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|---|---|--------------------|
| Course Code: 0714 02 CSE 3107 | Year: Third | Term: First |
| Course Title: Operating System and Systems Programming | | |
| Course Status: Core | | |
| Credit: 3.00 | | |
| Prerequisite(s): None | | |
| Rationale | Rationale: This course is designed to teach the design of operating systems and other systems. | |

| Course Contents | | CLOs |
|------------------------|--|-------------|
| Section A | | |
| 1 | Assembler: General Design procedures, Table Processing, Macro Language and Microprocessors | 1 |
| 2 | Loaders: Design of absolute loader and direct link loader, Linkers, Translators. | 1, 2, 3 |
| 3 | Evolution of Operating Systems: Early Operating Systems, Improvements in System Utilization, Spooling, Interrupts and Interrupt Handling. | 2, 3 |
| Section B | | CLOs |
| 4 | Systems: Microcomputer and Microcomputer Systems, Distributed Computing and Network Based Systems. | 2, 3 |
| 5 | Virtual Systems: Virtual Memory, Paging and Segmentation, Virtual Devices and Generalization to Virtual Systems. | 2, 3, 4 |
| 6 | Concurrency Management: Erroneous Results from concurrent Accesses, Concurrency on the basis of an Operating System, Cost Evaluation of Spooling, Long and Short Term Scheduling, Round Robin and Other Scheduling Policies. | 2, 3, 4 |
| 7 | State Space Description of Operating System: Process Creation and Removal, Samples of Process Life Cycle and Bootstrapping, Layered Concepts in Operating Systems, Kernel, Memory Manager, I/O systems, File Manager, Resource Manager, Command Interpreter and Application Programs. | 2, 3, 4 |

CSE 22 Batch

Course Teacher :

CT Questions

Class Test #1, Full Marks: 30 Time : 30 minutes
Each question has equal marks

Q1. Consider the following four processes with arrival times (in milliseconds) and their lengths of CPU bursts (in milliseconds) as shown below:

| Process | P1 | P2 | P3 | P4 |
|----------------|----|----|----|----|
| Arrival Time | 0 | 1 | 3 | 4 |
| CPU Burst Time | 3 | 1 | 3 | Z |

These processes are run on a single processor using preemptive Shortest Remaining Time First scheduling algorithm. If the average waiting time of the processes is 1 millisecond, then what is the value of Z?

Q2. Three process P1, P2 and P3 arrive at time zero. Their total execution time is 10ms, 15ms, and 20ms respectively. They spent first 20% of their execution time in doing I/O, next 60% in CPU processing and the last 20% again doing I/O. For what percentage of time was the CPU free? Use Round Robin algorithm with time quantum 5 milliseconds.

Class Test #2, Full Marks: 30 Time : 30 minutes
Marks Distribution: 1. 8 +8=16 2. 7 3. 7

Q.1 Memory request from four processes are 300k, 25k, 125k, and 50k , respectively (in order).



Based on these scenario, whether all the requests are satisfied if

- i. Best fit is applied
- ii. First fit is applied

Q2. Consider the system: Number of pages = 2k, Page size = 4k words, Physical address = 18 bits. Calculate the logical address space and number of frames.

Q3. Consider a system with logical address = 32 bits, physical address space = 64 MB and page size is 4 KB. The memory is byte addressable. Page table entry is 2 bytes. What is the approximate page table size?

Khulna University, CSE Discipline

Third Year, Term I

Course No.: 071402 CSE 3107, Course Title: Operating System and Systems Programming

Class Test #3, Full Marks: 30 Time : 40 minutes

Marks Distribution: 1.a 8 1.b 8 2.a 4 2.b 8 2.c 2

Q.1 (a) Why do we need page replacement? What are the disadvantages of optimal page replacement algorithm?

(b) Describe Clock Page Replacement algorithm.

Q.2(a) What are the conditions to hold to have a good solution for achieving mutual exclusion?

(b) Describe strict alternation'solution.

(c) What are the disadvantages of strict alternation?

