L-2/T-1/CSE **Date : 18/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2017-2018

Sub : **CSE 205** (Digital Logic Design)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Write the rules of subtraction for two n digit numbers M and N in base r. There are two cases ($M \geq N$) and ($M < N$). Find the value of 9 – 6.9 – 9.8 using complement rule where the base is Hexadecimal. **(2+5)**

   (b) Express $f(A, B, C, D)$ = SOP (0, 4, 8, 9, 10, 11, 12, 14) with the two level forms of logic "NOR-OR" and "AND-NOR". **(8)**

   (c) Using K-Map minimize $f(w, x, y, z)$ = SOP (1, 2, 4, 7, 9, 10, 12, 14) + d (0, 6, 8, 13). Find the *Prime Implicants* and *Essential Prime Implicants.* Write down the responsible *minterm* for each *Essential Prime Implicant.* **(12)**

   (d) Simplify the following expression to POS and SOP: $BCD' + ABC' + ACD$ **(8)**

2. (a) Design a digital circuit with logic gates which takes the values of two 3 bit binary numbers X and Y and returns a 3 bit binary number Z which is the maximum between X and Y. (X can be expressed as $X_2X_1X_0$, Y can be expressed as $Y_2Y_1Y_0$ and Z can be expressed as $Z_2Z_1Z_0$). **(10)**

   (b) Design a BCD adder-subtractor for two BCD input A and B. Addition and subtraction is selected by a selector bit x, if x is given 0, the circuit operates $A+B$, if x is given 1, the circuit operates $A–B$. Explain the operation 9+7 and 9–7 with your designed circuit. **(9+4)**

   (c) Design a 3 bit *CLA* circuit and show all types of "Carry" for 3+4 with your designed CLA. **(8+4)**

3. (a) Design a logic circuit for $f(w, x, y, z)$ = SOP(0, 2, 6, 7, 8, 10, 11, 13, 14) with 2x4 line decoder which has A, B as input lines, active low enable EN' and active low output D_0', D_1', D_2' and D_3'. (Use the minimum number of extra logic gates). **(12)**

   (b) Design a 8 to 3 priority encoder with the priority order of data input is given as 6, 0, 7, 4, 5, 3, 1, 2 (6 has the highest priority and 2 has the lowest priority). **(13)**

   (c) Using a 2 to 4 line decoder, design a half subtractor. (Consider decoder's output line D_0, D_1, D_2 and D_3 as active high. Enable EN' is active low. **(10)**

4. (a) For 3 bit Excess-3 code design an *odd parity checker* and *odd parity generator.* **(8)**

   (b) Using 8 x 1 line MUX design a logic circuit for $f(w, x, y, z)$ = POS(0, 2, 5, 6, 7, 8, 9, 10), where the MUX has selector bits S_0, S_1, S_2 input lines I_0, I_1, I_2, I_3 ...I_7, and active low

Contd P/2

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Contd ... Q. No. 4(b)

Enable EN′, (If $S_2S_1S_0 = 000$, I_0 is selected; if $S_2S_1S_0 = 001$, I_1 is selected; $S_2S_1S_0 = 010$, I_2 selected; ... so on.) **(15)**

(c) Design a 1 bit Full Adder using two 4 x 1 multiplexers. The MUX has selector bits S_0, S_1, input lines I_0, I_2, I_3 and active low Enable EN'. (If $S_1S_0 = 00$, I_0 is selected; if $S_1S_0 = 01$, I_1 is selected; $S_1S_0 = 10$, I_2 is selected; $S_1S_0 = 11$, I_3 is selected.) **(12)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) Design a synchronous counter that counts in the following sequences:
$0 \rightarrow 1 \rightarrow 2 \rightarrow 5 \rightarrow 4 \rightarrow 6 \rightarrow 0 \rightarrow 1 \rightarrow 2 \rightarrow \ldots$ **(20)**
Design the counter using S-R flipflops and draw the circuit diagram.
(d) Why do we use master-slave flipflops? **(5)**
(c) Given a 100-MHz clock signal, derive a circuit using D-flipflops to generate 50 MHz and 25 MHz clock signals. Draw a timing diagram for all of three clock signals. **(10)**

6. (a) Design an automatic vending machine. The candy bars inside the machine cost 3 Tk, and the machine accepts 1 Tk and 2 Tk only. An electromechanical system accepts the coins sequentially. The circuit produces a level output that delivers the candy whenever the amount received by the machine is 3 Tk or more. The excess amount is kept deposited for the next candy. Design a pulse mode circuit for the vending machine using S-R flipflops. Draw the circuit diagram. **(20)**
(b) Design a serial adder that computes the sum of two 4-bit binary numbers A and B stored in individual shift registers. The result of the addition is stored in the shift register representing A. **(10)**
(c) Define (i) Mealy machine and (ii) Moore machine. **(5)**

7. (a) For the state-table, in Figure 7(a), of a completely specified circuit, find the equivalence partitions and write the state-table of the minimal machine. Name the states those are equivalent. **(10)**
(b) For the incompletely specified machine shown in Figure 7(b), complete the implication table and determine the maximal compatibles and the maximal incompatibles. Find the upper bound and the lower bound of the number of states of the minimal machine. Give the state table of the minimal machine. **(15)**
(c) Design a 5 bit ring counter using a shift register and illustrate its operation using a timing diagram. **(10)**

