University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B.Sc. Examination, 2021
CHE – 1104, Chemistry

Total Marks: 70 Time: 3 Hours

(Answer any 5 (Five) of the following Questions)

1. a) What is photoelectric effect? Define-threshold frequency. How is photoelectric effect a failure of classical mechanics? 1+1 +1

b) Calculate the energy (in joules) of a photon with a wavelength of 3.75×10^4 nm. Given Planck's constant $=6.63\times10^{-34}$ J.s and velocity of light $= 3.00\times10^8$ m/s. 3

c) Why and how did Bohr's atomic model fail to explain atomic structure? 3

d) Find if the following combinations of the quantum numbers are correct or not? If not, correct them. 2

(a) $n = 4$; $l = 1$; $m_l = -2$ (b) $n = 3$; $l = 3$; $m_l = +1$

(c) $n = 4$; $l = 2$; $m_l = +2$ (d) $n = 2$; $l = 2$; $m_l = -1$

e) The electron configuration of cobalt (Co) in the ground state (Co, Z=27) is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^2$. How many unpaired electrons are in a gaseous Co^{3+} ion in its ground state? Apply Hund's rule to predict its magnetic property. 1+2

2. a) Note down the chemical basis of a breathalyzer showing appropriate reactions. 3

b) What kind of redox reaction the following reaction is? Indicate changes in the oxidation number of the elements. 3

$Cl_2(g) + 2OH^-(aq) \rightarrow ClO^-(aq) + Cl^-(aq)$

c) Define Brønsted acids and bases. Give an example of a conjugate pair in an acid-base reaction. 3

d) Define pOH. Write the equation relating pH and pOH. 2

e) Which of the following solutions can be classified as buffer systems? Explain your answer. 3

(i) KH_2PO_4/H_3PO_4,

(ii) $NaClO_4/HClO_4$.

3. a) What is SCUBA diving? Why is it used? What would happen if a diver rose to the surface from a depth of 20 ft rather quickly without breathing? Discuss with the help of applicable gas laws. 4

b) What are the significances of van der Waals constants, a and b in van der Waals equation for a real gas? 2

c) Explain why pressure exerted by 1 mol of NH_3 in a 1L vessel at 300 K is less than that exerted by 1 mol N_2 in a vessel of the same volume and also at 300K. 2

d) Write down the mathematical expression for the phase rule and explain each term in it. 2

e) Draw the phase diagram of CO_2 and explain why dry ice does not melt at ambient temperature and pressure. 2+2

4. a) State the second law of thermodynamics. 2

b) Chemical equilibrium is a dynamic process- explain. 3

c) State the principle of Le Chatelier and Brown and explain why higher pressure favors higher equilibrium yield in the synthesis of ammonia by the Haber's process. 1+2

d) The decomposition of methane to methyl radicals is a first-order reaction with a rate constant 5.36×10^{-4} s^{-1} at 700°C. Calculate the half-life of the following reaction. 2

$$C_2H_6(g) \rightarrow 2CH_3(g)$$

e) Show potential energy profiles for (i) exothermic and (ii) endothermic reactions. Define activation energy and mark in the profiles for both cases. 2+2

5. a) Write the cell reaction and electrode half-reactions for the following cell: 2

$Zn(s) \mid Zn^{2+}(aq) \parallel Cu^{2+}(aq) \mid Cu(s)\ Zn(s)$

b) What is the function of a salt bridge? What kind of electrolyte should be used in a salt bridge? 2

c) What are carbohydrates? How can you classify them based on their C=O function? Give example. 1+2

d) Draw the structures of two amino acids and give their names. What is a peptide bond? 2+1

e) *What are the Chargaff's rules regarding the structure of DNA?* 2

f) What are polymers? Give one example each of natural and a synthetic polymer. 1+1

6. a) (i) Write the Henderson-Hasselbalch expression for a buffer system containing CH_3COOH and CH_3COONa. 2