Khulna University, CSE Discipline

Third Year, Term I

Course No.: 071402 CSE 3107 Course Title: Operating System and Systems Programming

Class Test #4 Full Marks: 30

Marks

1. Discuss the factors to be considered for approaching a new machine. 10
2. Describe IBM 360 instruction format. 10
3. What is assembler? Mention the steps for designing an assembler. 10

Khulna University, CSE Discipline, Third Year, Term I

Course No.: 071402 CSE 3107 Course Title: Operating System and Systems Programming

Class Test #4 Full Marks: 30

Marks

1. Describe Not Recently Used (NRU) page replacement algorithm. 10
2. Write the algorithm for detecting deadlock with multiple instances of resources of each type. 10
3. Write down the policies to recover from deadlock. 10

Term Final :

Khulna University, Khulna
Computer Science and Engineering Discipline

3rd Year Term I Examination 2025

Session: 2023 – 2024

Course No.: 0714 02 CSE 3107, Course Title: Operating System and Systems Programming
Full Marks: 60 Time: 03 Hours Date: 03/07/2025

- The figures in the right margin indicate the full marks.
- Use separate answer sheet for each section.

Section A

There are **FOUR** questions in this section. Answer any **THREE** questions.

- | | | |
|------|--|----|
| 1(a) | What are the three main purposes of an operating system? What is the difference between timesharing and multiprogramming systems? [L1, CLO1] | 03 |
| 1(b) | In a multiprogramming and time-sharing environment, several users share the system simultaneously. This situation can result in various security problems. a. What are two such problems? [L1, CLO1] b. Can we ensure the same degree of security in a time-shared machine as in a dedicated machine? [L1, CLO1] | 03 |
| 1(c) | Describe the differences between symmetric and asymmetric multiprocessing. What are three advantages and one disadvantage of multiprocessor systems? [L1, CLO1] | 04 |
| 2(a) | Define process state. Draw the functional block diagram of process states. [L1, L2, CLO2, CLO3, CLO4] | 02 |
| 2(b) | What is race condition? Define critical section and noncritical section of a process. [L1, L2, CLO2, CLO3, CLO4] | 03 |
| 2(c) | Describe client-server operating system structure. [L2, CLO2, CLO3, CLO4] | 04 |
| 2(d) | What is internal fragmentation? [L1, CLO2, CLO3, CLO4] | 01 |
| 3(a) | Define scheduling, preemptive scheduling and non-preemptive scheduling. [L1, L2, CLO2, CLO3, CLO4] | 04 |
| 3(b) | Assume that the following processes arrive at time 0, in the order given, with the length of the CPU-burst time given in milliseconds. | 04 |

| Job | Burst time (in milliseconds) |
|-----|------------------------------|
| A | 10 |
| B | 29 |
| C | 3 |
| D | 7 |
| E | 12 |

- | | | |
|-------|---|----|
| (i) | Give the Gantt chart illustrating the execution of processes using FCFS, and non-preemptive SJF scheduling. [L3, L4, CLO2, CLO3, CLO4] | |
| (ii). | Calculate the average waiting time for each of the above algorithms. [L3, L4, CLO2, CLO3, CLO4] | |
| 3(c) | Define external fragmentation. How can we remove external fragmentation? [L1, L3, CLO2, CLO3, CLO4] | 02 |
| 4(a) | What are the functions of page table? [L1, CLO2, CLO3, CLO4] | 02 |
| 4(b) | Consider the following page reference string: a b c d c a d b e b a b c d. How many page fault would occur for the LRU page replacement algorithm, assuming four frames? Show all steps of page replacement. [L5, CLO2, CLO3, CLO4] | 04 |
| 4(c) | Describe Not Recently Used (NRU) page replacement algorithm. [L2, CLO2, CLO3, CLO4] | 04 |

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions.

- 5(a) Explain the difference between internal and external fragmentation. [L1, CLO2] 02
 5(b) Assuming a 1-KB page size, what are the page numbers and offsets for the following address references (provided as decimal numbers): [L1, CLO1] 03

- (i) 215201
- (ii) 650000
- (iii) 2000001

- 5(c) Consider the following segment table: [L4, CLO3] 03

| <u>Segment</u> | <u>Base</u> | <u>Length</u> |
|----------------|-------------|---------------|
| 0 | 217 | 600 |
| 1 | 2200 | 14 |
| 2 | 80 | 100 |
| 3 | 1317 | 570 |
| 4 | 1948 | 96 |

What are the physical addresses for the following logical addresses?

