VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

Winter Semester 2023-24

Continuous Assessment Test – I

SLOT E1+TE1

Programme Name & Branch: B.Tech & Computer Science and Engineering

Course Name & Code: Cryptography and Network Security & BCSE309L

Class Number (s): Applicable to all

Faculty Name (s): Applicable to all

Exam Duration: 90 Min. **Maximum Marks: 50**

General instruction(s):

Answer All the Questions and calculator is allowed

Q. No.	Question	Max Marks
1.	a) Find GCD, variables S and T by construct a table for the following inputs using Extended Euclidean Algorithm. 291, 41.	5

We use the following table:

q	r_1	r_2	r	s_1	s_2	s	t_1	t_2	t
6	291	42	39	1	0	1	0	1	−6
1	42	39	3	0	1	−1	1	−6	7
13	39	3	0	1	−1	14	−6	7	−97
	3	0		−1	14		7	−97	
	↑			↑			↑		
	gcd			s			t		

$$\gcd(291, 42) = 3 \quad \rightarrow \quad (291)(-1) + (42)(7) = 3$$

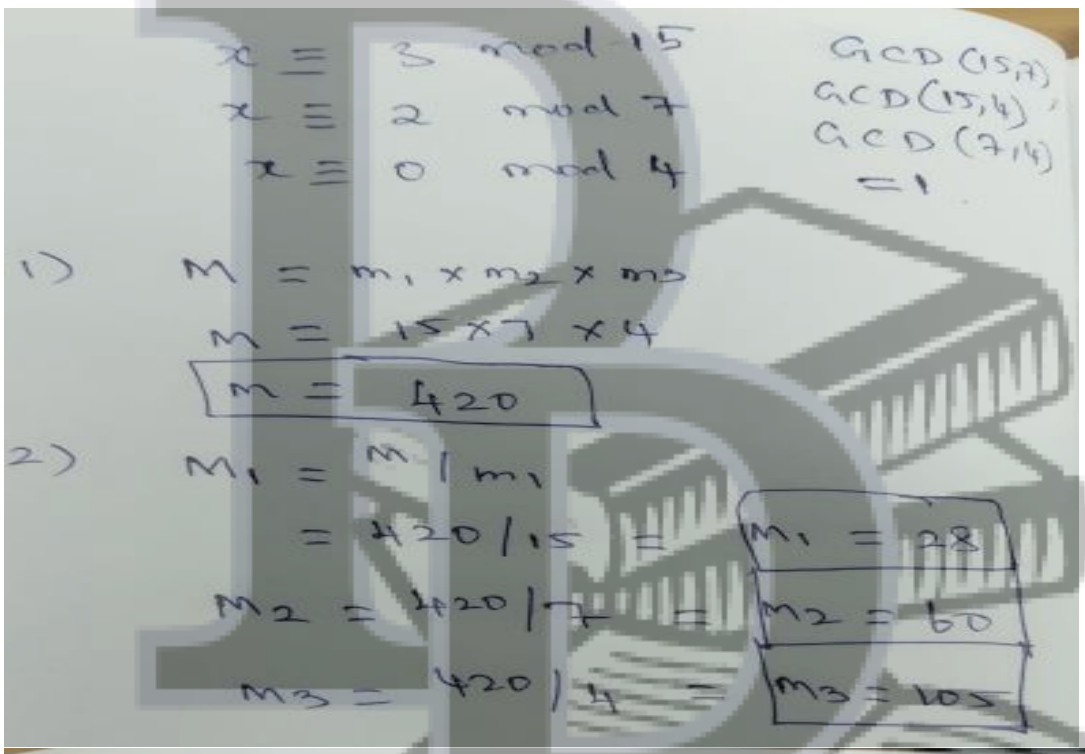
b) Find the remainder for $2^{20} + 3^{30} + 4^{40} + 5^{50} + 6^{60}$ mod 7 using Fermat's Little Theorem. 5