(ii) If $[CH_3COOH] = 0.5$ M and $[CH_3COONa] = 0.52$ M, calculate the pH of this buffer. [K_a of $CH_3COOH = 1.8\times10^{-5}$] 3

b) Why do we normally not quote K_a values for strong acids, such as HCl and HNO_3? Why is it necessary to specify temperature when giving K_a values? 2+2

c) Balance the following redox reaction: 3

$Fe^{2+} + Cr_2O_7^{2-} \rightarrow Fe^{3+} + Cr^{3+}$ (acidic medium)

d) Which of the following electron configurations are possible? Explain why the others are not. 2

(i) $1s^1\ 2s^2\ 2p^7$

(ii) $1s^2\ 2s^2\ 2p^5$

(iii) $1s^2\ 2s^2\ 2p^6\ 3s^3\ 3d^7$

(iv) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3d^8$

7. a) (i) Define colligative properties and list all of them. 1+2

(ii) In cold weather areas, an antifreeze liquid is usually added to the liquid fuel of cars in winter. Which of the colligative properties can you relate to this practice, and how? 2

b) Define vapor pressure. Why does the vapor pressure of a liquid reduce when a solute is added to it? 2+2

c) What is an ideal solution? 2

d) Two non-polar liquids A and B weighing 0.5 g and 1.0 g were mixed to prepare a solution giving a vapor pressure of 72.19 kPa at 25 °C. Vapor pressure of the pure liquids were 79.99 and 19.07 kPa, respectively. If the total number of moles in the mixture was 0.012 mol, find the molar mass of each liquid. 3

University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B.Sc. Examination, 2021
EEE – 1103, Electrical Circuits

Total Marks: 70 Time: 3 Hours

(Answer any 5 (Five) of the following Questions)

1. a) To which factors the resistance of a material depends? Relate those to find the resistance. 4
   b) Given the information provided in **Fig. 1.1**, find the unknown quantities: E, R_1, and I_3. 5

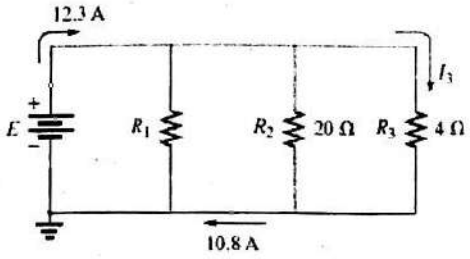

Fig. 1.1

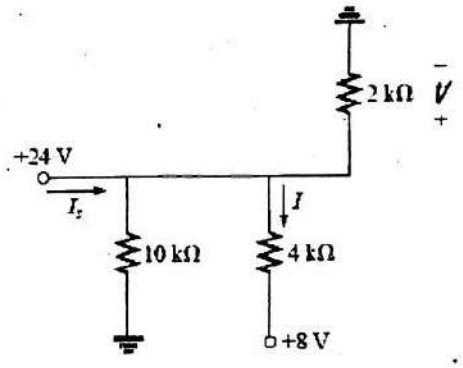

Fig. 1.2

c) For the network in **Fig. 1.2** above 5
   i) Find the current I ii) Determine the voltage V iii) Calculate the source current I_s

2. a) State voltage divider rule. Verify the statement with the help of a series circuit and Ohm's law. 4
   b) Determine the unknown *currents* in **Fig. 2.1** using Kirchhoff's *current* law. 3

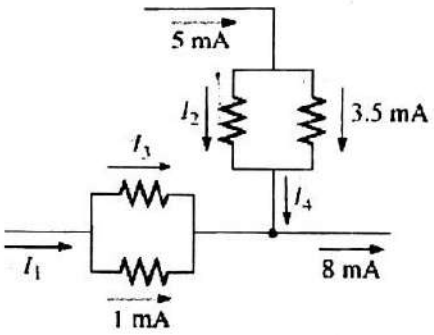

Fig. 2.1

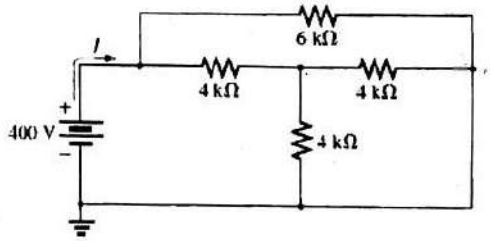

Fig. 2.2

c) Using a Y-Δ conversion, find the current I in the network in **Fig. 2.2**. 3
d) Determine the current I and the open-circuit voltage V in the network shown in **Fig. 2.3**: 4

