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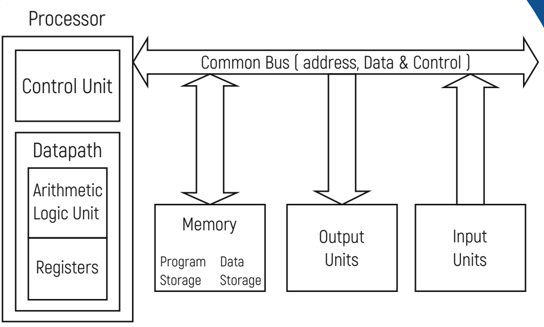
COMPUTER ORGANIZATION & ARCHITECTURE

Study Material with Classroom Practice Questions



Computer Organization & Architecture

(Solutions for Classroom Practice Questions)

1. Computer Arithmetic

01. Ans: (a)

Sol: E = e + Bias

03. Ans (a)

Sol: X = –14.25, S =1, e = original exponent

E = biased Exponent,

b = biasing amount

$14.25 = 1110.01 \times 2^0$

$= 1.11001 \times 2^3$

e = 3, E = 3 + 127

= 130

130 = 10000010 M = 1100100…0 (23 bits)

← 32 bits →

1 1 0 0	0 0 0 1	0 1 1 0	0 1 0 0	0 0 0
S = 1	E = 8		M = 23 bits	
C	1	6	4	0 0 . . . . . .

C1640000H

2. Memory Organization & Secondary Memory

01. Ans: (c)

Sol: T = 200 ns

∴ word frequency

$$= \frac{1}{200\times10^{-9}} = 5\times10^6 \text{ words/sec}$$

02. Ans:

Sol: (a) Capacity = T × S ×B

= 512 ×2048×4096× B

$= 2^9 \times 2^{11} \times 2^{12}$ B

$= 2^{32}$ B = 4 GB

(b) Data Transfer rate

1- Revolution disk covers = $2^{11}.\, 2^{12}$

= 8 MB

Disk speed 3000 rpm = 3000 revolutions in one minute

One minute = 60 sec = 60 ×1000ms

= 60,000 ms

3000 revolutions → 60,000 ms

1 revolution →?

$$= \frac{60000m}{3000} = 20\ ms$$

20 ms → 8 MB

1000 ms→ ?

$$= \frac{8000\ \text{M}\times\text{m}}{20\,\text{m}} = 400\,\text{MB}$$

Data Transfer rate = 400 MB /Sec

= 400 MBPS

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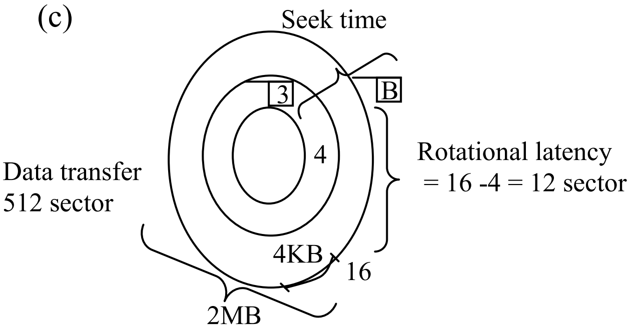
(c)



Data transfer 512 sectors

$$\frac{2MB}{4KB} = \frac{2^{21}}{2^{12}} = 2^9$$

T_{file}=$T_{seek\ time}$+$T_{rotational\ latency}$+Data Transfer time

(512 + 12) sectors are to be covered

20 ms → 2048 sectors

? → 524 sectors

Sectors requires = 5.117 ms

T_{file} = 10 ms + 5.117 ms = 15.117 ms

03. Ans: (a)

Sol: ROM is used for function table with large size because after program; ROM content is not possible to destroy and design cost is cheap.

04. Ans: (d)

Sol: Cache memory - A special very high speed memory called a cache is sometimes used to increase the speed of processing by making current programs and data available to the CPU at a rapid rate. The cache memory is employed in computer systems to compensate for the speed deferential between main memory access time and processor Logic.

05. Ans: (c)

Sol: The use of a cache in a computer system increases the Average speed of memory access

08. Ans: (b)

Sol: Average Latency time= ½ rotation time

Speed = 7200 rpm ⇒ 120 rps

For 1 rotation = 1/120 = 8.33ms

For ½ rotation = 4.166 ms

09. Ans: (a)

Sol: LIFO: Last In First Out

10. Ans: (d)

Sol: Hit ratio is defined as the number of hits divided by the total number of CPU references to the memory (hits plus misses)

$T_{avg} = H\,C + (1 - H)M$

Where H = hit ratio of cache memory

C = time to access information in cache memory

M = Miss penalty

= main memory access time

+ cache memory access time.

11. Ans: (c)

Sol: DRAM access much slower than SRAM

- More bits → longer wires
- Buffered access with two level addressing
- SRAM access latency : 2 - 3 ns
- DRAM access latency: 20 - 35 ns
- Static RAM -10 ns

- Hard disk for personal computers boast access times of about a to 15ms
- 200 times slower than average DRAM.

