University of Dhaka
Department of Computer Science and Engineering
3rd Year 2nd Semester Final Examination 2021
CSE-3201: Operating Systems (3 Credits)

Time: 3 hours

Total Marks: 70

Answer any five (5) out of the following seven (7) questions.

---

1. (a) (6 points) There are two major types of operating system designs: Monolithic kernel and Microkernel. Which kind of design better satisfies the following requirements (monolithic kernel, microkernels, or both)? Justify your answers.
   (i) Convenient access to operating system data structures by the kernel-level process.
   (ii) Adding/modifying operating system components by kernel developers.
   (iii) Strong security and reliability.

   (b) (4 points) Operating systems distinguish between user-level operations and kernel-level operations. Decide whether the following operations should be user or kernel, and briefly justify your answer (i) Disable all interrupts (ii) scanf(···).

   (c) (4 points) What is the parameter a user program must pass to a system call? Determine the steps passing parameters to the kernel during a system call to multiply two 64×64 matrices in the DSP unit. Assume that DSP is not directly accessible from user mode.

2. (a) (6 points) What are the benefits and the disadvantages of each of the following? [Consider both the system level and the programmer level.]
   i) Synchronous and asynchronous communication
   ii) Automatic and explicit buffering
   iii) Fixed-sized and variable-sized messages

   (b) (6 points) Consider a multi-core system and a multithreaded program written using the many-to-many threading model. Let the number of user-level threads in the program be greater than the number of processing cores in the system. Discuss the performance implications of the following scenarios.
   i) The number of kernel threads allocated to the program is less than the number of processing cores.
   ii) The number of kernel threads allocated to the program is equal to the number of processing cores.
   iii) The number of kernel threads allocated to the program is greater than the number of processing cores but less than the number of user-level threads.

   (c) (2 points) Which of the following components of program state are shared across threads in a multithreaded process?
   i) Register values
   ii) Heap memory
   iii) Global variables
   iv) Stack memory

3. (a) (8 points) Many CPU-scheduling algorithms are parameterized. For example, the RR algorithm requires a parameter to indicate the time slice. Multilevel feedback queues require parameters to define the number of queues, the scheduling algorithm for each queue, the criteria used to move processes between queues, and so on. These algorithms are thus really sets of algorithms (for example, the set of RR algorithms for all time slices, and so on). One set of algorithms may include another (for example, the FCFS algorithm is the RR algorithm with an infinite time quantum). What (if any) relation holds between the following pairs of algorithm sets?
   i) Priority and SJF
   ii) Multilevel feedback queues and FCFS
   iii) Priority and FCFS
   iv) RR and SJF

(b) (6 points) Discuss how the following pairs of scheduling criteria conflict in certain settings.

i) CPU utilization and response time

ii) Average turnaround time and maximum waiting time

iii) I/O device utilization and CPU utilization

4. (a) Consider the following segment of program:

```
1  uint32_t value;
2  uint32_t inc_count=0;
3  while(1){
4      value=count;
5      value++;
6      //we check is someother task(s) increase the count
7      if(value != count+1){
8          /* below is an SVC call*/
9          printf("Error %d != %d\n",value,count+1);
10     }else{
11         count=value;
12         inc_count++;
13     }
14  if(count >= 10000000){
15     /* below is an SVC call*/
16     uint16_t task_id = getpid();
17     /* display how many increments it has successfully done!! */
18     printf("Total increment done by task %d is: %d",task_id,inc_count);
19     /* above is an SVC call */
20     break;
21  }
22 }
```

(i) (3 points) Find the critical sections from the above code for a multiprocess environment. Explain why these sections are critical and creates inconsistency?

(ii) (3 points) Rewrite the above segment of code to resolve the synchronization issues. Note that the modification only inserts lines of code without deleting from the above code, and the solution must be free from busy waiting or spin locks.

