UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

MAY 2014 MAIN EXAMINATION

TITLE OF PAPER: **DIGITAL SYSTEMS II**

COURSE CODE: **EE324**

TIME ALLOWED: **THREE** HOURS

INSTRUCTIONS:

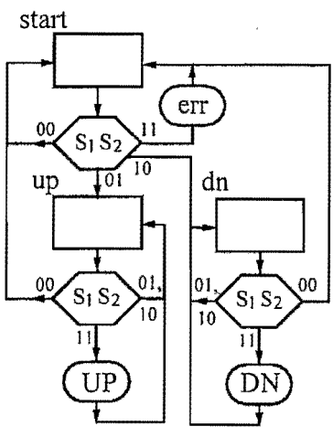
1. To answer, pick any five out of eight questions in the following pages.
2. Each question carries 20 marks.
3. Write answers in the space provided under the questions respectively. If you need extra space, use the page on the left of the question. Use the answer book as scratch paper.
4. Hand in both question book and answer book with the question book inserted in the answer book. Both books must be properly name and ID marked.
5. This paper has 9 pages, including this page.

DO NOT OPEN THE PAPER UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

Sequential Circuit:

Q1a 10pts: Drive a state table from the given ASM chart on the right.

Q1b 10pts: Convert the given ASM chart on the right into a state diagram.



Q2a 10pts: Design a sequential circuit to generate a number sequence, 021-746. Of course, a state table is necessary. Choice of FF is open to you.
Q2b 10pts: Derive a state equation from the state table.

Q3 20pts: A sequential circuit has two flip-flop (A and B)(Choice of FF is open to you), two inputs (x and y), and an output (z). The state equation and the circuit output function are as follows:

$$A(t+1) = AB + A\bar{x} + Ay + \bar{A}Bx + \overline{AB}\,\bar{y}$$

$$B(t+1) = \overline{AB}\,x + \bar{A}B\bar{x} + \bar{A}By$$

$$z = Axy + B\overline{x\,y}$$

Obtain the logic diagram, state table, and state diagram.

Practical design with ASM

Q4 20pts: Design an ASM chart of the operation process of a vending machine. It is a machine of returning no change and dispenses one can when the user inserts an amount equal or more than E3.00. A coin recognizing interface will input an appropriate code to the system as follows: 00=no coin, 01=E1.00, and 10=E2.00. A dispensing output is generated when there is enough money, to dispense a can. You must break the whole operation process into several stages or states. The suggested stages are: "insert coin", "more coin", "no more", and "dispense". You may create additional states as needed. (hint: Use: if insert E1, E1, and E1, then dispense. If insert E1 and E2, then dispense.)

Register-Transfer Circuit:

Q5a 10pts: Draw a block diagram to show all control signals, data inputs, and data outputs of a universal 4-bit binary up-down counter.

Q5b 10pts: Draw a block diagram to show all control signals, data inputs, and data outputs of a universal 4-bit binary register.

Q6 It is required to exchange data between two registers regA and regB. Use RAM as the intermediate storage device. regA, regB, and RAM are of the same byte size and in a common bus structure.

(a) 10pts: Draw the hardware circuit for this system. Of course, MAR, MBR, and memory unit must be included.

(b) 10pts: Use registry language to describe the operation.

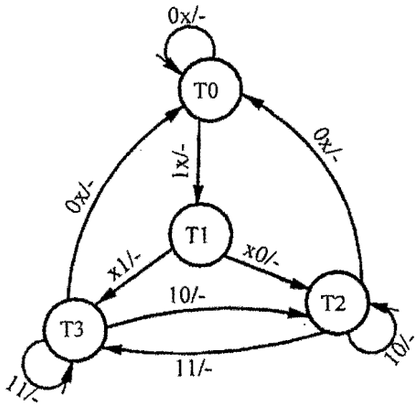
Control Circuit Design

Q7 20pts: Shown below is a 4-state state diagram of a control unit where control inputs are xy and output is nothing, as a whole symbolically xy/-. Design the control circuit by the sequence register and decoder structure with two JK ffs G_2 and G_1.

(a). Use the decoder outputs as conditions for the present states.

(b). Use the ff outputs as conditions for the present states.

Compare the two results and comment on the advantages and disadvantages in each case.



Q8 20pts: Shown on the right is the flowchart of a digital system that multiplies two unsigned binary integers M. and N (assume 4-bit data) by the repeated addition method. In the flowchart, registers are labeled as such: St, start; PR, product; BR, multiplicand; AR, multiplier.

(a). List the register transfer statements executed in each state,

(b). Draw a state diagram for the control,

(c). Design the control by the one ff per state structure,

(d). Draw the whole circuit of the system in a block diagram form.