(a) Basic I/O Programming file Operations

```
file1 = open('myfile.txt','w')
L = ["This is Delhi \n", "This is Paris \n", "This is London \n"]

file1.write("Hello \n")
file1.writelines(L)
file1.close()

file1 = open("myfile.txt","r+")
print("Output of Read function is ")
print(file1.read())
print()

file1.seek(0)

print("Output of ReadLine function is ")
print(file1.readline())
print()

file1.seek(0)

print("Output of Read(9) function is ")
print(file1.read(9))
print()

file1.seek(0)

print("Output of Readline(9) function is ")
print(file1.readline(9))

file1.seek(0)
```

```
# readlines function
print("Output of Readlines function is ")
print(file1.readlines())
print()
file1.close()
```

OUTPUT:

Output of Read function is

Hello

This is Delhi

This is Paris

This is London

Output of ReadLine function is

Hello

Output of Read(9) function is

Hello

Th

Output of Readline(9) function is

Hello

Output of Readlines function is

['Hello \n', 'This is Delhi \n', 'This is Paris \n', 'This is London \n']

2. Shortest Job First Algorithm

```
# Shortest Job First Non- Preemptive
print("Shortest Job First (Non- Preemptive) programming!".center(105, "~"),"\n")

# process to list
P = ['p1','p2','p3','p4']
p = P.copy()

# set a AT to list
AT = [0,1,2,3]
at = AT.copy()

# set a BT to list
BT = [8,4,9,5]
bt = BT.copy()

GC = [] # Create a Gantt chart
for i in range(len(P)):
    miv = bt.index(min(bt)) # min index value for bt !
    if i == 0:
        miv = at.index(min(at))
        GC.append([at[miv], p[miv], bt[miv]])
    else:
        GC.append([at[miv], p[miv], GC[i - 1][2] + bt[miv]])
    at.pop(miv);p.pop(miv);bt.pop(miv)
#print(GC)
CT = [i for i in range(1,6)]
TAT = [i for i in range(1,6)]
WT = [i for i in range(1,6)]
```

```
for i in range(len(P)):
    index = P.index(GC[i][1])
    CT[index] = GC[i][2]
    TAT[index] = CT[index] - AT[index]
    WT[index] = TAT[index] - BT[index]

print("*" * 105)
print("process : Arrival Time : Burst Time : Completion Time : Turn Around Time : Waiting Time ")
for i in range(len(P)):
    print(P[i]," " * 4,":",AT[i]," " * 10,":",BT[i]," " * 8,":",CT[i]," " * 14,":",TAT[i],
        " " * 14,":",WT[i])
print("*" * 105)
print("Average time of Turn Around time :", sum(TAT) / len(P))
print("Average time of Waiting time :", sum(WT) / len(P))
```

OUTPUT:

```
~~~~~~~~~~~~~~~~~Shortest Job First (Non-Preemptive) programming!~~~~~~~~~~~~~~~

*********************************************************************************
process : Arrival Time : Burst Time : Completion Time : Turn Around Time : Waiting Time
p1        : 0            : 8        : 8               : 8                : 0
p2        : 1            : 4        : 12              : 11               : 7
p3        : 2            : 9        : 26              : 24               : 15
p4        : 3            : 5        : 17              : 14               : 9
*********************************************************************************
Average time of Turn Around time : 14.25
Average time of Waiting time : 7.75
```

From the above Gantt chart, if the processes arrive in the order P1,P2,P3, and are served in FCFS order, we get the result shown above. The waiting time is 0 milliseconds for process P1, 24 milliseconds for process P2, and 27 milliseconds for process P3. Thus, the average waiting time is (0+ 24 + 27)/3 = 17 milliseconds.

Result: Thus the program for First Come First Serve is written using python programming language and executed successfully.

3. First Come First Served Algorithm.