(b) Let a system have five resources with multiple instances in matrix $E = [5, 10, 7, 9, 6]$. At the time, the t_0 operating system snapshot shows a set of five processes (P_1, P_2, P_3, P_4, P_5) do not hold any resources (matrix A=0). At the time, t_1, the processes request (matrix R_{t1}) for resources (instances) are as follows. Note that matrix Max tells the maximum number of resources the five processes can request.

$$R_{t1} = \begin{bmatrix} 0 & 2 & 1 & 3 & 0 \\ 1 & 1 & 2 & 2 & 1 \\ 0 & 2 & 1 & 0 & 0 \\ 1 & 3 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 \end{bmatrix}. \quad Max = \begin{bmatrix} 3 & 6 & 4 & 5 & 3 \\ 2 & 4 & 3 & 3 & 2 \\ 1 & 5 & 2 & 3 & 1 \\ 2 & 4 & 2 & 3 & 2 \\ 1 & 1 & 3 & 4 & 5 \end{bmatrix} \quad R_{t2} = \begin{bmatrix} 2 & 2 & 1 & 0 & 2 \\ 1 & 2 & 1 & 1 & 1 \\ 0 & 3 & 0 & 3 & 0 \\ 1 & 0 & 1 & 2 & 1 \\ 1 & 0 & 2 & 1 & 3 \end{bmatrix}$$

(i) (4 points) Does the system go to deadlock if the kernel allocates resources according to the request R_{t1} at t_1? or any possibility of being in a deadlock state.

(ii) (4 points) After assigning resources requested at t_1 at the time, t_2, the new request matrix is R_{t2}; what happens to the system if the kernel allocates resources based on R_{t2}?

5. Assume a simple paging system with 2^{32} bytes of physical memory, 2^{48} bytes of logical address space and pages that are 2^{24} bytes in size. Further assume that each page table entry contains 4 bits indicating protection and validity of the entry.

(a) (3 points) How many bits are used for the frame number and how many for the frame offset? What is the total size of the page table in number of bits?

(b) (4 points) Assume that the working set of a typical process is fixed throughout the process lifetime and consists of 20 pages. How many entries would you suggest for the Translation Lookaside Buffer (TLB) for this system? What would its total size be in number of bits? Explain your answer.

(c) (4 points) Further assume that TLB search time is 20ns, TLB hit ratio is 80% and memory access time is 100ns. How many page table levels would you need to achieve an effective access time of 160ns, and why?

(d) (3 points) Once in a few years back, DU EIS web server performance decreases because of accepting thousands of diverse requests simultaneously. Explain why? Note that an individual thread services an EIS server request.

6. (a) (4 points) A Unix i-node has 16 disk addresses for direct disk blocks and three addresses for single, double, and triple indirect blocks. If each indirect block contains 128 disk addresses, what is the maximum file size supported by this system? Assume disk blocks of 2KB.

(b) (5 points) Assume that you are user1 in a Unix file system and that you need to read the file /home/user1/test/test1.html which is stored in 3 disk blocks. Further assume that the / directory i-node is kept memory and each i-node and directory file fits in two disk block. How many disk accesses are required to read test1.html? Explain your answer.

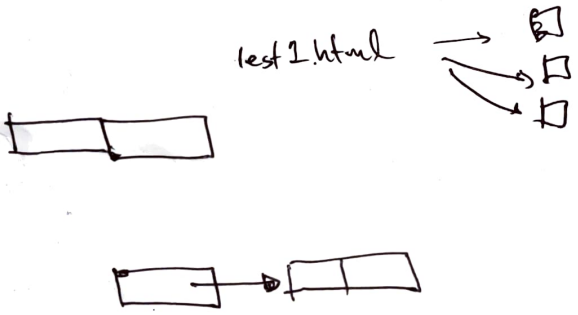
(c) (5 points) The DUOS deployed a virtual file system (VFS) to access directories and files. What should you do as a kernel developer if the department of CSE wants to deploy a new file system, csefs?

7. (a) (9 points) A hard disk having 2000 cylinders, numbered from 0 to 1999. the drive is currently serving the request at cylinder 143, and the previous request was at cylinder 125. The status of the queue is as follows

$$86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130$$

What is the total distance (in cylinders) the disk arm moves to satisfy the pending request for each of the following disk-scheduling algorithms? (i)SSTF, (ii) SCAN and (iii) C-SCAN

(b) (5 points) The University does not want to spend too many Dollars ($) due to envision economic crisis; however, the DU EIS needs to deploy RAID to keep student information to prevent possible loss. Proposed a RAID system for DU EIS and justify.



