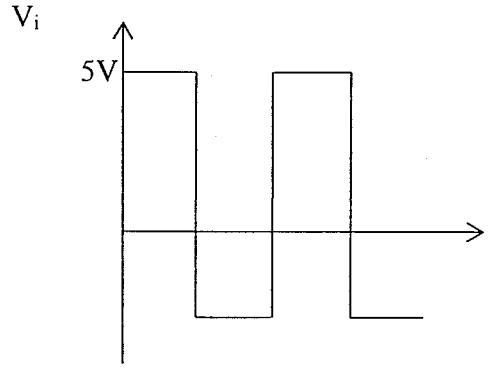
1. a. (i) Write down advantages of semiconductor device in electronic industries.

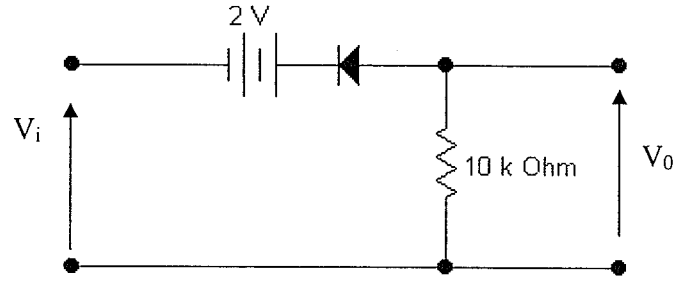
(ii) If a student claims that " An extrinsic semiconductors contains equal numbers of electrons and holes" discuss this statement.

(iii) Discuss the differences between the Light Emitting Diode (LED) and Photo Diode

(iv) Explain changes occurs in the depletion region when the PN junction is in (a) forward biased (b) reverse biased

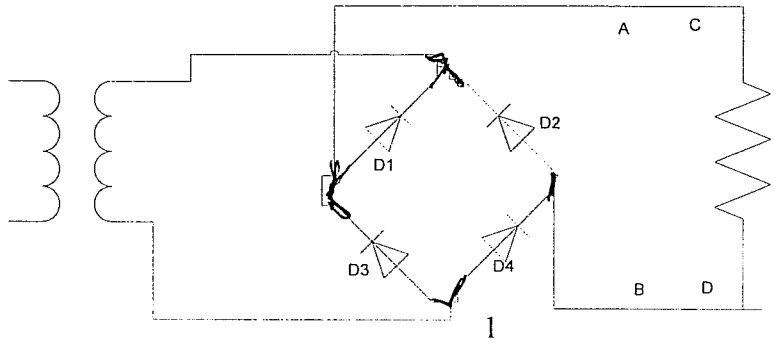
b. Plot output wave form (V_o) for the circuit in the following figure for the input (V_i) shown. Assume that forward voltage of the given diode is 0.7 V.





2. a. Figure shows an incorrect full wave bridge rectifier circuit drawn by a student.

(i) Redraw the correct circuit diagram in your answer sheet.



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(ii) Draw the smoothing capacitor in the correct position of your circuit diagram in order to get the smoothed output wave form.

(iii) Sketch the variation of the output wave forms for two different capacitor values, one high and one low.

(iv) Output wave of the transformer is $V_m sin 2\pi ft$ where V_m is peak voltage and f-frequency of the wave

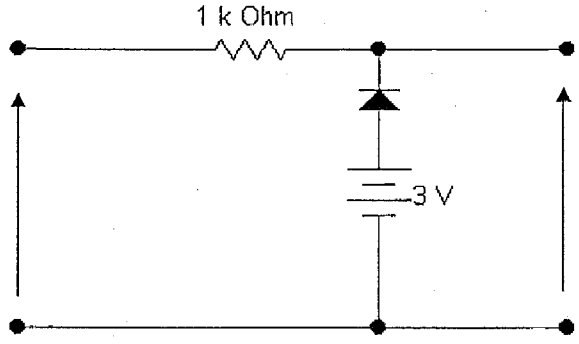
Show that dc value of the output voltage (V_{dc}) is given by

