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Operating System:

Paging: Questions

By: Vishvadeep Gothi

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in GATE

ME from IISc Bangalore
Mtech BITS Pilani in Data Science

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10+ Years in GATE/IES

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Computer Organization & Architecture, data structure, operating system, C-Programming, Data science, Machine Learning, Python, coding interview problems,

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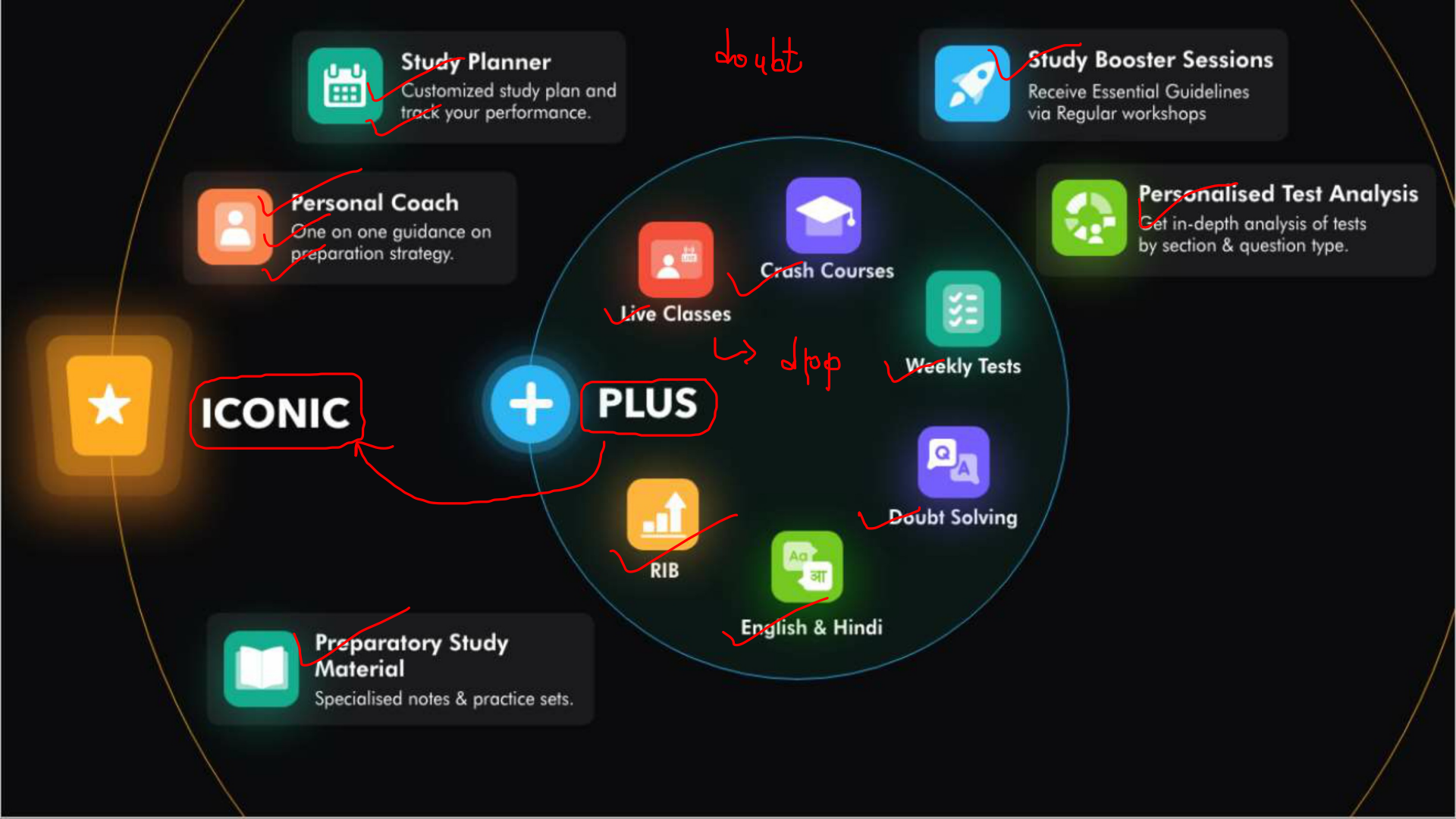
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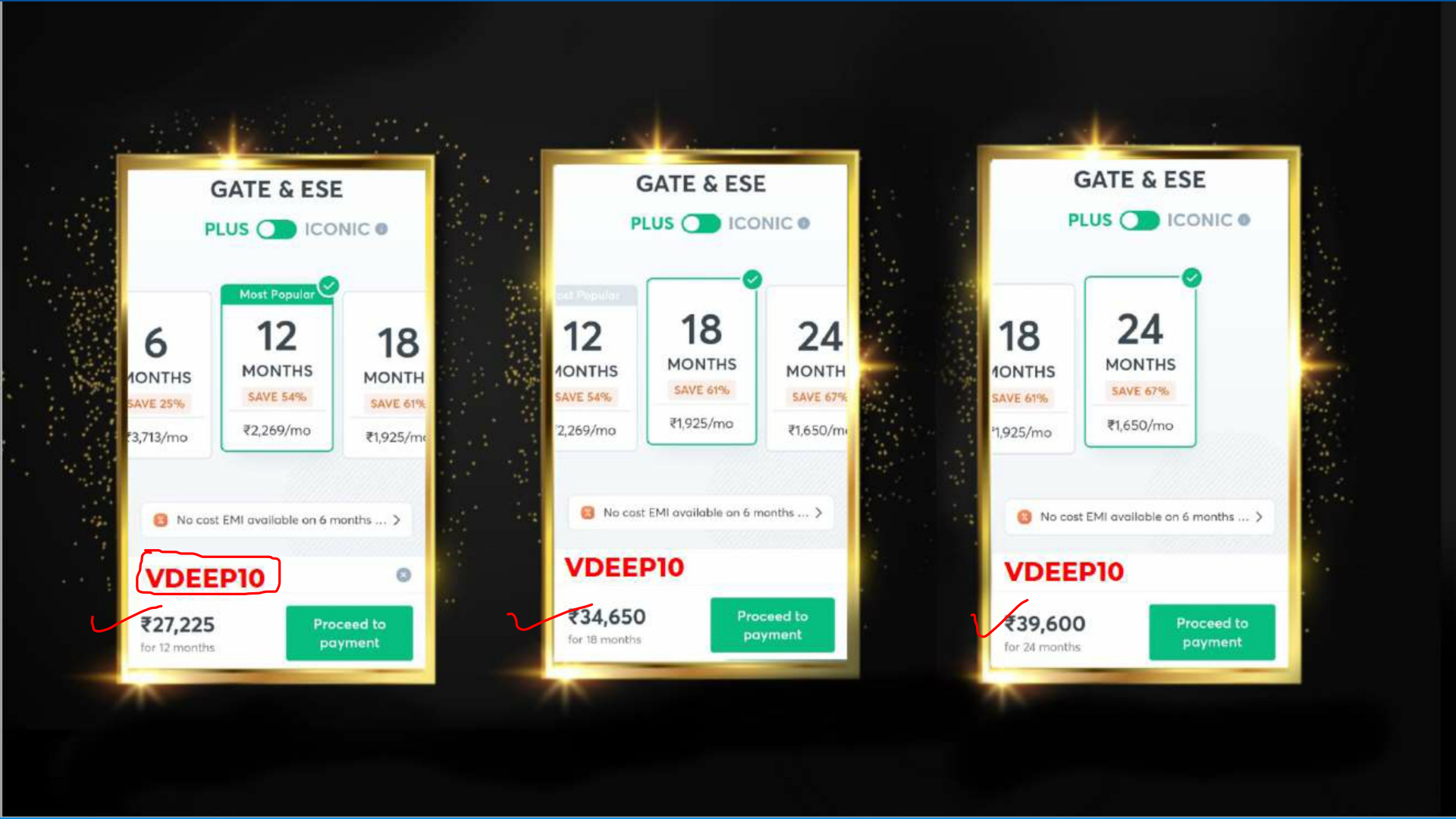