Contd P/3

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8. (a) Construct a primitive flow table for a fundamental mode circuit with the following specifications. The circuit has two inputs (x_1, x_2) and two outputs (z_1, z_2). When x_1x_2 = 00, z_1z_2= 00. The output 10 will be produced following the occurrence of the input sequence 00-01-11. The output will remain 10 until the input returns to 00, at which time it becomes 00. An output 01 will be produced following the receipt of the input sequence 00-10-11. And once again, the output will remain 01 until a 00 input occurs, which returns the output to 00. Determine the minimum row reduced flow table. **(10+10)**

(b) For the given reduced flow table in the Figure 8(b), find a valid assignment without any critical race and complete the modified flow table. **(10)**

(c) Design a 4 bit modulo-12 asynchronous up counter using J-K flip-flops. **(5)**

PS \ x_1x_2	NS,Z 00	01	11	10
A	D, 0	D, 0	F, 0	A, 0
B	C, 1	D, 0	E, 1	F, 0
C	C, 1	D, 0	E, 1	A, 0
D	D, 0	B, 0	A, 0	F, 0
E	C, 1	F, 0	E, 1	A, 0
F	D, 0	D, 0	A, 0	F, 0
G	G, 0	G, 0	A, 0	A, 0
H	B, 1	D, 0	E, 1	A, 0

Figure for question 7(a)

PS	NS,Z x = 0	x = 1
A	A, -	B, 1
B	G, -	D, 0
C	B, 1	B, -
D	A, 1	B, -
E	C, -	A, -
F	F, -	C, -
G	G, -	G, -

Figure for question 7(b)

x_1x_2	00	01	11	10
a	ⓐ/0	d/0	ⓐ/1	c/0
b	ⓑ/0	c/-	ⓑ/0	d/-
c	b/0	ⓒ/1	a/1	ⓒ/0
d	a/0	ⓓ/0	b/0	ⓓ/1

Figure for question 8(b)

L-2/T-1/CSE **Date: 30/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2017-2018

Sub: **EEE 263** (Electronic Circuits)

Full Marks: 280 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Determine the voltage gain v_o/v_i of the transistor amplifier shown in Fig. for Q. 1(a). Assume $\beta = 100$. **(26⅔)**

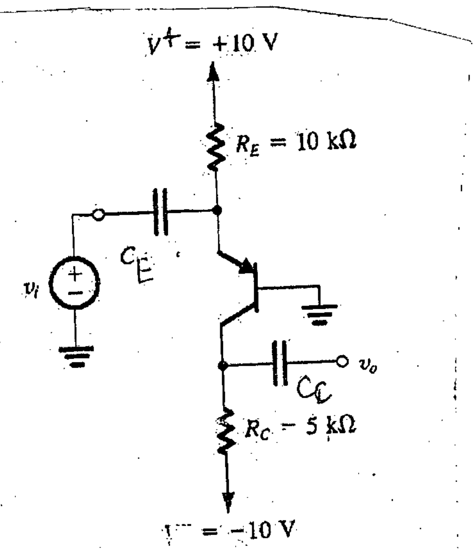

Figure for Q. 1(a)

(b) A CE amplifier utilizes a BJT with $\beta = 100$ and $V_A = 100$ V, is biased at $I_c = 1$ mA and has a collector resistance $R_c = 5$ kΩ. Find R_{in}, R_o, and A_{vo}. If the amplifier is fed with a signal source having a resistance of 5 kΩ, and a load resistance $R_L = 5$ kΩ is connected to the output terminal, find the resulting A_v and G_v. If v_π is to be limited to 5 mV, what are the corresponding v_{sig} and v_o with the load connected? **(20)**

2. (a) Determine the voltage gain v_o/v_i of the common-source MOSFET amplifier shown in Fig. for Q. 2(a). The transistor has $V_t = 1.5$ V, $k'_n(W/L) = 0.25$ mA/V^2, and $V_A = 50$ V. **(20)**

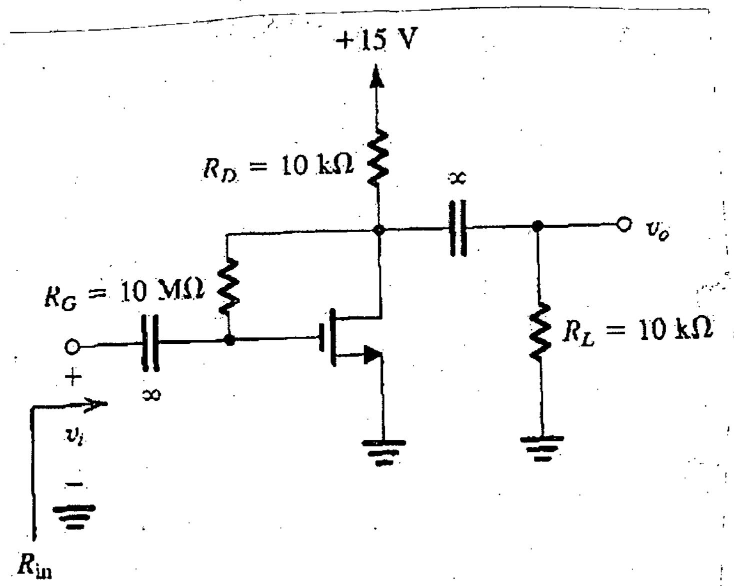

Figure for Q. 2(a)