```
print("FIRST COME FIRST SERVE SCHEDULLING")
n= int(input("Enter number of processes : "))
d = dict()

for i in range(n):
    key = "P"+str(i+1)
    a = int(input("Enter arrival time of process"+str(i+1)+": "))
    b = int(input("Enter burst time of process"+str(i+1)+": "))
    l = []
    l.append(a)
    l.append(b)
    d[key] = l

d = sorted(d.items(), key=lambda item: item[1][0])

ET = []
for i in range(len(d)):
    # first process
    if(i==0):
        ET.append(d[i][1][1])
    elif (d[i][1][0] > d[i-1][1][1]):
        ET.append(d[i][1][0] + d[i][1][1])
    # get prevET + newBT
    else:
```

```
        ET.append(ET[i-1] + d[i][1][1])

TAT = []
for i in range(len(d)):
    TAT.append(ET[i] - d[i][1][0])

WT = []
for i in range(len(d)):
    WT.append(TAT[i] - d[i][1][1])

avg_WT = 0
for i in WT:
    avg_WT +=i
avg_WT = (avg_WT/n)

print("Process | Arrival | Burst | Exit | Turn Around | Wait |")
for i in range(n):
     print("   ",d[i][0],"   |   ",d[i][1][0]," |    ",d[i][1][1]," |    ",ET[i],"  |    ",TAT[i],"  |   ",WT[i],"   |  ")
print("Average Waiting Time: ",avg_WT)
```

OUTPUT:

```
~~~~~~~~First Come First Served Algorithm~~~~~~~~~
processes Burst time Waiting time Turn around time
 1        24        0        24
 2        3         24       27
 3        3         27       30
Average Waiting time = 17.0
Average turn around time = 27.0
```

4. Round Robin CPU Scheduling Algorithm.

```
def findWaitingTime(processes, n, bt, wt, quantum):
    rem_bt = [0] * n

    # Copy the burst time into rt[]
    for i in range(n):
        rem_bt[i] = bt[i]
    t = 0 # Current time

    # Keep traversing processes in round
    # robin manner until all of them are
    # not done.
    while(1):
        done = True

        # Traverse all processes one by
        # one repeatedly
        for i in range(n):

            # If burst time of a process is greater
            # than 0 then only need to process further
            if (rem_bt[i] > 0) :
                done = False # There is a pending process
```

```
                if (rem_bt[i] > quantum) :

                    # Increase the value of t i.e. shows
                    # how much time a process has been processed
                    t += quantum

                    # Decrease the burst_time of current
                    # process by quantum
                    rem_bt[i] -= quantum

                # If burst time is smaller than or equal
                # to quantum. Last cycle for this process
                else:

                    # Increase the value of t i.e. shows
                    # how much time a process has been processed
                    t = t + rem_bt[i]

                    # Waiting time is current time minus
                    # time used by this process
                    wt[i] = t - bt[i]

                    # As the process gets fully executed
                    # make its remaining burst time = 0
                    rem_bt[i] = 0

        # If all processes are done
        if (done == True):
            break

# Function to calculate turn around time
def findTurnAroundTime(processes, n, bt, wt, tat):

    # Calculating turnaround time
```

```
    for i in range(n):
        tat[i] = bt[i] + wt[i]

# Function to calculate average waiting
# and turn-around times.
def findavgTime(processes, n, bt, quantum):
    wt = [0] * n
    tat = [0] * n

    # Function to find waiting time
    # of all processes
    findWaitingTime(processes, n, bt, wt, quantum)

    # Function to find turn around time
    # for all processes
    findTurnAroundTime(processes, n, bt, wt, tat)

    # Display processes along with all details
    print("Processes Burst Time    Waiting","Time Turn-Around Time")
    total_wt = 0
    total_tat = 0
    for i in range(n):
        total_wt = total_wt + wt[i]
        total_tat = total_tat + tat[i]
        print(" ", i + 1, "\t\t", bt[i],"\t\t", wt[i], "\t\t", tat[i])

    print("\nAverage waiting time = %.5f "%(total_wt /n) )
    print("Average turn around time = %.5f "% (total_tat / n))

# Driver code
if __name__ =="__main__":

    # Process id's
    proc = [1, 2, 3]
```

```
n = 3

# Burst time of all processes
burst_time = [24, 3, 3]

# Time quantum
quantum = 4;
findavgTime(proc, n, burst_time, quantum)
```