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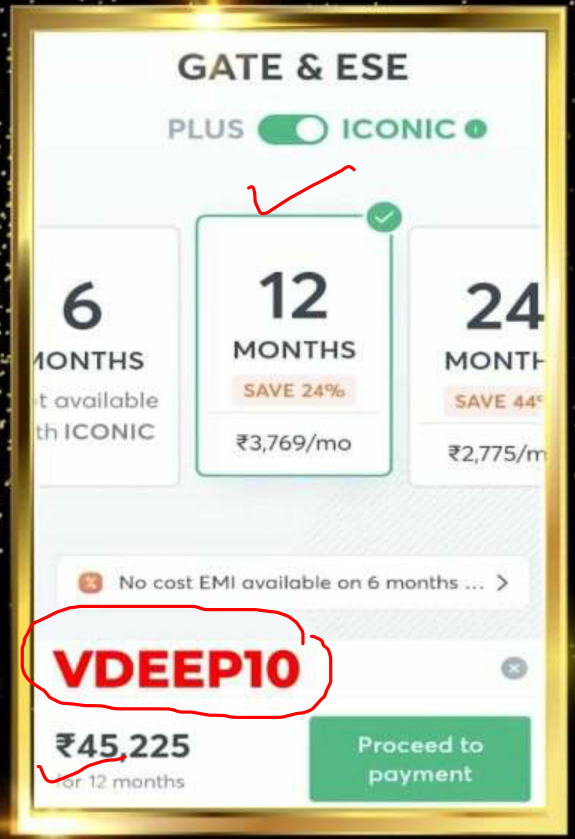
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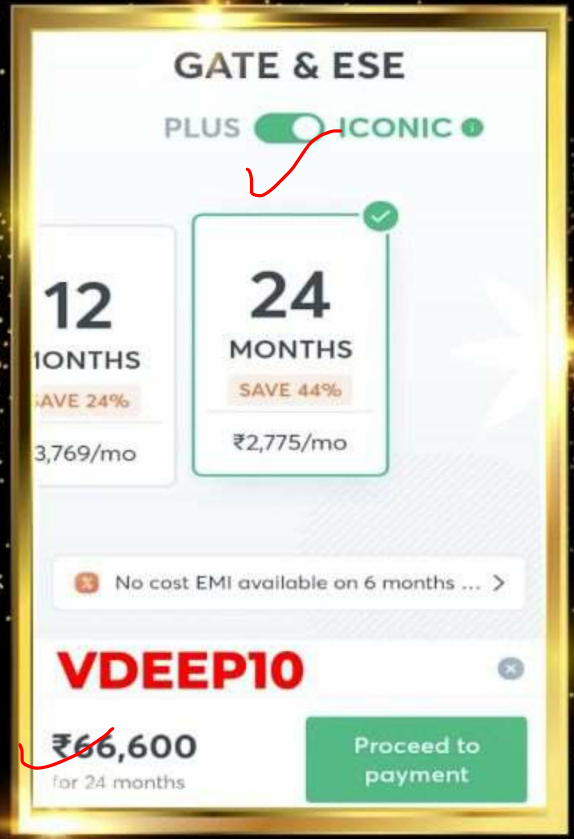
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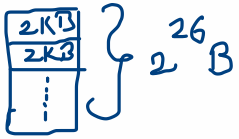


