

# Operating System

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## Notes

- PYQs of BEI's CT612, BCT's CT656, BCT's EX652 and BCT's EG682CT are combined.
- BEI's CT612 questions' markings are **stylized with this font for clarity**.
- The marking of questions of 66 Magh is **not given**. All marking given in this collection are **assumed** marks based on other pyq's.

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# 1 Introduction

(5 Hours/10 Marks)

## 1.1 Operating System and Function

1. Define operating system. [1] (80 Bh, **80 Ch**, **79 Ch**, **76 Bh**, 76 Ba, 75 Ba, **72 Ash**, 71 Ma, 65 Ka)
2. Explain the functions of Operating System. [3] (**76 Bh**, 75 Ba, 73 Ma, **68 Bh**) [4] (**72 Ash**)  
|→ What are the primary purposes of an operating system? Explain. [3] (**73 Bh**)
3. How does operating system provide a beautiful interface to user? [3] (81 Bh)
4. Justify how OS act as resource manager. [3] (81 Ba, **77 Ch**, 76 Ba) [4] (68 Ma, 65 Ka)
5. Explain the statement: Operating system acts as a broker between hardware and application program. [4] (80 Bh, **79 Ch**)
6. Explain OS as an Extended Machine. [2] (80 Ba, 70 Ma)  
|→ How does an OS create abstraction? Explain with reference to OS as an extended machine. [5] (**69 Bh**)
7. Explain the virtual machine structure. What are the benefits over other operating system architecture? [2+2] (**74 Bh**, **72 Ash**)
8. Why Operating system is termed as virtual machine? [2] (73 Ma)  
|→ Explain operating system as a virtual machine. [2] (**67 Mng**) [4] (80 Ba)
9. Why should the operating system prevent users from accessing the boot sector? [2] (**73 Bh**)
10. Explain in detail about context switching. [4] (**67 Mng**)
11. What features does an operating system expose on top of the hardware to enhance user experience? Explain. [8] (**66 Ma**)

## 1.2 Evolution of Operating System

1. Why operating system evolve over long periods of time? [1] (81 Ba)

## 1.3 Type of Operating System: Batch, Interactive, Multiprocessing, Time Sharing and Real Time System

1. Explain in brief any four types of OS. [5] (**73 Bh**)  
|→ Briefly mention the type of operating system. [4] (71 Ma)
2. List the essential properties for the Batch-oriented and Interactive operating system. [4] (**70 Bh**)
3. Write down the major differences between following types of operating system. [8] (**78 Ch**, **71 Bh**)
  - a. Batch system
  - b. Interactive system
  - c. Real time system
  - d. Time sharing system

4. Discuss the properties of batch system and real time system. [4] (76 Ba)
5. Explain multiprogramming, multiprocessing and distributed operating system. [6] (74 Bh)
6. For each of the following application which system (Batch or Interactive) is more suitable?
  - a. Word Processing
  - b. A flight simulator [6] (**70 Bh**)
  - c. Computing pi to million decimal places
  - d. Generating monthly bank statements
  - e. Generating mark statement by University
  - f. Data acquisition from temperature sensor

## 1.4 Operating System Components

1. What do you understand by firmware? Can you relate with operating system? Are there any linkages among hardware, software, firmware and operating system? [10] (70 Ma)

## 1.5 Operating System Structure: Monolithic, Layered, Micro-Kernel, Client-Server, Virtual Machine

1. What are the different structures of an operating system? [2] (**67 Mng**)
2. Why Exo-Kernel doesn't require Re-mapping of resources? [2] (81 Bh, **79 Ch**) [3] (**80 Ch**)
3. Is layered structure of operating system is better than monolithic structure? Explain. [3] (81 Bh, **79 Ch**) [4] (**80 Ch**) [10] (72 Ma)
4. Differentiate between Monolithic Kernel and Micro-Kernel. [4] (80 Ba) [5] (71 Ma)
5. Distinguish between kernel and micro-kernel. [3] (70 Ma)
6. Explain about microkernel. [5] (**68 Bh**)
7. Explain the Monolithic and layered architecture of operating system. Explain which architecture is better among them and why? [2+1] (**76 Bh**)  
 |→ Explain in brief about monolithic architecture and virtual machine. [3] (73 Ma)
8. Discuss about Microkernel and Monolithic structuring with their adv and disadv. [3] (**77 Ch**)
9. Why is the process table needed in a timesharing system? Is it also needed in personal computer systems running UNIX or Windows with a single user? [6] (79 Bh)
10. Distinguish between Shell and Kernel. [4] (79 Bh)

## 1.6 Operating System Services

### 1.6.1 System calls

1. What is system call in OS? [1] (**77 Ch, 76 Bh**, 75 Ba) [2] (73 Ma)
2. What is the purpose of a system call in an operating system? [2] (**78 Ch, 71 Bh**) [3] (**80 Ch**, 70 Ma)
3. Define system call and explain its working mechanism with suitable example. [5] (**69 Bh**)
4. Illustrate the execution of system call read() to read a file. [5] (75 Ba)

