Question 1(a) [3 marks]

What is Flow chart? List out symbols used in Flow chart.

Answer:

A **flowchart** is a graphical representation of an algorithm that shows the sequence of steps and decision points in a process using standardized symbols.

Flowchart Symbols Table:

Symbol	Name	Purpose
Oval	Terminal	Start/End of program
Rectangle	Process	Processing/Calculation steps
Diamond	Decision	Conditional statements
Parallelogram	Input/Output	Data input or output
Circle	Connector	Connect flowchart parts
Arrow	Flow line	Direction of flow

Key Points:

- **Visual representation**: Shows program logic graphically
- **Step-by-step**: Displays sequential flow of operations
- **Decision making**: Diamond symbols show conditional branches

Mnemonic: "Flow Charts Show Program Steps Visually"

Question 1(b) [4 marks]

Write a short note on for loop.

Answer:

The **for loop** is used to iterate over a sequence (list, tuple, string, range) in Python.

For Loop Table:

Component	Syntax	Example
Basic	`for variable in sequence:`	`for i in range(5):`
Range	`range(start, stop, step)`	`range(1, 10, 2)`
List	`for item in list:`	`for x in [1,2,3]:`
String	`for char in string:`	`for c in "hello":`

Simple Code Example:

```
for i in range(3):
    print(i)
# Output: 0, 1, 2
```

Key Features:

- **Automatic iteration**: No manual counter needed
- **Sequence traversal**: Works with any iterable object
- **Range function**: Creates number sequences easily

Mnemonic: "For Loops Iterate Through Sequences"

Question 1(c) [7 marks]

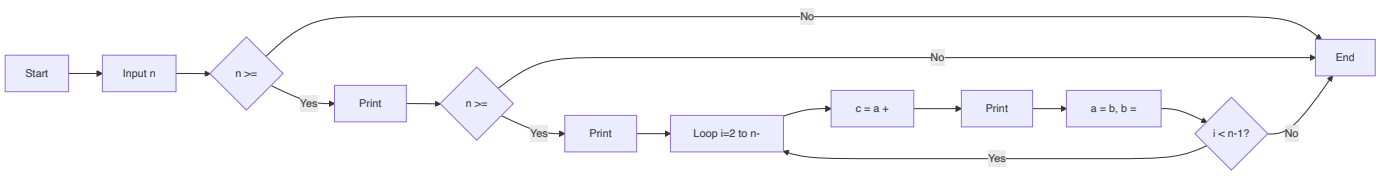
Write a program to display Fibonacci series up to nth term where n is provided by the user.

Answer:

Fibonacci Series Program:

```
# Get number of terms from user
n = int(input("Enter number of terms: "))

# Initialize first two terms
a, b = 0, 1

# Display first term
if n >= 1:
    print(a, end=" ")

# Display second term
if n >= 2:
    print(b, end=" ")

# Generate remaining terms
for i in range(2, n):
    c = a + b
    print(c, end=" ")
    a, b = b, c
```

Algorithm Flow:



Key Concepts:

- **Sequential generation**: Each term = sum of previous two
- **Variable swapping**: Update a, b values efficiently
- **User input**: Dynamic series length

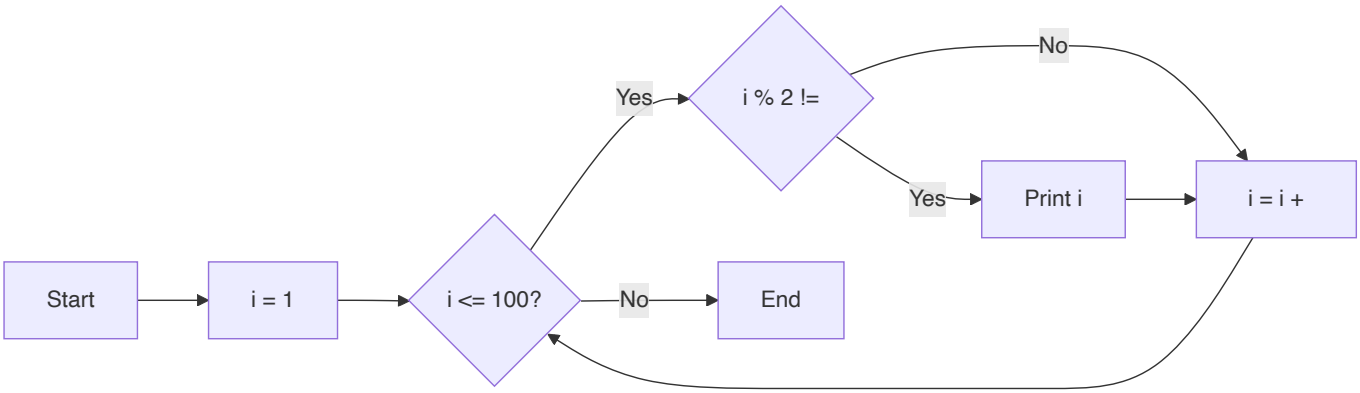
Mnemonic: "Fibonacci: Add Previous Two Numbers"

Question 1(c OR) [7 marks]

Draw a flow chart to print ODD numbers from 1 to 100.