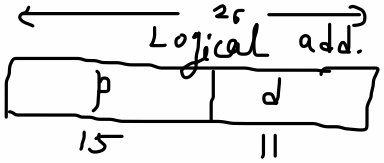
Consider a paged memory system with logical address of 26-bits and physical address of 32-bits. The page size is 2KB. Further consider that one page table entry size is 4bytes.

$2KB \rightarrow 2^{11}$ Bytes

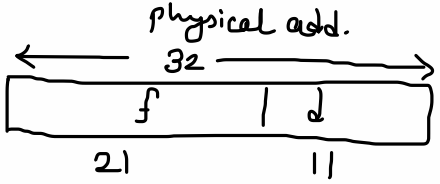
1. Bits in page offset = 11-bits
2. Number of pages in process 2^{15}
3. Bits for page number 15-bits
4. Number of frames in physical memory = 2^{21}
5. Bits for frame number = 21-bits
6. Page table size = 128KB

Question 1 Solution

$$\text{No. of pages} = \frac{\text{L.A.S.}}{\text{Page size}} = \frac{2^{26}\,B}{2^{11}\,B} = 2^{15} \Rightarrow \text{Page no.} = 15\text{-bits}$$

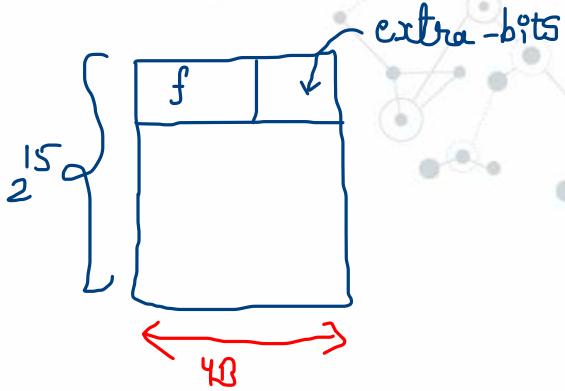


$$\text{No. of frames} = \frac{\text{P.A.S.}}{\text{Page size}} = \frac{2^{32}\,B}{2^{11}\,B} = 2^{21} \Rightarrow \text{Frame no.} = 21\text{-bits}$$



Question 1 Solution

P.T.



Page table size = No. of pages * 1 entry size

$= 2^{15} * 4B$

$= 2^{17} B$

$= 128KB$

---

1 entry size = 4B = 32-bits

= 21-bits + 11-bits

f extra

Question 2

1. 51-bits
2. 30-bits

A system has 64-bit virtual addresses and 43-bit physical addresses. If the pages are 8 kB in size, the number of bits required for VPN and PPN will be?

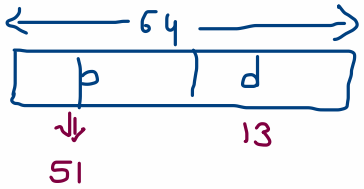
logical

$8\ kB \hookrightarrow 2^{13}\ B$

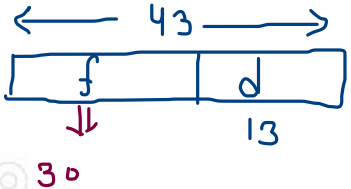
VPN → logical page no. (virtual)

PPN → physical page no. (frame no.)

logical add.



Physical add.



Question 3

page no. = 3-bits

d = 10-bits

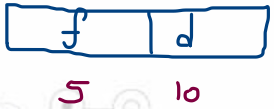
Consider a logical-address space of 8 pages, with page size 1024 bytes. The physical memory contains 32 frames.

frame no. = 5-bits

1. Bits in LA = 13-bits
2. Bits in PA = 15-bits
3. Page table size = 40-bits = 5 bytes

L.A.

P.A.



Page table size = no. of pages * 1 entry size

= 8 * 5-bits

= 40-bits

= 5 bytes

Question 4

$2^{12} \Rightarrow p = 12$ bits

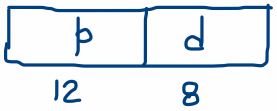
$2^8 \Rightarrow d = 8$ bits

1. 20-bits
2. 18-bits
3. 5k bytes

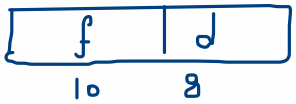
A system supports 4k pages of size 256 bytes each in a demand paging system. Main memory contain 1k frames. Number of bits required for logical address and physical address are? what is page table size?

$2^{10} \rightarrow f = 10$ bits

L.A.



P.A.



Page table size = 4K * 10-bits

= 40 k bits

= 5 K bytes

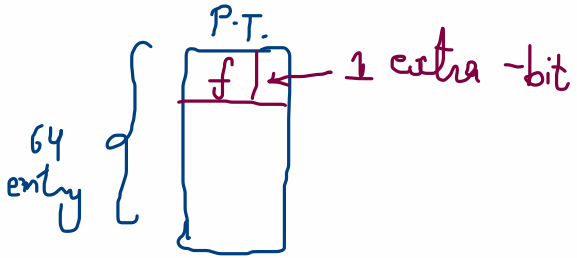
Question 5

L.A.S. = 2^{15} B = 32 kB

P.A.S. = 2^{19} B = 512 kB

What is the size of the physical address space & logical address space in a paging system which has a page table containing 64 entries of 11 bits each (including a valid bit) and page size of 512 bytes?

d = 9-bits



No. of pages = 64 = 2^6

⇓

p = 6-bits

entry size = 11-bits

f + 1 = 11

f = 10 bits

Question 6

2^{13} B $\Rightarrow$ d = 13-bits

A computer system implements 8 kilobyte pages and a 32−bit physical address space. Each page table entry contains a valid bit, a dirty bit, three permission bits, and the translation. If the maximum size of the page table of a process is 24 megabytes, the length of the virtual address supported by the system is __36__ bits.