OUTPUT:

---------Round robin Scheduling Algorithm---------

Processes	Burst Time	Waiting Time	Turn-Around Time
1	24	6	30
2	3	4	7
3	3	7	10

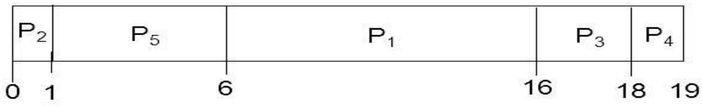
Average waiting time = 5.66667
Average turn around time = 15.66667

Calculation

Non-preemptive priority

Process	Burst Time	Priority	arrival time
P_1	10	3	0
P_2	1	1	0
P_3	2	4	0
P_4	1	5	0
P_5	5	2	0

- Priority Scheduling (non-preemptive)



- Average waiting time = (0 + 1 + 6 + 16 + 18)/5 = 8.2

Priority Scheduling

```
def findWaitingTime(processes, n, wt):
    wt[0] = 0
    for i in range(1, n):
        wt[i] = processes[i - 1][1] + wt[i - 1]

def findTurnAroundTime(processes, n, wt, tat):
    for i in range(n):
        tat[i] = processes[i][1] + wt[i]

def findavgTime(processes, n):
    wt = [0] * n
    tat = [0] * n

    findWaitingTime(processes,n,wt)
    findTurnAroundTime(processes, n, wt, tat)
    print("\nprocesses \tBurst time \tWaiting Time \tTurn-Around Time")
    total_wt = 0
    total_tat = 0
```

```
    for i in range(n):
        total_tat += wt[i]
        total_wt += tat[i]
        print(" ", processes[i][0], "\t\t",
            processes[i][1], "\t\t", wt[i],"\t\t",tat[i])



    print("Average turn around time = " + str(total_tat/n))
    print("Average Waiting time = " + str(total_wt /n))

def priorityScheduling(proc, n):
    proc = sorted(proc, key = lambda proc:proc[2], reverse = False)
    print("Order in which processes gets executed")

    for i in proc:
        print(i[0], end = " ")
    findavgTime(proc, n)

if __name__ == "__main__":

    # Process id's
    proc = [
        [1, 10, 3],
        [2, 1, 1],
        [3, 2, 3],
        [4, 1, 4],
        [5, 5, 2]
        ]
    n = 5
    priorityScheduling(proc, n)
```

OUTPUT:

Order in which processes gets executed

6. To implement reader/writer problem using semaphore.

```
# implement  reader write problem using semaphore

import threading
import time

class ReaderWriterProblem():
    def __init__(self):
        self.mutex = threading.Semaphore()
        self.wrt = threading.Semaphore()
        self.r_c = 0

    def reader(self):
        while True:
```

```
            self.mutex.acquire()
            self.r_c += 1

            if self.r_c == 1:
                self.wrt.acquire()

            self.mutex.release()
            print(f"\nReader {self.r_c} is reading")

            self.mutex.acquire()
            self.r_c -=1

            if self.r_c == 0:
                self.wrt.release()

            self.mutex.release()
            time.sleep(3)

    def writer(self):
        while True:
            self.wrt.acquire()
            print("Writing data .......")
            print("-"* 20)
            self.wrt.release()
            time.sleep(3)

    def main(self):
        t1 = threading.Thread(target = self.reader)
        t1.start()

        t2 = threading.Thread(target = self.writer)
        t2.start()

        t3 = threading.Thread(target = self.reader)
```

```
        t3.start()

        t4 = threading.Thread(target = self.reader)
        t4.start()

        t6 = threading.Thread(target = self.writer)
        t6.start()

        t5 = threading.Thread(target = self.reader)
        t5.start()

if __name__ == "__main__":
    c = ReaderWriterProblem()
    c.main()
```