- (i) 0, 440
- (ii) 1, 10
- (iii) 2, 520

- 5(d) Under what circumstances do page faults occur? Describe the actions taken by the operating system when a page fault occurs. [L4, CLO2] 02

- 6(a) What is deadlock? What are the necessary and sufficient conditions for deadlock? [L1, L2, CLO2, CLO3, CLO4] 02

- 6(b) Consider the following scenario of a system. 04

$$E = \begin{pmatrix} \text{Tape drives} \\ 4 \\ \text{Plotters} \\ 2 \\ \text{Scanners} \\ 3 \\ \text{Blu-rays} \\ 1 \end{pmatrix} \quad A = \begin{pmatrix} \text{Tape drives} \\ 2 \\ \text{Plotters} \\ 1 \\ \text{Scanners} \\ 0 \\ \text{Blu-rays} \\ 0 \end{pmatrix}$$

Current allocation matrix

$$C = \begin{pmatrix} 0 & 0 & 1 & 0 \\ 2 & 0 & 0 & 1 \\ 0 & 1 & 2 & 0 \end{pmatrix}$$

Where E is Existing Resource Vector

A is Available Vector

C is Current Allocation Matrix

R is Request Matrix

Request matrix

$$R = \begin{pmatrix} 2 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 2 & 1 & 0 & 0 \end{pmatrix}$$

- Does this system have deadlock? [L4, L5, CLO2, CLO3, CLO4]
 6(c) Write down the algorithm for detecting deadlock with single instance of each resource type. [L6, CLO2, CLO3, CLO4] 04

- 7(a) Discuss the factors to be considered for approaching a new machine. [L1, L2, CLO2, CLO3, CLO4] 04
 7(b) Describe IBM 360 instruction format. [L1, CLO2, CLO3, CLO4] 04
 7(c) Mention the steps for designing an assembler. [L2, CLO2, CLO3, CLO4] 02

- 8(a) What is the purpose of Pass 1 for an assembler? List data structures for an assembler during Pass 1. [L4, CLO2, CLO3, CLO4] 04

- 8(b) What is Loader? What are the functions of Loader? [L1, CLO2, CLO3, CLO4] 02

- 8(c) Describe Absolute loader with subroutine linkage. [L2, L3, CLO2, CLO3, CLO4] 04

CSE21 Batch

Course Teacher:

CT:

| | |
|--|-------|
| <p style="text-align: center;">Khulna University, CSE Discipline Third Year, Term II Course No.: CSE 2205 Course Title: Operating System and Systems Programming Class Test #1 Full Marks: 30, Time 30 Minutes</p> | |
| | Marks |

1. Define Operating System? What are the functions of operating system? 10
2. List the properties of Network Operating System, Real-time Operating System and Time-sharing Operating System. 10
3. Write down the functions of different layers in layered operating system. 10

Date: 16-05-2017

Khulna University
Computer Science and Engineering Discipline
3rd Year, Term II
Session 2015-2016
Course No.: CSE 3201

Full Title of Course: Operating Systems and System Programming
Full Mark: 60 Time: 3 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

- | | Marks |
|---|-------|
| 1. a) List the four steps that are necessary to run a program on a completely dedicated machine. | 02 |
| b) Assemble the advantages and disadvantages of batch processing OS. | 04 |
| c) Write some reason of using Direct Memory Access (DMA) for high speed I/O devices. | 03 |
| d) Define distributed system. | 01 |
| 2. a) Define process. Describe the main functions of process control block. | 02 |
| b) What is inter-process communication? What sorts of problems can be arisen during inter-process communication? | 03 |
| c) Describe virtual machine operating system structure with proper example. | 04 |
| d) Mention four conditions to hold to have a good solution for mutual exclusion. | 01 |
| 3. a) Discuss lottery scheduling algorithm and Fair-Share scheduling algorithm | 04 |
| b) Five batch jobs, A through E, arrive at a computer center almost at the same time. They have estimated running times of 10, 6, 2, 4, and 8 minutes. Their (externally determined) priorities are 3, 5, 2, 1, and 4, respectively, with 5 being the highest priority. For each of the following scheduling algorithms, determine the mean process turnaround time. Ignore process switching overhead | 04 |
| i. Round robin. | 02 |
| ii. Priority scheduling. | 04 |
| iii. First-come, first-served (run in order 10, 6, 4, 8). | 04 |
| iv. Shortest job first. | 02 |
| v. Defining Checkerboarding. How can we prevent Checkerboarding? | 02 |
| 4. a) Differentiate between paging and segmentation memory management. | 02 |
| b) Consider a swapping system in which memory consists of the following hole sizes in memory order: 10 MB, 4 MB, 20 MB, 18 MB, 7 MB, 9 MB, 12 MB, and 15 MB. Which hole is taken for successive segment requests of i. 12 MB ii. 10 MB iii. 9 MB iv. 8 MB v. 7 MB? Repeat the question for best fit, and worst fit. | 04 |
| c) Describe second chance page replacement algorithm with an example. | 04 |