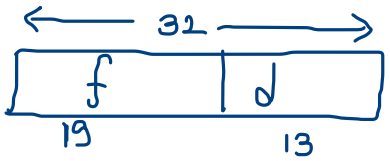
Page size = 8 KB

P.A. = 32-bits

P.T. entry = f + 1 valid + 1 dirty + 3 permission bits

P.T. size = 24 MB

P. A.



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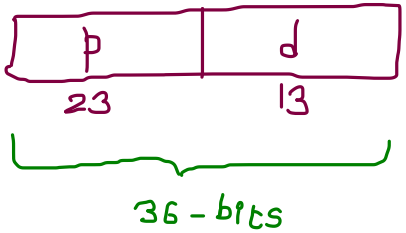

P. T. Size = no. of pages * 1 entry size

24 MB = n * (19 + 1 + 1 + 3) - bits

$24 * 2^{20} * 8$ bits = n * 24 - bits

n = 2^{23} pages

Page no. = 23-bits

Question 7

Homework

Consider a paged memory system with logical address space of L-bytes and physical address space of F-bytes. The page size is P-bytes. Further consider that one page table entry size is E-bytes.

1. Bits in page offset
2. Number of pages in process
3. Bits for page number
4. Number of frames in physical memory
5. Bits for frame number
6. Page table size

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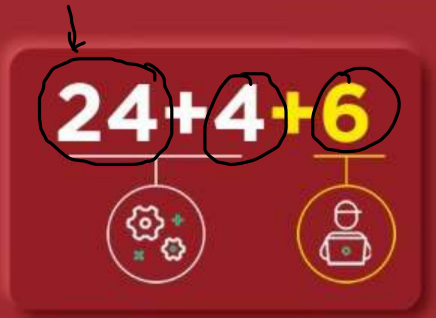