OUTPUT:

```
Reader 1 is reading
Writing data .......
--------------------
Writing data .......
--------------------

Reader 1 is reading

Reader 1 is reading

Reader 1 is reading
```

Result: Thus the program for Banker’s Algorithm is written using python programming language and executed successfully.

7. To implement Banker’s algorithm for Deadlock avoidance.

Program for page replacement algorithms:

```
# implement Banker's algorithm for Deadlock avoidance
P = 5
R = 3
def calculateNeed(need, maxm, allot):
    for i in range(P):
        for j in range(R):
            #print(need)
            #print("i:",i, "j:",j)
```

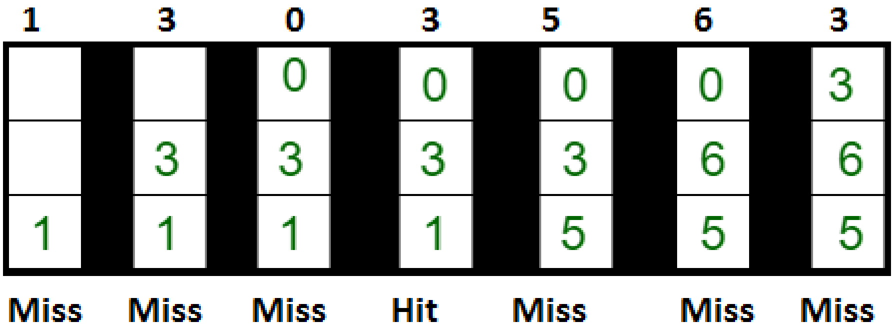
```
            need[i][j] = maxm[i][j] - allot[i][j]

def isSafe(processes,avail, maxm, allot):
    need = []
    for i in range(P):
        l = []
        for j in range(R):
            l.append(0)
        need.append(l)

    calculateNeed(need, maxm, allot)
    finish = [0] * P
    safeSeq = [0] * P

    work = [0] * R
    for i in range(R):
        work[i] = avail[i]
    count = 0
    while(count < P):
        found = False
        for p in range(P):
            if (finish[p] == 0):
                for j in range(R):
                    if (need[p][j] > work[j]):
                        break
                if (j == R - 1):
                    for k in range(R):
                        work[k] += allot[p][k]
                    safeSeq[count] = p
                    count += 1
                    finish[p] = 1
                    found = True

        if (found == False):
```

```
            print("System i not in safe state")
            return False

    print("System is in safe state.\nsafe sequence is: ", end = " ")
    print(*safeSeq)
    return True

if __name__ == "__main__":
    processes = [0,1,2,3,4]

    avail = [3,3,2]

    maxm = [ [7,5,3],
             [3,2,2],
             [9,0,2],
             [2,2,2],
             [4,3,3]
         ]

    allot = [[0,1,0],
             [2,0,0],
             [3,0,2],
             [2,1,1],
             [0,0,2]]

    isSafe(processes, avail, maxm, allot)
```

OUTPUT:

System is in safe state.

safe sequence is: 1 3 4 0 2



Total page fault = 6

ALGORITHM:

Step 1. Start the process

Step 2. Read number of pages n

Step 3. Read number of pages no

Step 4. Read page numbers into an array a[i]

Step 5. Initialize avail[i]=0 .to check page hit

Step 6. Replace the page with circular queue, while replacing check page availability in the frame Place avail[i]=1 if page is placed in the frame Count page faults

Step 7. Print the results.

Step 8. Stop the process.

Result: Thus the program for FIFO page replacement is written using python programming language and executed successfully.