University of Dhaka
Department of Computer Science and Engineering
3rd Year 2nd Semester B.Sc. Examination, 2021
CSE-3202: Numerical Methods (3 Credits)

Total Marks: 70 **Time: 3 Hours**

Answer any 5 (five) of the following 7 (seven) questions. Marks are given in the right margin.

1.(a) Write the advantages of "spline" in numerical interpolation. 3

(b) To make cubic spline from $n + 1$ number of points you need to solve a $|4n \times 4n|$ matrix. Write down the steps of making the matrix. 5

(c) Given that (1, 3), (3, 9), (5, 25) and (7, 49) are the control points: 6

(i) Make a $|3n \times 3n|$ matrix for quadratic spline.

(ii) $f(4) = ?$ on this quadratic spline.

2.(a) Use Simpson's 1/3 rule with $n = 10$ to approximate: $\int_1^2 \frac{1}{x} dx$ 5

(b) Approximate the integral of $\int_1^2 (\frac{1}{x^2}) dx$ with $n = 5$, using

(i) Left end-point approximation,

(ii) Right end-point approximation, and

(iii) Mid-point approximation.

And, determine absolute % error or each case.

3.(a) What is polynomial regression? 2

(b) For a given data-set, derive the rule for least square fitting a second-order polynomial. 6

(c) Fit a quadratic curve to the data-set given in the following table: 6

x_i	y_i
0	1
1	8
2	13
3	29
4	39
5	61

4.(a) Explain the stopping/termination criterion of an iterative process. 3

(b) (i) What are the situations where the Newton-Raphson method of finding the root of nonlinear function may fail? 6

(ii) Explain Secant method of finding the root of nonlinear function showing appropriate cause of overcoming the above problems.

(c) Find a root of the equation $f(x) = x^3 - x - 1$ using Secant method. 5

5.(a) Write the basic principle of Gauss-Jordan method. 3

(b) Explain the process of finding the solution of the system of linear equations step by step using LU decomposition (Doolittle) method. 6

(c) Solve the following system of equations using LU decomposition (Doolittle) method: 5

$3x_0 + 2x_1 + x_2 = 17$

$2x_0 - 3x_1 - 2x_2 = -5$

$x_0 + 3x_1 + 2x_2 = 14$

6.(a) Let $f(x) = \sqrt[3]{x}$, construct the third-degree interpolating polynomial, $P_3(x)$, for $f(x)$ using the points $x_0 = 1$, $x_1 = 3$, $x_2 = 5$ and $x_3 = 7$ using Lagrange interpolation polynomial. 6

(b) Demonstrate Gauss-Siedel method upto 4 iterations for the following system of linear equations with initial guess [1, 1, 1, 1]: 8

$$2x_0 - 2x_1 + x_2 + 2x_3 = -7$$

$$4x_0 + 2x_1 - x_2 + x_3 = 7$$

$$3x_0 + x_1 + 3x_2 + 2x_3 = -2$$

$$x_0 + 3x_1 - 2x_2 - x_3 = 11$$

7.(a) State Taylor's series for the function $f(x+h)$ and $f(x-h)$ and thus derive central difference quotient for differentiating a continuous function. 5

(b) Find the Taylor expansion of e^x about $x_0 = 0.25$ which use the first two, three, four and five and evaluate for $e^x = 0.5$, respectively. 5

(c) The table below gives the value of distances traveled by a car at various time intervals: 4

Time in second	*5*	*6*	*7*	*8*	*9*
Distance in km	*10.0*	*14.5*	*19.5*	*25.5*	*32.0*

Estimate velocity of the car at $t = 5$, 7 and 9 using *3-points forward difference* and *3-point backward difference* formula.