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

- | | |
|---|----|
| a) Compare between Windows and Linux in terms of i. Process Management ii. Security Issues | 04 |
| b) What is semaphore? Describe the solution of achieving mutual exclusion using semaphore variable. | 04 |
| c) Draw the process state diagram. | 02 |
| d) What is deadlock? What are the necessary and sufficient conditions for deadlock? | 02 |
| e) Consider the following state of a system with four processes, P1, P2, P3, and P4, and five types of resources, RC1, RC2, RC3, RC4, and RC5. The corresponding Current Allocation | 04 |

Matrix C, Request Matrix R and Existing Vector E are as follows:

$$C = \begin{bmatrix} 0 & 1 & 1 & 1 & 2 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 2 & 1 & 0 & 0 & 0 \end{bmatrix}$$

$$R = \begin{bmatrix} 1 & 1 & 0 & 2 & 1 \\ 0 & 1 & 0 & 2 & 1 \\ 0 & 2 & 0 & 3 & 1 \\ 0 & 2 & 1 & 1 & 0 \end{bmatrix}$$

$$E = (24144)$$

- ii) Find Available Matrix (A)
 iii) Using the deadlock detection algorithm, show that there is a deadlock in the system. Identify the processes that are deadlocked.

04

- c) Assume the following snapshot of a system

| | Allocation | | | Request | | | Available | | |
|------|------------|---|---|---------|---|---|-----------|---|---|
| | A | B | C | A | B | C | A | B | C |
| ✓ P0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ✓ P1 | 2 | 0 | 0 | 2 | 0 | 2 | 3 | 1 | 3 |
| ✓ P2 | 3 | 0 | 3 | 0 | 0 | 0 | 5 | 1 | 3 |
| ✓ P3 | 2 | 1 | 1 | 1 | 0 | 0 | 7 | 2 | 4 |
| P4 | 0 | 0 | 2 | 0 | 0 | 2 | 7 | 2 | 6 |

Answer the following questions using deadlock detection algorithm.

- i) Is the system in a safe state?
 ii) If process P2 makes an additional request for a resource of type C, will it be granted? If not, why?

7. a) Discuss the factors to be considered for approaching a new machine. 04
 b) Describe IBM 360 instruction format. 04
 c) Mention the steps for designing an assembler 02

8. a) Summarize the four functions of a loader. 02
 b) Explain the process of implementing a subroutine linkage with example. 03
 c) Design a "Compile-and-go" loader scheme. Mention some of its disadvantages. 03
 d) Differentiate between Absolute loader and Relocating loader. 02

CSE Discipline Third Year, Term II

Course No.: CSE 3201, Course Title: Operating System and Systems Programming
 Class Test #1
 Full Marks: 30, Time: 45 minutes

Marks
 5
 15

1. What is operating system? What are main the purposes of operating system?
 Write short note

- i) Time sharing operating
 ii) Real time operating
 iii) Spooling

5
 5

2. Briefly describe layered operating system structure.
 Describe First-Come-First-Served (FCFS) process scheduling algorithm with example.

Date: 01-12-2016

Khulna University
Computer Science and Engineering Discipline
3rd Year Term II Final Examination 2016
Session: 2014-2015
Course No: CSE 3201

Full Title of Course: Operating System and System Programming
Full Marks: 60
Hours: Time: 03

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

There are FOUR questions in this section. Answer any THREE questions.

1. (a) What is an operating system? What are the main functions of an operating system? 03
(b) Differentiate between timesharing and multiprogramming systems. 02
(c) Mention the differences between kernel and user mode? 02
(d) What is a trap instruction? Explain its use in operating systems. 03
2. (a) Define process. Describe the main functions of process control block. 02
(b) What is inter-process communication? What sorts of problems can be arisen during inter-process communication? 03
(c) Describe virtual machine operating system structure with proper example. 04
(d) Mention four conditions to hold to have a good solution for mutual exclusion. 01
3. (a) Consider the following set of processes, with the length of the CPU burst given in milliseconds. 08

| Process | Burst Time | Priority |
|----------------|------------|----------|
| P ₁ | 10 | 3 |
| P ₂ | 1 | 1 |
| P ₃ | 2 | 3 |
| P ₄ | 1 | 4 |
| P ₅ | 5 | 2 |

The processes are assumed to have arrived in the order P₁, P₂, P₃, P₄, P₅, all at time 0.

