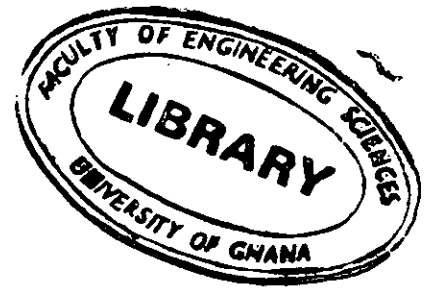




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## UNIVERSITY OF GHANA



### 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 (2½) HOURS

1

- a. Define the following parameters of power supply systems:
  - 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  $200\Omega$  load from a power transformer whose secondary voltage is  $240 \text{ V}_{\text{rms}}$ . 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,  $I_{\text{MAX}} = 15\text{mA}$ . If the input voltage is  $12\text{V}$ , calculate

the base resistor needed to switch the load "fully on".

[4marks]

c. Draw a circuit diagram of a single-stage common emitter (CE) transistor amplifier using a potential divider biasing 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 50k $\Omega$ , 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 preferred 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 stabilized 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 through the Zener diode if a load resistor of 40K $\Omega$  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 advantages 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]

