Jadavpur University
Master of Power Engg. 1st Semester 2017
Digital Systems

Time: 3hrs
Full Marks: 100

Answer any Five

1. Using FSM concepts, design a 4 bit synchronous down counter. 15
   Assuming a propagation delay of 40ns per F/F calculate the maximum clock frequency at which you can operate a 4-bit ripple counter. 5

2. With a suitable circuit deduce an expression for duty cycle and time period of a 555 timer connected to external resistances R_a,R_b and a capacitance C in an astable multi-vibrator mode. Is it possible to set the duty cycle to any value in this mode? Substantiate your answer. 15+5

3. For a TTL gate, with suitable representative values of I_{IH},I_{IL},I_{OH},I_{OL} and V_{IH},V_{IL},V_{OH},V_{OL} calculate the (i)Fan out and (ii) noise margin. 10
   Assuming these values design a pull up resistor for a TTL gate 10

4. Obtain the Z transform for $f(t) = e^{-\alpha t}$ sampled at an interval T and hence deduce the ROC. 5
   If $F(z)$ represents the Z transform for a discrete function $f(kT)$ deduce the Z-transform for the time-shifted function $f(k-N)T$. 5
   State and prove the final value theorem in discrete domain. 10

5. Deduce a mapping from s plane to z-plane using bilinear transformation (derive the transformation) 10
   Using this transformation can you deduce how does a point $z = 1.2$ map into the s plane? 10

6. Deduce the Fourier Transform of a time-shifted rectangular pulse of height H and width T 10
   If $F(\omega)$ be the Fourier Transform of $f(t)$ prove that $f(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} F(\omega)e^{i\omega t}\,d\omega$ 10

7. State and prove sampling theorem. 15
   Consider a signal $x(t) = 3Cos200\pi t$
   a. Determine the minimum sampling rate required to avoid aliasing. 1+4
   b. Suppose that the signal is sampled at the rate of Fs = 200 Hz, what is the discrete-time signal obtained after sampling?

8. Sketch the Manchester Coded signal for the bit sequence 11001010 5
   If bit stuffing is used for the bit sequence of 64 consecutive logical 1s, how will the bitwise efficiency change. 5
   Is it possible implement ring topology over a star connectivity of computer nodes? Explain 5
   A serial communication uses 8 bit data with no parity and 1 stop bit and has a speed of 4800 bps. How much time will this link take to transmit 1 MB? 5