# INSTITUTE OF AERONAUTICAL ENGINEERING
## (Autonomous)
Dundigal, Hyderabad - 500 043

## ELECTRONICS AND COMMUNICATION ENGINEERING

## TUTORIAL QUESTION BANK

| Course Name | : | SWITCHING THEORY AND LOGIC DESISN |
|---|---|---|
| Course Code | : | A30407 |
| Class | : | II B. Tech I Semester |
| Branch | : | ECE |
| Year | : | 2015 – 2015 |
| Course Coordinator | : | Mr B. Naresh |
| Course Faculty | : | Mr D. Loknath Reddy |

**OBJECTIVES**

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

| S. No | QUESTION | Blooms Taxonomy Level | Course Outcome |
|---|---|---|---|
| UNIT-I NUMBER SYSTEMS AND BOOLEAN ALGEBRA AND SWITCHING FUNCTIONS | | | |
| | Group - A   (Short Answer Questions) | | |
| 1 | Write short notes on binary number systems. | Remember | 1 |
| 2 | Discuss 1's and 2's complement methods of subtraction. | Understand | 1 |
| 3 | Discuss octal number system. | Understand | 1 |
| 4 | State and prove transposition theorem. | Remember | 2 |
| 5 | Show how do you convert AND logic to NAND logic? | Apply | 3 |
| 6 | Describe a short note on five bit bcd codes. | Remember | 1 |
| 7 | Illustrate about unit –distance code? State where they are used. | Apply | 1 |
| 8 | State about error correcting codes? | Remember | 1 |
| 9 | When do you say that a signal is asserted? | Understand | 1 |
| 10 | State about logic design and what do you mean by positive logic system? | Remember | 2 |
| | Group - II   (Long Answer Questions) | | |
| 1. | (a) Perform the subtraction with the following unsigned binary numbers by taking the 2's complement of the subtrahend: i. 100 – 110000      ii. 11010 - 1101. (b) Construct a table for 4 -3 -2 -1 weighted code and write 9154 using this code | Understand | 1 |

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|---|---|---|---|
| | Write short notes on binary number systems. | | |
| 2. | (a) Perform arithmetic operation indicated below. Follow signed bit notation:<br>    i. 001110 + 110010   ii. 101011 - 100110.<br>(b) Explain the importance of gray code | Understand | 1 |
| 3. | Find $(3250 - 72532)_{10}$ using 10's complement | Understand | 1 |
| 4. | As part of an aircraft's functional monitoring system, a circuit is required to indicate the status of the landing gears prior to landing. Green LED display turns on if all three gears are properly extended when the \gear down" switch has been activated in preparation for landing. Red LED display turns on if any of the gears fail to extend properly prior to landing. When a landing gear is extended, its sensor produces a LOW voltage. When a landing gear is retracted, its sensor produces a HIGH voltage. Implement a circuit to meet this requirement | Apply | 1 |
| 5. | (a) Divide 01100100 by 00011001<br>(b) Given that $(292)10 = (1204)b$ determine `b' | Understand | 1 |
| 6. | (a) What is the gray code equivalent of the Hex Number 3A7<br>(b) Find the biquinary of number code for the decimal numbers from 0 to 9<br>(c) Find 9's complement $(25.639)_{10}$ | Understand | 1 |
| 7. | (a) Find (72532 - 03250) using 9's complement.<br>(b) Show the weights of three different 4 bit self complementing codes whose only negative weight is - 4 and write down number system from 0 to 9. | Understand | 1 |
| 8. | Decimal system became popular because we have 10 fingers. A rich person On earth has decided to distribute Rs.one lakh equally to the following persons from various planets. Find out the amount each one of them will get in their  respective currencies:<br> A from planet VENUS possessing 8 fingers<br> B from planet MARS possessing 6 fingers<br> C from planet JUPITER possessing 14 fingers<br> D from planet MOON possessing 16 fingers | Apply | 1 |
| 9. | State and prove any 4 Boolean theorems with examples | Remember | 2 |
| 10. | (a) Simplify to a sum of 3 terms: A'C'D' +AC' +BCD + A'CD' + A'BC + AB'C'<br>(b) Given AB' + AB = C, Show that AC' + A'C = B | Apply | 3 |
| | **Group - III   (Analytical Questions)** | | |
| 1. | Convert (4085)9 into base-5? | Apply | 1 |
| 2. | Write the first 20 decimal digits in base 3? | Understand | 1 |
| 3. | Write the steps involved in unsigned binary subtraction using complements with examples | Remember | 1 |
| 4. | How do you perform addition of two signed binary number? Explain with examples. | Remember | 1 |
| 5. | Differentiate between binary code and BCD code? | Understand | 1 |
| 6. | How binary values are stored in memory? Explain | Understand | 1 |
| 7. | Write the Axiomatic Definitions of Boolean Algebra. | Remember | 2 |
| 8. | Write a table stating all the postulates and theorems of Boolean Algebra that are required for  Logic  minimization | Remember | 2 |
| 9. | Convert f(x)= x + y'z into canonical form | Understand | 3 |
| 10 | Differentiate between positive and negative logic. | Understand | 4 |
| | | | |
| | **UNIT-II**<br>**MINIMIZATION AND DESIGN OF COMBINATIONAL CIRCUITS** | | |
| | **Group - A   (Short Answer Questions)** | | |
| | | | |
| 1 | Define K-map? | Remember | 5 |
| 2 | Write the block diagram of 2-4 and 3-8 decoders? | Understand | 6 |