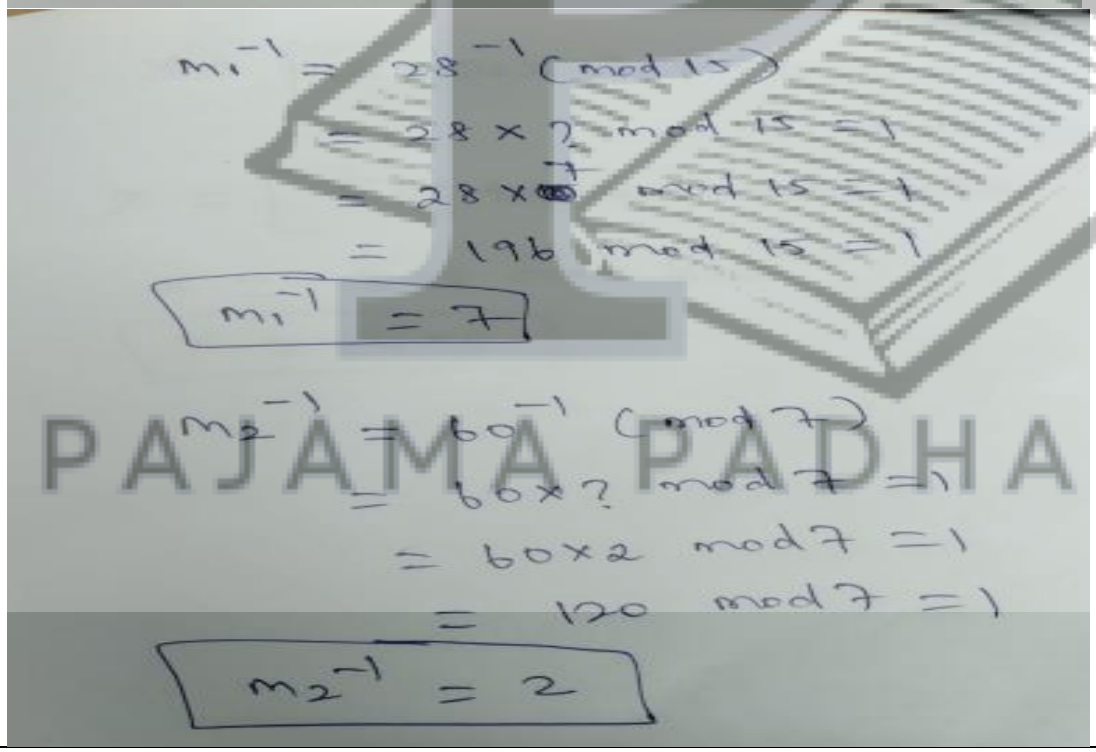
Find $2^{20} + 3^{30} + 4^{40} + 5^{50} + 6^{60} \bmod 7$.

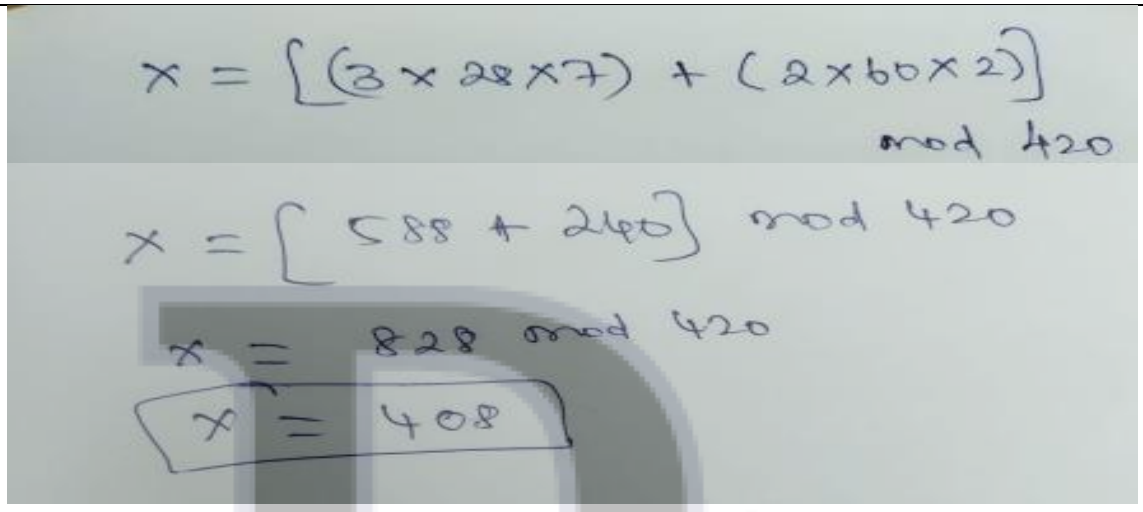
[Solution: $2^{20} + 3^{30} + 4^{40} + 5^{50} + 6^{60} \equiv 0 \bmod 7$]