Contd P/2

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Contd... Q. No. 2

(b) What is the reason of biasing a MOSFET? Write short note on the biasing technique of a discrete MOSFET using a fixed voltage at the gate and a resistance in the source R_S. **(11⅔)**

(c) Briefly explain the operation of MOSFET as a small-signal amplifier and also deduce its VTC from I_D-V_{DS} graph. **(15)**

3. (a) Calculate the collector current, emitter current and base current for the circuit shown in Fig. for Q. 3(a). Also verify the operating mode of the transistor. Assume $\beta = 100$. **(16)**

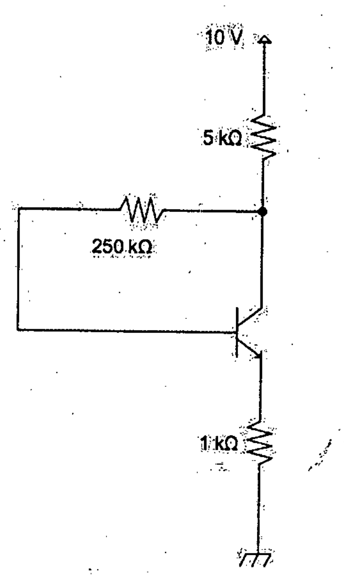

Figure for Q. 3(a)

(b) Determine the currents I_{C1} and I_{C2} for the circuit shown in Fig. for Q. 3(b). **(30⅔)**

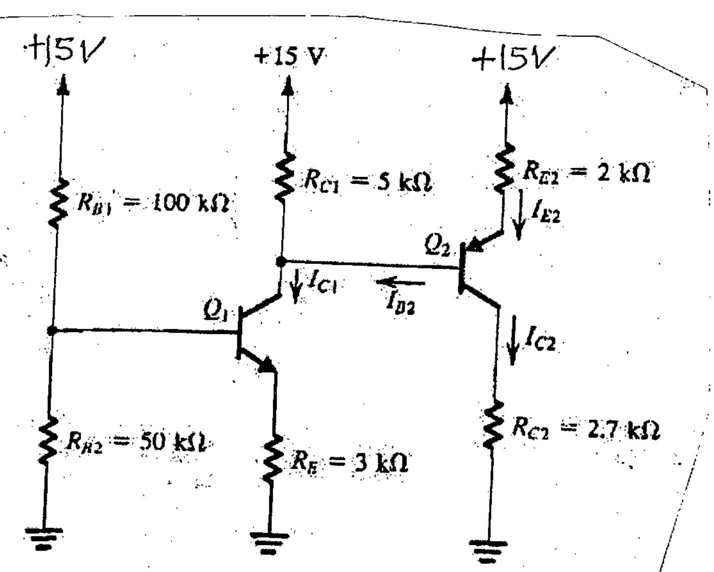

Figure for Q.3(b)

Contd P/3

4. (a) Consider a peak rectifier fed by a 60 Hz sinusoid having a peak value $V_p = 100$ V. Let the load resistance R = 10 kΩ. Find the value of the capacitance C that will result in peak-to-peak ripple of 2 V. Also calculate the fraction of the cycle during which the diode is conducting and the average and peak values of the diode current. **(10⅔)**

(b) Design a parallel-based clipper that will yield the voltage transfer function shown in Fig. for Q. 4(b). Assume 0.7 V as diode cut-in voltage. **(18)**

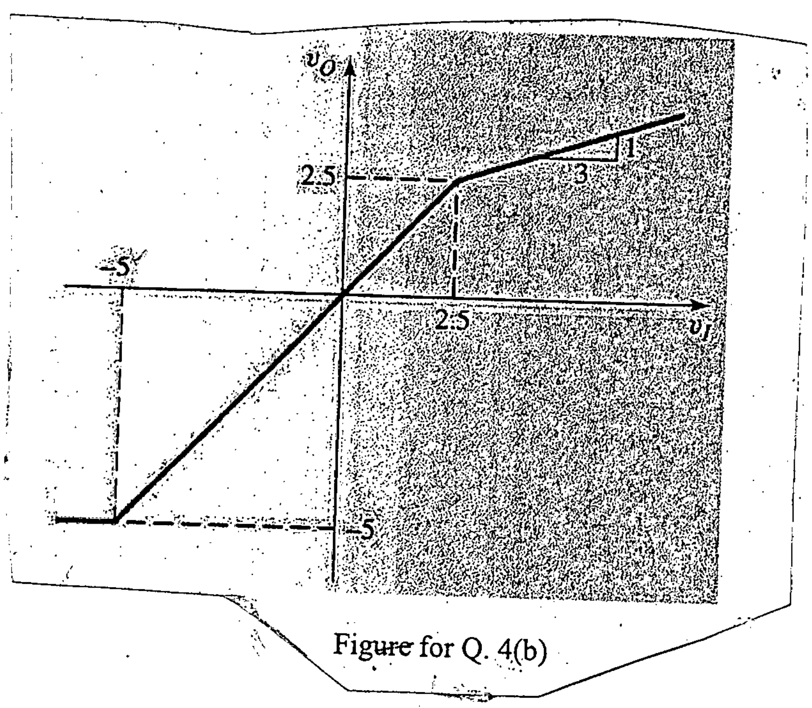

Figure for Q. 4(b)