12. Ans: (d)

Sol: Cache size = 4 K word

One set has 4 blocks

$$\therefore \text{Number of sets} = \frac{\text{Total number of blocks}}{4}$$

Number of words = 2^6

$\Rightarrow W = 6$

$$\text{Number of cache blocks} = \frac{4K}{64} = \frac{2^{12}}{2^6} = 2^6$$

$$\text{Number of cache sets} = \frac{2^6}{4} = 16 = 2^4$$

S = 4

13. Ans: (a)

Sol: Access time = Seek time + Average rotation delay

1 rotation time = 33.3 ms

$\therefore$ Average rotation time = 16.7 ms

Total access time = 46.7 ≈ 47 ms

14. Ans: (c)

Sol: Cache memory is used to improve the overall system performance.

15. Ans: (a)

Sol: Word size = 16-bit

Access time = 80-ns

No of bytes to be transferred = 1024-B

= 512 Words.

Total time = 512 × 80ns 96μs = 40.96 μs

16. Ans: (c)

Sol: $2^{12} \times 8 = 4096 \times 8 = 32768.$

17. Ans: (c)

Sol: Remain same because it is non-volatile memory

18. Ans: (d)

Sol: Hit Rate = 80%

T_{CM} = 10ns, T_{MM}= 100ns

$T_{Avg} = H\times T_{CM} + (1-H)\times T_{MM}$

$= (0.8\times 10\text{ns}) + 0.2\times 100\text{ns}$

$= 8\text{ns} + 20\text{ns} = 28 \text{ ns}$

3. Pipeline Organization

02. Ans: (b)

Sol: First task will be completed after n clocks (because there are n segments) and the remaining m-1 tasks are shipped out at the rate of one task per pipeline clock.

Therefore, n + (n−1) clock periods are required to complete m tasks using an n-segment pipeline. If all m tasks are executed without any overlap, mn clock periods are needed because each task has to pass through all n segments. Thus speed gained by an n segment pipeline can be shown as follows:

Speed up P(n) =

$$\frac{\text{number of clocks required when there is no overlap}}{\text{number of clocks required when tasks are overlapped in time}}$$

$$= \frac{mn}{n+m-1}$$

03. Ans: (c)

Sol: Max. stage delay = 160 μs

Buffer delay = 5 μs

Pipeline clock = 165 μs

$T_{1000} = (K + n - 1)\ T_p$ clock

$= (4+999) * 165 = \left(\frac{165495}{1000}\right)$ μs

$= 165.5$ μs

04. Ans: (b)

Sol: For D_1 processor, maximum $T_{seg} = 4$ ns,

$n = 100, k = 5$

Time = 104 × 4 ns = 416 ns

For D_2 processor,

$n = 100, k = 8, T_{seg} = 2$ ns

Time = 107 × 2 ns = 214 ns

Hence, 202 ns time will be saved

4. I/O Organization

01. Ans: (b)

Sol: External interrupts comes from input-output devices, from a timing device, from a circuit monitoring the power supply or internal from other external source

Example: I/O devices requesting transfer of data

- A DMA controller manages the data transfer
- A DMA controller can be implemented as separated controller from the processor or integrated controller in the processor.
- Based on the request length, the DMA controller optimizes transfer performance between source and destination with different external data by widths

02. Ans: (d)

Sol: The DMA is the most suitable for Hard disk.

03. Ans: (b)

Sol: On receiving an interrupt from an I/O device, the CPU branches off to the interrupt service routine after completion of the current instruction.

04. Ans: (c)

Sol: In microprocessor based systems DMA facility is required to increase the speed of data transfer between memory and the I/O devices.

05. Ans: (b)

Sol: An I/O processor controls the flow of information between main memory and I/O devices. It is the extension of concept of DMA.

06. Ans: (b)

Sol: For vectored hardware interrupt, the interrupting device supplies the respective address with additional hardware.

07. Ans: (a)

Sol: In a microprocessor based system, isolated I/O method is similar to “I/O mapped I/O” where the memory and I/O devices are provided with separate address space and address decoders.

08. Ans: (b)

Sol: Internal interrupts in a microprocessor based system are initiated by error conditions (Ex. Divide by zero overflow conditions). External interrupts are produced by external hardware which may occur at any point of time.

5. Instruction Set & Addressing Modes

01. Ans: (a)

Sol:

1. Direct	y = z[I]
2. Immediate	x = 5
3. Index	x = z + m
4. Auto	k = c+ +

02. Ans: (c)

Sol: Register indirect addressing lets you generate lots of different addresses when a program is executed. Address register indirect addressing is so called because it uses an address register to point at the location of the operand in memory; that is, the address of an operand is obtained indirectly via an address register. Instead of telling the computer where the operand is, you tell it where the address of the operand can be found.

03. Ans: (c)

Sol: **Relative Addressing mode**: Relative Addressing mode is used in intra segment branching.