| S. No | QUESTION | Blooms Taxonomy Level | Course Outcome |
|---|---|---|---|
| 3 | Define magnitude comparator? | Remember | 6 |
| 4 | What do you mean by look-ahead carry? | Remember | 6 |
| 5 | Simplify the Boolean function $x'yz + x'yz' + xy'z' + xy'z$ using K-map | Remember | 5 |
| 6 | How combinatorial circuits differ from sequential circuits? | Remember | 6 |
| 7 | What are the IC components used to design combinatorial circuits with MSI and LSI? | Understand | 6 |
| 8 | Define the importance of prime implications | Remember | 5 |
| 9 | Locate the minters in a three variable map for $f=\sum m(0,1,5,7)$ | Remember | 5 |
| 10 | Simplify the Boolean function $x'yz + x'yz' + xy'z' + xy'z$ without using K-map | Apply | 5 |
| | **Group - II   (Long Answer Questions)** | | |
| 1. | A combinational circuit has 4 inputs(A,B,C,D) and three outputs(X,Y,Z)XYZ represents a binary number whose value equals the number of 1's at the input<br> i  Find the minterm expansion for the X,Y,Z<br> ii. Find the maxterm expansion for the Y and Z | Apply | 5 |
| 2. | A combinational circuit has four inputs (A,B,C,D), which represent a binary-coded-decimal digit. The circuit has two groups of four outputs - S,T,U,V (MSB digit) and W,X,Y,Z.(LSB digit)Each group represents a BCD digit. The output digits represent a decimal number which is five times the input number. Write down the minimum expression for all the outputs. | Apply | 5 & 6 |
| 3. | Simplify the following Boolean expressions using K-map and implement them using NOR gates:<br>(a) F (A, B, C, D) = AB'C' + AC + A'CD'<br>(b) F (W, X, Y, Z) = W'X'Y'Z' + WXY'Z' + W'X'YZ + WXYZ. | Understand | 5 |
| 4. | Design BCD to Gray code converter and realize using logic gates | Understand | 6 |
| 5. | Design 2*4 decoder using NAND gates | Understand | 6 |
| 6. | Reduce the following expression using Karnaugh map (B 'A +  A'B + AB' ) | Understand | 5 |
| 7. | Design a circuit with three inputs(A,B,C) and two outputs(X,Y) where the outputs are the binary count of the number of "ON" (HIGH) inputs | Apply | 6 |
| 8. | A certain 4 input gate called LEMON gate realizes the switching function LEMON (A,B,C,D) = BC(A+D). Assuming that the input variables are available in both primed and unprimed form:<br>show a realization of the function $f(w,x,y,z)=\sum(0,1,6,9,10,11,14,15)$ with only three LEMON gates and one OR gate.<br>Can all switching functions be realized with LEMON/OR logic | Apply | 6 |
| 9. | Design a circuit with four inputs and one output where the output is 1 if the input is divisible by 3 or 7. | Apply | 6 |
| 10. | Implement Half adder using 4 NAND gates. | Apply | 6 |
| | **Group - III   (Analytical Questions)** | | |
| 1. | Implement the Boolean function F = AB + CD + E using NAND gates only. | Understand | 5 & 6 |
| 2. | Simplify the Boolean function $F(w, x, y, z) = \Sigma(1, 3, 7, 11, 15) + d(w, x, y, z) = \Sigma(0. 2, 5)$ | Apply | 5 |
| 3. | Realize the logic diagram of a full subtractor using only 2-input NAND gates | Apply | 6 |
| 4. | Realize the logic diagram of a full subtractor using only 2-input NOR gates | Apply | 6 |
| 5. | Use a multiplexer having three data select inputs to implement the logic for the function  $F = \Sigma (0, 1, 2, 3, 4, 10, 11, 14, 15)$ | Apply | 6 |
| 6. | Identify all the prime implicants and essential prime implicants of the following functions Using  karnaugh map. $F(A,B,C,D) = \Sigma(0,1,2,5,6,7,8,9,10,13,14,15)$. | Apply | 5 |
| 7. | Construct a 4 to 16 line decoder using 2 to 4 line decoders | Apply | 6 |
| 8. | Design a 4-bit Combinational circuit which generates the output as 2's complement of input binary number. Show that the circuit can be constructed with EX-OR gates | Apply | 6 |
| 9. | Design a combinatorial circuit that converts a decimal digit from 2,4,2,1 code | Understand | 6 |

