Patuakhali Science and Technology University

Department of Physics and Mechanical Engineering

2nd Semester (L-1, S-II) Final Examination of B.Sc. (Engg.) in CSE, July-December: 2022, Session: 2021-2022

Course Code: PHY 121, Course Title: Physics-II

Credit Hour: 3.0, Full Marks: 70, Total Time: 3 Hours

[Figures in the right margin indicate full marks. Split answering of any question is not recommended.]

Answer any five (05) from the following questions

1. (a) Define Unit cell. Briefly explain *4* types of unit cell with proper illustration. 1+4=5

(b) Write short note on: Translation, plane and space lattice 2

(c) What is crystal defect? Explain any *6* types of point defects that usually occur in crystals. 1+6=7

2. (a) Deduce the importance of coherent sources in case of interference to take place. 2

(b) A light of *4500 Å* wavelength from a narrow slit, falls on double slit acting as coherent sources, and after interference forms *11* fringes each of which have width of *0.3 cm*; on a screen that stays *350 cm* away from the coherent sources. Find the slit separation. 3

(c) Explain, how polarization reveals the true nature of light. 2

(d) Describe the phenomenon of "Polarization by Reflection" and from that fact, relate and state Brewster's Law. 7

3. (a) What is Optical fiber communication? State advantages of using optical fiber instead of traditional copper wires. 1+2=3

(b) State the basic criteria based on which optical fibers are categorised. 1

(c) Explain the structure, feature and transmission technique of transmission of light through the following two types of optical fiber: (i) single mode (ii) Multimode graded index. 6

(d) What do you mean by XRD? State and explain Bragg's Law in case of X-Ray reflection and prove that $n\lambda = 2d\sin\theta$ where letters have their usual meaning. 4

4. (a) How many types of elastic constants? Describe each of them with mathematical explanation. 4

(b) Show that for elongation strain the work done per unit volume is equal to $\frac{1}{2}$ stress × strain. 6

(c) (i) A student, using a circular loop of wire and a pan of soapy water, produces a soap bubble whose radius is 1.0 mm. The surface tension of the soapy water is $T = 2.5 \times 10^{-2}$ *N/m.* Determine the pressure difference between the inside and outside of the bubble. 4

(ii) The same soapy water is used to produce a spherical droplet whose radius is one-half that of the bubble, or *0.50 mm*. Find the pressure difference between the inside and outside of the droplet.

5. (a) State and explain rate of flow of a liquid. What is the equation of continuity? Derive an expression for the equation of continuity. 5

(b) Derive Bernoulli's equation for a fluid in streamline motion and show that $\frac{p}{\rho} + gh + v^2/2 = constant$, where the symbols have their conventional meanings. Write down the main applications of Bernoulli's equation. 6

(c) A venturimeter has a pipe having diameter of *0.2 m* and a throat having diameter of *0.15 m*. The levels of water columns in the two limbs differs by *0.1 m*. Calculate the amount of water discharged through the pipe in half an hour. Density of water = 10^3 *kg/m³*. 3

6. (a) State and explain the assumptions of Bohr's model of the hydrogen atom. Show that the equation of energy levels for hydrogen atom is $E_n = -\frac{13.6}{n^2} eV$, where the symbols have their conventional meanings. 6

(b) Write down the quantum numbers for hydrogen atom. State and explain the Pauli exclusion principle. 4

(c) Singly ionized helium, He^+, a hydrogen-like system, has one electron in the *1s* orbit when the atom is in its ground state. Find (i) the energy of the system in the ground state in electron volts and (ii) the radius of the ground state orbit. 4

7. (a) State and explain the four factor formula. 4

(b) Define multiplication factor. How does it relate to the four factor formula, and the probability that a thermal neutron will not leak and will not escape from the reactor? 4

(c) Sketch the processes that can occur to neutrons during a reactor cycle. Briefly describe the cycle. 6

Patuakhali Science and Technology University

B.Sc.Engg.(CSE) Level-1 Semester-II Final Examination-2022 (July-December)

Course Code: EEE 121 Course Title: Electronic Devices and Circuits

Credit Hour: 3.0 Full Marks: 70 Duration: 3 Hours.