University of Dhaka
Department of Computer Science and Engineering
3rd Year 2nd Semester B. Sc. Final Examination 2021
CSE-3203: Design and Analysis of Algorithms-II (3 Credits)

Total Marks: 70 **Time: 3 Hours**

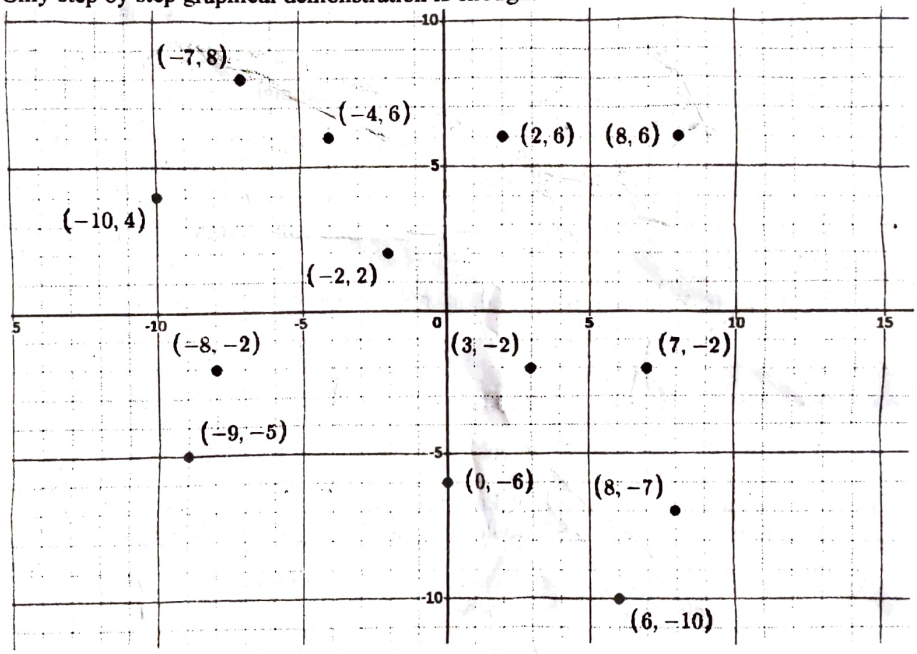
Answer any five (5) out of the following seven (7) questions. Marks are given in the right margin.

1 a) Insert the keys 10, 22, 31, 4, 15, 28, 17, 88 and 59 into a hash table of length 11 using double hashing with $h_1(k) = k$ and $h_2(k) = 1 + (k \bmod (m-1))$ [6]

b) "After completing insertions of question 1a searching for any key in the hash table should give a verdict (found at position x/not found) within 4 probes on an average"-Do you agree with this statement? Provide an explanation supporting your answer. [4]

c) Prove that in a hash table in which collisions are resolved by chaining, a successful search takes average-case time $\Theta(1+\alpha)$ under the assumption of simple uniform hashing. [4]

2 a) Consider the points plotted in the following figure. Find the convex-hull of these points using the Graham-Scan algorithm. You do not have to show calculations. Only step by step graphical demonstration is enough. [6]



b) Prove that Kirkpatrick-Seidel's convex hull algorithm takes O(n lg h) time. [4]

c) Sketch a $O(n^2 \lg n)$ time algorithm to identify whether any three points in a set of n points are collinear. [4]

3 a) Calculate the prefix function showing all the steps of the KMP algorithm for the pattern "abbababba". [6]

b) Suppose you are using the Rabin-Karp algorithm for string matching over the text "3141592653589793" in modulo 11 fashion. While searching for pattern "26", calculate the number of times character by character checking will be required. [4]

c) Design a finite automaton that can accept both pattern $P1 = \{a_1, a_2, \ldots, a_n, c_1, c_2, \ldots c_k, b_1, b_2, \ldots b_m\}$ and $P2 = \{p_1, p_2, \ldots p_x, c_1, c_2, \ldots, c_k, q_1, q_2, \ldots, q_y\}$. Minimize the number of states in your automaton. [4]

4 a) i) Write down a pseudocode to generate distinct permutation of a given string with duplicate characters with time complexity $O(n^2 * n!)$. [6]

ii) Modify the above algorithm to generate all permutations of a given string without duplicate characters. Also show that the time complexity of the algorithm is $O(n * n!)$ [4]

b) Simulate the backtracking algorithm for the N queen problem where N=3. [4]

5 a) Find the worst case competitive ratio of second-chance page replacement algorithm compared to optimal page replacement algorithm. [4]

Note: second-chance page replacement algorithm works as follows:

1) scans the page in FIFO fashion
2) If the oldest page is unmarked, it makes it the newest one and marks it for second chance
3) If the oldest one is marked (meaning it has already been given a chance), removes it

b) Write down the parallel algorithm to compute Fibonacci numbers. Specify the different threads and the interaction among the threads. [4]

c) Prove that the running time T_P of any multithreaded computation scheduled by a greedy scheduler on an ideal parallel computer with P processor is within a factor of 2 of optimal scheduler. [6]

6 a) For a given problem, is it possible to find the optimal solution from a solution of a decision problem? [2]

b) Suppose $Y \leq_p X$. Justify the following statements. [4]

i) If X can be solved in polynomial time, then Y can be solved in polynomial time.

ii) If Y cannot be solved in polynomial time, then X cannot be solved in polynomial time.

c) Prove that the Traveling salesman problem is an NP-complete problem. [4]

d) Show that 3-CNF satisfiability problem is reducible to the Clique problem. [4]

7 a) RSA would be trivial to crack knowing the factorization into two primes of n in the public key, explain why RSA would be trivial to crack knowing $\phi(n)$. [4]

b) How can we we decide whether a modular equation of the form $ax \equiv b \pmod n$ is solvable or not? If a solution exists, how can we calculate it? [6]

c) What does EXTENDED-EUCLID (F_k, F_{k+1}) return? Prove your answer. [4]

$\frac{b}{d}$ $35 \equiv 10 \pmod 5$

$d = F_K x + \dots$

$d = ax + by$

0 1 1 2 3 5

3	5	1		2	-1
5	3	1		-1	2
3	2	1		1	-1
2	1	1		0	1
1	0		1	1	0

35, 10, 50

University of Dhaka
Department of Computer Science and Engineering
3rd Year 2nd Semester Final Examination, 2021
CSE-3204: Formal Language, Automata and Computability (3 Credits)

Time: 3 hours **Total Marks: 70**

Answer any five (5) out of the following seven (7) questions. Marks are given in the right margin.

1 (a) Convert the following NFA in to a DFA **[4]**

	0	1
→p	{q, s}	{q}
*q	{r}	{q, r}
r	{s}	{p}
*s	Ø	{p}

(b) Design an Є-NFA for the language of strongs that contain either a number of 0s that's even or a number of 1s that's even. Convert it to equivalent DFA. **[4]**

(c) Convert the following regular expressions to NFA's with epsilon transitions. **[6]**

i. (0 + 1)01
ii. 00(0 + 1)*

2 (a) Consider the following regular expression R over alphabet {a, b, c}: **[6]**

$$R = (a \mid \epsilon)\ (b \mid c)^*\ (bc \mid ab)^*$$

Answer the following questions:

i. List all the strings of length ≤ 2 generated by expression R.

ii. Design the non-deterministic automaton A of expression R.

iii. Design the deterministic automaton of expression R, obtained from the previous one by means of the subset construction.

(b) Write regular expressions for the following languages **[4]**

i. The set of strings over {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, -} which indicates a valid integer number. Example: 0, 1, 12340, -5 etc.
ii. The set of strings over {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, -, .} which indicates a valid floating point number. Example: 0.2, .5, -2.3, 1 etc.

(c) Given L = {$a^n b^n$: n≥§ 0}, describe in English the complement of L. **[4]**

3 (a) i. Define a CFG that accepts all strings over $\{a, b\}^*$ with equal number of a's and b's. **[3+3]**
ii. Show the transition diagram of the PDA by final state that accepts the same language.

(b) Prove that Context Free languages are not closed under intersection. **[4]**

(c) Prove that Context Free languages are closed under Union. **[4]**

4 (a) Construct a Turing machine for subtraction of two unary numbers $f(a-b) = c$ where a is always greater than b. Assume that the TM will never be given an input where b is greater than or equal to a. For example, to perform $5-2$ the TM will have the following moves: $q_0 11111 - 11 \vdash^* q111 ** - ** B$ where q_0 is the initial state, q is some state of the TM and B is the symbol for Blank. **[6+2]**

i. Define the TM and define the transition function using a transition table.
ii. Draw the transition diagram.

