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CONFIDENTIAL

SET B

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2011 SESSION

SUBJECT CODE	:	FLB 10102
SUBJECT TITLE	:	ELECTRONIC DEVICES
LEVEL	:	BACHELOR
TIME / DURATION	:	9.00am – 11.00am (2 HOURS)
DATE	:	14 MAY 2011

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answers should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) questions only.
6. Answer all questions in English.
7. Formula is appended.

THERE ARE 9 PAGES OF QUESTIONS AND 1 PAGE OF APPENDIX EXCLUDING THIS PAGE

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

(a) State the factors that determine the conductivity of an atom.

(1 marks)

(b) State one (1) physical characteristic of semiconductor. Give 2 examples of elements being used as semiconductor.

(3 marks)

(c) During the formation of a PN junction, an n-type material is joined with a p-type material and diffusion process will occur.

i. State the factor that will limit the amount of diffusion.

(2 marks)

ii. Describe the diffusion process of electron and holes until the formation of the depletion layer and the barrier potential.

(4 marks)

Question 2

(a) The electrical behavior of diode can be described with ideal and practical model. Draw both models.

(2 marks)

(b) Refer to the circuit in **Figure 1**. Assume the diode is silicon and uses diode practical model. Input is pure sinusoidal with peak voltage of 5V.

i. Draw the resultant voltage output and indicate peaks numeric values.

(3 marks)

ii. Draw the resultant current across the diode (following direction anode-cathode) and indicate peaks numeric values. (Neglect the influence of R_1).

(2 marks)

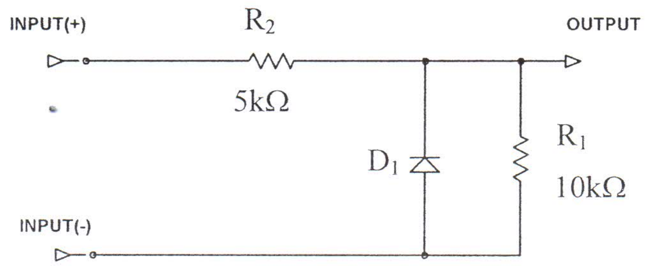

Figure 1

(c) Refer to Figure 2. Draw the output voltage and indicate all peaks numerical values. Given V_{B1} = 5.0V , V_{B2} = 7.0V and v_1=15. sin ωt Volt.

(3 marks)

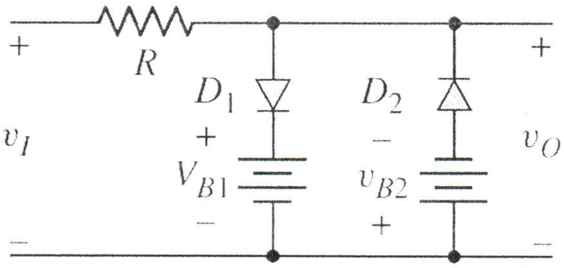

Figure 2

Question 3

A simple voltage regulation circuit is shown in **Figure 3**.

The data sheet gives the following information:

V_Z = 24V @ I_{ZT} = 10.5 mA, I_{ZK} = 0.25 mA and Z_{ZT} = 25 ohms, I_{ZM} = 38 mA, $P_{D(MAX)}$ = 500W.

R_i = 470 ohms.

(a) Determine zener output voltage at maximum permissible zener current.

(2 marks)

(b) Determine zener output voltage at I_{ZK}.

(2 marks)

(c) Calculate minimum value of V_{PS} that should be used to ensure full usage of zener. Assume that R_L is infinite.

(2 marks)

(d) Calculate the minimum resistance, R_L (equivalent to maximum load current), that can be used without affecting the zener regulation. (Assume V_{PS} the value calculated in (c).