[Figures in the right margin indicate full marks. Split answering of any question is not recommended.]

Answer any 5 of the following questions.

(a) Define *semiconductor*. Write down the effect of temperature on semiconductor. 03

(b) What is a *pn* junction? Discuss the behavior of a *pn* junction under forward and reverse biasing. 04

(c) What do you meant by *crystal diode*? How does a crystal diode work as a switch? 03

(d) An a.c. supply of *250 V* is applied to a half-wave rectifier circuit through a transformer of turn ratio *10:1*. Find (i) the output d.c. voltage and (ii) the peak inverse voltage. Consider the diode to be ideal. 04

(a) "A full-wave rectifier is twice as effective as a half-wave rectifier". Justify the statement. 06

(b) The four diodes used in a bridge rectifier circuit have forward resistances which may be considered constant at 1Ω and infinite reverse resistance. The alternating supply voltage is 260V r.m.s. and load resistance is 380 Ω. Calculate (i) mean load current and (ii) power dissipated in each diode. 04

(c) Define *ripple factor*. "The ripple factor of full-wave rectification is less than that of the half-wave rectification". Explain the statement. 04

(a) Describe the action of the following filter circuits: (i) *capacitor filter* (ii) *choke input filter* (iii) *capacitor input filter*. 06

(b) Define *transistor*. Derive the expression for the collector-current in *common base connection* of transistor. 04

(c) A transistor is connected in common-emitter (CE) configuration in which collector supply is 5V and the voltage drop across 600Ω load resistance connected in the collector circuit is 0.8V. If α=0.96, calculate: i. collector-emitter voltage ii. base current. 04

(a) Define *sinusoidal oscillator*. Write down the advantages of sinusoidal oscillator. Why an alternator can not be called oscillator? 03

(b) What is *oscillatory circuit*? What are the components of a oscilatory circuit? Describe the construction and circuit operation of the *Colpitt's oscillator*. 06

(c) A *1 pF* capacitor is available. Choose the inductor values in a Hartley oscillator so that *f*= *1 MHz* and $m_v = 0.2$. 03

(d) Write down the limitations of LC and RC oscillators. 02

(a) Define *photo-diode*. Write down the operating principle and applications of photo-diode. 04

(b) What is *JFET*? Describe the construction and working principle of JFET. 05

(c) Explain the construction and circuit operation of *D-MOSFET*. 05

(a) Define *triac*. Describe the construction and operation of triac circuit. 05

(b) State the operational theory of *varactor diode*. Write down the applications of varactor diode. 04

(c) What do you meant by *SCR*? Describe the working priciple of SCR. 05

Patuakhali Science and Technology University

2nd Semester (L-1, S-II) Final Examination of B.Sc. in CSE (Hons), July-Dec 2022

Course Code: LCM-121, Course Title: Communicative Language

Credit Hour: 2.0 Full Marks: 70 Duration: 2Hours

[Figures in the right margin indicate full marks. (Split answering of any question is not recommended)]

Answer any 5 of the following questions.

1. a) You are working on a payment processing app project. Write an email to the project authority to ask some quick questions regarding it. 7.0

   b) Imagine, you are Masum/Masuma from Dumki, Patuakhali. Recently you have visited your friend Roshan/Roshni's house in this winter vacation. Now write a letter to your friend thanking him/her for the hospitality returning your home. 7.0

