RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

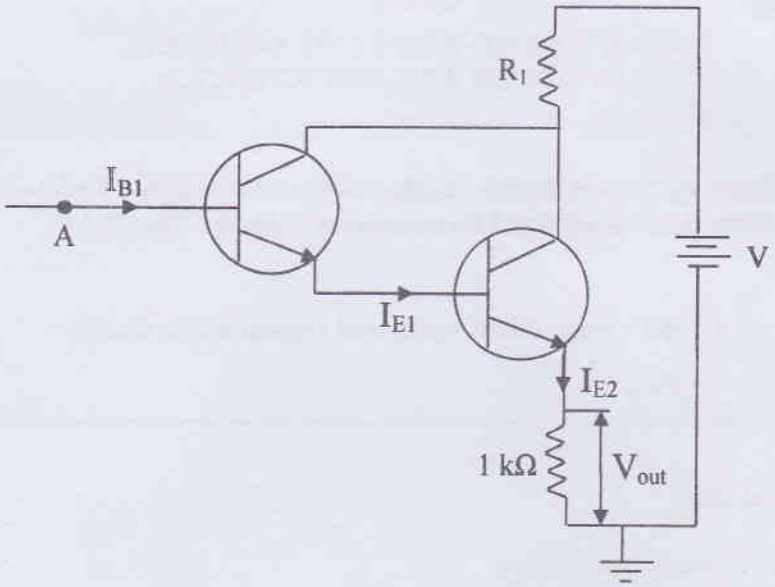
B.Sc. (General) Degree in Information & Communication Technology
First Year Semester I Examination – April / May 2015

ICT 1303 – Basic Electronics and Digital Logic Design

Instructions for candidates

- This is a closed book examination.
- There are **FOUR (4) pages** in the question paper.
- Time allowed will be **THREE (3) hours.**
- Question paper consists of **SIX (6) questions.**
- **Answer any FIVE (5) questions**
- All questions carry equal marks.

Q1. The Following circuit diagram shows a use of two Bipolar Junction Transistors (BJT) in current amplification. This is known as Darlington pair circuit, where the output current (I_{E1}) of the first transistor is fed as the input current for the second transistor.



1) If the current gain β = 100 for both transistors, find the output current (I_{E2}) when the input current I_{B1} = 1 μA. **(6 Marks)**
2) Find the output voltage (V_{out}) across the 1 kΩ resistor. **(4 Marks)**
3) If the V_{BE}= 0.7 V for both transistors, find the voltage at point A. **(4 Marks)**
4) Plot the I_C vs V_{CE} graph for various values of I_B in a BJT and mark the three main biasing modes on the same graph. **(3 Marks)**
5) State the biasing modes the transistor should operate when it is used as an amplifier and a switch. **(3 Marks)**

Q2. Semiconductors have electrical conductivities that are falling between conductors and insulators.

1) What are intrinsic semiconductors? **(2 Marks)**
2) Briefly discuss the electrical conductivities of intrinsic semiconductors at room temperature (300 K) and absolute zero temperature (0 K) **(4 Marks)**
3) Using Si crystal as an example, explain how a **p** - type semiconductor is formed from an intrinsic semiconductor. **(4 Marks)**
4) Draw the I-V curve for a diode and mark forward bias, reverse bias and break down regions on it. **(4 Marks)**
5) Give electronic devices (or components) that can be used in following situations
   a. To reduce the current flow on a circuit **(2 Marks)**
   b. To convert AC current in to DC current **(2 Marks)**
   c. To remove unwanted signal interferences **(2 Marks)**

Q3.

1) Convert the following Binary numbers into Hexadecimal and Octal numbers
   a. 1101101 **(2 marks)**
   b. 10110111 **(2marks)**
   c. 11011 **(2 marks)**
2) What are the advantages and Disadvantages of Diode Logic Gates? **(4 marks)**
3) Design a circuit with 3 inputs (A,B,C) and 2 outputs (Y,Z) with respect to the following conditions
   a. Y is 1 if A is 1 OR B AND C are 1
   b. Z is 1 if B OR C is 1 but not both
   c. Z is 1 if A AND B AND C are 1

   Write the Truth table and obtain the Sum of Products (SOP) expression **(4 marks)**
4) Simplify the expression you obtained in part(3) using two Karnaugh maps and draw the simplified circuit diagram **(6 marks)**

Q4.

1) Draw the circuit diagrams for following Boolean expressions using minimum number of logic gates as possible. **(4 marks)**
   a. $\overline{(A+B)}.(C+D)$
   b. $\overline{\overline{X}+\overline{Y}}$
   c. $\overline{X.Y} \oplus Y.Z$
   d. $(\overline{A}.\overline{B}) + (\overline{A}.B) + (A.\overline{B}) + (A.B)$
2) Simplify the following expressions using theorems in Boolean algebra. **(6 marks)**
   a. $(A+C).(A.D + A.\overline{D}) + A.C + C$
   b. $A.\overline{B}.(\overline{A}+B)(\overline{B}+B)$
3) Prove the following theorems using truth tables.
   a. $\overline{A+B} = \overline{A}.\overline{B}$ **(3Marks)**
   b. $\overline{A.B} = \overline{A} + \overline{B}$ **(3Marks)**
4) Draw the Logical Symbols for XOR and NOR gates and write down the relevant truth tables. **(4 marks)**

Q5.

1) What is a multiplexer? How does it differ from a Decoder? **(4 marks)**
2) Write the truth table for a 1-bit 4 by 1 multiplexer **(4 marks)**
3) Obtain the Sum of Products (SOP) expression and draw the circuit diagram using minimum number of logic gates **(4marks)**
4) What are the differences between combinational logical components and sequential logical components **(4 marks)**
5) Draw the circuit diagram of a Gated S-R Flip-Flop using logic gates and write the truth table **(4 marks)**

Q6.

1) Briefly explain the functions of a binary encoder. **(3 marks)**
2) Write the truth table of an 8 to 3 binary encoder and obtain the Sum of Products (SOP) expressions for the 3 outputs. **(6 marks)**
3) What is a counter in digital electronics? **(3 marks)**
4) Design a 3 bit up counter using T flip-flops. **(4 marks)**
5) State whether the following components are combinational or sequential.
   a. Register **(1 mark)**
   b. Decoder **(1 mark)**
   c. Timer **(1 mark)**
   d. Comparator **(1 mark)**

----------***End***----------