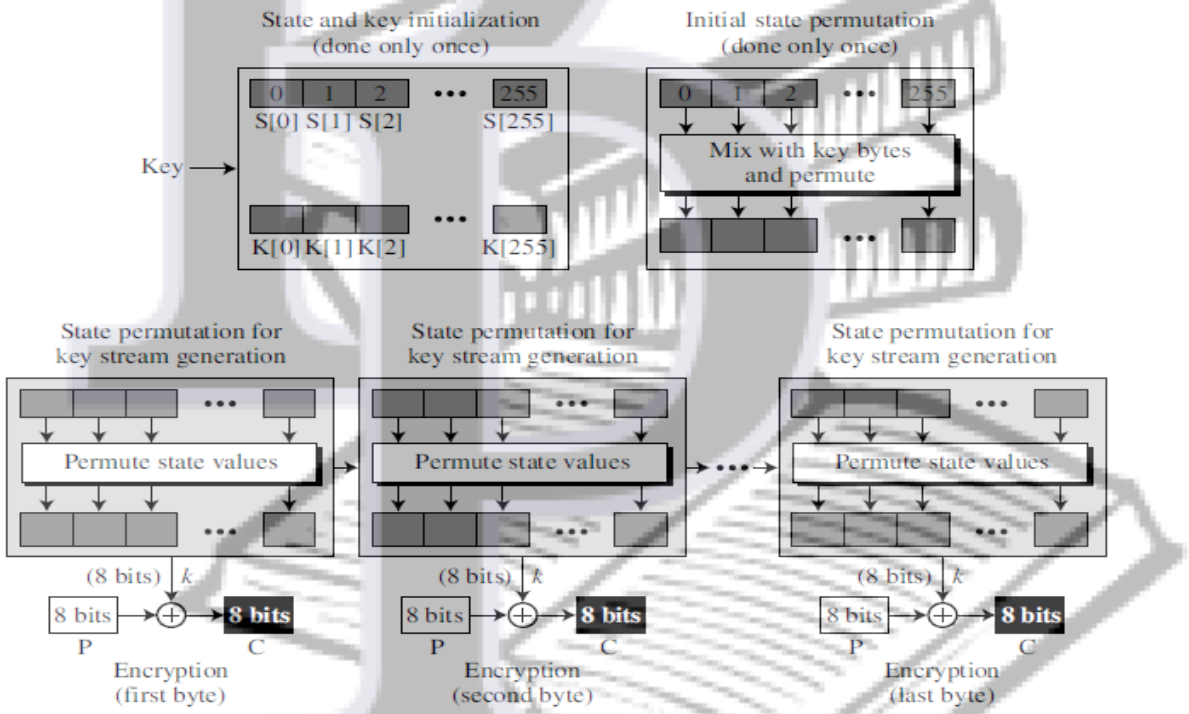
By Fermat's Little Theorem, $2^6 \equiv 3^6 \equiv 4^6 \equiv 5^6 \equiv 6^6 \equiv 1 \bmod 7$. Thus, $2^{20} + 3^{30} + 4^{40} + 5^{50} + 6^{60} \equiv 2^2 + 3^0 + 4^4 + 5^2 + 6^0 \equiv 4 + 1 + 2^8 + 25 + 1 \equiv 4 + 1 + 4 + 4 + 1 \equiv 14 \equiv 0 \bmod 7$.

2.	A hoard of gold pieces comes into the possession of a band of 15 pirates. When they come to divide up the coins, they find that 3 are left over. Their discussion of what to do with these extra coins becomes animated, and by the time some semblance of order returns there remain only 7 pirates capable of making an effective claim on the hoard. When, however, the hoard is divided between these seven it is found that 2 pieces are left over. There ensues an unfortunate repetition of the earlier disagreement, but this does at least have the consequence that the 4 pirates who remain are able to divide up the hoard evenly between them. What is the minimum number of gold pieces which could have been in the hoard?	10







3.	Draw an architecture of RC4 algorithm and discuss the process of initialization, initial state permutation, key stream generation and encryption in detail.  Architecture – 2 Initialization process - 2 Initial state permutation - 2 Key stream generation - 2 Encryption - 2	10
4.	a) Explain the DES feistel structure in detail with neat diagram.	5