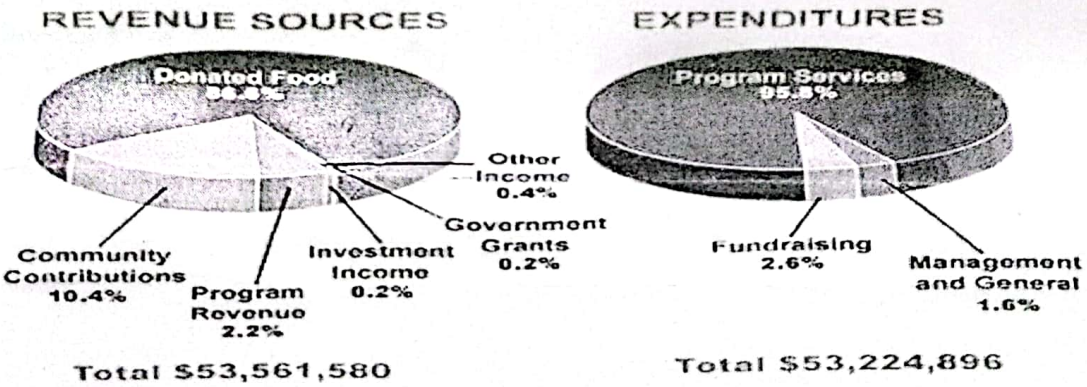
2. a) Construct a conversation with your friend about your career planning and its development. 6.0

   b) 'Lead Soft Bangladesh Ltd' is looking for a skilled and experienced Web Developer for their company. Prepare a CV along with a job letter applying for the post to the H.R. of that institution advertised in the *Daily Star* on 10th of January 2024. 8.0

3. a) Transcribe the following words using IPA symbols: (*any four*) 4.0
   Sea, Main, Nurse, Bird, Love, Ship

   b) Write Short Notes on the topics below: 4.0
   (i) Preparations for a Job Interview
   (ii) Fundamentals of a Presentation

   c) The pie chart shows the amount of money that a children's charity located in the USA spent and received in one year, 2016.Summarise the information by selecting and reporting the main features and make comparisons where relevant. 6.0



4. a) Develop a Paragraph on: **Cybersecurity and Data Privacy in the Digital Age** 8.0

   b) Use the word bracketed to form a new word that fits into the blank: 6.0

   i) Jannat gave all her------- to her mother so that she could pay for her father's burial. (**SAVE**)

   ii) A ---------- sound came from the cellar. (**METAL**)

   iii) My sister can sometimes be very--------, so just do what she says. (**PERSUADE**)

   iv) There are a lot of politicians who enjoy -------and always want to be in the media. (**PUBLIC**)

   v) I'm very worried about the --------of some students. They just don't seem to care about their education. (**RESPONSIBLE**)

   vi) It was an --------journey. We experienced a lot of problems but were able to cope with all of them. (**EVENT**)

5. a) Ask for the underlined part and make the Wh questions: 5.0

i) She is opening a present.
ii) The boys are hiding under Tom's bed.
iii) The telephone is ringing.
iv) Sarah has to stop because of a security check.
v) At sunset Peter is walking along the beach.

b) Choose the right modal verbs from the options bracketed to fill the gap: 5.0

i) Phone her now. She ------- home by now. (has to be/ must be/ would be)
ii) How did you do in the test? - OK. It ------ worse! (could be/ could have been/ might be)
iii) I ------move the table. It was too heavy. (mustn't /couldn't /shouldn't)
iv) You ------ eat so much chocolate. It's not good for you. (don't have to/ shouldn't/ mustn't)
v) ------ have a cup of tea? (Can you/ would you like/ do you)

c) Complete the following conditional sentences: 4.0

i) If I had time, I ---------- shopping with you.
ii) If you ---------- English, you will get along with them perfectly.
iii) If they had gone for a walk, they ---------- the lights off.
iv) Would you mind if I ---------- the window?

6. a) Correct the following sentences: 7.0

i) Will you go to Agra yesterday?
ii) Neither of these children have stolen your pen.
iii) The show ended before I reached the cinema hall.
iv) He as well as his brothers have come.
v) He went to work despite of his illness.
vi) Mathematics are my favourite subject.
vii) My friends house is big and expensive.

b) Choose the correct form of the verb that agrees with the subject: 7.0

i) Every one of those books (is/are) fiction.
ii) (Is/Are) the news on at five or six?
iii) The movie, including all the previews, (take/takes) about two hours to watch.
iv) The committee members (leads/lead) very different lives in private.
v) There (were/is) many difficulties regarding the situation.
vi) The jury (were/was) not convinced.
vii) Somebody (is/are) waiting at the door for you.