(b) let $P = (Q_P, \Sigma, \Gamma, \delta_P, q_P, Z_0, F_P)$ be the PDA that accepts L by final state, and let $A = (Q_A, \Sigma, \delta_A, q_A, F_A)$ be the DFA for R. **[6]**
Construct a PDA that accepts the language $L - \bar{R}$, where $\bar{R} = \Sigma^* - R$

5 (a) Let G be the following grammar: **[5]**

$$S \rightarrow AS|SB|0|1$$
$$A \rightarrow AA|0$$
$$B \rightarrow BB|1$$

Use the CYK algorithm to determine whether the string 011000 is in $L(G)$.

(b) Prove that the language **[5]**
$L = \{w|w \in (a+b)^*$ **and** w **is a pallindrome with odd length**$\}$ is not a regular language.

(c) Prove that the number of vertices ($|V|$) of a non-empty binary tree T is the number of its edges ($|E|$) plus one. **[4]**

6 (a) Convert the following CFG into Chomsky Normal Form (CNF). Show the step-by-step conversion. **[7]**

$$S \rightarrow ASB$$
$$A \rightarrow aAS|C|a|\epsilon$$
$$B \rightarrow SbS|A|C|bb$$
$$C \rightarrow CDE|\epsilon$$
$$D \rightarrow A|B|ab$$

(b) Prove that the language $L = \{ww|w \in \{0,1\}^*\}$ is not a context free language. **[7]**

7 (a) Let, $L = L(P_F)$ for some PDA $P_F = (Q, \Sigma, \Gamma, \delta_F, q_0, Z_0, F)$. **[4+3]**

i. Define a PDA $P_N = (Q_N, \Sigma, \Gamma_N, \delta_N, p_0, X_0)$ such that $L = N(P_N)$
ii. Prove that if $w \in L(P_F)$ then $w \in L(P_N)$

(b) Let $G = (V, T, Q, S)$ be a CFG. **[3+4]**

i. Define a PDA (by empty stack) P such that $N(P) = L(G)$.
ii. Prove that if $(q, x, A) \vdash_P^* (q, \epsilon, \epsilon)$ then $A \Rightarrow_G^* x$. In other words, prove that starting at A being in the stack, if P can empty its stack by consuming input x, then A derives x in G.

University of Dhaka
Department of Computer Science and Engineering
3rd Year 2nd Semester B.Sc. Examination, 2021
STAT-3205: Introduction to Probability and Statistics (3 Credits)

Total Marks: 70 **Time: 3 Hours**

Answer any 5 (five) of the following 7 (seven) questions. Marks are given in the right margin.

1. a) How can you classify the data using levels of measurement? Write down the differences among those levels. 3

b) The following is the number of minutes to commute from work to home for a sample of workers in Dhaka: 9

28	25	37	41	19	32	26	16	23	23
29	36	31	26	32	25	31	43	35	42
38	33	28							

I) Use a relative frequency histogram to describe the data. Describe the shape and location of the histogram.

II) Draw the box plot for the measurements. Does there exist any outlier in this distribution?

III) Calculate the standard deviation of the distribution using range approximation.

c) Define 'descriptive statistics' and 'inferential statistics' with example. 2

2. a) State Tchebysheff's Theorem. What are the advantages of Tchebysheff's Theorem in comparison to the Empirical rule? 4

b) What do you measure using the standard deviation of a distribution? 2

c) The following data shows the sales calls (x) and copies sold (y) for 10 salespersons. 6

Sales calls (x)	Copies sold (y)
20	30
40	60
20	40
30	60
10	30
10	40
20	40
20	50
20	30
30	70

I) Calculate r, the correlation coefficient between x and y.

II) Interpret the value of r in defining the direction and strength of the linear relationship between x and y.

III) Calculate the regression line of x and y.

d) A set of data has a mean of 75 and a standard deviation of 5. You know nothing else about the size of the dataset or the shape of the data distribution. What can you say about the proportion of measurements that are less than 65? 2

3. a) What are the differences between mutually exclusive and independent events? 3

b) Suppose P(A) = 0.125 and P(B) = 0.511. 4

I) If P(A|B) = 0.1, what is P(A ∩ B)?

II) If P(A|B) = 0.1, are A and B independent?

III) If P (A ∩ B) = 0, are A and B independent?