| S. No | QUESTION | Blooms Taxonomy Level | Course Outcome |
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| | to the 8,4,-2,-1 code? | | |
| 10 | Design a combinatorial circuit that accepts a three bit number and generates an output Binary number equal to the square of the input number? | Understand | 6 |

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**UNIT-III**
**SEQUENTIAL MACHINES FUNDAMENTALS**

**Group - A   (Short Answer Questions)**

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| S. No | QUESTION | Blooms Taxonomy Level | Course Outcome |
|---|---|---|---|
| 1. | What do you mean a stable state? | Remember | 7 |
| 2. | What is a Flip-Flop? | Understand | 7 |
| 3. | What are the applications of Flip-Flops? | Remember | 7 |
| 4. | Express your view about synchronous latch? | Understand | 7 |
| 5. | How do you build a latch using universal gates? | Apply | 7 |
| 6. | What is the flip-flop memory characteristic? | Understand | 7 |
| 7. | Distinguish between synchronous and asynchronous latch? | Remember | 7 |
| 8 | What is meant by clocked flip-flop? | Remember | 7 |
| 9. | Why a gated D latch is called a transparent latch? | Remember | 7 |
| 10. | What are the two types of flip-flops? | Remember | 7 |

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**Group - II   (Long Answer Questions)**

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| S. No | QUESTION | Blooms Taxonomy Level | Course Outcome |
|---|---|---|---|
| 1. | Analyze the clocked sequential circuits. | Understand | 7 |
| 2. | Examine with the help of a block diagram, the basic components of a Sequential Circuit? | Remember | 7 |
| 3. | Compare RS and JK flip-flops. | Understand | 7 |
| 4. | Describe about T – Flip-flop with the help of a logic diagram and characteristic table. Derive a T-flip-flop from JK and D flip-flops. | Understand | 7 |
| 5. | Define Latch. Explain about Different types of Latches in detail | Remember | 7 |
| 6. | Explain about all flip flops in detail with diagram | Remember | 7 |
| 7. | Derive the characteristic equations for all Flip-Flops. | Remember | 7 |
| 8. | Memorize about basic macro cell logic diagram and explain. | Remember | 7 |
| 9. | Differentiate combinational and sequential circuits | Understand | 7 |
| 10. | Explain the working principle of JK Flip-Flop in detail. | Understand | 7 |

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**Group - III   (Analytical Questions)**