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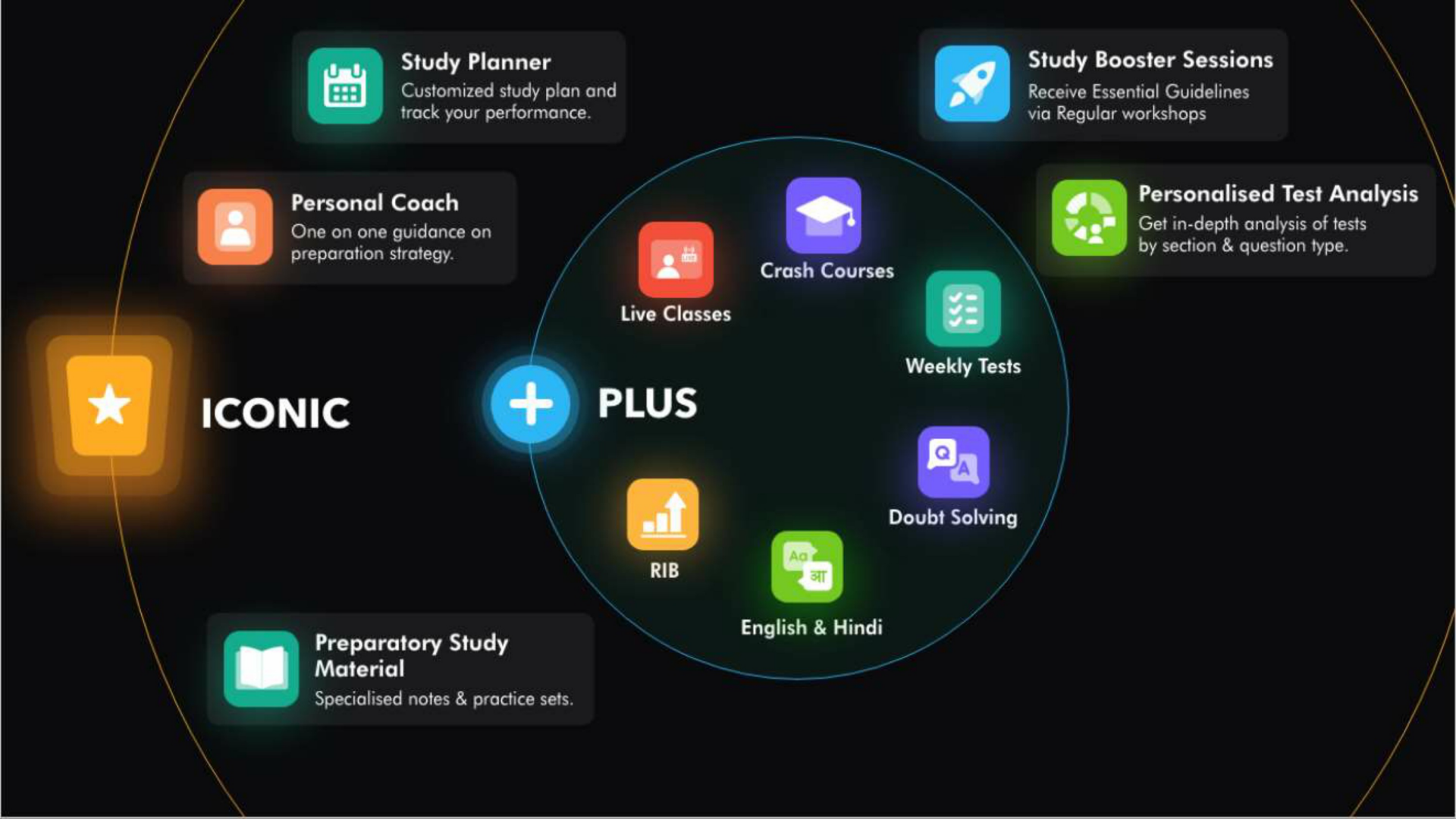
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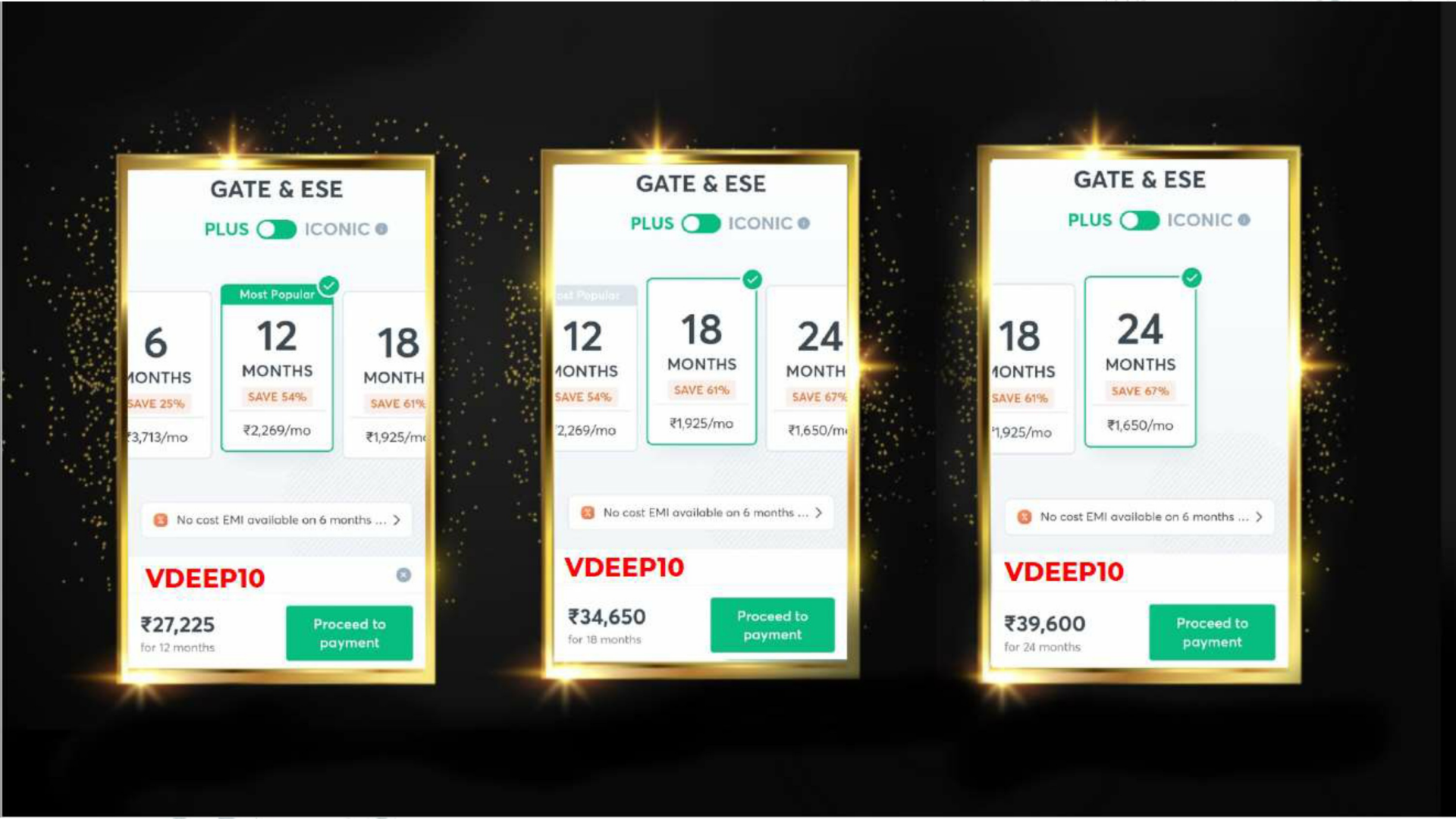