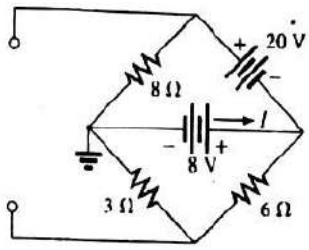

Fig. 2.3

3. a) Write the mesh equations for the network in **Fig. 3.1**. Using determinants, determine the values of the loop currents. 6

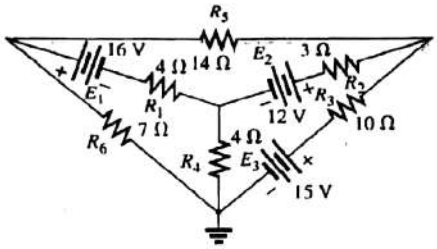

Fig. 3.1

b) Find the unknown quantities for the network in **Fig. 3.2** using the information provided. 4

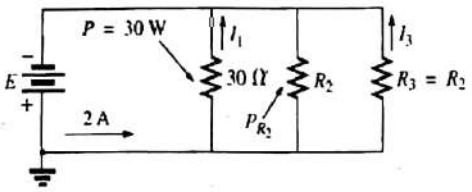

Fig. 3.2

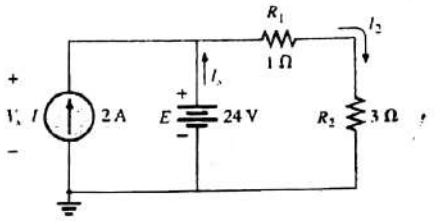

Fig. 3.3

c) For the network in **Fig. 3.3**: 4

i) Find voltage V_s. ii) Calculate current I_2. iii) Find the source current I_s

4. a) What is a super-node approach? Illustrate using an example network. 4

b) Write the nodal equations for the network in **Fig. 4.1**. Using determinants, solve for the nodal voltages. 6

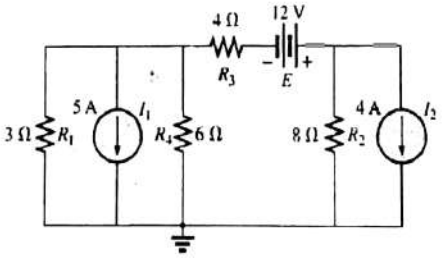

Fig. 4.1

c) When a bridge is called balanced in a bridge network? Explain with an example. 4

5. a) State Maximum Power Transfer Theorem. What are the advantages and disadvantages of using the Maximum Power Transfer Theorem? 4

b) Find the Thévenin equivalent circuit for the portions of the network shown in **Fig. 5.1** external to points a and b. 6

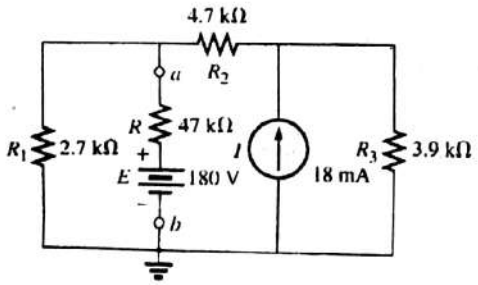

Fig. 5.1

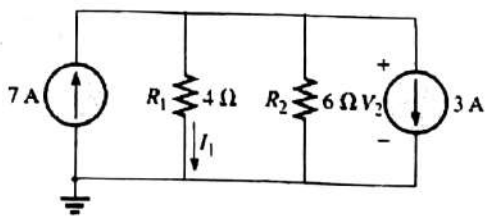

Fig. 5.2

c) Find the voltage V_2 and the current I_1 for the network in **Fig. 5.2**. 4

6. a) Using superposition, find the voltage across the 6 A source shown in **Fig. 6.1.** 6