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| S. No | QUESTION | Blooms Taxonomy Level | Course Outcome |
|---|---|---|---|
| 1. | Explain the operation of SR Flip-Flop using asynchronous inputs with truth table. | Remember | 7 |
| 2. | Explain the Flip-Flop operating characteristics in detail | Remember | 7 |
| 3. | Draw the schematic circuit of an edge triggered flip-flop with "active low preset" and "active low clear" using NAND gats and explain its operation | Understand | 7 |
| 4. | Convert a JK FF to i) SR  ii) T  iii) D | Understand | 7 |
| 5. | Convert a SR FF to i) JK ii) D   iii) T | Understand | 7 |
| 6. | Convert a D FF to i) JK ii)SR   iii) T | Understand | 7 |
| 7. | Convert a T FF to i) JK ii) D   iii) SR | Understand | 7 |
| 8. | Discuss the applications of flip-flops | Remember | 7 |
| 9. | Give the transition table for the following flip-flops i)  SR FF  ii) D FF | Understand | 7 |
| 10 | Give the transition table for the following flip-flops i)  JK FF  ii) T FF | Understand | 7 |

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**UNIT-IV**
**SEQUENTIAL CIRCUIT DESIGN AND ANALYSIS**

**Group - A   (Short Answer Questions)**

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| S. No | QUESTION | Blooms Taxonomy Level | Course Outcome |
|---|---|---|---|
| 1. | What are Shift registers? | Remember | 8 |
| 2. | Distinguish between a shift register and counter? | Understand | 8 |
| 3. | What are the applications of shift registers? | Remember | 8 |
| 4. | Discuss about a bidirectional shift register? | Understand | 8 |

| S. No | QUESTION | Blooms Taxonomy Level | Course Outcome |
|---|---|---|---|
| 5. | Summarize about a dynamic shift register? | Understand | 8 |
| 6. | Describe about UART? | Understand | 8 |
| 7. | Classify of counters? | Understand | 8 |
| 8. | What are the advantages and disadvantages of ripple counters? | Remember | 8 |
| 9. | What do you mean by terminal count? | Remember | 8 |
| 10. | State variable modulus counter? | Remember | 8 |
| | **Group - II   (Long Answer Questions)** | | |
| 1. | Explain the design of Sequential circuit with an example. Show the state reduction, state  assignment | Remember | 8 |
| 2. | Explain Serial Transfer in 4-bit shift Registers | Remember | 8 |
| 3. | Explain about Binary Ripple Counter | Understand | 8 |
| 4. | Define BCD Counter and Draw its State table for BCD Counter | Remember | 8 |
| 5. | Explain the state reduction and state assignment in designing sequential circuit. Consider  one example in the above process | Understand | 8 |
| 6. | Design a sequential circuit with two D flip-ops A and B. and one input x. when x=0, the state of the circuit remains the same. When x=1,the circuit goes through the state transition from 00 to 11 to 11 to 10 back to 00.and repeats | Apply | 8 |
| 7. | Design a Modulo-12 up Synchronous counter Using T-Flip Flops and draw the Circuit diagram | Apply | 8 |
| 8. | Explain the Ripple counter design. Also a decade counter design | Remember | 8 |
| 9. | Write short notes on shift register? Mention its application | Remember | 8 |
| 10. | Design a left shift and right shift for the following data  10110101 | Apply | 8 |
| | **Group - III   (Analytical Questions)** | | |
| 1. | How many decade counters are required to convert a clock of 10 MHz to 100 Hz? | Understand | 8 |
| 2. | What do you mean by presetting the counter? | Remember | 8 |
| 3. | Assume that a 4-bit ripple counter is holding the count 0100.What will be the count after 29 pulses? | Understand | 8 |
| 4. | What do you mean by resetting the counter? | Understand | 8 |
| 5. | Compare state diagram and state table? | Remember | 8 |
| 6. | What do you mean by initial state and final state? | Understand | 8 |
| 7. | How do you test for the problem of lockout of a counter? How do you eliminate this problem? | Apply | 8 |
| 8. | Generate the pulse train 100110 using indirect logic | Apply | 8 |
| 9. | Design a type-D counter that goes through the states 0,2,4,6,0,…The undesired states must always go to a 0 on the next clock pulse? | Apply | 8 |
| 10 | Design a 3bit up/down counter which counts up when control signal M=1 and counts down when M=0. | Apply | 8 |
| | **UNIT-V**<br>**SEQUENTIAL CIRCUITS & ALGORTHMIC STATE MACHINES** | | |
| | **Group - A   (Short Answer Questions)** | | |
| 1. | What are the capabilities and limitations of FSM? | Understand | 9 |
| 2. | Demonstrate about successor? | Understand | 9 |
| 3. | Describe about terminal state? | Understand | 9 |
| 4. | Define a strongly connected machine? | Remember | 9 |
| 5. | List the advantage of having equivalent states? | Remember | 9 |
| 6. | State 'state equivalence theorem'. | Understand | 9 |
| 7. | Tell about distinguishing sequence? | Remember | 9 |
| 8. | Define state compatibility? | Understand | 9 |
| 9. | Describe a merger graph? | Understand | 9 |