Answer:

Flowchart for ODD Numbers 1 to 100:



Corresponding Python Code:

```
for i in range(1, 101):
    if i % 2 != 0:
        print(i, end=" ")
```

Alternative Method:

```
for i in range(1, 101, 2):
    print(i, end=" ")
```

Key Elements:

- **Loop control**: i from 1 to 100
- **Odd check**: i % 2 != 0 condition
- **Step increment**: Move to next number

Mnemonic: "Odd Numbers: Remainder 1 When Divided by 2"

Question 2(a) [3 marks]

Write a Program to find whether a number is Palindrome or not.

Answer:

Palindrome Check Program:

```
# Input number
num = int(input("Enter a number: "))
temp = num
reverse = 0

# Reverse the number
while temp > 0:
    reverse = reverse * 10 + temp % 10
    temp = temp // 10

# Check palindrome
if num == reverse:
    print(f"{num} is palindrome")
else:
    print(f"{num} is not palindrome")
```

Algorithm Table:

Step	Operation	Example (121)
1	Get last digit	121 % 10 = 1
2	Build reverse	0*10 + 1 = 1
3	Remove last digit	121 // 10 = 12
4	Repeat until 0	Continue process

Key Points:

- **Digit extraction**: Use modulo (%) operator
- **Reverse building**: Multiply by 10 and add digit
- **Comparison**: Original equals reversed

Mnemonic: "Palindrome Reads Same Forward Backward"

Question 2(b) [4 marks]

Explain features of Python Programming.

Answer:

Python Features Table:

Feature	Description	Benefit
Easy Syntax	Simple, readable code	Faster development
Interpreted	No compilation needed	Quick testing
Object-Oriented	Classes and objects support	Code reusability
Open Source	Free to use	No licensing cost
Cross-Platform	Runs on multiple OS	Wide compatibility
Large Libraries	Extensive built-in modules	Rich functionality

Key Advantages:

- **Beginner-friendly**: Easy to learn and understand
- **Versatile**: Web development, AI, data science
- **Community support**: Large developer community
- **Dynamic typing**: No variable type declaration needed

Mnemonic: "Python: Easy, Powerful, Popular Programming"

Question 2(c) [7 marks]

Explain basic structure of Python Program.

Answer:

Python Program Structure:

```
#!/usr/bin/env python3
# Shebang line (optional)

"""
Documentation string (docstring)
Describes program purpose
"""

# Import statements
import math
from datetime import date

# Global variables
PI = 3.14159
count = 0

# Function definitions
def calculate_area(radius):
    """Calculate circle area"""
    return PI * radius * radius
```

```
# Class definitions
class Calculator:
    def __init__(self):
        self.result = 0

# Main program execution
if __name__ == "__main__":
    # Program logic here
    radius = 5
    area = calculate_area(radius)
    print(f"Area: {area}")
```

Structure Components Table:

Component	Purpose	Example
Shebang	System interpreter	`#!/usr/bin/env python3`
Docstring	Program documentation	`"""Program description"""`
Imports	External modules	`import math`
Variables	Global data storage	`PI = 3.14159`
Functions	Reusable code blocks	`def function_name():`
Classes	Object templates	`class ClassName:`
Main block	Program execution	`if __name__ == "__main__":`

Key Principles:

- **Indentation**: Defines code blocks (4 spaces recommended)
- **Comments**: Use # for single line, """ """ for multi-line
- **Modularity**: Organize code in functions and classes

Mnemonic: "Structure: Import, Define, Execute"

Question 2(a OR) [3 marks]

Write a Program to reverse a string.

Answer:

String Reversal Program:

```python
# Method 1: Using slicing
string = input("Enter a string: ")
reversed_string = string[::-1]
print(f"Reversed: {reversed_string}")

# Method 2: Using loop
string = input("Enter a string: ")
reversed_string = ""
for char in string:
    reversed_string = char + reversed_string
print(f"Reversed: {reversed_string}")
```

Reversal Methods Table:

Method	Syntax	Example
Slicing	`string[::-1]`	"hello" → "olleh"
Loop	Build character by character	Add each char to front
Built-in	`"".join(reversed(string))`	Join reversed sequence

Key Concepts:

- **Slicing**: Most efficient method
- **Concatenation**: Build string character by character
- **Indexing**: Access string positions

Mnemonic: "Reverse: Last Character First"

Question 2(b OR) [4 marks]

Explain Logical Operators with example.

Answer:

Python Logical Operators:

Operator	Symbol	Description	Example	Result
AND	`and`	Both conditions true	`True and False`	`False`
OR	`or`	At least one condition true	`True or False`	`True`
NOT	`not`	Opposite of condition	`not True`	`False`

Example Code:

```python
a = 10
b = 5
```

```python
# AND operator
if a > 5 and b < 10:
    print("Both conditions true")

# OR operator
if a > 15 or b < 10:
    print("At least one condition true")

# NOT operator
if not (a < 5):
    print("a is not less than 5")
```

Truth Table:

A	B	A and B	A or B	not A
T	T	T	T	F
T	F	F	T	F
F	T	F	T	T
F	F	F	F	T

Key Uses:

- **Complex conditions**: Combine multiple checks
- **Decision making**: Control program flow
- **Boolean logic**: True/False operations

