2005 Paper 11 Question 1

Digital Electronics

(*a*) A Moore machine is required which produces the counting sequence 0,1,2,3,4,5,0. Give a minimum sum-of-products for each of the next state variables for an implementation of this Moore machine. [6 marks]

(*b*) Design a two-bit Gray code counter which produces the binary sequence 00,01,11,10,00. The counter should be designed as a Moore machine consisting of D flip-flops (with enable inputs) and a minimal number of logic gates. An additional input (`E`) is required to enable or disable counting which can be connected directly to the enable inputs of the D flip-flops. What is the final circuit diagram? [6 marks]

(*c*) The 0→5 and Gray-code counters are coupled together to produce a state machine with following state sequence and output pattern in Morse code for SOS ($\cdots\ - - -\ \cdots$):

State sequence		Output
00	000	0
00	001	1
00	010	0
00	011	1
00	100	0
00	101	1
01	000	0
01	001	1
01	010	1
01	011	1
01	100	0
01	101	1
11	000	1
11	001	1
11	010	0
11	011	1
11	100	1
11	101	1
10	000	0
10	001	1
10	010	0
10	011	1
10	100	0
10	101	1

With the aid of a circuit diagram, explain how the two counters are coupled together to produce the sequencer, and how the required Morse code output can be generated from this sequencer. [8 marks]