Effective Address = Program Counter + Displacement

Relative Base Addressing Mode: Effective Address = PC + BR + displacement . Where PC stands for program counter and BR stands for base register.

“The code is dependent means the option is direct addressing mode”.

04. Ans: (b)

Sol: Base register addressing mode is used to relocate the program from one segment to other segment.

6. C Language

01. Ans: (a)

Sol: A program that translates a high-level language program into a object module is called a complier.

02. Ans: (b)

Sol: double is used to define BIG floating point numbers. It reserves twice the storage for the number.

03. Ans: (a)

Sol: Characters are assigned variables by using single quotes, where strings we use double quotes.

04. Ans: (c)

Sol : #define SALES_TAX_RATE 0.0825 is a valid constant

05. Ans: (c)

Sol: printf (“%d%c%f”, 23, ‘z’, 4.1);

07. Ans: (b)

Sol: The value of x is decremented by one after the print statement.

08. Ans: (c)

Sol: Left side of assignment operator allows only one variable, not a expression

In option (b) the meaning of

a * = b gives a = a * b

In option (d) b = 0 is first evaluate the result is assign to 'a' because '=' operator is right to left associativity.

Finally option (c) is invalid

09. Ans: (b)

Sol: Except option (b) remaining all expressions having different precedence levels but in option (b) '*', '/' operators are having same precedence levels, so for evaluation we need associativity. Here associativity is 'left to right'.

10. Ans: (a)

Sol: Option (b), (c), (d) are logical operators. Where as option (a) is a statement.

11. Ans: (a)

Sol: Option (b), (c), (d) are relational operators which compare the two variables and gives result in the form of boolean data type i.e. true (or) false.

Where as option (a) is assignment operators which assign the value to variable.

12. Ans: (d)

Sol: The complement of equal (= =) operator is not equal (! =)

13. Ans: (b)

Sol: for, while and do……while are looping constructs but switch case is a statement.

14. Ans: (c)

Sol: Before entering into the loop while checks the condition i.e., while is pre-test loop, where 'do-while' is post test loop.

15. Ans: (a)

Sol: The address of (&) operator is used to extract the address for a variable.

16. Ans: (c)

Sol: The syntax int *p; is used to declare a pointer variable to an integer.

17. Ans: (c)

Sol: For creating a pointer we use '*' and address of variable we use '&'.

18. Ans: (c)

Sol: We can increment the pointer value and comparing but we can't divide prt + 5 is the pointes value 5 elements away. ++ ptr pre-increment of pointer & that points to next address.

19. Ans: (b)

Sol: A variable length string can be controlled by a length or a delimiter. The C language uses a null to terminate variable length strings.

20. Ans: (c)

Sol: The statement **employee.name** is used to declare the name of the employee.

21. Ans: (b)

Sol: for loop iterate 10 times because every time 'i' value getting to double, means 'i' initially 1, then 2, 4, 8, 16, 32, 64, 128, 256, 512 finally 1024 give false value to for loop. So total 10 times of iteration.

22. Ans: (c)

Sol: For every 'i' value 'j' loop iterates 10 times and 'i' will iterate 10 times, So 10 × 10 = 100 iterations possible.

23. Ans: (b)

Sol: Both statements are the definitions of break and continue respectively.

24. Ans: (b)

Sol: **Loop:** In computer programming, a loop is a sequence of instructions that is continually repeated until a certain condition is reached.

7. Basics of Operating Systems

01. Ans: (a)

Sol: Multi programming by definition is ability of OS to manage multiple ready to run program in memory. Remaining all other options are not correct/ Invalid.

02. Ans: (d)

Sol: Programmers can access OS resources through system call routines..

03. Ans: (d)

Sol: Presence of multiple CPU's is multiprocessor OS, where as multiprogramming can be possible with only one CPU.

04. Ans: (d)

Sol: Interrupts are used for Invoking system calls, Indicating complication of I/O, Sometimes pre-empting running process from CPU.

05. Ans: (c)

Sol: A processor in the context of computing a piece of hardware that executes a set of instructions.

06. Ans: (d)

Sol: The basic goal of multiprogramming is to keep the devices along with the CPU busy.

07. Ans: (b)

Sol: Zombie implies the process entry still exists in the process table maintained by OS.

08. Ans: (c)

Sol: Processes are generally swapped out from memory to Disk when they are decided to be suspended.

09. Ans: (b)

Sol: Suppose a Processor does not have any Stack Pointer Register It can have subroutine call instruction, but no nested subroutine calls.

10. Ans: (d)

Sol: When an Interrupt occurs, an Operating System May change state of interrupted process to 'blocked' and schedule another process.

8. Process Characteristics and Applications

01. Ans: (d)

Sol: Process gets blocked when it requires I/O or request any resource. Remaining are done by OS.

02. Ans: (d)

Sol: Block initiated by process and Ready by OS.

03. Ans: (a)

Sol: Whenever an interrupt occurs, while process is running on CPU, it gets preempted and goes to ready once.

04. Ans: (a)

Sol: Process running in user mode has to increase the PC Contents.