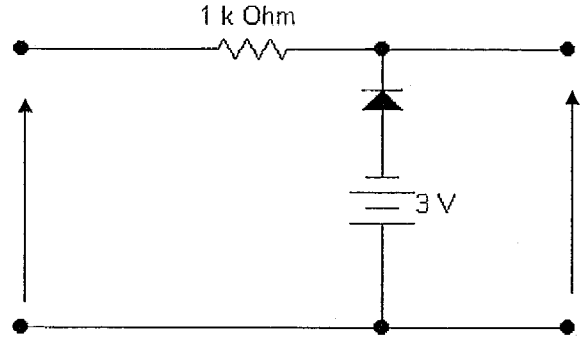
$$V_{dc} = \frac{2V_m}{\pi}$$

(v) If you are given a zener diode having V_Z= 9 V, modify and redraw the given circuit to obtain a regulated voltage supply.

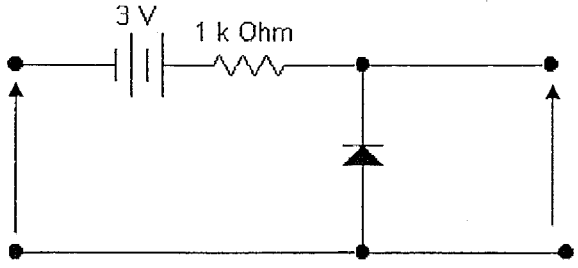
b. i. What do you understand by a Clipper circuit and a Clamper circuit

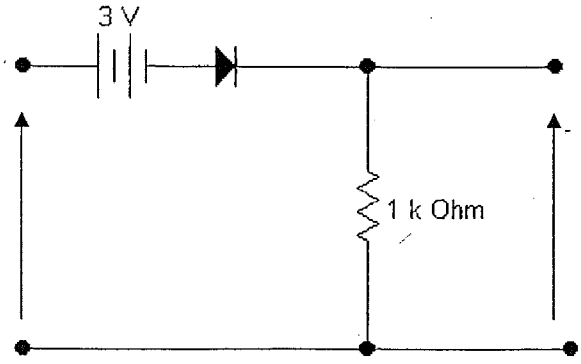
ii. Draw the output wave form for the following circuit diagrams when the input wave form is a sinusoidal with V_m = 10 V.





iii. Draw the output wave form for the following clamping circuits when the input wave form is a sinusoidal with V_m = 10 V.





3. a. i. Define the hybrid parameters h_{fe} and h_{ie} for a basic transistor circuit in CE configuration.

ii. Voltage gain(A_V)of a transistor amplifier is given by the following expression.

$$A_V = -\frac{h_f R_L}{(1 + h_o R_L)h_i}$$

When $\frac{1}{h_o} \gg R_L$ show that for practical purposes the above expression can be reduced to $-\frac{h_{fR_L}}{h_i}$ (Here Symbols have their usual meanings)

b. A CE configuration transistor amplifier with self-bias or voltage-divider bias is required to have a voltage gain of about -200. An *npn* silicon transistor with $h_{fe} = 100$, h_{ie}= 1 kΩ and maximum collector power dissipation of 75 mW is available. (Neglecting h_{re} and h_{oe} and using V_{CC}= 12 V)

i. Draw the circuit diagram with R_1 , R_2 , R_L and R_E (Here Symbols have their usual meanings)

ii. Find the value of R_L

iii. Determine the current I_C through R_L assume that $V_{CG} = V_{CC}/2$ where G is the ground terminal.

iv. Assuming power dissipation of the collector and emitter (CE) junction as 15 mW. Show that V_{EG} = 1.2 V, hence find the R_E

4. a. i. Discuss the fundamental differences among class A, class B and class C amplifiers

ii. Discuss the differences between the parallel and series tuned circuits

iii. What is a tuned amplifier?