IV) If P(A ∪ B) = 0.65, are A and B mutually exclusive?

c) The table below shows the occurrence of diabetes in 100 people. 5

	Diabetes (D)	No Diabetes (ND)
Not overweight (N)	5	45
Overweight (O)	17	33

I) Construct a tree diagram for this experiment. How many simple events are there?

II) What is the probability that a randomly selected person "has diabetes" given that he/she is "not overweight"?

III) What is the probability that a randomly selected person "has no diabetes" given that he/she is " overweight"?

d) A bag contains 10 red and 5 blue balls. 7 balls are drawn without replacement from the bag. What is the probability that at least 4 blue balls will be selected? 2

4 a) A survey of people in a given region showed that 20% were smokers. The probability of death due to lung cancer, given that a person smoked, was roughly 10 times the probability of death due to lung cancer, given that a person did not smoke. If the probability of death due to lung cancer in the region is 0.006, what is the probability of death due to lung cancer given that a person is a smoker? 3

b) A man is known to speak the truth 3/4 times. He draws a card and reports it is king. Find the probability that it is actually a king. 3

c) Suppose that a particular disease is present in 18% of the population and that there is a screening test designed to detect this disease if present. The test does not always work perfectly. Sometimes the test is negative when the disease is present, and sometimes it is positive when the disease is absent. The table below shows the proportion of times that the test produces various results. 6

	Test is Positive	Test is Negative
Disease present (D)	0.06	0.11
disease absent (ND)	0.03	0.80

I) Find the probability of a false positive, that the test is positive, given that the person is disease-free.

II) Find the probability of a false negative, that the test is negative, given that the person has the disease.

d) A box contains 6 M&M chocolates, of which 4 are red and 2 are green. A child selects 2 M&Ms at random. What is the probability that exactly one is red? 2

5 a) A home security system is designed to have a 99% reliability rate. Suppose that nine homes equipped with this system experience an attempted burglary. Find the probabilities of these events: 4

I) At least one of the alarms is triggered.

II) More than seven of the alarms are triggered.

III) Exactly five of the alarms are triggered.

b) The probability density function (PDF) of a random variable X is: 5

$$f(x) = k(4 - x^2), -2 \le x \le 2.$$

I) Determine the value of the constant k.

II) Find $P(-1 < x < 1)$. III) Find the mean of x.

c) Suppose that in country S, 40% of the people support party A, 30% of the people support party B, 20% support party C, and 10% support party D. Let Q be a specific policy. Given that 50% of the supporters of party A are in favors of Q, 40% of the supporters of party B are in favors of Q, 30% of the supporters of party C are in favors of Q, and 100% of the supporters of party D are in favors of Q. If we draw a citizen from this imaginary country at random, what is the probability that the citizen supports Q? 5

6. a) The number of people, x entering the intensive care unit at a particular hospital on any one day has a Poisson probability distribution with mean equal to five persons per day. What is the probability that the number of people entering the intensive care unit on a particular day is two? Less than or equal to two? 4

b) A case of medicine has 12 bottles, 3 of which contain expired medicines. A sample of 4 bottles is randomly selected from the case. 4

I) Find the probability distribution for x, the number of bottles of expired medicines in the sample.

II) What are the mean and variance of x?

c) Assume that the heights of students have a mean of 65.5 inches and a standard deviation of 3.0 inches. 6

I) What proportion of all men will be taller than 6 feet?

II) What is the probability that a randomly selected man will be between 5'8" and 6'1" tall?

III) One randomly selected student is 4'1". Is this an unusual height?

7. a) Why a normal random variable is standardized? When is it appropriate to use the normal approximation to binomial probabilities? 4

b) IQ scores have a mean of 100 and a standard deviation of 16. Albert Einstein reportedly had an IQ of 160. 4

I) What is the difference between Einstein's IQ and the mean?

II) How many standard deviations is that? III) Convert Einstein's IQ score to a z score.