Draw Gantt charts that illustrate the execution of these processes using the following scheduling algorithm: FCFS, SJF, priority (smaller number higher priority) and RR (quantum =1).

4. (b) Write short note on Critical-Section problem. 02
4. (a) Differentiate between paging and segmentation memory management. 02
(b) Consider a swapping system in which memory consists of the following hole sizes in memory order: 10 MB, 4 MB, 20 MB, 18 MB, 7 MB, 9 MB, 12 MB and 15 MB. Which hole is taken for successive segment requests of
i. 12 MB
ii. 10 MB
iii. 9 MB
for first fit? Repeat the question for best fit, and worst fit. 04
4. (c) Describe second chance page replacement algorithm with an example. 04

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

5. (a) Compare between Windows and Linux in terms of
 i. Process Management
 ii. Security Issues 03
- (b) What is semaphore? Describe the solution of achieving mutual exclusion using semaphore variable. 04
- (c) Draw the diagram of process state. Discuss the state changes for a process execution. 03

6. (a) What is deadlock? What are the necessary and sufficient conditions for deadlock? 02
- (b) Consider the following state of a system with four processes, P1, P2, P3, and P4, and five types of resources, RC1, RC2, RC3, RC4, and RC5. The corresponding Current Allocation Matrix C, Request Matrix R and Existing Vector E are as follows: 04

$$C = \begin{matrix} 0 & 1 & 1 & 1 & 2 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 2 & 1 & 0 & 0 & 0 \end{matrix} \quad R = \begin{matrix} 1 & 1 & 0 & 2 & 1 \\ 0 & 1 & 0 & 2 & 1 \\ 0 & 2 & 0 & 3 & 1 \\ 0 & 2 & 1 & 1 & 0 \end{matrix} \quad E = (24144)$$

- i) Find Available Matrix (A)
 ii) Using the deadlock detection algorithm, show that there is a deadlock in the system. Identify the processes that are deadlocked.

- (c) Consider the following snapshot of a system: 04

| | Allocation | Max | Available |
|----|--------------------|--------------------|--------------------|
| P0 | A B C D 0 0 1 2 | A B C D 0 0 1 2 | A B C D 1 5 2 0 |
| p1 | 1 0 0 0 | 1 7 5 0 | |
| p2 | 1 3 5 4 | 2 3 5 6 | |
| p3 | 0 6 3 2 | 0 6 5 2 | |
| p4 | 0 0 1 4 | 0 6 5 6 | |

Answer the following questions using the banker's algorithm:

- i. What is the content of the request matrix?
 ii. Is the system in a safe state?

7. (a) Discuss the factors to be considered for approaching a new machine. 04
 (b) Describe IBM 360 instruction format. 04
 (c) Mention the steps for designing an assembler 02

8. (a) Define internal and external fragmentation. 02
 (b) How many page faults would occur with reference string 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 5, 0, 1, 7, 0, 1 using i) LRU ii) FIFO iii) Optimal page replacement algorithms. 03 frames are available and initially empty. 06
 (c) What is Thrashing? Describe the cause of Thrashing. 02

Khulna University, CSE Discipline
Third Year, Term II
Course No.: CSE 3201
Course Title: Operating System and Systems Programming

Class Test #1

Full Marks: 30

Marks

- | | |
|--|----|
| 1. Write down the functions of different layers in layered operating system. | 10 |
| 2. What are the advantages of microkernel system structure? | 10 |
| 3. Differentiate between virtual machine operating system structure and exokernel operating system structure | 10 |

Khulna University, CSE Discipline
Third Year, Term II, Course No.: CSE 3201, Course Title: Operating System and Systems Programming
Class Test #2, Full Marks: 30, Time : 30 Minutes

1. Differentiate between preemptive scheduling and nonpreemptive scheduling
2. Assume that the following processes arrive at time 0, in the order given, with the length of the CPU-burst time given in milliseconds

| Job | Burst time (in seconds) |
|-----|-------------------------|
| A | 10 |
| B | 29 |
| C | 3 |
| D | 7 |
| E | 12 |

Answer

- a. Give the Gantt chart illustrating the execution of processes using FCFS, Round Robin (quantum=10) and non-preemptive SJF scheduling.
b. Calculate the average waiting time for each of the above algorithm

Khulna University, CSE Discipline
Third Year, Term II, Course No.: CSE 3201, Course Title: Operating System and Systems Programming
Class Test #3, Full Marks: 30, Time : 30 Minutes

1. What is paging? What is the purpose of page table?
2. What is the principle of optimal page replacement algorithm?
3. Consider the following page reference string: a b c d c a d b e b a b c d. How many page fault would occur for the LRU page replacement algorithm, assuming four frames.