05. Ans: (b)

Sol: Round Robin scheduling algorithm is especially used for time sharing system. It is similar to FCFS but preemption is added to switch between processes small unit of time called time Quantum or time slice is defined.

06. Ans: (d)

Sol: A critical region (section) is the portion of program text that involves shared variables.

07. Ans: (a)

Sol: Time of submitting a request to the time at which initial response is generated.

08. Ans: (a)

Sol: If the system is non-preemptive, then if a long process is running it will cause starvation to longer process.

09. Ans: (c)

Sol: Round Robin is non-priority based and does not need any knowledge of service times of processes.

10. Ans: (d)

Sol: Generally if multithreading is done at user level then the whole process gets blocked otherwise only the respective thread gets blocked.

11. Ans: (a)

Sol: CPU efficiency is a measure of useful computation over total computational work. Total work includes the time for context switching.

12. Ans: (b)

Sol: Round Robin being preemptive, with time quantum can result in reducing prolonged waiting of processes and thereby improves inter-activeness.

13. Ans: (b)

Sol: Real time environments are constrained by strict Deadlines. Hence priority based scheduling is required to challenge the deadlines.

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14. Ans: (d)

Sol: Round Robin Scheduling is based on Time Quantum and arrival times of process.

15. Ans: (c)

Sol: Cycle stealing is used for DMA operation

16. Ans: (a)

Sol: Race condition implies that multiple processes are contending competitively or cooperatively to access critical resources.

17. Ans: (c)

Sol: Semaphores always satisfy all the conditions of synchronization requirements.

18. Ans: (c)

Sol: Processes are generally swapped out from memory to Disk when they are decided to be suspended.

19. Ans: (c)

Sol: RR is a pre-emptive scheduler, which is designed especially for time-sharing systems. In other words, it does not wait for a process to finish or give up control. In RR, each process is given a time slot to run. If the process does not finish, it will "get back in line" and receive another time slot until it has completed.

20. Ans: (b)

Sol: Total number of jobs executed per unit time (also called throughput)is maximum in SJF. Since shorter jobs are executed first and more number of jobs will be executed per unit time.

21. Ans: (b)

Sol: FCFS / FIFO is non-preemptive as preemption takes place only after completion of the process. Remaining algorithms are preemptive.

22. Ans: (b)

Sol: once every process got scheduled one time each (for T time units).

All processes have now the same waiting time = (n-1) T (n = number of processes).

Till now, the scheduling was Round Robin with pre-emption at periods of T. The same analysis can be extended for further scheduling as all the processes have the same priority = (n-1)T.

23. Ans: (c)

Sol: A CPU generally handles an interrupt by executing an interrupt service routine by checking the interrupt register after finishing the execution of the current instruction.

26. Ans: (c)

Sol: If the time-slice used in the round-robin scheduling policy is more than the maximum time required to execute any process, then the policy will Degenerate to first come first serve

27. Ans: (a)

Sol: As given process scenario

Process_id	Arrival time	Burst time	Complete time
P_1	0	8	14
P_2	0	4	10
P_3	0	2	6

Preparing Gantt chart for Round-Robin scheduling, Q = 2

Complete time of processes P_1, P_2 and P_3 as 14, 10, 6.

P_1	P_2	P_3	P_1	P_2	P_1	P_1

0 2 4 6 8 10 12 14

Turnaround time of a process

= Complete time – Arrival time.

P_id	Turnaround time
P_1	14
P_2	10
P_3	6

Average turnaround time $= \frac{14+10+6}{3}$

$= 10\,\text{ms}$.

28. Ans: (a)

Sol: Given scenario of the processes

Process	Burst time
P_1	10
P_2	29
P_3	3
P_4	7
P_5	12

FCFS:

P_1	P_2	P_3	P_4	P_5

0 10 39 42 49 61

Non-Preemptive SJF

P_3	P_4	P_1	P_5	P_2

0 3 10 20 32 61

Round-Robin:

P_1	P_2	P_3	P_4	P_5	P_2	P_5	P_2

0 10 20 23 30 40 50 52 61

Average waiting times for FCFS, SJF and RR are 28 ms, 13 ms and 23 ms respectively.

9. Memory Managements

01. Ans: (b)

Sol: Number of Memory Chips required = Memory Required/Chip Size; Each Row having 2 chips of dimension 256×4 will get memory of capacity 256 B; 128 rows each having 2 chips will organize memory of capacity 32 KB.

02. Ans: (d)

Sol: In board memory is like RAM and out board memory is like Hard-Disk and off-time storage is like magnetic tape;

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03. Ans: (a)

Sol: The number of allocation units

$= 1\text{GB}/64\text{ KB} = 2^{14}$.

1 bit is required for each allocation unit.

