Course: "Fundamentals of Cryptography"

Laboratory work No. 7.

The purpose of the laboratory work: the study of the Rijndael algorithm.

Exercises:

1. Perform SunBytes transformations.

Assignment condition: Encode message M using the Rijndael encryption table. Use your name as message M, writing it in hexadecimal format (HER) using the ASCII code table. Replace each byte of the data array using the Rijndael encryption table.

2. a) In the Rijndael forward substitution table, represent the entries 01 ac 03 04 64 06 0d 10 in decimal notation.

b) In the Rijndael inverse permutation table, represent the elements f1 f3 f4 f6 f8 ff 10 in decimal notation.

3. Using the ShiftRows operation, perform the initial transformation of the model data block, assuming that each cell contains one byte of information:

63	7c	77	7b
ca	82	c9	7d
b7	fd	93	26
04	c7	23	c3

4. Form a data block of the inverse transformation corresponding to the data block presented in exercise 3 and apply the ShiftRows operation to the resulting block similar to task 3.

5. Form a table of byte order in the encryption key if the length of the encryption key is 160 bytes.

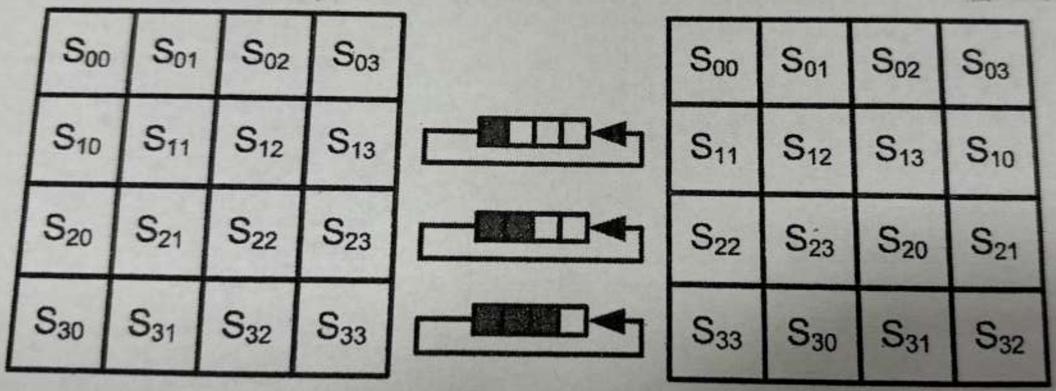
Optional:

6. Perform the multiplication operation in the Galois field.

5*7=

7. Calculate the affine transformation of triangle ABC with coordinates A (0,0), B (0,100), C (200,0) for M = 2, v = -100. Specify the coordinates of the resulting triangle and analyze the completeness of this problem.

7



S_{00}	S_{01}	S_{02}	S_{03}
S_{10}	S_{11}	S_{12}	S_{13}
S_{20}	S_{21}	S_{22}	S_{23}
S_{30}	S_{31}	S_{32}	S_{33}

S_{00}	S_{01}	S_{02}	S_{03}
S_{11}	S_{12}	S_{13}	S_{10}
S_{22}	S_{23}	S_{20}	S_{21}
S_{33}	S_{30}	S_{31}	S_{32}

ShiftRows

4.13

		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	ds	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	e4	a9	6c	56	f4	ea	65	7a	ae	08
	c	ba	78	25	2e	1c	a6	b4	c6	e8	dd	74	1f	4b	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