8. First In First Out Algorithm.

implement of FIFO page replacement in Operating system.

```
from queue import Queue
# Fucntion to find page faults using FIFO
def pageFaults(pages, n, capacity):
    s = set()
    indexes = Queue()
    page_faults = 0
    for i in range(n):
        if (len(s) < capacity):

            if (pages[i] not in s):
                s.add(pages[i])
                page_faults += 1
                indexes.put(pages[i])
        else:
            if (pages[i] not in s):
                val =  indexes.queue[0]
                indexes.get()
                s.remove(val)
                s.add(pages[i])
                indexes.put(pages[i])
                page_faults += 1
        print(s,end = " ")
        print("Page Fault Count", page_faults)
    return page_faults

if __name__ == "__main__":
    pages = [3,2,1,0,3,2,4,3,2,1,0,4]
    n = len(pages)
    capacity = 3
    print("Total page fault count",pageFaults(pages, n, capacity))
```

OUTPUT:

{3} Page Fault Count 1

Calculation

Let's take the following reference string to understand the LFU Page Replacement algorithm.

7 0 1 2 0 3 0 4 2 3 0 3 1 2 0

Find the number of page faults when the LFU page replacement policy is used. Also, consider the page frame size to be three.

Solution:

Reference String:

7 0 1 2 0 3 0 4 2 3 0 3 1 2 0

String	7	0	1	2	0	3	0	4	2	3	0	3	1	2	0
Frame 3			1	1	1	3	3	3	2	2	2	2	1	1	1
Frame 2		0	0	0	0	0	0	0	0	3	3	3	3	3	0
Frame 1	7	7	7	2	2	2	2	4	4	4	0	0	0	2	2
Miss/Hit	M	M	M	M	H	M	H	M	M	M	M	H	M	M	M

Total number of reference strings = 15

Total number of page faults or page misses = 12

Result: Thus the program for LRU page replacement is written using python programming language and executed successfully.

9. Least Recently Used Algorithm.

```
# python3 program for LRU page replacement algorithm
size = 3
reference_string = [7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 1, 2, 0]

# creating a list to store the current pages in memory
pages = []

# page faults
faults = 0

# page hits
hits = 0

# iterating the reference string
for ref_page in reference_string:

    # if a ref_page already exists in pages list, remove it and append it at the end
    if ref_page in pages:
        pages.remove(ref_page)

        pages.append(ref_page)

        # incrementing the page hits
        hits += 1

    # if ref_page is not in the pages list
    else:
        # incrementing the page faults
        faults +=1

        # check length of the pages list. If length of pages list
        # is less than memory size, append ref_page into pages list
        if(len(pages) < size):
            pages.append(ref_page)
```

EXPERIMENT.NO 10

AIM: To Write a Python program to simulate the First- Fit contiguous memory allocation technique.

ALGORITHM:

Step 1:Start the program

Step 2: Write the function to find the First Fit

Step 3: Get the number of process,block size using len function.

Step 4: Use two for loop with range process and block size

Step 5: Check whether not occupied[j] and (block_size[j] >= process_size[i]):