Dept. of Computer and Communication Engineering

Faculty of Computer Science and Engineering
Patuakhali Science and Technology University

Final Examination of B. Sc. Engineering in CSE Level: 1 Semester: II Session: 2021-2022

Course Code	Course Title	July December 2022	Credit: 03
CCE-121	Object Oriented Programming		Time: 03 Hr
			Marks: 70

Answer any 05 out of 06 Questions (Split answers are highly discouraged)

[A] i) Identify and fix the errors in the following code: **14**

```
public class Welcome {
  public void Main(String[] args) {
    System.out.println('Welcome to Java!');  } )
```

ii) How do you write a statement to let the user enter a double value from the keyboard? What happens if you entered 5a when executing the following code?

iii) If today is Tuesday, what will be the day in 100th days? Write a mathematical java expression to find the day.

iv) How do you obtain the current second, minute, and hour?

v) Show the output of the following code:

```
int a = 6;
int b = a++;
System.out.println(a);
System.out.println(b);
a = 6;
b = ++a;
System.out.println(a);
System.out.println(b);
```

vi) Suppose x = 3 and y = 2; show the output, if any, of the following code. What is the output if x = 3 and y = 4? What is the output if x = 2 and y = 2? Draw a flowchart of the code.

```
if (x > 2) {
  if (y > 2) {
    z = x + y;
    System.out.println("z is " + z);
  } }
  else
    System.out.println("x is " + x);
```

vii) What is y after the following switch statement is executed? Rewrite the code using an if-else statement.

```
x = 3;
y = 3;
switch (x + 3) {
  case 6: y = 1;
  default: y += 1;
}
```

viii) How many times are the following loop bodies repeated? What is the output of each loop?

```
int i = 1;
while (i < 10)
  if (i % 2 == 0)
    System.out.println(i);
```

ix)

```
int i = 1;
while (i < 10)
  if (i % 2 == 0)
    System.out.println(i + i);
```

x)

```
int i = 1;
while (i < 10)
  if ((i+1) % 2 == 0)
    System.out.println(i);
```

xi) Can you always convert a while loop into a for loop? Convert the following while loop into a for loop.

```
int i = 1;
int sum = 0;
while (sum < 10000) {
  sum = sum + i;
  i++; }
```

xii) How many times is the println statement executed?

```
for (int i = 0; i < 10; i++)
  for (int j = 0; j < i; j++)
    System.out.println(i * j);
```

xiii) What is wrong in the following program?

```
public class Test {
  public static void method(int x) {
  }
  public static int method(int y) {
    return y;
  }
}
```

xiv) Determine the value of the variables in the statement product *= x++; after the calculation is performed. Assume that all variables are type int and initially have the value 5.

2 [A] Can you save a Java source file by another name than the class name? Is Empty .java file name a valid source file name? Explain with example. **3**

[B] Explain the types of java variables with an example. **3**

[C] Explain Java for Loop vs while Loop vs do-while Loop in terms of the parameter of introduction, when to use, syntax, example, and syntax for infinitive loop. **4**

[D] Write an Object and Class Example: Initialization through method and shows the output. **4**

3 [A] Write a Java program to demonstrate the working of a banking-system where we deposit and withdraw amount from our account. Creating an Account class which has deposit () and withdraw () methods. **3**

[B] Write a java program to demonstrate the use of the constructor overloading. **3**

[C] Differentiate between constructor and method in Java. **3**

[D] Show the output of the following code: **2**

```
public class Test {
  public static void main(String[] args) {
    int[] a = {1, 2};
    swap(a[0], a[1]);
    System.out.println("a[0] = " + a[0]    + " a[1] = " + a[1]);
  }
  public static void swap(int n1, int n2) {
    int temp = n1;
    n1 = n2;
    n2 = temp;
  }
}
```