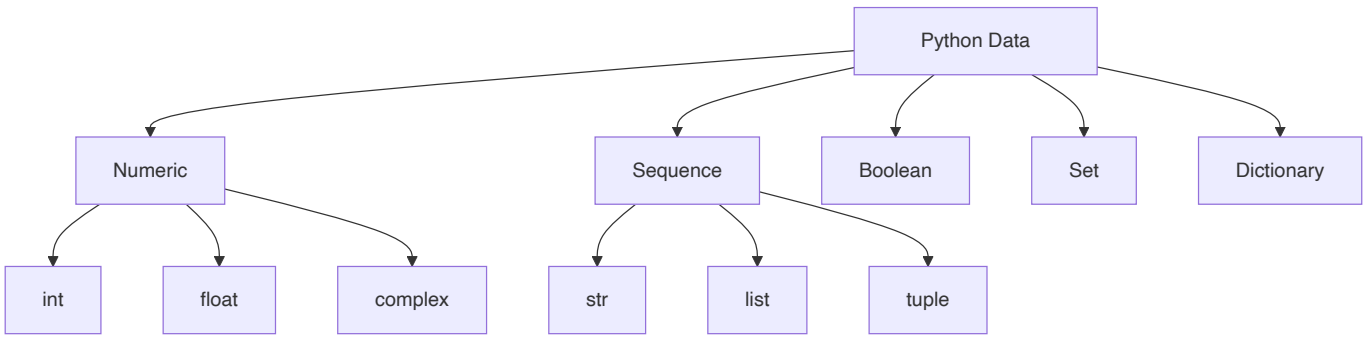
Mnemonic: "AND needs All, OR needs One, NOT reverses"

Question 2(c OR) [7 marks]

Explain different Data Types in Python Programming language

Answer:

Python Data Types Classification:



Data Types Table:

Type	Example	Description	Mutable
int	`42`	Whole numbers	No
float	`3.14`	Decimal numbers	No
str	`"hello"`	Text data	No
list	`[1,2,3]`	Ordered collection	Yes
tuple	`(1,2,3)`	Ordered immutable	No
dict	`{"a":1}`	Key-value pairs	Yes
bool	`True/False`	Boolean values	No
set	`{1,2,3}`	Unique elements	Yes

Example Code:

```
# Numeric types
age = 25          # int
price = 99.99     # float
complex_num = 3+4j # complex

# Sequence types
name = "Python"          # string
numbers = [1,2,3,4]      # list
coordinates = (10,20)    # tuple

# Other types
is_active = True         # boolean
unique_items = {1,2,3}   # set
student = {"name":"John", "age":20}  # dict
```

Key Features:

- **Dynamic typing**: No need to declare variable types
- **Type conversion**: Convert between compatible types
- **Built-in functions**: `type()`, `isinstance()` for checking types

Mnemonic: "Python Types: Numbers, Sequences, Collections"

Question 3(a) [3 marks]

What is flow control in Python? Explain with example

Answer:

Flow control manages the execution order of program statements using conditional and loop structures.

Flow Control Types Table:

Type	Statement	Purpose	Example
Sequential	Normal execution	Line by line	`print("Hello")`
Selection	if, elif, else	Decision making	`if x > 0:`
Iteration	for, while	Repetition	`for i in range(5):`
Jump	break, continue	Loop control	`break`

Example Code:

```
# Selection example
age = 18
if age >= 18:
    print("Adult")
else:
    print("Minor")

# Iteration example
for i in range(3):
    print(f"Count: {i}")
```

Key Concepts:

- **Conditional execution**: Code runs based on conditions
- **Loop structures**: Repeat code blocks
- **Program flow**: Control execution path

Mnemonic: "Flow Control: Decide, Repeat, Jump"

Question 3(b) [4 marks]

Write a program to explain nested if statement.

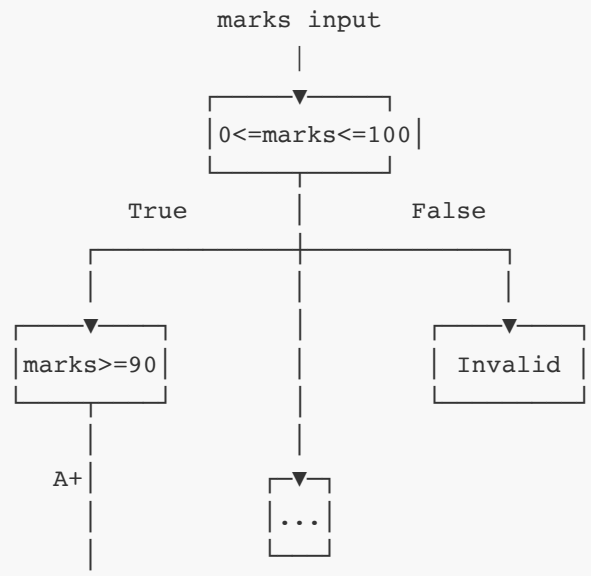
Answer:

Nested If Statement Program:

```
# Grade calculation using nested if
marks = int(input("Enter marks: "))

if marks >= 0 and marks <= 100:
    if marks >= 90:
        grade = "A+"
    elif marks >= 80:
        if marks >= 85:
            grade = "A"
        else:
```

```
            grade = "B+"
    elif marks >= 70:
        grade = "B"
    elif marks >= 60:
        grade = "C"
    else:
        grade = "F"
    print(f"Grade: {grade}")
else:
    print("Invalid marks")
```

Nested Structure Diagram:



Key Features:

- **Multiple levels**: if inside if statements
- **Complex conditions**: Handle multiple criteria
- **Logical structure**: Organize decision trees

Mnemonic: "Nested If: Decisions Within Decisions"

Question 3(c) [7 marks]

Write a program to Explain types of Arguments and Parameters.