Khulna University, Khulna

Computer Science and Engineering Discipline

3rd Year, Term II, Examination 2018

Session: 2017-2018

Course No: CSE 3201

Full Title of Course: Operating System and System Programming

Full Marks: 60

Time: 03 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

There are **FOUR** questions in this section. Answer any **THREE** questions

1. a) What is an operating system? Describe real-time operating system and server operating system. 3
b) Distinguish between multiprogramming and time sharing operating systems. 2
c) Mention the differences between kernel and user mode. 2
d) What is a trap instruction? Explain its use in operating system. 3
2. a) Define process. Describe the main functions of process control block. 2
b) What is inter-process communication? What sorts of problems can be arisen during inter-process communication? 3
c) Describe monolithic operating system structure. 4
d) Mention four conditions to hold to have a good solution for mutual exclusion. 1
3. a) Discuss Round Robin scheduling algorithm with an example. 4
b) Five batch jobs A through E, arrive at a computer center at almost the same time. They have estimated running times of 10, 6, 2, 4, and 8 minutes. Their (externally determined) priorities are 3, 5, 2, 1, and 4, respectively, with 5 being the highest priority. For each of the following scheduling algorithms, determine the mean process turnaround time.
i. Shortest Job First scheduling algorithm.
ii. Priority scheduling algorithm.
c) Differentiate between external fragmentation and internal fragmentation. 2
4. a) Differentiate between paging and segmentation memory management. 2
b) Consider a swapping system in which memory consists of the following hole sizes in memory order: 10 MB, 4 MB, 20 MB, 18 MB, 7 MB, 9 MB, 12 MB, and 15 MB. Which hole is taken for the requests of
i) 12 MB for first fit and worst fit.
ii) 10 MB for first fit and worst fit.
c) Describe second chance page replacement algorithm with an example. 4

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

5. a) Discuss Strict Alternation technique for achieving mutual exclusion. What is the disadvantage of Strict Alternation technique? 5
b) What is semaphore? Describe the solution of achieving mutual exclusion using semaphore variable. 5
6. a) Define safe state and unsafe state. 2
b) Consider the following state of a system with four processes, P1, P2, P3, and P4, and five types of resources, RC1, RC2, RC3, RC4, and RC5. The corresponding Current Allocation Matrix C, Request Matrix R and Existing Vector E are as follows: 4

$$C = \begin{array}{|c|c|c|c|c|} \hline 0 & 1 & 1 & 1 & 2 \\ \hline 0 & 1 & 0 & 1 & 0 \\ \hline 0 & 0 & 0 & 0 & 1 \\ \hline 2 & 1 & 0 & 0 & 0 \\ \hline \end{array}$$

$$R = \begin{array}{|c|c|c|c|c|} \hline 1 & 1 & 0 & 2 & 1 \\ \hline 0 & 1 & 0 & 2 & 1 \\ \hline 0 & 2 & 0 & 3 & 1 \\ \hline 0 & 2 & 1 & 1 & 0 \\ \hline \end{array}$$

$$E = (24144)$$

- | | | |
|-----|--|---|
| i) | Find Available Matrix (Λ) | |
| ii) | Using the deadlock detection algorithm, show that there is a deadlock in the system. Identify the processes that are deadlocked. | |
| c) | Describe techniques for deadlock avoidance with careful resource allocation. | 4 |
| 7. | a) Discuss about John von Neumann machine structure. | 4 |
| | b) What are the functions of an assembler? Describe the format of the machine instruction table. | 5 |
| | c) What is the function of EQU pseudo-instruction? | 1 |
| 8. | a) What is the purpose of Pass1 for an assembler? List data structures for an assembler during Pass1. | 3 |
| | b) What is loader? What are the functions of loader? | 3 |
| | c) Describe “Compile – and – go” loader with subroutine linkage. | 4 |