04. Ans: (a)

Sol: The size of the page $= 2^{32-(9+11)}$

$= 2^{12}$bytes = 4 KB

The number of pages

= Top level pages + second level pages

$= 2^{20}/2^{12}$ (Top level pages)

$+ 2^{20}$(second level pages)

$\approx 2^{20} = 1\text{M}$

05. Ans: (d)

Sol: Using Best fit the request for 120 K gets placed in 150 K and 10 K in 30 K and 250 K gets placed in 300 K; at this juncture 60 K can't get placed and hence the total left over free memory is 120 K.

08. Ans: (c)

Sol: L.A.S = 4K × 512 = 2^{21} ⇒ L.A = 21 bits.

P.A.S = 1K×512 = 2^{19} ⇒ P.A = 19 bits.

09. Ans: (b)

Sol: Use the equation:

$E_{mat}= x(c+m) + (1-x)(c+2m)$

10. Ans: (c)

Sol: Larger pages leads to less number of pages and less number of entries in page table.

11. Ans: (a)

Sol: The formula for optimal page size is $\sqrt{2.S.e}$ values of S = 32 MB; e = 4B

13. Ans: (c)

Sol: Larger Pages implies less number of pages.

14. Ans: (a)

Sol: Smaller Pages will involve less internal fragmentation.

17. Ans: (a)

Sol: Fixed partitioning technique limits or restrict the degree of multiprogramming to the number of partitions.

18. Ans: (a)

Sol: Using the equation

$E_{mat} = (1-P)\, m + P*S$;

Here m = 5 μs; S = 50 ms;

1−P = 0.9999 & P = 0.0001

Substituting in the above equation

$E_{mat} = 10\ \mu s$

19. Ans: (b)

Sol: Due to Belady's anomaly, sometimes page fault increases with the increase in page fault rate.

20. Ans: (b)

Sol: The Number of page faults using optimal replacement is 11, giving a page fault rate of 50%, using the equation.

$E_{mat} = P*s + (1-p)*m$;

Where P = 50%; m = 1 ms; s = 30 ms;

21. Ans: (a)

Sol: Apply optimal replacement

22. Ans: (d)

Sol: All will not follow locality of reference.

23. Ans: (b)

Sol: High page fault rate implies thrashing which can be controlled by decreasing degree of multiprogramming and addition of more main memory.

24. Ans: (a)

Sol: It's the work of addressing modes to provide minimum required pages, OS has the work to provide more pages.

25.

Sol: Logical Address = 13 bits
Physical Address = 15 bits

26. Ans: (c)

Sol: Threads refer to the execution of different processes simultaneously in the CPU.

Virtual address space is implemented in Memory.

The File system in the way in which data in a disk is organized.

A signal is acted upon using the mechanism of interrupts.

29. Ans: (a)

Sol: Both statements are true and statement II is the correct explanation for statement I

10. File System Implementation

01. Ans: (a)

Sol: Convert the Hex value to binary stream calculate the % of '0's to the total Binary length of string.

02. Ans: (a)

Sol: Surface capacity = 512 * 1K * 4 KB
$= 2^{31} = 2$ GB

∴ Disk capacity = 32 * surface capacity
$= 32\times2$ GB = 64 GB

03. Ans: (d)

Sol: All peripherals (External devices) require device driver.

05. Ans: (a)

Sol: Seek time is the dominating time in most of the IO operations.

09. Ans: (d)

Sol: Maximum file size
$= 8\times2\text{KB}+1\text{K}\times2\text{KB}+1\text{K}\times1\text{K}\times2\text{KB} = 2.2$ GB

10. Ans: (b)

Sol: Number of Blocks on Disk $= \frac{40\text{MB}}{2\,\text{KB}} = 20\,\text{K}$

1 Block can store 16 K bits;

Hence 20 K bits can be stored in 2 Blocks.

12. Ans: (a)

Sol: $\frac{1024\text{K}}{4\text{B}} = 256\,\text{K}$

$256\text{ K} \times 4 = 1024\text{ K} = 1\text{M}$

13. Ans: (b)

Sol: **Mounting:** Before your computer can use any kind of storage device (HDD, CD-ROM) your OS must make it accessible through the computer's file system. This process is called mounting.

If mounting is automatically done by OS, then it is known as implicit mounting.

If mounting is done by user (line in Linux), it is known as explicit mounting.

11. Protection & Security

02. Ans: (c)

Sol: The unique name in capabilities can be reused, but only if it can be guaranteed that no references remain to the old use of the name.

12. Introduction to Database

01. Ans: (c)

Sol: DBMS is a collection of program that enables user to create and maintain a database.

02. Ans: (b)

Sol: Physical database design is the process of selecting the data storage and data access characteristics of the database

03. Ans: (c)

Sol: A database is a collection of related data necessary to manage an organization

04. Ans: (b)

Sol: The database environment has Users, Database and Database administration except Separate files

05. Ans: (b)

Sol: In Relational model of database, data is stored in tables

07. Ans: (a)

Sol: Data redundancy is not the feature of database

08. Ans: (a)

Sol: Record stores the data items that are grouped together

09. Ans: (d)

Sol: NULL indicates that there is no value.