IV) If we consider "usual IQ scores to be those that convert z scores between -2 and 2, is Einstein's IQ usual or unusual?

c) State Central Limit Theorem. What are the advantages of this theorem? 4

d) Differentiate stratified random sample and cluster sample with examples. 2

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
+0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
+0.1	.53983	.54380	.54776	.55172	.55567	.55966	.56360	.56749	.57142	.57535
+0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
+0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
+0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
+0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
+0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
+0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
+0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
+0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
+1	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
+1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
+1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
+1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91308	.91466	.91621	.91774
+1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
+1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
+1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
+1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
+1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
+1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
+2	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
+2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
+2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
+2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
+2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
+2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
+2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
+2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
+2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
+2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
+3	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
+3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
+3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950
+3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
+3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
+3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
+3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99988	.99988	.99989
+3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
+3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
+3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997
+4	.99997	.99997	.99997	.99997	.99997	.99997	.99998	.99998	.99998	.99998

1.2 – Positive Z Table

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-0	.50000	.49601	.49202	.48803	.48405	.48006	.47608	.47210	.46812	.46414
-0.1	.46017	.45620	.45224	.44828	.44433	.44034	.43640	.43251	.42858	.42465
-0.2	.42074	.41683	.41294	.40905	.40517	.40129	.39743	.39358	.38974	.38591
-0.3	.38209	.37828	.37448	.37070	.36693	.36317	.35942	.35569	.35197	.34827
-0.4	.34458	.34090	.33724	.33360	.32997	.32636	.32276	.31918	.31561	.31207
-0.5	.30854	.30503	.30153	.29806	.29460	.29116	.28774	.28434	.28096	.27760
-0.6	.27425	.27093	.26763	.26435	.26109	.25785	.25463	.25143	.24825	.24510
-0.7	.24196	.23885	.23576	.23270	.22965	.22663	.22363	.22065	.21770	.21476
-0.8	.21186	.20897	.20611	.20327	.20045	.19766	.19489	.19215	.18943	.18673
-0.9	.18406	.18141	.17879	.17619	.17361	.17106	.16853	.16602	.16354	.16109
-1	.15866	.15625	.15386	.15151	.14917	.14686	.14457	.14231	.14007	.13786
-1.1	.13567	.13350	.13136	.12924	.12714	.12507	.12302	.12100	.11900	.11702
-1.2	.11507	.11314	.11123	.10935	.10749	.10565	.10383	.10204	.10027	.09853
-1.3	.09680	.09510	.09342	.09176	.09012	.08851	.08692	.08534	.08379	.08226
-1.4	.08076	.07927	.07780	.07636	.07493	.07353	.07215	.07078	.06944	.06811
-1.5	.06681	.06552	.06426	.06301	.06178	.06057	.05938	.05821	.05705	.05592
-1.6	.05480	.05370	.05262	.05155	.05050	.04947	.04846	.04746	.04648	.04551
-1.7	.04457	.04363	.04272	.04182	.04093	.04006	.03920	.03836	.03754	.03673
-1.8	.03593	.03515	.03438	.03362	.03288	.03216	.03144	.03074	.03005	.02938
-1.9	.02872	.02807	.02743	.02680	.02619	.02559	.02500	.02442	.02385	.02330
-2	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
-2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
-2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
-2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
-2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
-2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
-2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
-2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
-2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
-2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
-3	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00104	.00100
-3.1	.00097	.00094	.00090	.00087	.00084	.00082	.00079	.00076	.00074	.00071
-3.2	.00069	.00066	.00064	.00062	.00060	.00058	.00056	.00054	.00052	.00050
-3.3	.00048	.00047	.00045	.00043	.00042	.00040	.00039	.00038	.00036	.00035
-3.4	.00034	.00032	.00031	.00030	.00029	.00028	.00027	.00026	.00025	.00024
-3.5	.00023	.00022	.00022	.00021	.00020	.00019	.00019	.00018	.00017	.00017
-3.6	.00016	.00015	.00015	.00014	.00014	.00013	.00013	.00012	.00012	.00011
-3.7	.00011	.00010	.00010	.00010	.00009	.00009	.00008	.00008	.00008	.00008
-3.8	.00007	.00007	.00007	.00006	.00006	.00006	.00006	.00005	.00005	.00005
-3.9	.00005	.00005	.00004	.00004	.00004	.00004	.00004	.00004	.00003	.00003
-4	.00003	.00003	.00003	.00003	.00003	.00003	.00002	.00002	.00002	.00002

1.1 – Negative Z Table