UNIVERSITY OF GHANA

BACHELOR OF SCIENCE IN ENGINEERING
SECOND SEMESTER EXAMINATIONS, 2015/2016

DEPARTMENT OF COMPUTER ENGINEERING
CPEN 306: MICROELECTRONICS DEVICES AND CIRCUITS

INSTRUCTION:
ANSWER ALL FIVE (5) QUESTIONS.

TIME ALLOWED: TWO AND HALF ($2^1/_2$) HOURS

1

a. Define the following parameters of power supply systerms:
- i. Efficiency of rectification. [1mark]
- ii. Ripple factor. [1mark]
- iii. Peak inverse voltage (PIV). [1mark]

b. Draw a full-wave bridge rectifier with a capacitor input filter. [3marks]

c. With the aid of input and output waveforms briefly explain how the 1.b works. [3marks]

d. A single-phase full-wave rectifier uses an ideal diode (zero forward resistance and infinity reverse resistance) to supply power to a **200Ω** load from a power transformer whose secondary voltage is **240 Vrms**. Calculate, the following:
- (i) D.C voltage. [4marks]
- (ii) Ripple voltage. [4marks]
- (iii) PIV. [3marks]

2.

a. With the aid of a circuit diagram explain how a transistor can be used as an electronic switch. [3marks]

b. A switching NPN silicon transistor has a forward current gain, $\beta = 100$ and maximum collector current, $I_{MAX} = 15mA$. If the input voltage is **12V**, calculate

the base resistor needed to swith the load "fully on". [4marks]

c. Draw a circuit diagram of a single-stage common emitter (CE) transistor amplifier using a potential divider baising network. [3marks]

d. Give the function of each component in **2. c.** [4marks]

e. If the input signal frequency of the transistor amplifier drawn in **2.c** is given as ranging from **100Hz to 20kHz** and the emitter resistor as **50kΩ**, calculate the required value of the capacitor needed at the emitter terminal to ensure DC stabilization. [6marks]

3.

a. Besides Germanium(Ge) and Silicon(Si) which are the most widely used semiconductor materials,give three other types semiconductor compounds which are used in opto-electronic devices which are more responsive to light. [3marks]

b. Draw a circuit diagram of an opto-isolator (opto-coupler) and explain how it works. [6marks]

c. Give two advantages of opto-isolators in microelectronic circuits. [2marks]

d. Draw the output waveforms and also give one application of the following multivibrators:

i. Astable multivibrator. [3marks]

ii. Monostable multivibrator. [3marks]

iii. Bistable multivibrator. [3marks]

4.

a. Draw a block diagram of a sine wave oscillator and briefly explain how it works. [3marks]

b. Give four requirements for a circuit to produce a continuous oscillation. [4marks]

c. State two reasons why crystal oscillators are mostly prefered to LC or RC oscillators in computer circuits. [2marks]

d. Draw a circuit diagram of a crystal oscillator and briefly explain how it works. [4marks]

e. The equivalent circuit of a crystal oscillator has a series inductance of **5H** and a series capacitance of **0.08pF**. If the shunt capacitance is **20pF** determine the series and the parallel resonant frequency [7marks]

5.

a. A **6V DC** stablilized voltage needed to operate a computer is to be produced from a **25V** full-wave bridge rectifier using a Zener diode as the regulating element. If the maximum power rating of the diode is **14W**, calculate the following:

(i) Current that will flow throgh the Zener diode if a load resistor of **40KΩ** is connected across it. [4marks]

(ii) Value of the series current-limiting resistor (R_S). [4marks]

(iii) Total load current(I_L) [4marks]

(iv) Total supply current (I_s). [4marks]

b. Give two advatages that switched mode power supply has over linear power supply. [2marks]

c. Give three unique features of operational amplifiers (Op-Amps) that makes them so versatile in electronic applications. [2marks]