(4 marks)

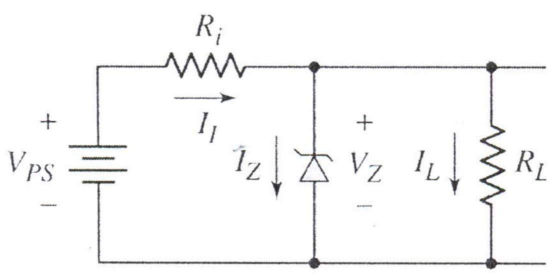

Figure 3

Question 4

A basic full wave rectifier is shown in **Figure 4**. Assume only silicon diodes are used in the rectifier. Ratio of the transformer is 5:1. Given v_1 = 240Vac 50Hz, R = 330 ohms. Calculate;

(a) the average power delivered to the load.

(7 marks)

(b) the peak power delivered.

(2 marks)

(c) the PIV of each diode.

(1 marks)

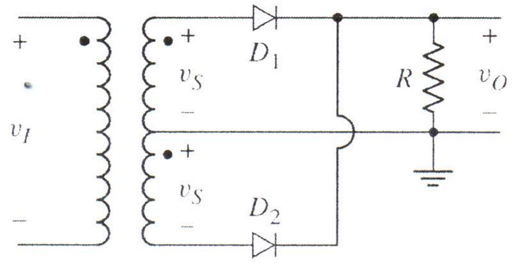

Figure 4

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only TWO (2) questions.

Question 5

Consider the transistor biasing circuit as shown in **Figure 5**. Assume β = 100, V_{CC} =10V, R_1=56 kΩ, R_2=12.2 kΩ, R_C=2 kΩ, R_E=0.4 kΩ, $V_{BE(ON)}$=0.7V.

(a) Derive the expression of $R_{IN(base)}$, the transistor base input resistance. Assume $I_E \bullet R_E \rangle\rangle V_{BE}$. (Hint: definition of input resistance is $R_{IN} = \frac{V_{IN}}{I_{IN}}$). Obtain the numerical value of $R_{IN(base)}$.

(8 marks)

(b) Assume $R_{IN(base)}$ = 40 kΩ. The circuit being a NOT STIFF voltage divider, ($R_{IN(base)}$ is NOT NEGLIGIBLE), determine:

i. Collector current, I_{CQ}.

(8 marks)

ii. collector-emitter voltage, V_{CEQ}.

(4 marks)

iii. Saturation parameters $I_{C(SAT)}$ and $V_{CE(OFF)}$. Assume $V_{CE(SAT)}$ = 0.3V.

(7 marks)

(Hint: First perform KVL around the loop containing the parameters to be solved, then identify known and unknown parameters).

(c) Sketch the DC load line and determine whether the amplifier is midpoint biased.

(3 marks)

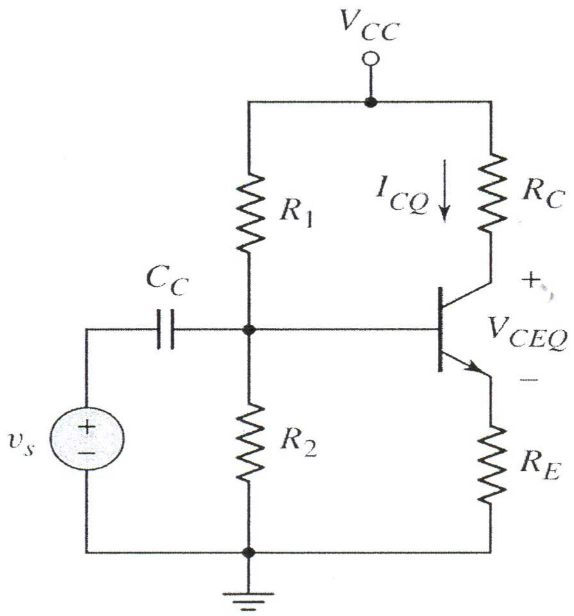

Figure 5

Question 6

A student has obtained the schematic of a proven power supply rectifier which is shown in **Figure 6**. Since it is to be used in a digital electronics project, the student has to evaluate the power supply's performance and has to upgrade its components if necessary. You are the partner of the student in his project and would like to help him in the calculations.

Assume:

- The transformer ratio is 85:6. R_i = 220 Ω, C = 470μF, R_L = 850 Ω.
- V_Z = 3.9V, Z_Z= 40Ω.
- v_i is from TNB (240Vac, 50 Hz) and each diode voltage drop is 0.7V.