[E] Fill in the blanks in each of the following statements: **3**

i) Methods that perform common tasks and do not require objects are called ----------methods.

ii) The ----------operator can be used to ensure that two conditions are *both* true before choosing a certain path of execution.

iii) Use the expression---------- to receive the total number of arguments in a command line. Assume that command-line arguments are stored in String[] args.

iv) The public methods of a class are also known as the class's ----------or----------.
v) If the loop-continuation condition in a for header is initially ,---------- the program does not execute the for statement's body.
vi) Repeating a set of instructions, a specific number of times is called ---------- repetition.

4 [A] "A class can't extend more than one class but can implement more than one interface" – justify the statement with a proper example. 4

[B] Write a code to show the creation of java custom exception. Also give a brief explanation. 4

[C] Can you overload methods by changing the return type in java? Why or why not? 2

[D] Explain the impact of thread priorities in multithreading. 2

[E] How does the ***sleep()*** method affect the state of a thread? 2

5 [A] Explain the significance and usage of the ***final*** keyword in java. Provide examples for each context where it can be applied. 4

[B] How is ***instance of*** operator different from "= =" in java? And in what scenarios would you prefer using one over another? 3

[C] Differentiate between dynamic binding and static binding. 3

[D] When is an instance initializer block executed in the lifecycle of an object? Give step by step overview. 2

[E] Illustrate a scenario where a ***finally*** block might not be executed? 2

6 [A] Briefly explain the output of the following Java programs. 4

i)
```
class Adder{
static int add(int a,int b){return a+b;}
static double add(int a,int b){return a+b;}
} }
class TestOverloading3{
public static void main(String[] args){
System.out.println(Adder.add(11,11));
}
}
```

ii)
```
import java.io.*;
class ThreadJoin extends Thread {
public void run()
{
for (int j = 0; j < 2; j++) {
try {
Thread.sleep(300);
System.out.println("The current thread name is: " + Thread.currentThread().getName());
} catch(Exception e)
{
System.out.println("The exception has bee n caught: " + e); } System.out.println( j );
} }
}
```

```
public class ThreadJoinExample {
public static void main (String args[]) {
ThreadJoin th1 = new ThreadJoin();
ThreadJoin th2 = new ThreadJoin();
ThreadJoin th3 = new ThreadJoin();
th1.start();
try {
System.out.println("The current thread name is: "+ Thread.currentThre ad().getName());
th1.join(); }
catch(Exception e) {
System.out.println("The exception has been caught " + e); }
th2.start();
try {
System.out.println("The current thread name is: " + Thread.currentThr ead().getName());
th2.join(); }
catch(Exception e) {
System.out.println("The exception has been caught " + e); }
th3.start();
}
}
```

iii)
```
interface Drawable{
void draw();
static int cube(int x){return x*x*x;}
}
class Rectangle implements Drawable{
public void draw()
{System.out.println("drawing rectangle");}
}
class TestInterfaceStatic{
public static void main(String args[]){
Drawable d=new Rectangle();
d.draw();
System.out.println(Drawable.cube(3));
}
}
```

iv)
```
class TestExceptionPropagation2{
 void m(){
  throw new java.io.IOException("device error");
}
 void n(){
  m(); }
 void p(){
 try{
  n(); }
catch(Exception e){System.out.println("exception handeled"); } }
public static void main(String args[]){
TestExceptionPropagation2 obj=new TestExceptionPropagation2();
  obj.p();
  System.out.println("normal flow");
}
}
```

[B] Mention different uses of ***super*** keyword in java. Write a code showing different usage of ***super*** keyword. 4

[C] Can we use ***throw*** and ***throws*** together in java? Write a code to show the case. 2

[D] What are the rules behind exception handling with method overriding in Java? 2

[E] How to put two public classes in a package? 2

Patuakhali Science and Technology University

Faculty of Computer Science and Engineering

2nd Semester (L-1, S-2) Final Examination of B.Sc.Engg.(CSE) July- December-22, Session:2021-22.