10. Ans: (c)

Sol: Architecture of a database is viewed as three levels

11. Ans: (d)

Sol: Tree is used to organize the records in hierarchical model

13. Ans: (c)

Sol: Conceptual design involves modeling independent of the DBMS.

14. Ans: (d)

Sol: DBMS helps to achieve data independence and centralized control of data

13. ER and Relational Model

01. Ans: (c)

Sol: If two students hold joint account then BankAccount_Num is not a candidate key and will not uniquely determine other attribute.

03. Ans: (b)

Sol: Derived attribute is an attribute that represents a value that is derivable from two or more attributes in an entity

04. Ans: (d)

Sol: On removal of row (2,4), row (5,2) and (7,2) must also be deleted as they depend on value 2. On removal of row (5,2), row (9,5) must also be deleted as it depends on value 5.

05. Ans: (b)

Sol: Entity type - Relation

Key attributes - Primary key

Composite attributes - Set of simple attributes

Weak Entity set - Child table

Value set - Domain

06. Ans: (b)

Sol: Name of the dependent : Discriminator attribute

Salary of a person: Composite attribute

Telephone number : Multi valued attribute

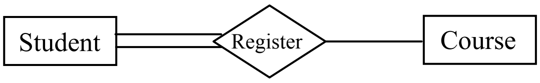
Date of birth: Stored attribute

07. Ans: (b)

Sol: When a tuple from the dominant is deleted the related tuple from the subordinate also be deleted.

08. Ans: (b)

Sol:



09. Ans: (c)

Sol: The tuples present at a particular moment is called relation instance.

10. Ans: (c)

Sol: Cardinality is the number of tuples in a relation instance.

11. Ans: (b)

Sol: In an E-R diagram, entities are represented by rectangles

12. Ans: (c)

Sol: In an E-R, diagram relationship is represented by diamond shaped box

13. Ans: (a)

Sol: Rows of a relation are called tuples

14. Ans: (a)

Sol: The employee salary should not be greater than Rs.2000, comes under integrity constraint

15. Ans: (d)

Sol: Students and courses enrolled is an example of many-to-many relationship

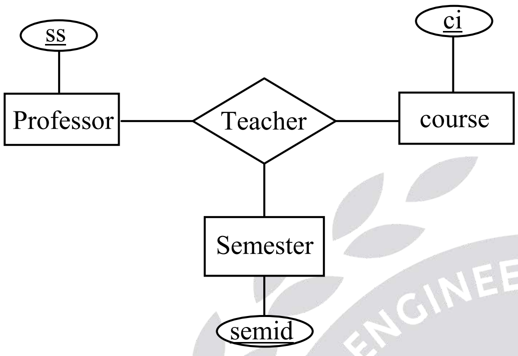
16. Ans: (a)

Sol: An attribute of one table matching the primary key of another table, is called as foreign key

17. Ans:

Sol:

1



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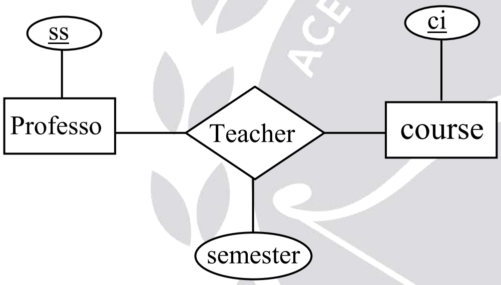

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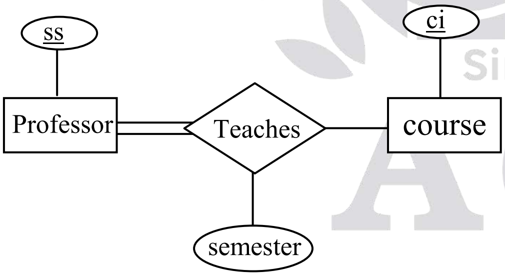

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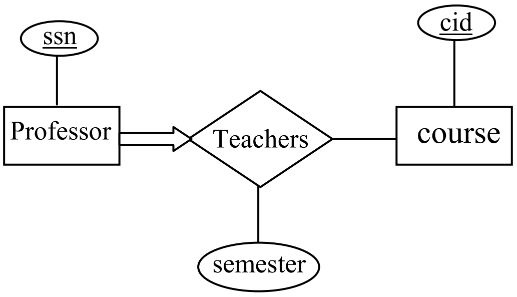

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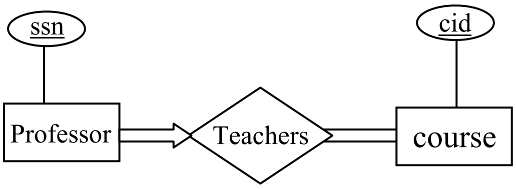