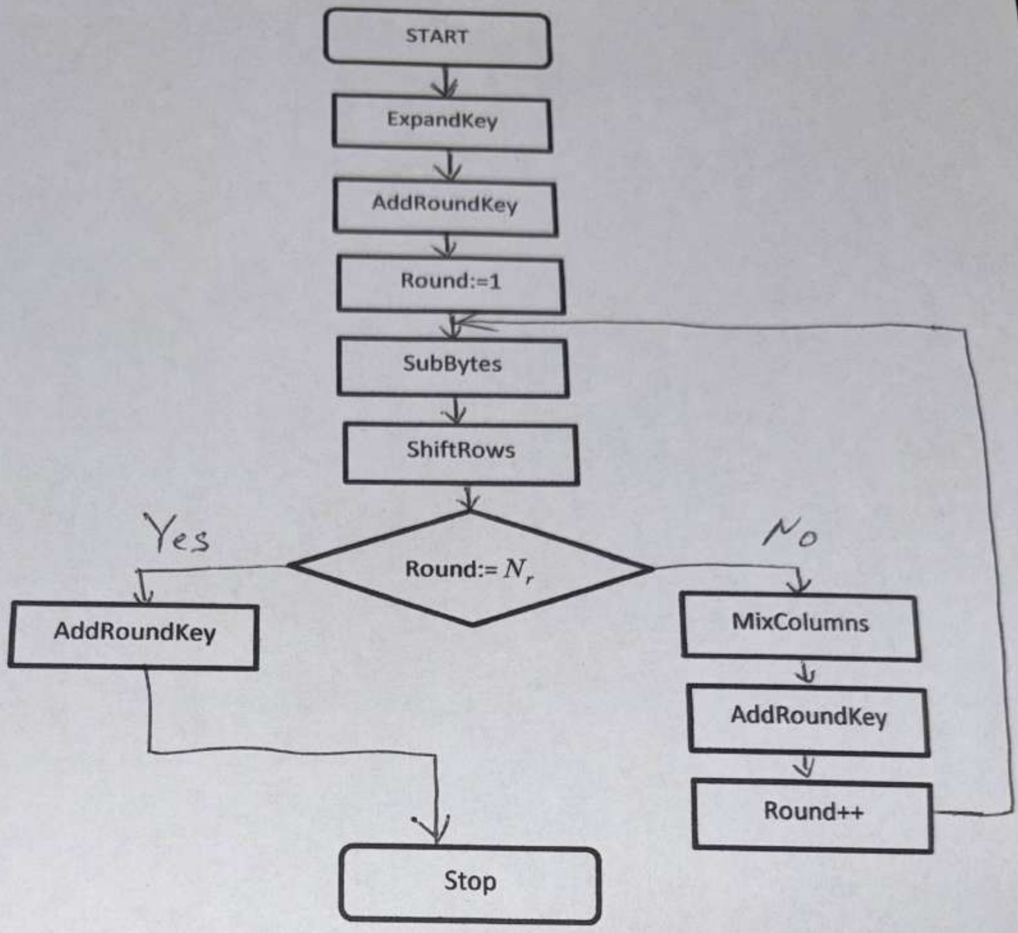
{fe} → {bb}.

4.14

		y															
		0	1	2	3	4	5	6	7	8	9	a	**b**	c	d	e	f
x	0	52	09	6a	d5	30	36	a5	38	bf	40	a3	9e	81	f3	d7	fb
	1	7c	e3	39	82	9b	2f	ff	87	34	8e	43	44	c4	de	e9	cb
	2	54	7b	94	32	a6	c2	23	3d	ee	4c	95	0b	42	fa	c3	4e
	3	08	2e	a1	66	28	d9	24	b2	76	5b	a2	49	6d	8b	d1	25
	4	72	f8	f6	64	86	68	98	16	d4	a4	5c	cc	5d	65	b6	92
	5	6c	70	48	50	fd	ed	b9	da	5e	15	46	57	a7	8d	9d	84
	6	90	d8	ab	00	8c	bc	d3	0a	f7	e4	58	05	b8	b3	45	06
	7	d0	2c	1e	8f	ca	3f	0f	02	c1	af	bd	03	01	13	8a	6b
	8	3a	91	11	41	4f	67	dc	ea	97	f2	cf	ce	f0	b4	e6	73
	9	96	Ac	74	22	e7	ad	35	85	e2	f9	37	e8	1c	75	df	6e
	a	47	f1	1a	71	1d	29	c5	89	6f	b7	62	0e	aa	18	be	1b
	b	fc	56	3e	4b	c6	d2	79	20	9a	db	c0	**fe**	78	cd	5a	f4
	c	1f	dd	a8	33	88	07	c7	31	b1	12	10	59	27	80	ec	5f
	d	60	51	7f	a9	19	b5	4a	0d	2d	e5	7a	9f	93	c9	9c	ef
	e	a0	e0	3b	4d	ae	2a	f5	b0	c8	eb	bb	3c	83	53	99	61
	f	17	2b	04	7e	ba	77	d6	26	e1	69	14	63	55	21	0c	7d

{bb} → {fe}.

4.7


START
ExpandKey
AddRoundKey
Round:=1
SubBytes
ShiftRows
Round:= N_r
Yes
No
AddRoundKey
MixColumns
AddRoundKey
Round++
Stop

AES