(c) A voltage regulator circuit is shown in Fig. for Q. 4(c). The voltage regulator has to power a car radio at $V_L = 9$ V from an automobile battery whose voltage may vary between 11 and 13.6 V. The current in the radio will vary between 0 (off) to 100 mA (full volume). Determine the value of the current-limiting resistor R_i and maximum power dissipated in the Zener diode. **(18)**

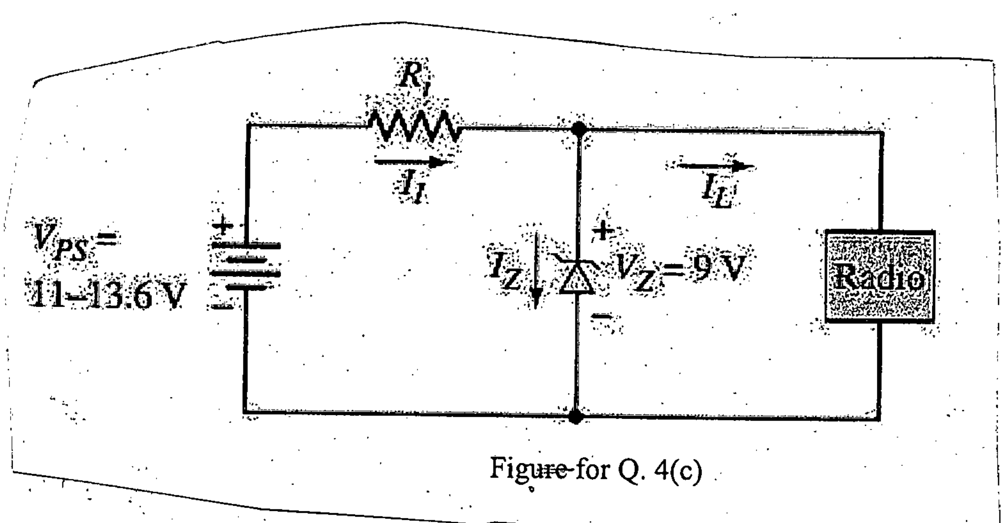

Figure for Q. 4(c)

Contd P/4

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) For the circuit shown in Fig. for Q. 5(a) find V_O. Assume that, the MOSFET is in saturation and $k_n' \frac{W}{L} = 1\ mA/V^2$ and $V_t = 0.7\ V$. **(10)**

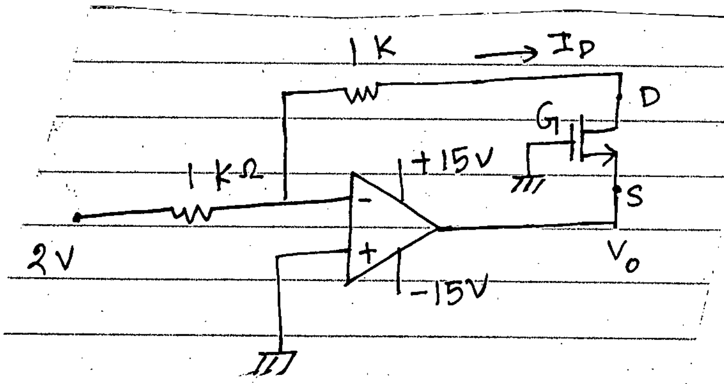

Fig for Q. 5(a)

(b) Consider the circuit and input voltage waveform shown in Fig. for Q. 5(b). **(16)**

(i) if R = 10 kΩ, C = 0.1 μF, and Op-Amp is ideal, sketch the output voltage waveform to scale.

(ii) if R = 10 kΩ, what value of C is required for the peak to peak output amplitude to be 2 V?

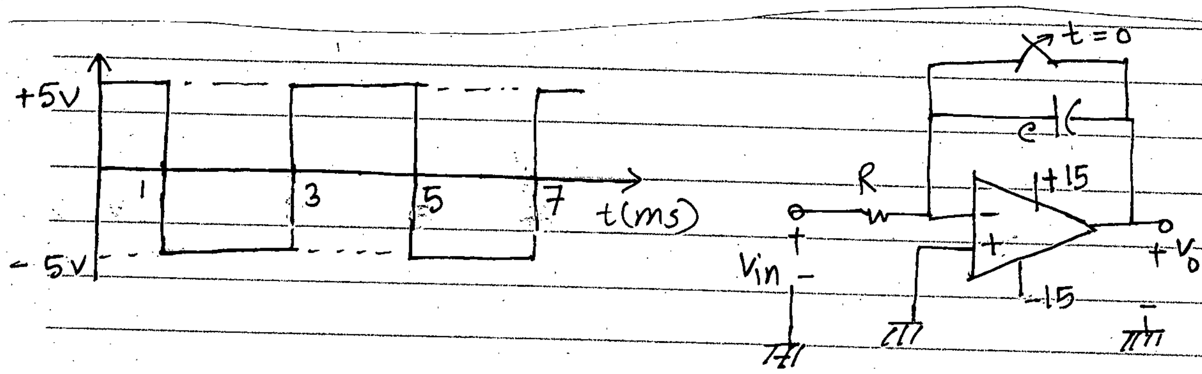

Fig. for Q. 5(b)