Course Code: MAT-121, Course title: Mathematics-II, Credit Hour: 3.0, Full marks: 70, Time: 3.0 hours

[Figure in the right margin indicates full marks. Split answering of any question is not recommended.]

Answer any 5 of the following questions.

1. a) Define unit matrix, diagonal matrix, symmetric matrix. 03

b) Find the inverse of the matrix 05

$$A=\begin{bmatrix}3 & 4 & -1\\ 1 & 0 & 3\\ 2 & 5 & -4\end{bmatrix}$$

c) Solve the system of equations by using matrix method 06

$$x+2y+3z=6$$
$$2x+4y+z=7$$
$$3x+2y+9z=14$$

2. a) Define Characteristics Matrix, Eigen values and Eigen vectors. 03

b) Find the all eigen values and all associated eigen vectors of the following matrix 07

$$A=\begin{pmatrix}2 & 2\\ 1 & 3\end{pmatrix}$$

c) Find the rank of the matrix $A=\begin{bmatrix}1 & 2 & 3\\ 3 & 4 & 5\\ 2 & 1 & 1\end{bmatrix}$ 04

3. a) Define vector and scalar with example. 03

b) What is the condition for cross product of vector to be zero? 03

c) Find the angle between the vectors $\vec{i}+\vec{j}+\vec{k}$ and $\lambda^2\vec{i}-2\lambda\vec{j}+\vec{k}$. For what value of λ will the vectors be perpendicular? 04

d) Determine a unit perpendicular to the plane of $\vec{a}$ and $\vec{b}$ where $\vec{a}=4\vec{i}+3\vec{j}-\vec{k}$ and $\vec{b}=2\vec{i}-6\vec{j}-3\vec{k}$. Also obtain sine of the angle between $\vec{a}$ and $\vec{b}$. 04

4. a) Write the condition for invariants of the equation $ax^2+2hxy+by^2+2gx+2fy+c=0$ 02

b) Verify that when the axes are turned through an angle $\frac{\pi}{4}$, the equation $5x^2+4xy+5y^2-10=0$ transforms to one in which the xy is absent. 05

c) Transform the equation $9x^2+15xy+y^2+12x-11y-15=0$ so as to remove the terms in x, y and xy. 07

5. a) Illustrate the conditions that the two straight lines represented by the equation $ax^2+2hxy+by^2=0$ will be parallel and perpendicular. 01

b) Find for what values of λ, the equation $2\lambda xy-y^2+4x+2y+8=0$ represents a pair of straight lines. 02

c) Derive the equation of bisectors of the angles between the straight lines represented by the homogeneous equation of second degree. 07

d) Prove that the condition that the gradient of one of the lines represented by $ax^2 + 2hxy + by^2 = 0$ should be the square of that of the other is that $ab(a+b) = 6abh - 8h^3$ 04

6. a) Enlist the condition that the general equation of second degree may represent a circle. 01

b) Find the equation of the circle passing through the intersection of the circles $x^2 + y^2 = 2ax$ and $x^2 + y^2 = 2by$ and having its centre on the line $\frac{x}{a} - \frac{y}{b} = 2$ 06

c) Define rectangular hyperbola and conjugate hyperbola 02

d) Reduce the equation $x^2 - 6xy + 9y^2 - 2x - 3y + 1 = 0$ to its standard form 05

Patuakhali Science and Technology University

Faculty of Computer Science and Engineering

Department of Computer Science and Information Technology

2nd Semester (Level-1, Semester-II), Final Examination of B.Sc. Engg. CSE, July-December 2022

Session: 2021-22

Course Code: CIT-121 Course Title: Discrete Mathematics

Full Marks: 70 Duration: 3 hours

[Figures in the right margin indicate full marks] Answer any 5 of the following questions.