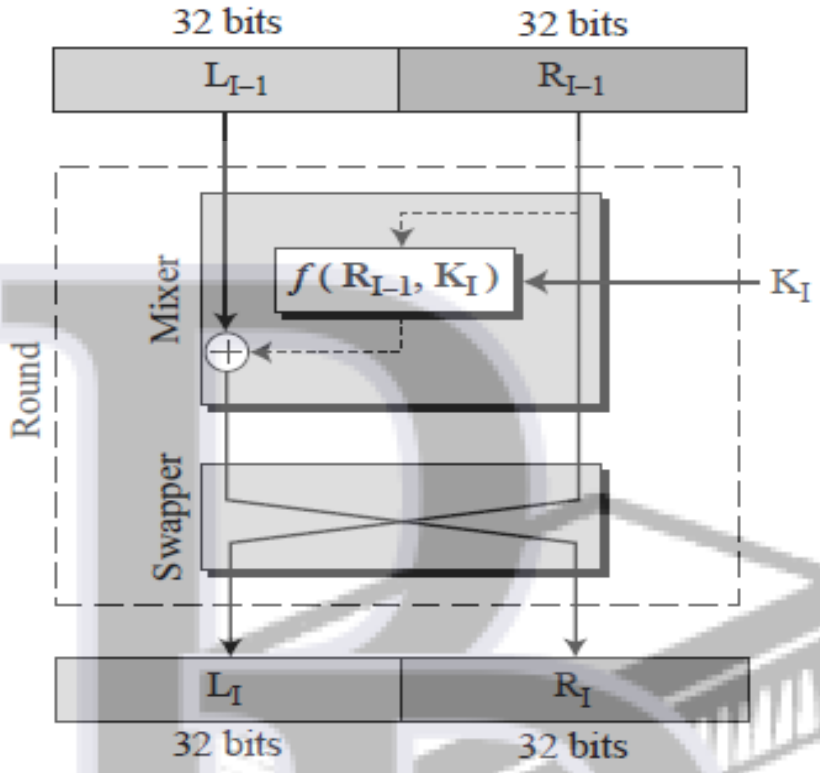


Fig. 6.4 *A round in DES (encryption site)*

b) Answer the following questions about S-boxes in DES:

i) Show the result of passing the input 111111 through S-box 2. 5
ii) Show the result of passing the input 000000 through S-box 7.

S-box 2 Table

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	15	01	08	14	06	11	03	04	09	07	02	13	12	00	05	10
1	03	13	04	07	15	02	08	14	12	00	01	10	06	09	11	05
2	00	14	07	11	10	04	13	01	05	08	12	06	09	03	02	15
3	13	08	10	01	03	15	04	02	11	06	07	12	00	05	14	09

S-box 7 Table

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	4	11	2	14	15	00	08	13	03	12	09	07	05	10	06	01
1	13	00	11	07	04	09	01	10	14	03	05	12	02	15	08	06
2	01	04	11	13	12	03	07	14	10	15	06	08	00	05	09	02
3	06	11	13	08	01	04	10	07	09	05	00	15	14	02	03	12

i)

Input: 1 1111 1 → 3, 15 → Output: 09 (1001)

ii)

Input: 0 0000 0 → 0, 0 → Output: 04 (0100)

5. Find the third round key of AES 128 using the following second round key which is given in hexadecimal, S-Box table and round constant 04. 10

Second Round Key

56	C7	76	A0
08	1A	43	3A
20	B1	55	F7
07	8F	69	FA

S-Box Table

		Y															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
X	0	63	7C	77	7B	F2	6B	6F	C5	30	01	67	2B	FE	D7	AB	76
	1	CA	82	C9	7D	FA	59	47	F0	AD	D4	A2	AF	9C	A4	72	C0
	2	B7	FD	93	26	36	3F	F7	CC	34	A5	E5	F1	71	D8	31	15
	3	04	C7	23	C3	18	96	05	9A	07	12	80	E2	EB	27	B2	75
	4	09	83	2C	1A	1B	6E	5A	A0	52	3B	D6	B3	29	E3	2F	84
	5	53	D1	00	ED	20	FC	B1	5B	6A	CB	BE	39	4A	4C	58	CF
	6	D0	EF	AA	FB	43	4D	33	85	45	F9	02	7F	50	3C	9F	A8
	7	51	A3	40	8F	92	9D	38	F5	BC	B6	DA	21	10	FF	F3	D2
	8	CD	0C	13	EC	5F	97	44	17	C4	A7	7E	3D	64	5D	19	73
	9	60	81	4F	DC	22	2A	90	88	46	EE	B8	14	DE	5E	0B	DB
	A	E0	32	3A	0A	49	06	24	5C	C2	D3	AC	62	91	95	E4	79
	B	E7	C8	37	6D	8D	D5	4E	A9	6C	56	F4	EA	65	7A	AE	08
	C	BA	78	25	2E	1C	A6	B4	C6	E8	DD	74	1F	4D	BD	8B	8A
	D	70	3E	B5	66	48	03	F6	0E	61	35	57	B9	86	C1	1D	9E
	E	E1	F8	98	11	69	D9	8E	94	9B	1E	87	E9	CE	55	28	DF
	F	8C	A1	89	0D	BF	E6	42	68	41	99	2D	0F	B0	54	BB	16