### 1.6.2 Shell commands

1. What do you mean by Shell? [1] (**77 Ch**)
2. What is pipe and shell? [4] (68 Ma)

### 1.6.3 Shell programming

1. Write short notes on Shell Programming. [4] (**75 Bh**)

## 2 Process Management

(6 Hours/10 Marks)

### 2.1 Introduction to Process

1. Define process in OS and explain possible states. [2] (75 Bh)

#### 2.1.1 Process description

1. What is priority of a process? Why do we need it? Explain. [2] (80 Bh)

#### 2.1.2 Process states

#### 2.1.3 Process control

1. Explain fork() and spawn() system calls in the OS. [3] (81 Ba)
2. Explain Context Switching with an example. [2] (80 Ch)
3. What information does a process control block contain? [3] (79 Ch)

### 2.2 Threads

### 2.3 Processes and Threads

1. Define Process and Threads. [2] (76 Bh)
2. Write the difference between thread and process. [1] (77 Ch) [2] (79 Ch, 76 Ba)
3. Why threads are called light weight process? [2] (81 Bh)
4. What is multithreading? Explain five state process model with figure. [4] (80 Ba)
5. State 5-State process model. [2] (78 Ch)
6. What are the advantages and disadvantages of implementing threads in user space? [4] (79 Ch)
7. Explain how multi threading provide better solution than single threading solution. [3] (77 Ch)

### 2.4 Scheduling

#### 2.4.1 Types of scheduling

1. Differentiate between Preemptive and Non-Preemptive Scheduling. [2] (80 Ba)



#### 2.4.2 Scheduling in batch system

#### 2.4.3 Scheduling in Interactive System

#### 2.4.4 Scheduling in Real Time System

#### 2.4.5 Thread Scheduling

#### 2.4.6 Numericals

1. Consider the following set of processes, with length of the CPU burst time given in milliseconds. [8] (81 Bh, 77 Ch)

Process	Burst time	Priority
P1	0	3
P2	2	6
P3	4	4
P4	6	5
P5	8	2

- A. All the processes are assumed to have arrived in order all at time 0.
    - a. Draw Gantt Chart Using FCFS, SJF scheduling algorithm.
    - b. Find average turnaround time for each scheduling algorithm.
  - B. Draw Gantt chart illustrating RR (quantum = 2) and highest ratio next (HRN) scheduling. Also find average waiting and average turn around time for each of the algorithm.
2. Schedule the following set of process according to Round-Robin scheduling algorithm with Quantum time = 4ms and calculate the average waiting time and average Turn-around time, throughput and CPV utilization. [3] (81 Ba)

Process	Arrival time (ms)	CPU time (ms)
A	0	12
B	2	8
C	5	7
D	10	9

3. Consider the following set of processes, with length of the CPU burst time given in milliseconds. [8] (80 Ch)

Process	Arrival Time	Burst Time
P1	0	4
P2	2	5
P3	4	3
P4	6	6
P5	8	3

With all the given information, draw the Gantt Chart and calculate the average waiting time (AWT), average turnaround time (ATAT), CPU utilization and throughput for the

- Round Robin (RR) (Quantum Time = 2)
- Highest Response Ratio Next (HRRN)

- Make schedule for the processes mentioned in the table below as per Shortest Remaining Time First (SRTF) algorithm. Also calculate average turnaround time and average waiting time, throughput and CPU utilization. [6] (80 Bh)

Process	Burst Time	Arrival Time	Priority
P <sub>1</sub>	3	0	3
P <sub>2</sub>	6	1	5
P <sub>3</sub>	1	2	2
P <sub>4</sub>	4	3	1
P <sub>5</sub>	2	4	4

- Apply MLQ scheduling for following set of processes of two queues Q1 and Q2 where Priority of Q1 is greater than that of Q2 and Q1 uses Round Robin (Time Quantum = 2) and Q2 uses FCFS. Construct Gantt-Chart and computer average TAT for above scenario. [4] (80 Ba)

Process	AT	BT	Queue Number
P1	0	5	1
P2	2	12	2
P3	5	3	1
P4	10	6	1

- Consider following set of process with given arrival and CPU burst time. Calculate the average waiting time for each of process for non-primitive shortest job first (SJF) and Round Robin Scheduling Algorithms with quantum size 4. [5] (79 Ch)

Process	Arrival Time	Burst Time
P0	0	13
P1	1	6
P2	4	4
P3	6	20

7. Consider the following set of processes, with arrival time and the length of CPU burst time given in millisecond as below: [6] (76 Ba)

Processes	Arrival time	Burst time
A	0	3
B	1	6
C	4	4
D	6	2

- Draw Gantt chart illustrating the execution of these processes using FCFS, SRTN and RR (Quantum = 2) scheduling.
  - What is the waiting time and Turnaround time of each process for each of the scheduling algorithm?
8. Let us consider five process with given arrival time and length of the CPU burst given in milliseconds. Calculate the turnaround time and waiting time for all processes applying First Come First Serve, Shortest Job first and Round Robin (time quantum = 3) algorithms.