1. (a) What is discrete mathematics? Why study discrete mathematics? **2**

(b) Find the number of elements in each finite set: **3**

i. $A = \{2, 4, 6, 8, 10\}$

ii. $B = \{x : x^2 = 4\}$

iii. $C = \{x : x > x + 2\}$

iv. $D = \{x : x$ is a positive integer, x is a divisor of $15\}$

v. $E =$ {letters in the alphabet preceding the letter m}

vi. $F = \{x : x$ is a solution to $x^3 = 27\}$

(c) Shade the set $(A \cup B) \cap (A \cup C)$. **2**

(d) A survey on a sample of 25 new cars being sold at a local auto dealer was conducted to see which of three popular options, air-conditioning (A), radio (R), and power windows (W), were already installed. The survey found: **7**

15 had air-conditioning

12 had radio

5 had air-conditioning and power windows

9 had air-conditioning and radio

4 had radio and power windows

3 had all three options

2 had no options

Find the number of cars that had: (i). only power windows, (ii). Only air-conditioning, (iii). Only radio, (iv). Radio and power windows but not air-conditioning, (v). Air-conditioning and radio, but not power windows, (vi). Only one of the options.

2. (a) Explain the main difference between an ordered pair (a, b) and the set $\{a, b\}$ with two elements. And Discuss the geometrical representation of $R^2 = R \times R$ as a point in the plane. **2**

(b) Let R and S be the relations on $X = \{a, b, c\}$ defined by **4**

$R = \{(a, b), (a, c), (b, a)\}$ and $S = \{(a, c), (b, a), (b, b), (c, a)\}$

Find the composition $S \circ R$ for the relations S and R. (Matrices)

(c) Given $A = \{1, 2\}$, $B = \{x, y, z\}$, and $C = \{3, 4\}$. Find $A \times B \times C$ and $n(A \times B \times C)$. **3**

(d) Sketch the graph of $h(x) = \begin{cases} 0, if\ x = 0 \\ \frac{1}{x}, if\ x \neq 0 \end{cases}$ **2**

(e) Which of the function in fig: 1-2 are one-to-one and onto? **3**

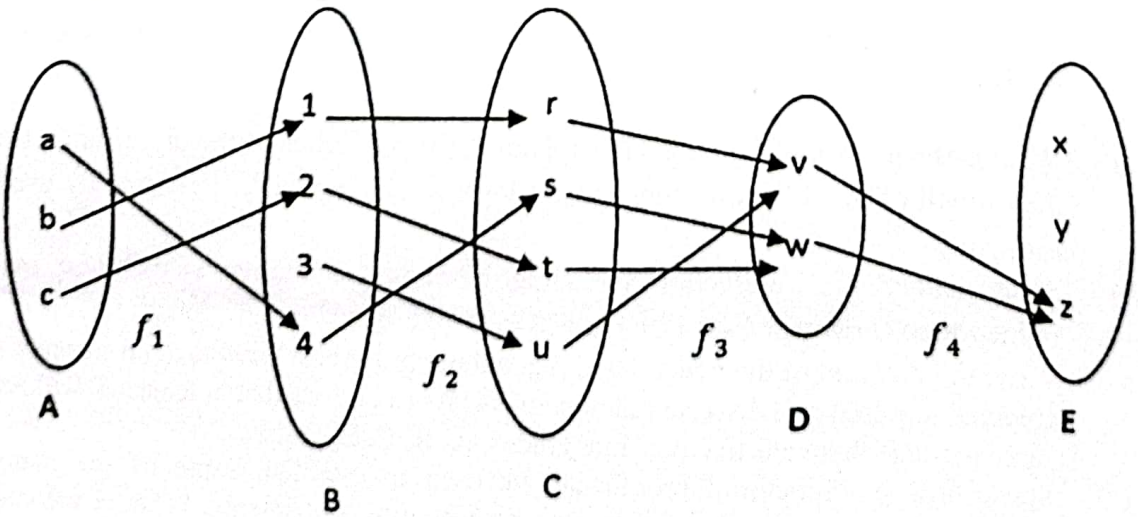


Figure: 1-2

3. (a) Draw a diagram of each of the following multi graphs $G(V, E)$ where $V = \{P_1, P_2, P_3, P_4, P_5\}$ and (i). $E = [\{P_2, P_4\}, \{P_2, P_3\}, \{P_3, P_5\}, \{P_5, P_4\}]$
(ii). $E = [\{P_1, P_1\}, \{P_2, P_3\}, \{P_2, P_4\}, \{P_3, P_2\}, \{P_4, P_1\}, \{P_5, P_4\}]$