(c) Design a circuit using Op-Amp and Digital Circuits for given input wave shape v_{in} and output wave shape v_{out} in Fig. for Q. 5(c). **(20⅔)**

Assume a 5 V level to be digital 1 and –5 V level to be digital 0.

Contd P/5

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Contd... Q. No. 5(c)

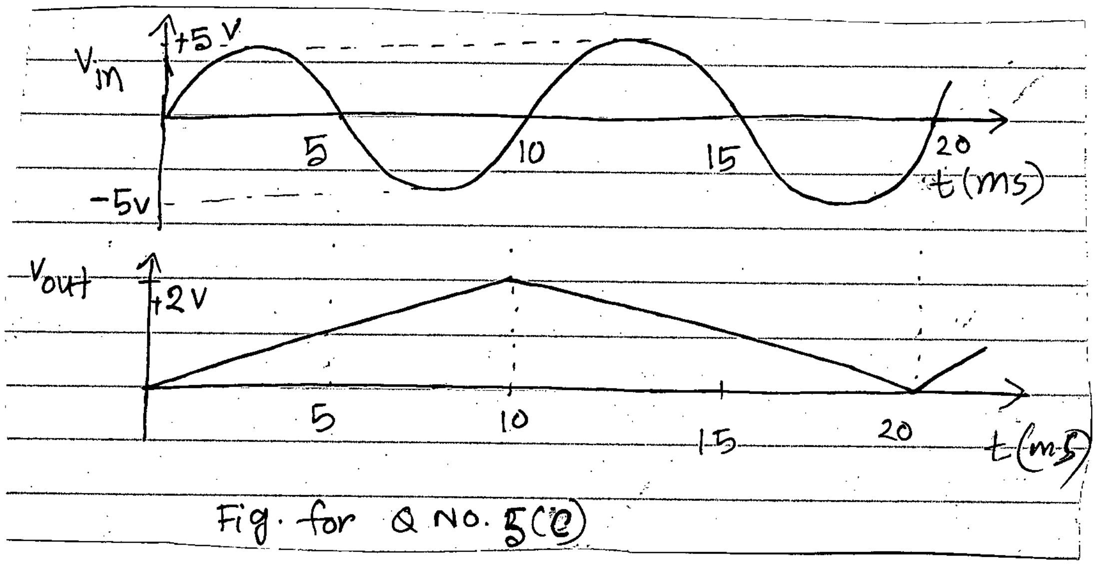

Fig. for Q NO. 5(c)

6. (a) Determine the type of filter that is shown in the circuit in Fig. for Q. No. 6(a) by computing the transfer function in the frequency domain. **(18)**

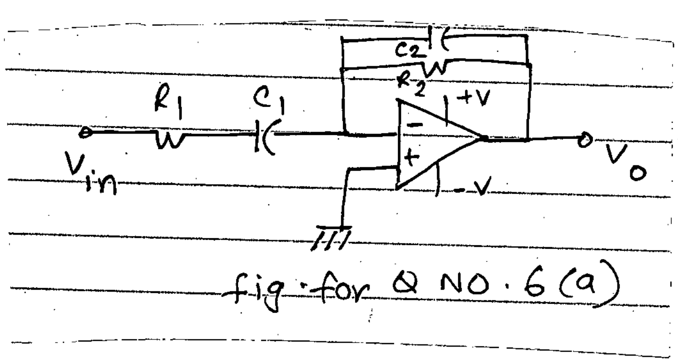

fig for Q NO. 6 (a)

(b) Design a 2nd order bandpass filter with lower cut off frequency f_{CL} = 20 kHz and higher cut off frequency f_{CH} = 200 kHz. **(10⅔)**

(c) For the oscillator circuit shown in Fig. for Q. 6(c) find oscillation frequency (w), β-network gain (β), and amplifier gain (A). Also design this oscillator for an oscillation frequency of 1 kHz. **(18)**