Process	Arrival time	CPU time
P1	0	9
P2	1	5
P3	2	2
P4	3	6
P5	4	8

[6] (79 Bh)

9. Assume the process arrived in the order p<sub>1</sub>, p<sub>2</sub>, p<sub>3</sub>, p<sub>4</sub> and p<sub>5</sub> all time 0, priority 1 as highest and 4 as lowest. [8] (78 Ch)

Process	Burst Time	priority
p <sub>1</sub>	10	3
p <sub>2</sub>	1	1
p <sub>3</sub>	2	3
p <sub>4</sub>	1	4
p <sub>5</sub>	2	2

- Draw the gantt chart

- b. Calculate average waiting time and average turnaround for the following scheduling algorithm.
- Round robin (quantum = 1)
  - priority preemptive
  - preemptive SJF
  - FCFS
10. Consider the following processes, with the length of the CPU burst time in millisecond. The processes are assumed to have arrived in the order P1, P2, P3, P4, P5 all at time 0. [Lowest number being Highest Priority] [6] (75 Bh)

Process	Burst Time	Priority
P1	10	3
P2	1	1
P3	2	5
P4	1	4
P5	5	2

Draw Gantt chart illustrating priority and RR (quantum = 1) scheduling. Also find average waiting time and average turn-around time for each of the algorithms.

11. Consider the following set of processes, with arrival time and the length of CPU burst time given in millisecond as below: [4+4] (76 Bh)

Processes	Arrival time	Burst time
A	0	3
B	1	6
C	4	4
D	6	2
E	7	3

- Draw Gantt chart illustrating the execution of these processes using FCFS, SRTN and RR (Quantum = 3) scheduling.
- What is the waiting time and Turnaround time of each process for each of the scheduling algorithm?

## 2.5 Multiprocessor Scheduling concept

### **3 Process Communication and Synchronization**

(5 Hours/10 Marks)

**3.1 Principles of Concurrency**

**3.2 Critical Region**

**3.3 Race Condition**

**3.4 Mutual Exclusion**

**3.5 Semaphores and Mutex**

**3.6 Message Passing**

**3.7 Monitors**

**3.8 Classical Problems of Synchronization: Readers-Writers Problem, Producer Consumer Problem, Dining Philosopher problem**

## 4 Memory Management

(6 Hours/10 Marks)

- 4.1 Memory address, Swapping and Managing Free Memory Space
- 4.2 Resident Monitor
- 4.3 Multiprogramming with Fixed Partition
- 4.4 Multiprogramming With Variable Partition
- 4.5 Multiple Base Register
- 4.6 Virtual Memory Management
  - 4.6.1 Paging
  - 4.6.2 Segmentation
  - 4.6.3 Paged Segmentation
- 4.7 Demand Paging
- 4.8 Performance
- 4.9 Page Replacement Algorithms
- 4.10 Allocation of Frames
- 4.11 Thrashing

## **5 File Systems**

(6 Hours/10 Marks)

### **5.1 File: Name, Structure, Types, Access, Attribute, Operations**

### **5.2 Directory and File Paths**

### **5.3 File System Implementation**

#### **5.3.1 Selecting Block Size**

#### **5.3.2 Impact of Block Size Selection**

#### **5.3.3 Implementing File: Contiguous Allocation, Link List Allocation, Link List Allocation with Table, Inode**

#### **5.3.4 Implementing Directory**

### **5.4 Impact of Allocation Policy on Fragmentation**

### **5.5 Mapping File Blocks on The Disk Platter**

### **5.6 File System Performance**

### **5.7 Example File Systems: CD ROM file system, MS-DOS file system, Unix File system**

## **6 I/O Management and Disk Scheduling**

(4 Hours/7 Marks)

### **6.1 Principles of I/O Hardware**

### **6.2 Principles of I/O software**

### **6.3 I/O software Layer**

### **6.4 Disk**

#### **6.4.1 Hardware**

#### **6.4.2 Formatting**

#### **6.4.3 Arm scheduling**

#### **6.4.4 Error handling**

#### **6.4.5 Stable Storage**



## 7 Deadlock

(5 Hours/10 Marks)

- 7.1 Principles of deadlock
- 7.2 Deadlock Prevention
- 7.3 Deadlock Avoidance
- 7.4 Deadlock Detection
- 7.5 Recovery from deadlock
- 7.6 An Integrated Deadlock Strategies
- 7.7 Other Issues: Two phase locking, Communication Deadlock, Live-lock, Starvation

## 8 Security

(4 Hours/7 Marks)

- 8.1 Security breaches
- 8.2 Types of Attacks
- 8.3 Security Policy and Access Control
- 8.4 Basics of Cryptography
- 8.5 Protection Mechanisms
- 8.6 Authentication
- 8.7 OS Design Considerations For Security
- 8.8 Access Control Lists And OS Support

## **9 System administration**

(4 Hours/6 Marks)

**9.1 Administration Tasks**

**9.2 User Account Management**

**9.3 Start And Shutdown Procedures**

**9.4 Setting up Operational Environment for a New User**

**9.5 AWK tool, Search, Sort tools, Shell scripts, Make tool**