Answer:

Types of Arguments and Parameters:

```
# 1. Positional Arguments
def greet(name, age):
    print(f"Hello {name}, you are {age} years old")

greet("John", 25)  # Positional arguments
```

```python
# 2. Keyword Arguments
greet(age=30, name="Alice")  # Keyword arguments

# 3. Default Parameters
def introduce(name, city="Unknown"):
    print(f"{name} lives in {city}")

introduce("Bob")  # Uses default value
introduce("Carol", "NYC")  # Override default

# 4. Variable-length Arguments (*args)
def sum_all(*numbers):
    return sum(numbers)

result = sum_all(1, 2, 3, 4, 5)
print(f"Sum: {result}")

# 5. Keyword Variable Arguments (**kwargs)
def display_info(**info):
    for key, value in info.items():
        print(f"{key}: {value}")

display_info(name="David", age=28, city="Boston")
```

Parameters Types Table:

Type	Syntax	Example	Description
Positional	`def func(a, b):`	`func(1, 2)`	Order matters
Keyword	`def func(a, b):`	`func(b=2, a=1)`	Name specified
Default	`def func(a, b=10):`	`func(5)`	Default value
*args	`def func(*args):`	`func(1,2,3)`	Variable positional
**kwargs	`def func(**kwargs):`	`func(a=1, b=2)`	Variable keyword

Function Call Examples:

```python
def example(pos1, pos2, default=100, *args, **kwargs):
    print(f"pos1: {pos1}")
    print(f"pos2: {pos2}")
    print(f"default: {default}")
    print(f"args: {args}")
    print(f"kwargs: {kwargs}")

example(1, 2, 3, 4, 5, name="test", value=42)
```

Key Concepts:

- **Flexibility**: Different ways to pass data

- **Order importance**: Positional vs keyword
- **Variable arguments**: Handle unknown number of inputs

Mnemonic: "Parameters: Position, Keywords, Defaults, Variables"

Question 3(a OR) [3 marks]

Explain break and continue statement with example.

Answer:

Break and Continue Statements:

Break Statement:

```
# Break example - exit loop
for i in range(10):
    if i == 5:
        break
    print(i)
# Output: 0, 1, 2, 3, 4
```

Continue Statement:

```
# Continue example - skip iteration
for i in range(5):
    if i == 2:
        continue
    print(i)
# Output: 0, 1, 3, 4
```

Comparison Table:

Statement	Purpose	Action	Example Use
break	Exit loop	Terminates entire loop	Exit on condition
continue	Skip iteration	Jump to next iteration	Skip specific values

Key Differences:

- **Break**: Completely exits loop
- **Continue**: Skips current iteration only
- **Flow control**: Manage loop execution

Mnemonic: "Break Exits, Continue Skips"

Question 3(b OR) [4 marks]

Create a program to display the following pattern

```
1
12
123
1234
12345
```

Answer:

Number Pattern Program:

```python
# Method 1: Using nested loops
rows = 5
for i in range(1, rows + 1):
    for j in range(1, i + 1):
        print(j, end="")
    print()  # New line

# Method 2: Using string manipulation
for i in range(1, 6):
    line = ""
    for j in range(1, i + 1):
        line += str(j)
    print(line)

# Method 3: Using join
for i in range(1, 6):
    numbers = [str(j) for j in range(1, i + 1)]
    print("".join(numbers))
```

Pattern Logic Table:

Row	Numbers	Range	Output
1	1	1 to 1	1
2	1,2	1 to 2	12
3	1,2,3	1 to 3	123
4	1,2,3,4	1 to 4	1234
5	1,2,3,4,5	1 to 5	12345

Key Concepts:

- **Nested loops**: Outer for rows, inner for numbers
- **Range function**: Generate number sequences
- **Print control**: Use end="" to avoid newlines

Mnemonic: "Pattern: Row Number Determines Column Count"

Question 3(c OR) [7 marks]

Explain the following mathematical functions by writing a code for each: 1. abs() 2. max() 3. pow() 4. sum()

Answer:

Mathematical Functions in Python:

```
# 1. abs() - Absolute value
numbers = [-5, 3.7, -10.2, 0]
print("abs() function examples:")
for num in numbers:
    print(f"abs({num}) = {abs(num)}")

# 2. max() - Maximum value
list1 = [4, 7, 2, 9, 1]
print(f"\nmax() function examples:")
print(f"max({list1}) = {max(list1)}")
print(f"max(10, 25, 5) = {max(10, 25, 5)}")
print(f"max('hello') = {max('hello')}")  # Alphabetically

# 3. pow() - Power function
print(f"\npow() function examples:")
print(f"pow(2, 3) = {pow(2, 3)}")      # 2^3 = 8
print(f"pow(5, 2) = {pow(5, 2)}")      # 5^2 = 25
print(f"pow(8, 1/3) = {pow(8, 1/3)}")  # Cube root of 8

# 4. sum() - Sum of sequence
numbers = [1, 2, 3, 4, 5]
print(f"\nsum() function examples:")
print(f"sum({numbers}) = {sum(numbers)}")
print(f"sum({numbers}, 10) = {sum(numbers, 10)}")  # With start value
```

Functions Summary Table:

Function	Syntax	Purpose	Example	Result
abs()	`abs(x)`	Absolute value	`abs(-5)`	5
max()	`max(iterable)`	Maximum value	`max([1,5,3])`	5
pow()	`pow(x, y)`	x raised to power y	`pow(2, 3)`	8
sum()	`sum(iterable)`	Sum of values	`sum([1,2,3])`	6