Perform the following calculation or analysis:

(a) Peak voltage value at rectifier output $V_{C(P)}$ (voltage at the diodes cathodes).

(4 marks)

(b) I_S, the total current through R_i.(assume $V_{C(P)}$ as peak voltage).

(3 marks)

(c) The value of ripple voltage through the filter, V_R.

(4 marks)

(d) The equivalent circuit of R_i , V_Z , and R_L when it is subjected to the input ripple, V_R (analysis in AC only, without DC). The output ripple is $V_{R(OUT)}$. Then obtain the gain equation of $V_{R(OUT)}$ over V_R . Obtain numerical value of $V_{R(OUT)}$.

(7 marks)

(e) For digital electronics, the final ripple voltage, $V_{R(OUT)}$, is required to be made smaller than 50mV. Calculate the minimum required value for filter capacitance C in **Figure 6**.

(5 marks)

(f) The output voltage V_L from **Figure 6** is tapped into a circuit where a certain voltage range tunable 1.25V to 2.7V is required. (Ignore the current drive requirement). Thus a circuit employing the LM317 regulator is developed. The circuit is depicted in **Figure 7**. R_2 is a variable resistor 0-5kΩ. Calculate R_1 to achieve the required voltage regulation.

(5 marks)

(g). The Input-Output Voltage Differential for the LM317 mentioned above is 40V. Determine the maximum input voltage (V1) for the circuit in **Figure 7**.

(2 marks)