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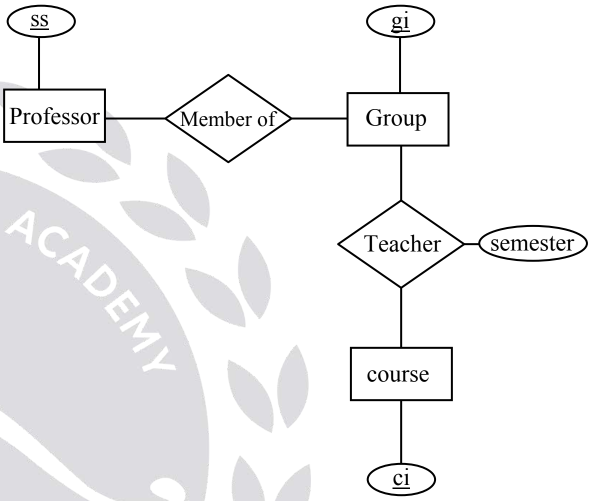

18. Ans: (b)

Sol: Strong entities E_1 and E_2 are represented as separate tables, in addition to that many to many relationship (R_2) must be converted as separate table by having primary keys of E_1 and E_2 as foreign keys. One to many relationship must be transferred to 'many' side table by having primary key of one side as foreign key. Hence we will have minimum of 3 tables.

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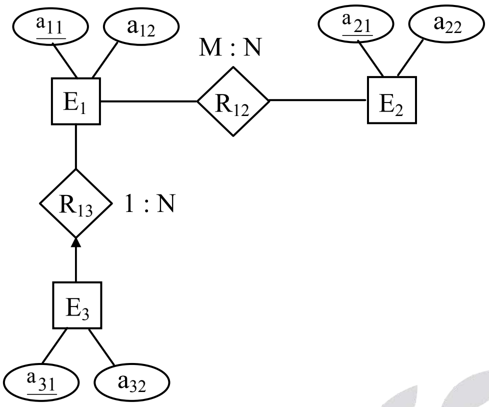
19. Ans: (c)

Sol:



If we convert into Relational model, the following relations will result.

1) $E_1(\underline{a_{11}}, a_{12})$

2) $E_2(\underline{a_{21}}, a_{22})$

3) $R_{12}(\underline{a_{11}\, a_{21}})$

4) $E_3R_{13}(\underline{a_{31}}, a_{32}, a_{11})$

20. Ans: (b)

Sol: Strong entities E_1 and E_2 are represented as separate tables, in addition to that many to many relationship (R_2) must be converted as separate table by having primary keys of E_1 and E_2 as foreign keys. One to many relationship must be transferred to 'many' side table by having primary key of one side as foreign key. Hence we will have minimum of 3 tables.

14. Functional Dependencies

01. Ans: (b)

Sol: From the given schema we conclude that "A functionally determines B and B does not functionally determine C'.

02. Ans: (d)

Sol: The FD BC → A holds good

03. Ans: (d)

Sol: The FD C → B doesn't hold over Relation R.

04. Ans: (d)

Sol: The FD BC → A holds good.

06. Ans: (c)

Sol: Trivial FDs are satisfied by all relations in a Database

08. Ans: (c)

Sol: AF^+ = AFDE not ACDEFG as given.

09. Ans: (d)

Sol: AB^+ = {ABCDEF}

10. Ans: (b)

Sol: CD^+ from functional dependencies (FDs) = **C**DE**A**B, it includes RHS attributes AC so it can be derived from FDs BD^+ from functional dependencies (FDs) = BD only, RHS attributes CD are not included in the closure hence it cannot be derived BC^+ from functional dependencies

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(FDs) = B**CD**EA, it includes RHS attributes CD, so it can be derived from FDs AC^+ from functional dependencies
(FDs) = A**CB**DE, it includes RHS attributes BC so it can be derived from FDs

11. Ans: (b)

Sol: $ACEH^+$ contains all the attributes of R.

12. Ans: (d)

Sol: Closure of $AEH^+ = BEH^+ = DEH^+$ = A, B, C, D, E, H. If any closure includes all attributes of a table then it can become candidate key of the table. Closure of AEH, BEH, DEH includes all attributes of table hence they are candidate keys.

13.

Sol: CK: ACD, BCD, ECD.

14. Ans: (d)

Sol: ck: ABF, EBF, CBF, ADF, EDF, CDF.

16. Ans: (a)

Sol: G not covers the dependency D → E of F.

18.

Sol:

$$\left.\begin{array}{l} AD \rightarrow CF \\ \quad C \rightarrow B \\ \quad B \rightarrow E \end{array}\right\} \text{Canonical set}$$

$$\left.\begin{array}{l} AD \rightarrow C \\ \quad C \rightarrow B \\ AB \rightarrow F \\ \quad B \rightarrow E \end{array}\right\} \text{Minimal set}$$

19.

Sol: In AB → C; B is redundant as A determines B and in D → AC; C is redundant as D determines C. Therefore the minimal set: A → BC and D → AC.

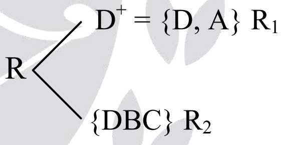
15. Normalizations

01.

Sol: (1) C → D
C → A
B → C
C.K: B, 2NF but not 3NF

(2) 2NF but not 3NF as no partial dependency CK: BD.