Detailed Examples:

```
# Real-world usage
distances = [-10, 15, -8, 12]  # Signed distances
actual_distances = [abs(d) for d in distances]
print(f"Actual distances: {actual_distances}")
```

```python
scores = [85, 92, 78, 96, 88]
highest_score = max(scores)
total_score = sum(scores)
print(f"Highest: {highest_score}, Total: {total_score}")

# Calculate compound interest
principal = 1000
rate = 0.05
time = 3
amount = principal * pow(1 + rate, time)
print(f"Compound Interest Amount: {amount}")
```

Key Applications:

- **abs()**: Distance calculations, error handling
- **max()**: Finding extremes, competition results
- **pow()**: Scientific calculations, compound interest
- **sum()**: Total calculations, statistics

Mnemonic: "Math Functions: Absolute, Maximum, Power, Sum"

Question 4(a) [3 marks]

Explain scope of variables.

Answer:

Variable Scope refers to the region where a variable can be accessed in a program.

Scope Types Table:

Scope	Description	Lifetime	Access
Local	Inside function	Function execution	Function only
Global	Outside functions	Program execution	Entire program
Built-in	Python keywords	Python session	Everywhere

Example Code:

```
x = 10  # Global variable

def my_function():
    y = 20  # Local variable
    print(f"Local y: {y}")
    print(f"Global x: {x}")

my_function()
print(f"Global x: {x}")
# print(y)  # Error: y not accessible here
```

Key Rules:

- **Local variables**: Created inside functions
- **Global variables**: Accessible throughout program
- **LEGB rule**: Local → Enclosing → Global → Built-in

Mnemonic: "Scope: Local Lives in Functions, Global Lives Everywhere"

Question 4(b) [4 marks]

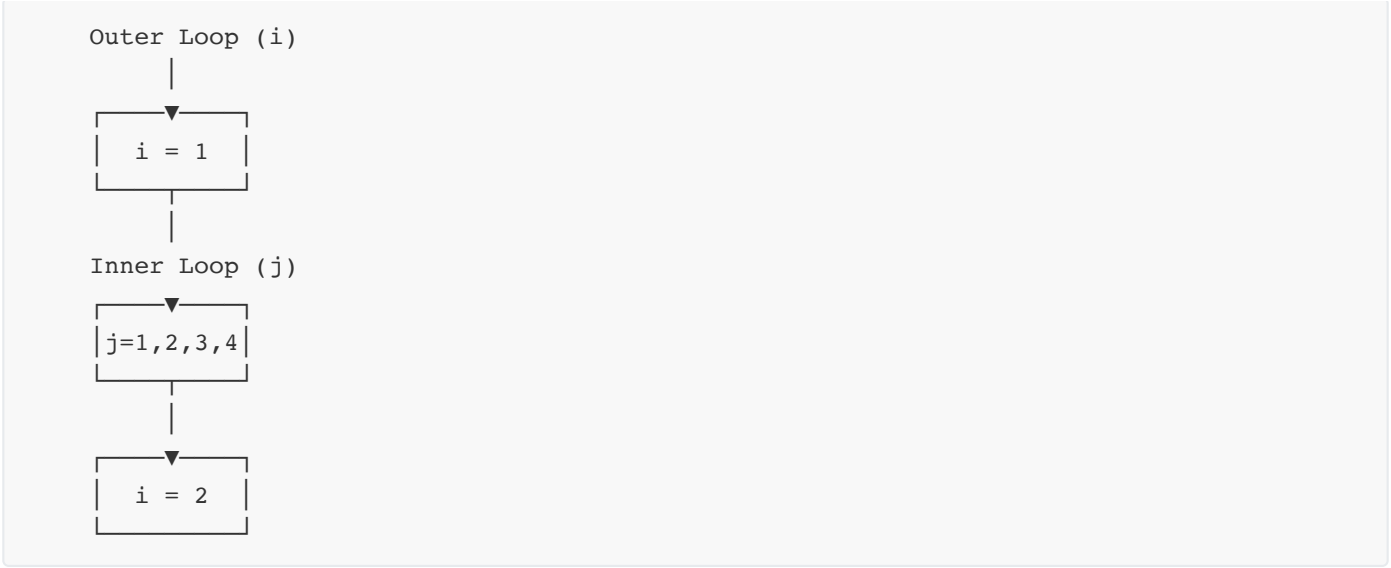
Develop a program to create nested LOOP and display numbers.

Answer:

Nested Loop Program:

```
# Example 1: Number grid
print("Number Grid Pattern:")
for i in range(1, 4):
    for j in range(1, 5):
        print(f"{i}{j}", end=" ")
    print()  # New line after each row

# Example 2: Multiplication table
print("\nMultiplication Table:")
for i in range(1, 4):
    for j in range(1, 6):
        result = i * j
        print(f"{result:3}", end=" ")
    print()

# Example 3: Number pyramid
print("\nNumber Pyramid:")
for i in range(1, 5):
    for j in range(1, i + 1):
        print(j, end=" ")
    print()
```

Nested Loop Structure:



Key Concepts:

- **Outer loop**: Controls rows/major iterations
- **Inner loop**: Controls columns/minor iterations
- **Execution flow**: Inner completes before outer increments

Mnemonic: "Nested Loops: Outer Controls Inner"

Question 4(c) [7 marks]

Write a program to create a list of ODD and EVEN numbers in range of 1 to 50.