| S. No | QUESTION | Blooms Taxonomy Level | Course Outcome |
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| 10. | State FSM compatibles? | Remember | 9 |
| | **Group - II   (Long Answer Questions)** | | |
| 1. | Differentiate between Race free and Latch free design? | Understand | 9 |
| 2. | Draw the ASM chart to count the number of ones in a register? | Apply | 9 |
| 3. | Draw the ASM chart for a binary multiplier? | Apply | 9 |
| 4. | Explain the concept of ASM chart? | Understand | 9 |
| 5. | Obtain the primitive flow table for the circuit with two inputs, x1 and x2, and two outputs, z1 and z2,that satisfy the following four conditions: a. When $x1x2 = 00$, the output is $z1z2 = 00$. b. When $x1 = 1$ and x2 changes from 0 to 1, the output is $z1z2 = 01$. c. When $x2 = 1$ and x1 changes from 0 to 1, the output is $z1z2 = 10$. d. Otherwise the output does not change. | Apply | 9 |
| 6. | An asynchronous sequential circuit is described by the excitation function $Y = x1x'2 + (x1 + x'2)y$ and the output function $z = y$. a. Draw the logic diagram of the circuit. b. Derive the transition table and output map. c. Obtain a two state flow table. | Apply | 9 |
| 7. | Find the circuit that has no static hazards and implements the Boolean function $F(A, B, C, D) = \Sigma(0, 2, 6, 7, 8, 10, 12)$. | Apply | 9 |
| 8. | Draw the ASM chart for adding or subtracting the two signed magnitude numbers A and B? | Remember | 9 |
| 9. | Write the differences between Mealy and Moore type machines. | Understand | 9 |
| 10. | A sequential circuit has 2 inputs w1=w2 and an output z. It's function is to compare the i/p sequence on the two i/p's. If w1=w2 during any four consecutive clock cycles, the circuit produces z=1 otherwise z=0 w1= 0110111000110 w2= 1110101000111 z=0000100001110 | Apply | 9 |
| | **Group - III   (Analytical Questions)** | | |
| 1. | Explain the operations in microwave oven and construct the ASM chart for them. | Apply | 9 |
| 2. | Design a synchronous state machine to generate following sequence of states. Represent the machine by a state diagram /ASM chart and display the onset of state 7(111) with the help of LED(use jk flip-flops). | Apply | 9 |
| 3. | Draw an ASM chart for a 2 bit binary counter having one enable line E such that E=1(counting enabled) E=0(Counting disabled). | Apply | 9 |
| 4. | Show that 8 exit paths in an ASM block emanating from the decision boxes that check the eight possible binary value of three control variables x,y,z. | Apply | 9 |
| 5. | Draw the ASM chart of binary multiplier and design the control circuit using each of the following methods a)JK FF and gates. b)D FF and decoder | Apply | 9 |
| 6. | Design control logic circuit using multiplexers. | Understand | 9 |
| 7. | Draw the ASM chart for a 3 bit up-down counter. | Understand | 9 |
| 8. | Draw the ASM chart for SR Flip-Flop. | Understand | 9 |
| 9. | Draw the ASM chart for JK Flip-Flop. | Understand | 9 |
| 10 | Design a mod 5 counter using multiplexers. | Understand | 9 |

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