(3) R is in 3NF but not in BCNF



Not D.P ABC → D lost

(4) C.K = A
No Partial Dependency
∴ 2NF
R is in 2NF but not in BCNF & 3NF
$BC^+ = \{BCD\}$ R_1
$= \{ABC\}$ R_2

(5) AB → C
AB → D
C → A
D → B

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Candidate Keys = AB, CD, BC, AD

R is in 3NF but not in BCNF.

C+ {C, A} R_1

D+ {D, B} R_2

{C, D} R_3

Not D.P AB → CD lost.

02. Ans: (d)

Sol: Since $R1 \cap R2 \neq \phi$, R1 and R2 might have two attributes each and no common attribute. Any relation with 2 attributes satisfies 2 NF and 3 NF.

03. Ans: (b)

Sol: 1 represents Partial FD and 2 represents T.D

04. Ans: (c)

Sol: In FD A → C, R in 1NF but not in 2NF

05. Ans: (a)

Sol: In FD D → C, R is in 2NF but is in 3NF

06. Ans: (a)

Sol: Every binary relation is in BCNF.

08. Ans: (a)

Sol: Relation contains PFD: B → F.

09. Ans: (b)

Sol: Relation contains TD: C → E.

10. Ans: (d)

Sol: BC → D is Transitive FD.

11. Ans: (a)

Sol: B → F is PFD.

12. Ans: (d)

Sol: 1 NF - Unique rows

2 NF - Partial Dependencies

BCNF - Candidate keys

3 NF - Transitive dependencies

13. Ans: (b)

Sol: ACH is a key

14. Ans: (d)

Sol: E → G is Partial F.D.

15. Ans: (b)

Sol: In 2 NF every non-prime attribute is fully dependent functionally on the candidate key of relational schema

16.

Sol: R_1(CD)

R_2(FG)

R_3(AF)

R_4(ABCE)

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16. Transaction & Concurrency Control

01. Ans: (c)

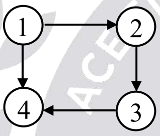
Sol: Atomocity : Recovery Manager
Isolation : Concurrency Control Sub system
Durability: Transaction Manager
Consistency Preservation : User

02. Ans: (d)

Sol: Every strict schedule is both recoverable and cascadeless.

03. Ans: (c)

Sol: Precedence graph



04. Ans: (b)

Sol: In S_1 $R_2(x)$ and $W_1(x)$ conflicts hence $T_2 < T_1$. Also $W_1(y)$ and $W_2(y)$ conflicts hence $T_1 < T_2$. There is no serial schedule that satisfies both $T_2 < T_1$ and $T_1 < T_2$.

In S_4 $R_2(x)$ and $W_1(x)$ conflicts hence $T_2 < T_1$. Also $W_1(y)$ and $W_2(y)$ conflicts hence $T_1 < T_2$. There is no serial schedule that satisfies both $T_2 < T_1$ and $T_1 < T_2$

05. Ans: (d)

Sol: S1 and S2 are conflict equivalent to serial schedule T_2, T_3, T_1.

S3 is not conflict equivalent as 2RA, 3WA ($T_2 < T_3$) and 3WA, 2WA ($T_3 < T_2$) are the conflict operations. There is no serial schedule that satisfies both $T_2 < T_3$ and $T_3 < T_2$.

06.

Sol: Not Conflict Serializable,
Not View Serializable,
Recoverable, Avoids Cascading aborts,
Not strict.

07.

Sol: Conflict Serializable,
View Serializable,
Serializable,
Recoverable,
Cascading aborts, Not strict

08.

Sol: Conflict Serializable,
View serializable,
Serializable,
Recoverable,
Cascading aborts, Not strict

09.

Sol: Not Conflict Serializable,
Not View Serializable,
Not avoids cascading aborts, not strict,
Recoverable, cascading aborts

10.

Sol: Conflict Serializable,
View serializable,
Serializable,
Recoverable,
Avoids cascading aborts,
Not strict

11.

Sol: Not Conflict Serializable, Views serializable through Thomas write rule, Serializable, Recoverable, Avoids cascading aborts, Not strict

12.

Sol: Conflict Serializable,
View Serializable,
Serializable,
Recoverable,
Avoids cascading aborts,
Not strict

13.

Sol: Not Conflict Serializable,
Not View Serializable,
Not Serializable,
Not Recoverable,
No need cascading aborts,
Not strict

14.

Sol: Conflict Serializable,
View Serializable,
Serializable,
Not Recoverable,
No need cascading aborts,
Not strict

15.

Sol: Conflict Serializable,
View Serializable,
Serializable,
Recoverable,
Avoid cascading aborts,
Strict

16.

Sol: Conflict Serializable,
View Serializable,
Serializable,
Recoverable,
Avoid cascading aborts,
Strict

17.

Sol: Not Conflict Serializable,
View Serializable as per Thomas write rule,
Serializable,
Recoverable,
Cascading aborts,
Not strict

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