Answer:

ODD and EVEN Numbers Program:

```
# Method 1: Using loops and conditions
odd_numbers = []
even_numbers = []

for i in range(1, 51):
    if i % 2 == 0:
        even_numbers.append(i)
    else:
        odd_numbers.append(i)

print("ODD Numbers (1-50):")
print(odd_numbers)
print(f"Count: {len(odd_numbers)}")

print("\nEVEN Numbers (1-50):")
print(even_numbers)
print(f"Count: {len(even_numbers)}")

# Method 2: Using list comprehension
odd_list = [i for i in range(1, 51) if i % 2 != 0]
```

```
even_list = [i for i in range(1, 51) if i % 2 == 0]

print(f"\nOdd (List Comprehension): {odd_list[:10]}...")  # First 10
print(f"Even (List Comprehension): {even_list[:10]}...")  # First 10

# Method 3: Using range with step
odd_range = list(range(1, 51, 2))   # Start 1, step 2
even_range = list(range(2, 51, 2))  # Start 2, step 2

print(f"\nOdd (Range method): {odd_range[:10]}...")
print(f"Even (Range method): {even_range[:10]}...")
```

Number Classification Table:

Type	Condition	Range 1-10	Count (1-50)
ODD	`n % 2 != 0`	1,3,5,7,9	25
EVEN	`n % 2 == 0`	2,4,6,8,10	25

Statistical Analysis:

```
# Analysis of generated lists
print(f"\nStatistical Analysis:")
print(f"Total numbers: {len(odd_numbers) + len(even_numbers)}")
print(f"Odd percentage: {len(odd_numbers)/50*100}%")
print(f"Even percentage: {len(even_numbers)/50*100}%")
print(f"Largest odd: {max(odd_numbers)}")
print(f"Largest even: {max(even_numbers)}")
```

Key Techniques:

- **Modulo operator**: `%` for remainder check
- **List comprehension**: Concise list creation
- **Range function**: Generate sequences efficiently

Mnemonic: "Odd/Even: Remainder 1/0 When Divided by 2"

Question 4(a OR) [3 marks]

Explain String Slicing with example.

Answer:

String Slicing extracts parts of a string using `[start:stop:step]` syntax.

Slicing Syntax Table:

Syntax	Description	Example	Result
`s[start:stop]`	From start to stop-1	`"hello"[1:4]`	"ell"
`s[start:]`	From start to end	`"hello"[2:]`	"llo"
`s[:stop]`	From beginning to stop-1	`"hello"[:3]`	"hel"
`s[::step]`	Every step character	`"hello"[::2]`	"hlo"
`s[::-1]`	Reverse string	`"hello"[::-1]`	"olleh"

Example Code:

```
text = "Python Programming"

# Basic slicing
print(f"First 6 chars: {text[:6]}")      # "Python"
print(f"Last 11 chars: {text[7:]}")      # "Programming"
print(f"Middle part: {text[2:8]}")       # "thon P"

# Step slicing
print(f"Every 2nd char: {text[::2]}")    # "Pto rgamn"

# Negative indexing:**
print(f"Last character: {text[-1]}")     # "g"
print(f"Reverse: {text[::-1]}")          # "gnimmargorP nohtyP"
```

Key Features:

- **Zero-based indexing**: Start from 0
- **Negative indexing**: Count from end (-1)
- **Immutable**: Original string unchanged

Mnemonic: "Slice: Start, Stop, Step"

Question 4(b OR) [4 marks]

Write a program using user defined function to find the factorial of a given number.

Answer:

Factorial Function Program:

```
def factorial(n):
    """Calculate factorial using recursion"""
    if n == 0 or n == 1:
        return 1
    else:
        return n * factorial(n - 1)
```

```python
def factorial_iterative(n):
    """Calculate factorial using loop"""
    result = 1
    for i in range(1, n + 1):
        result *= i
    return result

# Main program
number = int(input("Enter a number: "))
if number < 0:
    print("Factorial not defined for negative numbers")
else:
    result1 = factorial(number)
    result2 = factorial_iterative(number)
    print(f"Factorial of {number} = {result1}")
```

Factorial Table:

n	Factorial	Calculation
0	1	Base case
1	1	Base case
3	6	3 × 2 × 1
5	120	5 × 4 × 3 × 2 × 1

Key Concepts:

- **Recursion**: Function calls itself
- **Base case**: Stops recursive calls
- **User-defined**: Custom function creation

Mnemonic: "Factorial: Multiply All Numbers Below"

Question 4(c OR) [7 marks]

Write a user defined function to check whether a sub string is present in a given string.