(b) Distinguish between Hamiltonian graph and Eulerian graph. 3

(c) Draw three regular graph with six vertices, complete graphs k_5, and k_{10} and $k_{5,3}$ graph. 4

(d) i. Give an example of a general tree using a diagram. 4
ii. Describe the universal address system for the vertices of an ordered rooted tree T, and give an example.

4. (a) Calculate 4! Using the recursive definition 2
i. If $n = 0$, then $n! = 1$.
ii. If $n > 0$, then $n! = n \cdot (n-1)!$

(b) Define Boolean searching strategy. How does a web search engine support the Boolean searching technique? When is a compound proposition satisfiable? Explain the steps in the construction of a compound proposition that asserts every row, every column, and every one of the nine 3×3 blocks contain each of the nine possible numbers of a 9×9 Sudoku puzzle. 4

(c) What is quantification in propositional function? State the connection between quantification and looping. Show that $\neg\forall x(P(x) \rightarrow Q(x))$ *and* $\exists x(P(x) \wedge \neg Q(x))$ are logically equivalent using De Morgan's law for universal quantifiers. Translate the statement $\forall x(C(x) \vee \exists y(C(y) \wedge F(x, y)))$ into English, where $C(x)$ is "x has a computer," $F(x,y)$ is "x and y are friends," and the domain for both x and y consists of all students at the Faculty of CSE in PSTU. 4

(d) Define rules of inference with examples. Show that the premises "Everyone in the discrete mathematics class has taken a course in computer science" and "Maryam is a student in the class" imply the conclusion "Maryam has taken a course in computer science." Prove that $\sqrt{2}$ is irrational by giving proof by contradiction. 4

5. a) Define modular arithmetic. Find the value of $(19^3 \bmod 31)^4 \bmod 23$. State the fast modular exponentiation algorithm, using this algorithm to find $3^{644} \bmod 645$. 4

b) What is prime factorization? Explain the procedure proposed by Sieve of Eratosthenes to find all primes not exceeding 100. State Fermat's little theorem. Find $7^{222} \bmod 11$ using Fermat's little theorem. Show that the integer 561 is a Carmichael number. 5

(c) What is the pseudorandom number? Find the sequence ofpseudorandomnumbers generated by the linear congruential method with modulus m = 9, multiplier a = 7, increment c = 4, and seed $x_0 = 3$. Encrypt the message STOP using the RSA cryptosystem with key (2537, 13). Note that 2537 = 43.59, p = 43 and q = 59 are primes, and gcd(e, (p-1)(q-1)) = gcd(13, 42.58) = 1. 5

6. a) What is the growth of functions in explaining the properties of the algorithm? Demonstrate the growth of the following functions: $1, \log n, n, n \log n, n^2, 2^n, n!$ commonly used in big-O estimates. 4

b) State mathematical induction including basis and inductive steps? Use mathematical induction to show that $1+2+2^2+\ldots+2^n = 2^{n+1}-1$ for all nonnegative integers n. 3

c) Write the theorem of the generalized pigeonhole principle. What is the minimum number of students required in a discrete mathematics class to be sure that at least six will receive the same grade if there are five possible grades, A, B, C, D, and F? 3

(d) Show how combinatorial proofs can be used to establish some of the many different identities that express relationships among binomial coefficients. What is the coefficient of $x^{12}y^{13}$ in the expansion of $(x+y)^{25}$? What is Pascal's identity? Illustrate Pascal's triangle using Pascal's identity. 4