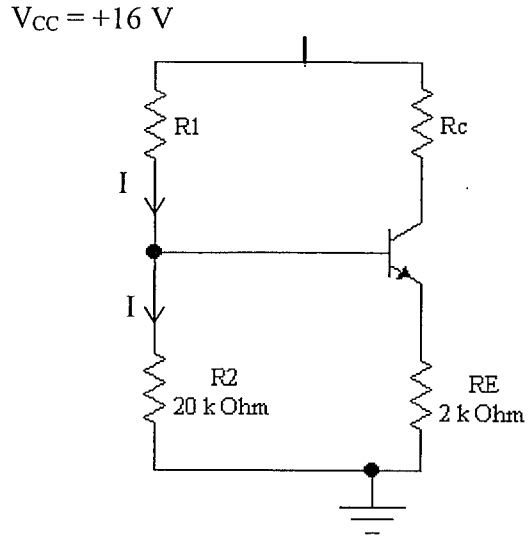
iv. Explain with a circuit diagram the operation of a single-tuned amplifier

b. An *npn* transistor circuit given below has α = 0.985 and V_{BE} = 0.3 V. and R_2 = 20 kΩ, R_E = 2 kΩ and V_{CC} =16 V . Answer the following questions placing Q point at I_C = 2 mA and V_{CE} = 6 V

i. Determine the current gain β

ii. Show that the voltage across R_2 is 4.3 V

iii. Determine the R_C and R_1 assuming current passing through R_1 and R_2 are same.



5. a. i. Determine the binary equivalent of 13.875

ii. Find the decimal equivalent of 101.1101

iii. Determine the binary equivalent of the hexadecimal number A5D

iv. Find the hexadecimal equivalent for the decimal number of 581

v. Perform the binary addition 11000.11 + 101.111

b. Prove that the following expressions using Boolean Algebra

i. $ABC + A\bar{B}C + AB\bar{C} = A(B + C)$

ii. $(A+B)(A+C) = A+BC$

iii. $(A + B)(A + \bar{B})(\bar{A} + C) = AC$

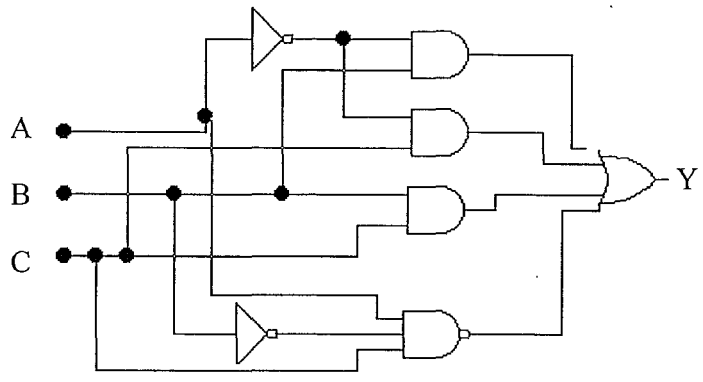
iv. $(\bar{A} + B)(A + B) = B$

c. Find the complement $(\bar{Y})$ of the expressions given below

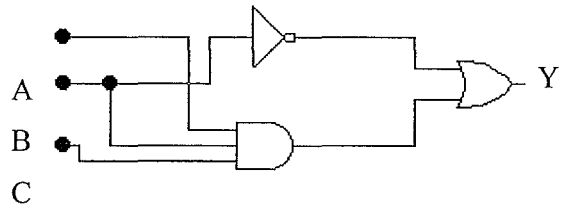
i. $Y = AB\bar{C} + A\overline{BC}$

ii. $Y = \bar{A} + (B\bar{C} + \bar{B}C)$

6. i. Obtain the Boolean expressions for the output Y in the logic circuits given below.
   ii. Simplify the Boolean expressions that you have written in part (i)
   iii. Draw the logic circuit diagrams for the simplified Boolean expressions.



Circuit diagram 1



Circuit diagram 2

b. Simply the following function by using K map method.

   i. $X = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + AB\bar{C}$

   ii. $X = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$

   iii. $X = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}C + AB\bar{C}$

   iv. $X = \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}C + ABC$

c. A burglar alarm should be activated when the two conditions given below are simultaneously satisfied

   (a) The main entrance door of the building is open, and

   (b) The bed room door and /or the kitchen door is open.

Write the truth table and construct the logic expression to operate the alarm using one AND gate and one OR gate.