Answer:

Substring Check Function:

```python
def find_substring(main_string, sub_string):
    """Check if substring exists in main string"""
    if sub_string in main_string:
        index = main_string.find(sub_string)
        return True, index
    else:
        return False, -1
```

```python
def count_substring(main_string, sub_string):
    """Count occurrences of substring"""
    return main_string.count(sub_string)

def find_all_positions(main_string, sub_string):
    """Find all positions of substring"""
    positions = []
    start = 0
    while True:
        pos = main_string.find(sub_string, start)
        if pos == -1:
            break
        positions.append(pos)
        start = pos + 1
    return positions

# Main program
text = input("Enter main string: ")
search = input("Enter substring to search: ")

found, position = find_substring(text, search)
if found:
    print(f"Substring '{search}' found at position {position}")
    count = count_substring(text, search)
    all_pos = find_all_positions(text, search)
    print(f"Total occurrences: {count}")
    print(f"All positions: {all_pos}")
else:
    print(f"Substring '{search}' not found")
```

String Methods Table:

Method	Purpose	Example	Result
`find()`	Find first position	`"hello".find("ll")`	2
`count()`	Count occurrences	`"hello".count("l")`	2
`in`	Check existence	`"ll" in "hello"`	True
`index()`	Find position (error if not found)	`"hello".index("e")`	1

Key Features:

- **Multiple methods**: Different ways to search
- **Position tracking**: Return index of found substring
- **Error handling**: Check before processing

Mnemonic: "Substring: Search, Find, Count, Position"

Question 5(a) [3 marks]

Explain how to create and access a List with example.

Answer:

List Creation and Access:

```
# Creating lists
empty_list = []
numbers = [1, 2, 3, 4, 5]
mixed = [1, "hello", 3.14, True]
nested = [[1, 2], [3, 4], [5, 6]]

# Accessing elements
print(f"First element: {numbers[0]}")      # 1
print(f"Last element: {numbers[-1]}")      # 5
print(f"Slice: {numbers[1:4]}")            # [2, 3, 4]
```

List Access Methods:

Method	Syntax	Example	Result
Index	`list[i]`	`[1,2,3][1]`	2
Negative	`list[-i]`	`[1,2,3][-1]`	3
Slice	`list[start:stop]`	`[1,2,3,4][1:3]`	[2,3]

Key Features:

- **Ordered collection**: Elements have positions
- **Mutable**: Can be modified after creation
- **Mixed types**: Different data types allowed

Mnemonic: "Lists: Create, Index, Access"

Question 5(b) [4 marks]

List out the operations that can be performed on a LIST. Write a program to create and copy one List into another List.

Answer:

List Operations and Copy Program:

```
# Original list
original = [1, 2, 3, 4, 5]
print(f"Original list: {original}")

# Copying methods
```

```
shallow_copy = original.copy()
slice_copy = original[:]
list_copy = list(original)

# Modify original
original.append(6)
print(f"After append: {original}")
print(f"Shallow copy: {shallow_copy}")

# List operations demonstration
numbers = [10, 20, 30]
numbers.append(40)          # Add to end
numbers.insert(1, 15)       # Insert at position
numbers.remove(20)          # Remove specific value
popped = numbers.pop()      # Remove and return last
```

List Operations Table:

Operation	Method	Example	Result
Add	`append()`	`[1,2].append(3)`	[1,2,3]
Insert	`insert()`	`[1,3].insert(1,2)`	[1,2,3]
Remove	`remove()`	`[1,2,3].remove(2)`	[1,3]
Pop	`pop()`	`[1,2,3].pop()`	[1,2]

Key Concepts:

- **Shallow copy**: Independent list with same elements
- **Deep copy**: Needed for nested structures
- **Multiple methods**: Different copying techniques

Mnemonic: "List Operations: Add, Insert, Remove, Pop, Copy"

Question 5(c) [7 marks]

List and give use of various Built in methods of LIST

Answer:

Built-in List Methods:

```
# Sample list for demonstrations
fruits = ['apple', 'banana', 'cherry', 'apple']
numbers = [3, 1, 4, 1, 5, 9, 2]

# Modification methods
fruits.append('date')              # Add to end
fruits.insert(1, 'avocado')       # Insert at index
```

```
fruits.remove('apple')            # Remove first occurrence
last_fruit = fruits.pop()         # Remove and return last
fruits.clear()                    # Remove all elements

# Search and count methods
fruits = ['apple', 'banana', 'apple', 'cherry']
count = fruits.count('apple')     # Count occurrences
index = fruits.index('banana')    # Find first index

# Sorting and reversing
numbers.sort()                    # Sort in place
numbers.reverse()                 # Reverse in place
sorted_copy = sorted(fruits)      # Return sorted copy

# Extension
more_fruits = ['grape', 'orange']
fruits.extend(more_fruits)        # Add multiple items
```

List Methods Summary:

Category	Method	Purpose	Returns	Modifies Original
Add	`append(x)`	Add item to end	None	Yes
Add	`insert(i,x)`	Insert at position	None	Yes
Add	`extend(list)`	Add multiple items	None	Yes
Remove	`remove(x)`	Remove first x	None	Yes
Remove	`pop(i)`	Remove at index	Removed item	Yes
Remove	`clear()`	Remove all	None	Yes
Search	`index(x)`	Find position	Index	No
Search	`count(x)`	Count occurrences	Count	No
Sort	`sort()`	Sort in place	None	Yes
Sort	`reverse()`	Reverse order	None	Yes
Copy	`copy()`	Shallow copy	New list	No

Practical Examples:

```
# Shopping cart example
cart = []
cart.append('milk')
cart.extend(['bread', 'eggs', 'butter'])
print(f"Items in cart: {len(cart)}")

if 'milk' in cart:
    cart.remove('milk')
    print("Milk removed from cart")

cart.sort()
print(f"Sorted cart: {cart}")
```

Key Applications:

- **Data management**: Add, remove, organize items
- **Search operations**: Find and count elements
- **Sorting**: Organize data in order

Mnemonic: "List Methods: Add, Remove, Search, Sort, Copy"

Question 5(a OR) [3 marks]

Explain how to create and traverse a string by giving an example.