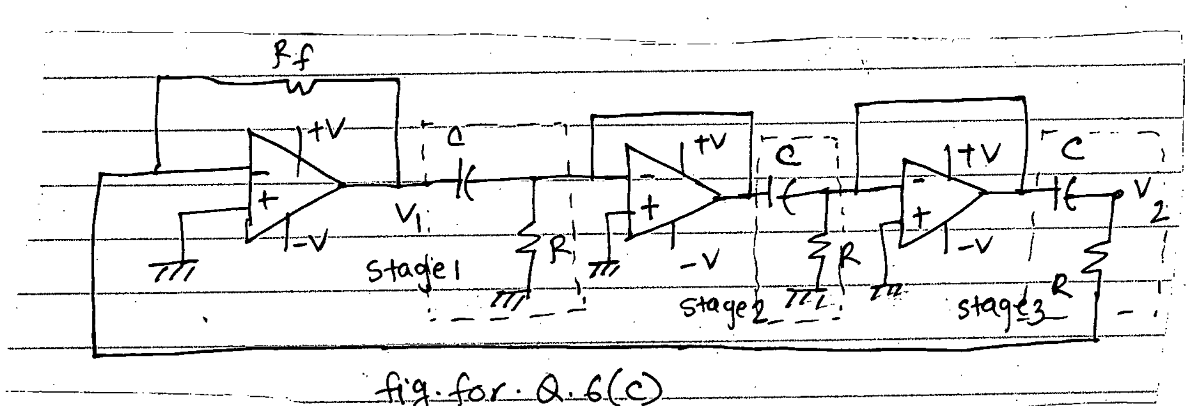

fig. for. Q. 6(c)

Note that, each state is separated by a source follower circuit. Hence each stage will give a phase shift of 60° and 3 stages will give in total 180 phase shift. Here, $\beta = \frac{v_2}{v_1}$.

Contd P/6

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7. (a) Draw a CMOS complex gate for the logic function $f(a,b,c,d) = \Sigma\, m(0,1,2,4,6,8,10,12,14)$. Use as few transistors as possible. **(15)**

(b) Draw a PLA programmed to implement the following functions– **(15)**

$$Y_1 = A\overline{B}C + \overline{A}C + B$$
$$Y_2 = \overline{B}AC + AB\overline{C} + \overline{B}$$
$$Y_3 = \overline{A}C + B\overline{C}A$$

(c) Implement the function $f(x_1, x_2, x_3) = \sum m(2,3,4,6,7)$ using two input LUTs (Look Up Table). You can use as many LUTs as needed. **($16\frac{2}{3}$)**

8. (a) Design a four line to two line priority encoder circuit with active high inputs and outputs, with priority assigned to the higher order data input line $(I_4 > I_3 > I_1)$. Use NOR gate only for the circuit implementation. **($16\frac{2}{3}$)**

(b) Design a modulo-12 up counter with synchronous Reset. **(15)**

(c) Design a four bit shift Register using D Flip-Flops and four to one Multiplexer with Mode selection inputs S_1 and S_0. The Register operates according to the following function table. **(15)**

S_1	S_0	Register Operation
0	0	No change
0	1	Complement the four output
1	0	Clear Register to 0 (synchronous with the clock)
1	1	Shift Right

L-2/T-1/CSE **Date : 03/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2017-2018

Sub : **CSE 203** (Data Structure and Algorithms I)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Write down two versions of binary search algorithm. Simulate the algorithm on the array 2 3 5 6 8 10 12 15 20 21 23 in finding 1, 6, 23, 24 by drawing tables containing values low, high and mid. **(10+10=20)**

   (b) Write down the algorithm for constructing a mincost arborescence in the following digraph from vertex r showing every step in separate diagraphs. ra(7), rx(2), ax(1), xy(5), ya(3), xc(6), cb(4), bx(2), yb(2), where weight of the edge has been given in parentheses. **(15)**

2. (a) Write down an algorithm for job sequencing with deadlines. Solve the problem instance with profit and deadline values (p_i, d_i) as follows: (7, 5), (6,5), (5,2), (4,7), (3,7), (3,7) (3,6), (2,7), (2,1), (2,5), (2,3), (2,1), (1,1). **(10+10)**

   (b) Write down the Quicksort algorithm. Use partition algorithm for finding the smallest 5 values of the array 6, 1, 7, 2, 8, 3, 9, 4, 10, 5, 11, 17, 4, 5 showing every step. **(5+10)**

3. (a) Construct a maxheap with data of Q. No. 2(b) by insertion and adjustment. Show changes in values in the right side of the node. Carry out complexity analysis for both the algorithms. **(5+5+10)**

   (b) Write down the mergesort algorithm. Simulate it using data of Q. No. 2(b). **(15)**

4. (a) Write down an algorithm for constructing a minimum spanning tree. Construct it for the underlying graph of Q. No. 1(b). **(10+10)**

   (b) Discuss Presumed Optimal Solution for Multipeg Tower of Hanoi Problem with properties. Solve the problem for (n, p) = (395, 8). **(5+10)**

SECTION – B

There are **NINE** questions in this Section. Answer any **SEVEN** questions.

5. (a) What is the difference between the following two asymptotic complexities: Big-O (O) and Little-O (o)? **(5+10)**

   (b) Find appropriate f(n) and g(n) (if any) for each of the following cases:

Contd P/2

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Contd ... Q. No. 5(b)

(i) f(n) is O(g(n)), but g(n) ≠ O(f(n))

(ii) f(n) = O(g(n)), and f(n) = Ω(g(n))

(iii) f(n) = Ω(g(n)), and f(n) = ω(g(n))

(iv) f(n) = θ(g(n)), and f(n) =ω(g(n))

6. (a) "Given a directed graph *G*, both BFS and DFS from a particular starting vertex *s* will traverse the same set of vertices." Do you agree with this statement? Justify your answer. **(8+7)**

   (b) Suppose you are going to represent a very dense graph. You want to optimize both the space requirement and time for accessing an edge in the graph. Which representation (between adjacency list and adjacency matrix) would you prefer? Justify your answer.