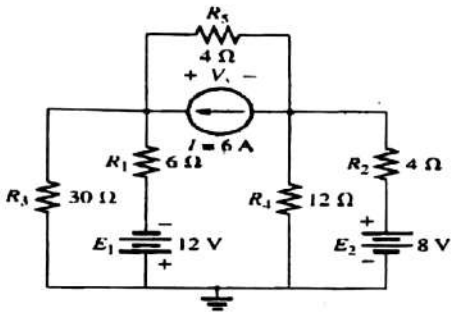

Fig. 6.1

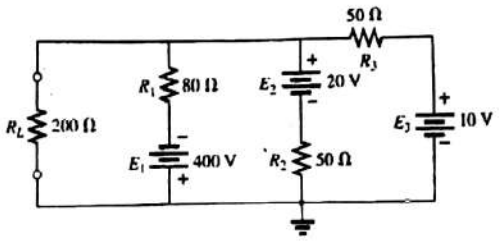

Fig. 6.2

b) Using Millman's theorem, find the current through and the voltage across the resistor R_L shown in **Fig 6.2.** 4

c) Using substitution theorem, draw three equivalent branches for the branch a-b of the network in **Fig. 6.3.** 4

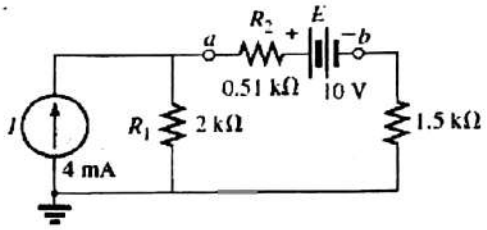

Fig. 6.3

7. a) Describe the characteristics of a capacitive network during the discharging phase. 6

b) State the Faraday's Law of Electromagnetic Induction. What would be the polarity and magnitude of the induced voltage during the Electromagnetic induction? 4

c) Find the phase relationship between the following waveforms: 4

i) $v = 2\cos(\omega t - 30°)$
$i = 5\sin(\omega t + 60°)$

ii) $i = -\sin(\omega t + 30°)$
$v = 2\sin(\omega t + 10°)$

University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B.Sc. Examination, 2021
CSE – 1101, Fundamentals of Computers and Computing

Total Marks: 70 Time: 3 Hours

(Answer any 5 (Five) of the following Questions)

1. a) List and draw the different flowchart symbols. Design a flowchart to find the median of 5 input numbers (a, b, c, d, e). 4
   b) Describe different types of variables that are used in the C/C++ programs with their use and limitations. 5
   c) Write a C program that takes two dates (given in the form **YYYY:MM:DD**) A and B as input and decides whether the first date is earlier than the second date or not. 5

Sample Input	Sample Output
2020:05:05 2020:05:06	YES
2020:05:05 2020:01:05	NO

2. a) Compare and contrast between Proprietary and Open Source software. 5
   b) List the main functionalities of an Operating System (OS). 4
   c) Suppose that you are given a polygon with 6 sides. The six points of the polygon are given according to their position as: (x1,y1), (x2,y2), (x3,y3), (x4,y4), (x5,y5), and (x6,y6). Design a flow chart or write a C program that takes a point (x,y) from the user and identifies whether the point (x, y) stays inside the polygon or not. 5

3. a) Consider two hexadecimal numbers A = $(ABED)_{16}$ and B = $(BED0B)_{16}$. Find the result of A×B without using any other base as intermediary steps. Note that only writing the answer or using other bases as intermediary steps will not carry any marks. 3
   b) Suppose that two hardware supports 8-bit and 16-bit number systems, respectively. In a modern computer, a 32-bit number system is used. Can you propose a mechanism for the modern computer to accommodate both the earlier number systems? If yes, then explain the mechanism. 3
   c) Consider the following single-precision floating-point decimal numbers and represent those according to the IEEE-754 standard. The final result should be written in hexadecimal (Base-16) form. 4 × 2
      (i) 1971.31416 (ii) 100.0101