Step 6: Assign allocate[i] = j

occupied[j] = True

break

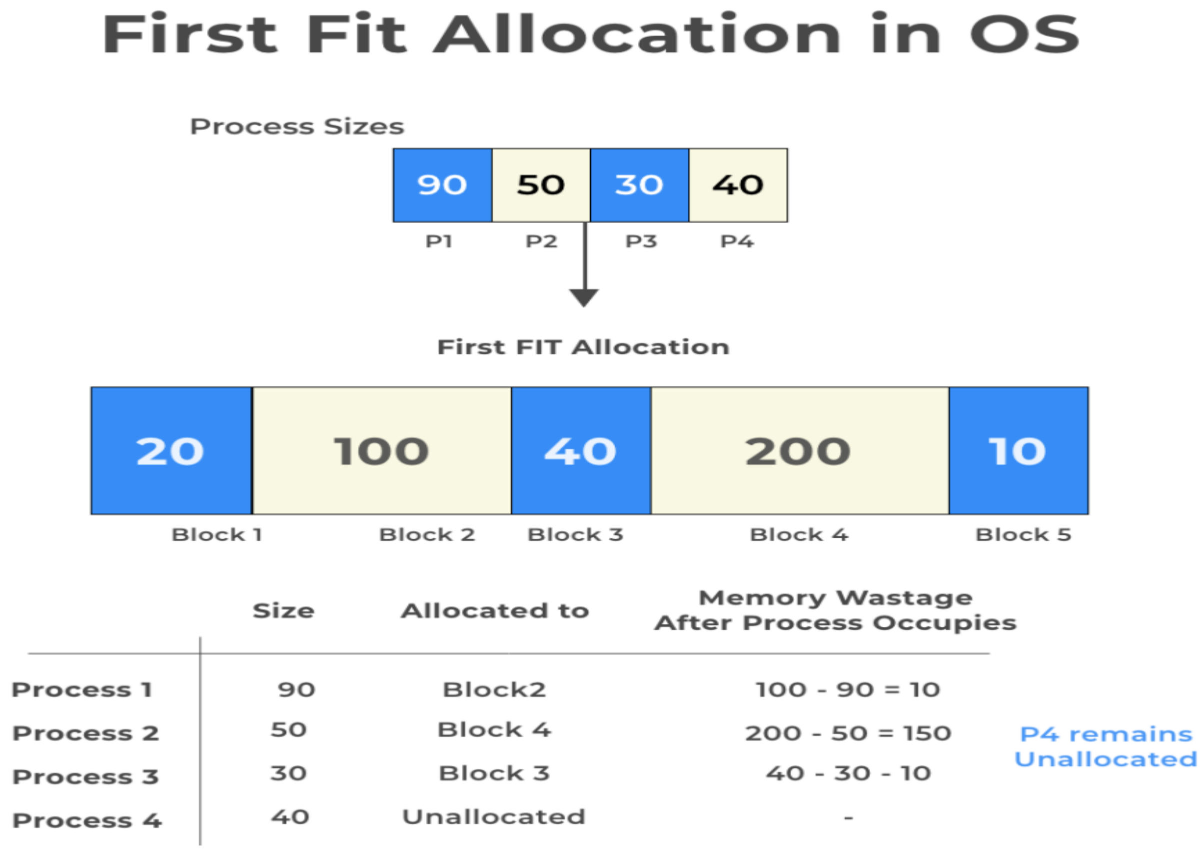
Step 7: Repeat step 4 to step 6.

Step 8: Print file no,size,block no,size and fragment.

Step 9: Stop the program.

Result: Thus the program for First- Fit contiguous memory allocation technique is written using python programming language and executed successfully.

CALCULATION:



10. To implement first fit, best fit and worst fit algorithm for memory management.

```
# python3 program for first fit memory management algorithm
# 9th a
def FirstFit(block_size, blocks, process_size, processes):
    allocate = [-1] * processes
    occupied = [False] * blocks

    for i in range(processes):
        for j in range(blocks):
            if not occupied[j] and (block_size[j] >= process_size[i]):

                allocate[i] = j
                occupied[j] = True
                break
    print("Process No.\t process size \t\t Block no.")

    for i in range(processes):
        print(i+1,"\t\t\t",process_size[i], "\t\t\t", end = "   ")
```

EXPERIMENT.NO 11

AIM: To Write a Python program to simulate the Best- Fit contiguous memory allocation technique.

ALGORITHM:

Step 1:Start the program

Step 2: Write the function to find the BestFit

Step 3: Get the number of process,block size using len function.