7. Given a set $S = \{x_1, x_2, \dots x_n\}$ of real numbers where $x_1 \leq x_2 \dots \leq x_n$, write a greedy algorithm to determine the smallest set of unit-length intervals that contain all the numbers in *S*. For example, an interval [1.5, 2.5] is a unit length interval (since 2.5 – 1.5=1), and it contains all the real numbers from 1.5 to 2.5 (including 1.5 and 2.5). You have to find the smallest set of such unit length intervals which contains all the real numbers in *S*. Prove the correctness of your algorithm, and analyze the running time. **(15)**

8. Give an optimal greedy algorithm for solving the fractional knapsack problem. Prove that your algorithm is optimal. **(15)**

9. (a) Briefly explain how a directed acyclic graph $G=(V, E)$ can be topologically sorted i.e. how its vertices can be ordered in such a way that if (u, v) is an edge then u appears before v in the ordering (pseudo-code is not needed). **(5+10)**

   (b) Suppose, you are developing a feature for Facebook. You have access to everyone's friend list and the goal is to show how any two users are connected through a chain of "a friend of a friend". That is for two users A and B, you want to show a sequences of individuals $X_0, X_1, X_2, \dots, X_n$ where X_0 = A, $X_n = B$ and X_i is friends with X_{i+1} for i=0, ..., $n-1$ such that length of the sequence (i.e. number of intermediate individuals) is minimized. Explain how this can be formulated using a graph and what algorithm you would use.

10. (a) Briefly explain with examples (i) Optimal substructure, and (ii) Overlapping subproblems. **(8+7)**

Contd P/3

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Contd ... Q. No. 10

(b) Recall the divide-and-conquer algorithm discussed in the class for merge sort. Analyze the running time of this algorithm.

11. Recall the problem of finding the number of inversions discussed in the class. Given a sequence of n numbers $a_1, \ldots, a_n$, which we assume are all distinct, we define an inversion to be a pair $i < j$ such that $a_i >$ aj. Give an $O(n \log n)$ divide-and-conquer algorithm to count the number of inversions between two orderings. **(15)**

12. Consider the following instance of a 0-1 knapsack problem.

Knapsack capacity = 6

Item	Weight	Value
1	2	7
2	1	8
3	2	12
4	2	6
5	2	10

Solve this instance using dynamic programming. You have to show the dynamic programming table and find the optimal set items using the dynamic programming table. **(15)**

13. Given two strings, the longest common substring problem is to find the longest string that are substrings of the given two strings. For example, for two strings S_1 = "buetcserocks" and S_2 = "bdcserocks", the longest common substring is "cserocks". Give a dynamic programming algorithm to find the length of the longest common substring. **(15)**

L-2/T-1/CSE **Date: 12/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2017-2018

Sub: **MATH 245** (Complex Variables and Statistics)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Determine where the following functions are differentiable **(11)**

   (i) $f(z) = x^3 + i(1-y)^3$ (ii) $f(z) = z\,Im(z)$

   Hence discuss the analyticity of these functions.

   (b) Describe mathematically and graphically the region represented by $|z| \ge |z - 2i|$. **(7)**

   (c) Find the principle value of $\left[\frac{e}{z}\left(-1-\sqrt{3}i\right)\right]^{3\pi i}$. **(7)**

   (d) Prove that under the transformation, $w = \frac{(z-i)}{(iz-1)}$ the region $Im(z) \ge 0$ is mapped into the region $|w| \le 1$. **(10)**

2. (a) Write down Cauchy Riemann equation in polar form. Test the differentiability of the function $f(z) = e^{-\theta}\cos(\ln r) + ie^{-\theta}\sin(\ln r)$, $(r > 0,\ 0 < \theta < 2\pi)$ in the indicated domain and hence show that, $f'(z) = i\frac{f(z)}{z}$. **(15)**

   (b) Solve the equation cos z = 2 by equating the real and imaginary parts in the equation. **(10)**

   (c) Show that $v(x, y) = \frac{x}{x^2+y^2} + \cosh x \cos y$ is a harmonic function. Find an analytic function $f(z) = u(x, y) + iv(x, y)$ and express $f(z)$ in terms of z. **(10)**

3. (a) Evaluate $\int_C z^2 dz$, where, C is the part of the unit circle traversing anticlockwise from the point $z = 1$ to the point $z = i$. **(7)**

   (b) Using Cauchy integral formula show that, **(11)**

$$\oint_C \frac{e^{3z}}{z-\pi i}dz = \begin{cases} -2\pi i, & \text{if } C \text{ is the circle } |z-1| = 4 \\ 0, & \text{if } C \text{ is the ellipse } |z-2|+|z+2| = 6 \end{cases}$$

   (c) Express $f(z) = \frac{z}{(z-1)(2-z)}$ in a Laurent series valid in the region $|z - 1| > 1$. **(7)**

Contd P/2

MATH 245/CSE

Contd ... Q. No. 3

(d) Evaluate the integral $\oint_C \frac{\sin 3z}{\left(z-\frac{\pi}{4}\right)^4} dz$ by Cauchy residue theorem, where C = {(x, y): |x| ≤ 2, |y| ≤ 2}, positively oriented. **(10)**

4. Evaluate the following integral using the method of contour integration: **(17+18)**

(i) $\int_0^{2\pi} \frac{\sin 2\theta}{5-3\cos\theta} d\theta$ (ii) $\int_0^{\infty} \frac{\sin mx}{x} dx$

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) A time study was conducted in a factory with the help of two samples A and B consisting of 7 workers. The time taken by the workers in each case was recorded as follows: **(15)**

	Time taken in minutes						
Sample A	130	124	119	134	142	130	141
Sample B	132	144	136	143	132	133	140

(i) Which sample takes less time on an average?