4. a) Once two friends Jack and Jim were making notes on the lecture provided by their teacher on "Components of a Computer System" and found a sentence as "Among the components of a computer system, Human ware is the most important". Now, they start arguing about its correctness. Jack was sure that the statement is wrong and his logic was human is not a substance and cannot be a part or component of a computer system. However, Jim was quite sure about the correctness of the sentence. Your task is to stand beside either Jack or Jim and provide a proper justification of your choice. 5
   b) While learning the basics of a computer, you get to know the advantages of a computer. Its impact on our everyday life is really amazing. However, there are some dark sites too in our life. Whatever the effect is, we human beings are responsible for both types of impacts. In an actual sense, computer technology is still not beyond our control. Do you agree? If yes, then write some limitations of a computer system. If your answer is no, then justify your answer. 5
   c) What are ASCII code and Unicode? Describe the advantages of Unicode over ASCII code. 4

5. a) "Computer Network can be created without having any Internet connection" – Give your opinion with a logical explanation. 4

b) Differentiate between LCD and LED monitors. 5

c) List three (3) devices with explanations that can be used both as input and output functions. 5

6. a) "Storage technologies are developing with the cost of per unit storage decreasing" – Give your opinion on the given statement with proper explanation. 3

b) Consider the Machine Instructions for some Machine Language below. 4 × 2

Opcode	Operand	Descriptions
0	000	RESET all the register values to 0
1	RXY	LOAD the value XY to the register no .
2	RXY	LOAD the value from memory address XY to the register no R
3	RXY	STORE the value to the memory address XY from the register no R
4	RST	ADD the integer values from register no S and T and STORE the result into the register no R
5	RST	ADD the float values from register no S and T and STORE the result into the register no R
6	RST	GET the integer values from register no S and T and STORE the AND result into the register no R
7	RST	GET the integer values from register no S and T and STORE the OR result into the register no R
8	RS0	GET the integer value from register no S and STORE the NOT (Complement) result into the register no R
9	RST	GET the integer values from register no S and T and STORE the XOR result into the register no R
A	RSX	GET the integer values from register no S and STORE the X bit RIGHT shifted result into the register no R
B	RSX	GET the integer values from register no S and STORE the X bit LEFT shifted result into the register no R
C	000	HALT the program

Write a valid sequence of machine instructions to compute the values of both the expressions and that store the result in Register no 0.

(i) $1 \times 17 - 63 + 8/3$

(ii) $(1 << 3) + (7 + (127 >> 3)) - 3 \times 2$

Note that the very first and the very last instructions of each sequence should be 0000 and C000, respectively.

c) Write a comparative study between SRAM and DRAM 3

7. a) Draw the block diagram and describe the internal architecture of an ALU of a microprocessor. 5

b) What is a BUS in a computer system? Briefly describe each type of BUS used in a computer system. 4

c) What is a CPU cycle? Illustrate the execution process of a micro-processor while executing the operation: 5+7*9 5

Note: Illustration should include the involvement of ALU, CU (Control Unit), and their components along with address bus, control bus, and data bus.

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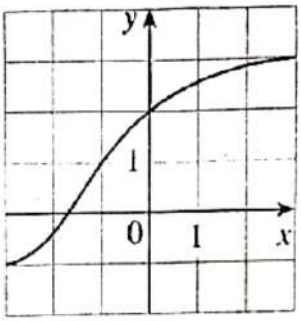
1st Year 1st Semester B.Sc. Examination, 2021
MATH – 1105, Differential and Integral Calculus

Total Marks: 70 Time: 3 Hours

(Answer any 5 (Five) of the following Questions)

1. a) Sketch the Graph of the functions. Also find their domain and range. 3+3
   i. $h(x) = \sqrt{4 - x^2}$ ii. $f(x) = 4 - |x - 2|$
   b) What the vertical line test tells about a function? 2
   c) Find the inverse function of $f(x) = 3x-5$ 3
   d) The graph of the function f is given below. 3



What are the domain and range of f^{-1}?