Step 4: Use two for loop with range process and block size

Step 5: Check if block_size[j] >= process_size[i]:

Step 6: If so check if bestIdx == -1:

bestIdx = j

Step 7: Else check block_size[bestIdx] > block_size[j]:

brestIdx = j

Step 8: Print file no,size,block no,size and fragment.

Step 9: Stop the program.

Result: Thus the program for Best- Fit contiguous memory allocation technique is written using python programming language and executed successfully.

```
# Python3 implementation of Best - Fit algorithm
# Function to allocate memory to blocks
# as per Best fit algorithm
def bestFit(blockSize, m, processSize, n):

    # Stores block id of the block
    # allocated to a process
    allocation = [-1] * n

    # pick each process and find suitable
    # blocks according to its size ad
    # assign to it
    for i in range(n):

        # Find the best fit block for
```

```
bestFit(blockSize, m, processSize, n)
```

OUTPUT:

Process No.	**Process Size**	**Block no.**
1	212	4
2	417	2
3	112	3
4	426	5

EXPERIMENT.NO 12

AIM: To Write a Python program to simulate the Worst- Fit contiguous memory allocation technique.

ALGORITHM:

Step 1:Start the program

Step 2: Write the function to find the WorstFit

Step 3: Get the number of process,block size using len function.

Step 4: Use two for loop with range process and block size

Step 5: Check if block_size[j] >= process_size[i]:

Step 6: If so check if bestIdx == -1:

    bestIdx = j

Step 7: Else check block_size[bestIdx] > block_size[j]:

    brestIdx = j

Step 8: Print file no,size,block no,size and fragment.

Step 9: Stop the program.

Result: Thus the program for Worst- Fit contiguous memory allocation technique is written using python programming language and executed successfully.

 # 9 (c) implement worst fit algorithm for memory management

 # python3 program for worst fit memory management algorithm

```
def worstFit(blockSize, m, processSize, n):

    # Stores block id of the block
    # allocated to a process

    # Initially no block is assigned
    # to any process
    allocation = [-1] * n

    # pick each process and find suitable blocks
```

```
blockSize = [100, 500, 200, 300, 600]
processSize = [212, 417, 112, 426]
m = len(blockSize)
n = len(processSize)

worstFit(blockSize, m, processSize, n)
```

OUTPUT:

```
                 Worst Fit Algorithm
Process No. Process Size     Block no.
1                212          5
2                417          2
3                112          5
4                426         Not Allocated
```

EXPERIMENT.NO 13

AIM: To Write a Python program to simulate the interprocess communication

ALGORITHM:

Step 1: Start the program

Step 2 : import multiprocessing from python library

Step 3: Define two functions namely sender and receiver

Step 4: With the help of while loop print the message

Step 5 : Stop the program

Result: Thus the program for Inter process Communication technique is written using python programming language and executed successfully.

13. Program for Inter-process Communication.

```
# python3 program for multiprogramming shared memory
import multiprocessing
def sender(conn, msgs):
    """
    function to send messages to other end of pipe
    """
    for msg in msgs:
```

```
        conn.send(msg)
        print("Sent the message: {}".format(msg))
    conn.close()

def receiver(conn):
    """
    function to print the messages received from other
    end of pipe
    """
    while 1:
        msg = conn.recv()
        if msg == "END":
            break
        print("Received the message: {}".format(msg))

if __name__ == "__main__":
    # messages to be sent
    msgs = ["hello", "hey", "hru?", "END"]

    # creating a pipe
    parent_conn, child_conn = multiprocessing.Pipe()

    # creating new processes
    p1 = multiprocessing.Process(target=sender, args=(parent_conn,msgs))
    p2 = multiprocessing.Process(target=receiver, args=(child_conn,))

    # running processes
    p1.start()
    p2.start()

    # wait until processes finish
    p1.join()
    p2.join()
```

OUTPUT:

```
Sent the message: hello
Sent the message: hey
Sent the message: hru?
Sent the message: END
Received the message: hello
Received the message: hey
Received the message: hru?
```