(ii) Which of the samples is more variable?

(b) From the data given below calculate Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness and comment on the shape of the distribution: **(20)**

Profits (in lacs)	10-20	20-30	30-40	40-50	50-60
No. of companies	18	20	30	22	10

6. (a) Calculate the two regression equations from the data given below: **(15)**

Marks in Mathematics	48	36	39	44	31
Marks in Business	38	34	42	39	34

Also, estimate the mark in Mathematics if a student scored 35 in Business and the mark in Business if another student scored 43 in Mathematics.

(b) A bag contains 8 green and 10 white balls. Two drawings of 4 balls are made such that (i) the balls are replaced before the second trial, and (ii) the balls are not replaced before the second trial. Find the probability that the first drawing will give 4 green and the second 4 white balls in each case. **(10)**

(c) A box contains 8 red, 3 white and 9 blue balls. If 3 balls are drawn at random, find the probability that (i) all 3 are red, (ii) 2 are red and 1 is white, (iii) at least 1 is white. **(10)**

Contd P/3

MATH 245/CSE

7. (a) Define conditional probability distribution of two continuous random variables X and Y. Suppose that the joint density function of the continuous random variables X and Y is

$$f(x, y) = \begin{cases} \frac{1}{4}x(1+3y^2), & 0 < x < 2,\ 0 < y < 1 \\ 0, & \text{otherwise.} \end{cases}$$

Find $g(x)$, $h(y)$ and $f(x \mid y)$. Hence evaluate $p\left[\frac{1}{4} < X < \frac{1}{2} \mid Y = \frac{1}{3}\right]$. **(15)**

(b) If X is a binomial random variable with probability distribution $b(x;\, n, p)$ and $n \to \infty$, $p \to 0$, $np \to \lambda$ remains constant then show that $b(x;\, n, p) \to p(x, \lambda)$.

In a certain industrial facility accidents occur infrequently. It is known that the probability of an accident on any given day is 0.005 and accidents are independent of each other. What is the probability that (i) in any given period of 400 days there will be an accident on one day and (ii) there are at most 3 days with an accident? **(15)**

(c) Explain the terms 'null hypothesis' and 'alternative hypothesis'. **(5)**

8. (a) If family incomes are normally distributed with mean \$16,000 and standard deviation \$2,000, find the probability that a family picked at random will have an income (i) between \$15,000 and \$18,000, (ii) below \$15,000, (iii) above \$18,000. (Necessary chart 1 is attached) **(15)**

(b) Explain the terms 'level of significance' and 'degrees of freedom'.

The mean weekly sale of a chocolate bar company in candy stores was 153.7 bars per store. After an advertising campaign, the mean weekly sale in 29 stores for a typical week increased to 169.4 and showed a standard deviation of 19.7. Was the advertising successful? Use a 5% level of significance. (Necessary chart 2 is attached) **(20)**

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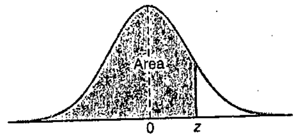

Table **A.3** Areas under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
−3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
−3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
−3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
−3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

For Question No. 8(a)

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Table A.3 (continued) Areas under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

For Question No. 8(a)

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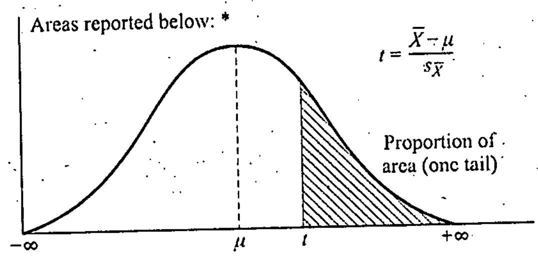
APPENDIX 5

Student's *t* Distribution



Proportions of Area for the *t* Distributions

df	*0.10*	*0.05*	*0.025*	*0.01*	*0.005*
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
40	1.303	1.684	2.021	2.423	2.704
60	1.296	1.671	2.000	2.390	2.660
120	1.289	1.658	1.980	2.358	2.617
∞	1.282	1.645	1.960	2.326	2.576

*Example: For the shaded area to represent 0.05 of the total area of 1.0, value of *t* with 10 degrees of freedom is 1.812

Source: From Table III of Fisher and Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, 6th ed., 1974, published by Longman Group Ltd., London (previously published by Oliver & Boyd, Edinburgh), by permission of the authors and publishers.

For Question No. 8(b)