2. a) Find the domain and range of the following functions. 4
   i. $f(x) = e^{-x} + 1$ ii. $f(x) = \ln(x-1)$
   b) i. Use implicit differentiation to find dy/dx for the Folium of Descartes $x^3 + y^3 = 3xy$ 3+2
   ii. Find an equation for the tangent line to the Folium of Descartes at the point $(3/2, 3/2)$
   c) Prove that the equation $x^3 + x - 1 = 0$ has exactly one real root. 5

3. a) Consider the following function: 3+3

$$f(x) = \begin{cases} \sqrt{x-4} & \text{if } x > 4 \\ 8 - 2x & \text{if } x < 4 \end{cases}$$

   i. determine whether $\lim_{x \to 4} f(x)$ exists
   ii. Is $f(x)$ continuous and differentiable at $x = 4$?

   b) Find the value of $\lim_{x \to -\infty} \frac{4x^2 - x}{2x^3 - 5}$ 3

   c) Graph the function 5

$$f(x) = \frac{\sqrt{2x^2 + 1}}{3x - 5}$$

How many horizontal and vertical asymptotes do you observe? Use the graph to estimate the values of the limits

$$\lim_{x \to \infty} \frac{\sqrt{2x^2 + 1}}{3x - 5} \quad \text{and} \quad \lim_{x \to -\infty} \frac{\sqrt{2x^2 + 1}}{3x - 5}$$

4. a) Find where the function $f(x) = 3x^4 - 4x^3 - 12x^2 + 5$ is increasing and where it is decreasing. 5

b) Find the local maximum and minimum values of the function 4

$$g(x) = x + 2\sin x \qquad 0 <= x <= 2\pi$$

c) In case of finding maximum and minimum values of a function mention the cases where the 2nd Derivative test fails. What the curve of 2nd derivative (f'') tells about the shape of a function f. 3+2

5. a) Compute: $\lim_{x\to\infty}(\sqrt{x^2+1} - x)$ 4

b) Apply L'Hospital's rule to solve: 7

i. $\lim_{x\to 0}\frac{\tan x - x}{x^3}$ ii. $\lim_{x\to 0}(1 + \sin x)^{\frac{1}{x}}$

c) Find an equation of the tangent line to the parabola $y = x^2$ at the point $P(1, 1)$. 3

6. Evaluate the following integrals (Any 4) 14

i. $\int \frac{2x^2 - x + 4}{x^3 + 4x}\,dx.$

ii. $\int \frac{1}{x^2\sqrt{x^2+4}}\,dx$

iii. $\int \sin^4 x\,dx.$

iv. $\int x^2\sqrt{x-1}\,dx$

v. $\int e^x \cos x\,dx$

7. a) Use the antiderivative method to find the area under the graph of $y = x^2$ over the interval $[0,1]$ 4

b) Find the area of the ellipse $x^2/a^2 + y^2/b^2 = 1$ 4

c) Find the area of the region enclosed by the parabolas $y = x^2$ and $y = 2x - x^2$ 4

d) What is the difference between the *Antiderivative* and *Definite Integral*. 2

University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B.Sc. Examination, 2021
CSE – 1102: Discrete Mathematics

Total Marks: 70 Time: 3 Hours

(Answer any 5 (Five) of the following Questions)

1. a) Find out the cardinal number of the set Z. 3

   b) Draw the graph of the function $f(x) = 2x + 1$ $(x \in Z)$. What kind of function is this? Explain your answer. 3

   c) Find transitive closure of the relation $R = \{(1,2), (2,3), (3,1)\}$ defined on S= {1,2,3} . 3

   d) Determine whether the relation $R = \{(a, b) | a \equiv b \ mod \ 3\}$ is equivalence relation on the set {0, 1, 2, 3, 4, 5}. 5

2. a) Can you conclude that $A = B$ if A, B and C are sets such that $A \cup C = B \cup C$? Give reason. 3

   b) Find the sets A and B if $A - B = \{1, 5, 7, 8\}$, $B - A = \{2, 10\}$, and $A \cap B = \{3, 6, 9\}$. 2

   c) For the following subproblems, fill in the blanks with appropriate relationship chosen from the list $\{\in, \supseteq, \subseteq, =, none\}$. You should choose the relationship which must be true, not just one which can be true. 2

      i) $\overline{B - A}$ _____ (A-B)

      ii) $A \cup (\overline{B \cap C})$ _____ $(A \cup C) \cap (A \cup \overline{B})$

   d) Give an example with explicit formula of a function from **N** to **N** that is 4

      i) one-to-one, but not onto.