Second Round Key = 56 C7 76 A0
08 1A 43 3A
20 B1 55 F7
07 8F 69 FA
↑ W4 ↑ W5 ↑ W6 ↑ W7

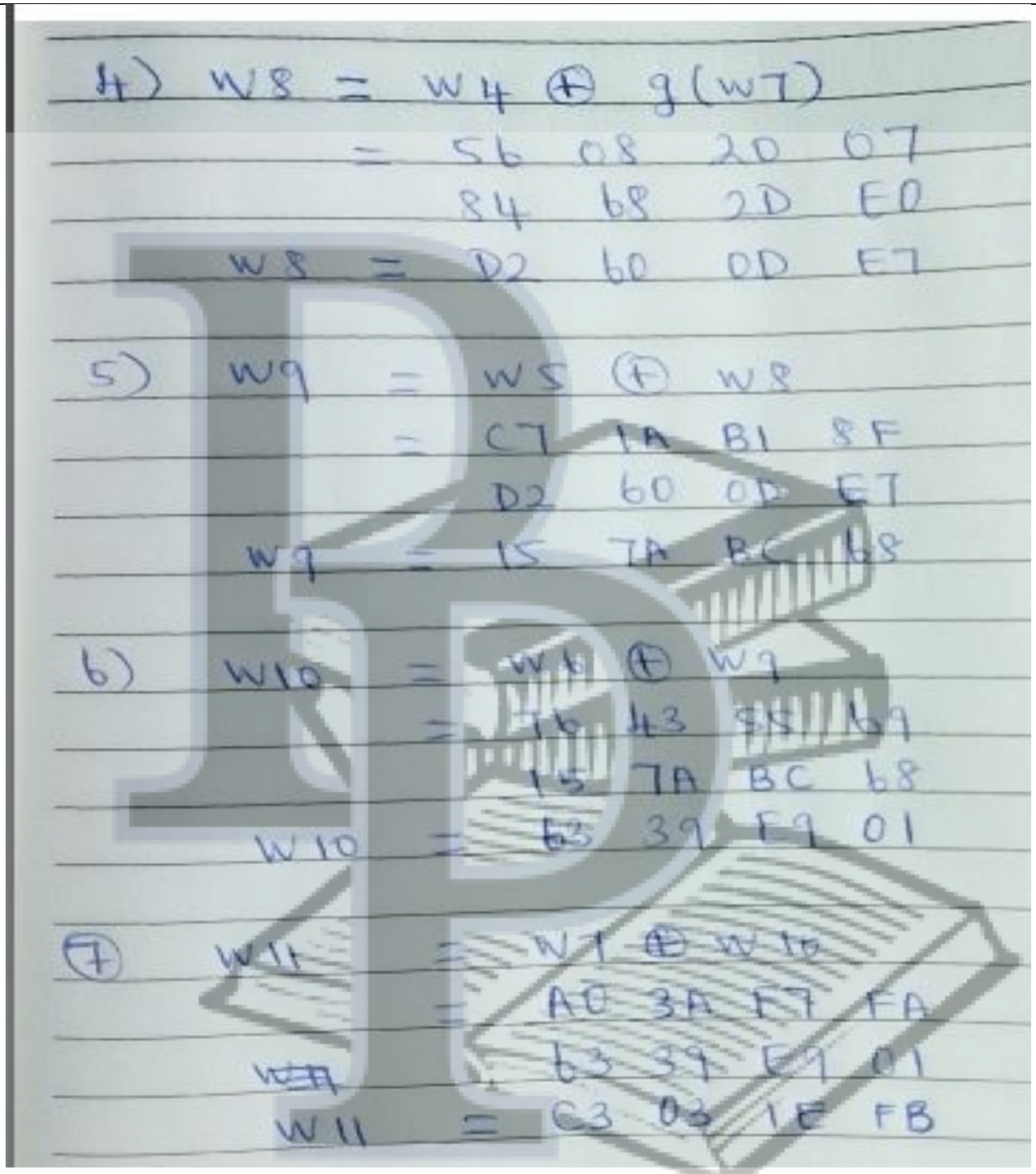
Find
g(W7) = g(A0 3A F7 FA)

1) Rotword one byte circular shift
= 3A F7 FA A0

2) Subword = 80 68 2D E0

3) EX OR with RC
= 80 68 2D E0 XOR
04 00 00 00

g(W7) = 84 68 2D E0



Round 3 key:

D2 60 0D E7 15 7A BC 68 63 39 E9 01 C3 03 1E FB