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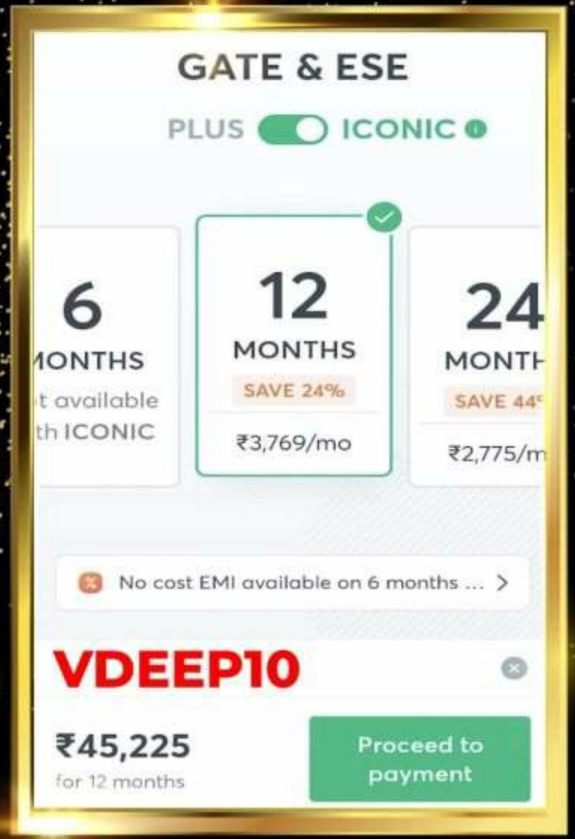
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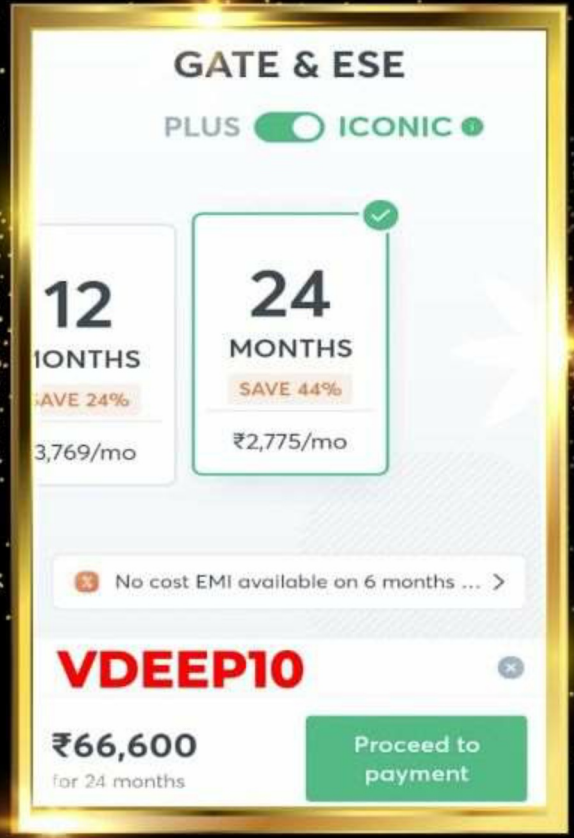
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