      ii) onto but not one-to-one.

   e) Consider these functions from the set of students in a discrete mathematics class. Under what conditions is the function one-to-one if it assigns to a student his or her 3

      i) student identification number

      ii) final grade in the class

3. a) How many license plates can be made using either three digits followed by three letters or three letters followed by three digits 2

   b) How many number must be selected from the set of {1, 3, 5, 7, 9, 11, 13, 15} to guarantee that at least one pair of these numbers add up to 16 2

   c) Suppose that there are nine students in a discrete mathematics class at a small college. 4

      i) Show that the class must have at least five male students or at least five female students.

      ii) Show that the class must have at least three male students or at least seven female students.

   d) One hundred tickets, numbered 1, 2, 3, ..., 100, are sold to 100 different people for a drawing. Four different prizes are awarded, including a grand prize. How many ways are there to award the prizes if 6

      i) There are no restriction?

      ii) The people holding tickets 19, 47 and 73 all win prizes?

      iii) The people holding tickets 19 and 47 win prizes, but the people holding tickets 73 and 97 do not win prizes?

4. a) Determine whether each of these conditional statements is true or false.

      i) $1 + 1 = 3$ if and only if monkeys can fly.

      ii) If $1 + 1 = 3$, then $2 + 2 = 4$. 3

   Write down the contrapositive of the proposition mentioned in (ii). 1

   b) Use quantifiers, logical connectives, and mathematical operators to express the statement "Every positive integer is the sum of the squares of four integers". 2

c) Use predicates, quantifiers, logical connectives, and mathematical operators to express the following argument. 8

i) All hummingbirds are richly colored.
ii) No large birds live on honey.
iii) Birds that do not live on honey are dull in color.
iv) Hummingbirds are small.

Can you conclude iv) i.e. "Hummingbirds are small" from the first three? Prove this using logical equivalence and rules of inferences. Clearly label which rule you are using in each step.

5. a) Solve the following congruence equations:

i) $5x \equiv 1 \pmod{14}$. 1
ii) $5x \equiv 1 \pmod{10}$. 1
iii) $3x \equiv 5 \pmod{9}$. 1
iv) $3x \equiv 6 \pmod{9}$. 2

b) Using Chinese Remainder theorem, find the smallest positive integer x such that when x is divided by 2 it yields a remainder 1, when x is divided by 3 it yields a remainder 2, and when x is divided by 5 it yields a remainder 4. 4

c) Let a = 18, b = 49 and gcd(49, 18) = 1. Consider the equation ax + by = 1 and find out the values of x and y using Euclidean algorithm. 5

6. a) Assume that the population of the world in 2002 was 6.2 billion and is growing at the rate of 1.3% a year

i) Set up a recurrence relation for the population of the world after n years of 2002. 1
ii) Find an explicit formula for the population of the world after n years of 2002. 3

b) Using mathematical induction, prove that $n^2 - 7n + 12$ is nonnegative whenever n is an integer with $n \geq 3$. 4

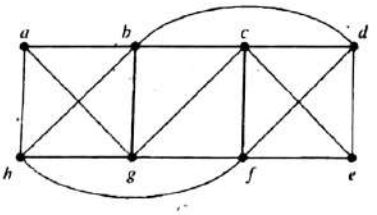
c) Use strong induction to show that if you can run one mile or two miles, and if you can always run two more miles once you have run a specified number of miles, then you can run any number of miles. 4

d) Mention the features of the subsets which can create partition of a set. 2

7. a) With example define distance between any two vertices of a graph. 2

b) If exist, find Euler circuit of W_n where $n > 2$. 2

c) Draw the planar representation of this graph and find out number of regions. 2



d) Using Welch Powell algorithm find the chromatic number of the above graph. 3

e) Are the following graphs isomorphic to each other? 5