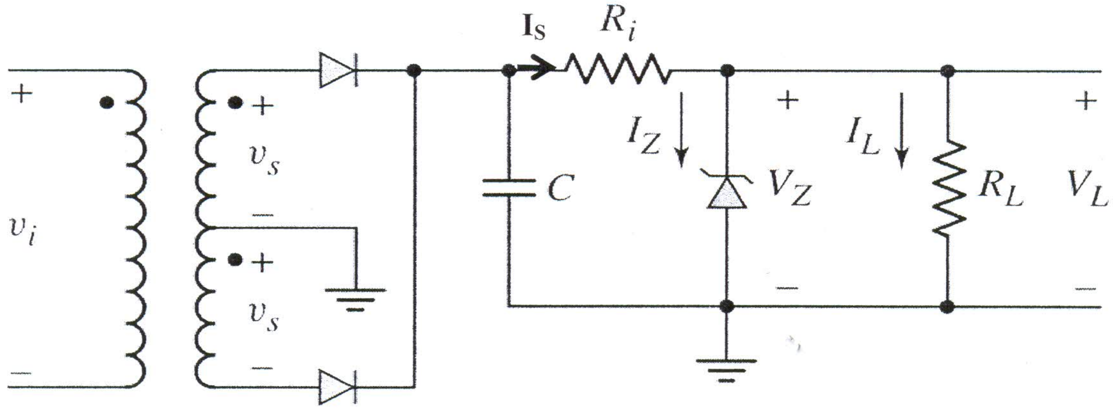

Figure 6

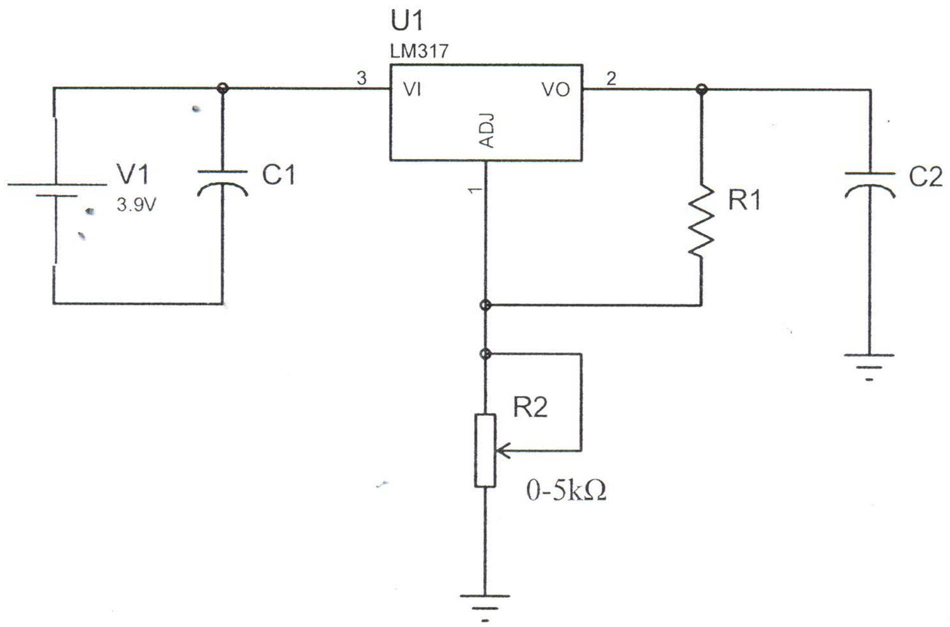

Figure 7

Question 7

Consider the Class – A amplifier circuitry as shown in **Figure 8**. Determine the voltage gain (A_V) of the amplifier. Assume the ac emitter resistance, $r'_e = \dfrac{25mV}{I_E}$.

Calculate:

(a) Base voltage, V_B

(5 marks)

(b) Emitter voltage, V_E

(5 marks)

(c) Emitter current, I_E

(5 marks)

(d) AC emitter resistance, r'_e

(5 marks)

(e) AC resistance of collector circuit, r_C.

(5 marks)

(f) Voltage gain of the amplifier, A_V .

(5 marks)

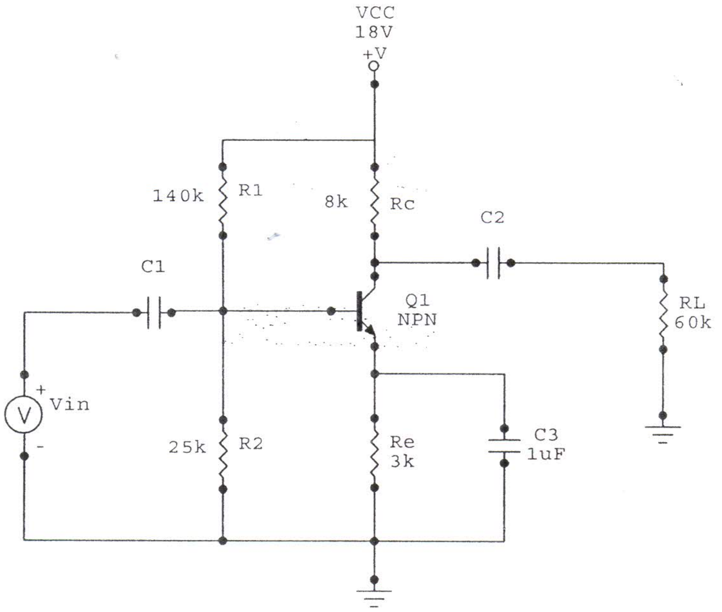

Figure 8

END OF QUESTION PAPER

APPENDIX

FORMULA

HALF WAVE

$$V_{L(PK)} = V_{2(PK)} - V_F$$
$$V_{(AVE)} = 0.318 \times V_{L(PK)}$$
$$PIV = V_{2(PK)}$$

FULL WAVE CENTER TAPPED TRANSFORMER

$$V_{L(PK)} = \frac{V_{2(PK)}}{2} - V_F$$
$$V_{(AVE)} = 0.636 \times V_{L(PK)}$$
$$PIV = V_{2(PK)} - V_F$$

FULL WAVE BRIDGE

$$V_{L(PK)} = V_{2(PK)} - 2 \times V_F$$
$$V_{(AVE)} = 0.636 \times V_{L(PK)}$$
$$PIV = V_{2(PK)} - V_F$$

ZENER DIODES

$$V_{ZK} = V_{ZT} - Z_Z \cdot (I_{ZT} - I_{ZK})$$
$$V_{ZM} = V_{ZT} + Z_Z \cdot (I_{ZM} - I_{ZT})$$
$$I_{ZM} = \frac{P_{D(MAX)}}{V_{ZT}}$$