Answer:

String Creation and Traversal:

```
# String creation methods
string1 = "Hello World"        # Double quotes
string2 = 'Python Programming' # Single quotes
string3 = """Multi-line
string example"""              # Triple quotes

# String traversal methods
text = "Python"

# Method 1: Using for loop
for char in text:
    print(char, end=" ")
print()

# Method 2: Using index
for i in range(len(text)):
    print(f"{text[i]} at index {i}")

# Method 3: Using enumerate
for index, char in enumerate(text):
    print(f"Index {index}: {char}")
```

Traversal Methods Table:

Method	Syntax	Use Case
Direct	`for char in string:`	Simple character access
Index	`for i in range(len(s)):`	Need position info
Enumerate	`for i, char in enumerate(s):`	Both index and character

Key Concepts:

- **Immutable**: Strings cannot be changed
- **Iterable**: Can loop through characters
- **Indexing**: Access individual characters

Mnemonic: "Strings: Create, Loop, Access"

Question 5(b OR) [4 marks]

List out the operations that can be performed on a String. Write a code for any 2 operations

Answer:

String Operations:

```
# String operations examples
text = "Python Programming"

# Operation 1: String concatenation and formatting
first_name = "John"
last_name = "Doe"
full_name = first_name + " " + last_name
formatted = f"Hello, {full_name}!"
print(f"Concatenation: {full_name}")
print(f"Formatting: {formatted}")

# Operation 2: String case conversion and splitting
sentence = "learn python programming easily"
title_case = sentence.title()
upper_case = sentence.upper()
words = sentence.split()
print(f"Title case: {title_case}")
print(f"Upper case: {upper_case}")
print(f"Split words: {words}")
```

String Operations Table:

Category	Operation	Example	Result
Join	Concatenation	`"Hello" + " World"`	"Hello World"
Case	`upper()`	`"hello".upper()`	"HELLO"
Case	`lower()`	`"HELLO".lower()`	"hello"
Case	`title()`	`"hello world".title()`	"Hello World"
Split	`split()`	`"a,b,c".split(",")`	['a','b','c']
Replace	`replace()`	`"hello".replace("l","x")`	"hexxo"
Strip	`strip()`	`" hello ".strip()`	"hello"
Find	`find()`	`"hello".find("e")`	1

Key Features:

- **Immutable**: Operations return new strings
- **Method chaining**: Combine multiple operations
- **Flexible**: Many built-in operations available

Mnemonic: "String Operations: Join, Case, Split, Find"

Question 5(c OR) [7 marks]

List and give use of various built – in methods of String.

Answer:

Built-in String Methods:

```
# Sample string for demonstration
text = "  Python Programming Language  "
sample = "Hello World Programming"

# Case conversion methods
print(f"Original: '{text}'")
print(f"upper(): {text.upper()}")
print(f"lower(): {text.lower()}")
print(f"title(): {text.title()}")
print(f"capitalize(): {text.capitalize()}")
print(f"swapcase(): 'Hello'.swapcase()}")

# Whitespace methods
print(f"strip(): '{text.strip()}'")
print(f"lstrip(): '{text.lstrip()}'")
print(f"rstrip(): '{text.rstrip()}'")

# Search and check methods
print(f"find('Python'): {text.find('Python')}")
print(f"count('o'): {sample.count('o')}")
```

```
print(f"startswith('  Py'): {text.startswith('  Py')}")
print(f"endswith('ge  '): {text.endswith('ge  ')}")

# Character type checking
test_string = "Python123"
print(f"isalpha(): {'Python'.isalpha()}")
print(f"isdigit(): {'123'.isdigit()}")
print(f"isalnum(): {test_string.isalnum()}")

# Split and join methods
words = sample.split()
joined = "-".join(words)
print(f"split(): {words}")
print(f"join(): {joined}")

# Replace method
replaced = sample.replace("World", "Universe")
print(f"replace(): {replaced}")
```

String Methods Classification:

Category	Methods	Purpose	Example
Case	`upper(), lower(), title(), capitalize()`	Change case	`"hello".upper()` → "HELLO"
Whitespace	`strip(), lstrip(), rstrip()`	Remove spaces	`" hi ".strip()` → "hi"
Search	`find(), index(), count()`	Find substrings	`"hello".find("e")` → 1
Check	`startswith(), endswith()`	Test string ends	`"hello".startswith("h")` → True
Type Check	`isalpha(), isdigit(), isalnum()`	Character types	`"123".isdigit()` → True
Split/Join	`split(), join()`	Break/combine	`"a-b".split("-")` → ['a','b']
Replace	`replace()`	Substitute text	`"hi".replace("i","o")` → "ho"

Real-world Examples:

```
# Email validation example
email = "  USER@EXAMPLE.COM  "
clean_email = email.strip().lower()
is_valid = "@" in clean_email and "." in clean_email
print(f"Clean email: {clean_email}")
print(f"Valid format: {is_valid}")

# Text processing example
user_input = "python programming"
formatted_title = user_input.title()
word_count = len(user_input.split())
print(f"Formatted: {formatted_title}")
print(f"Word count: {word_count}")
```

Key Applications:

- **Data cleaning**: Remove unwanted spaces, fix case
- **Text processing**: Search, replace, split content
- **Validation**: Check string format and content
- **Formatting**: Prepare text for display

Mnemonic: "String Methods: Case, Clean, Check, Change"