SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR-572103

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CRYPTOGRAPHY AND NETWORK SECURITY LAB (7RCSL01)

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Evaluation:

Write Up (10 marks)	Clarity in concepts (10 marks)	Implementation and execution of the algorithms (10 marks)	Viva (05 marks)	Total (35 marks)

Sl.No	Name of the Faculty In-Charge	Signature
1.	Sunitha N R	
2.	A H Shanthakumara	

Question No: 5

Generate and print 48-bit keys for all sixteen rounds of DES algorithm, given a 64-bit initial key.

Algorithm: To Generate 48-bits key, follow the flow-chart and tables given below.

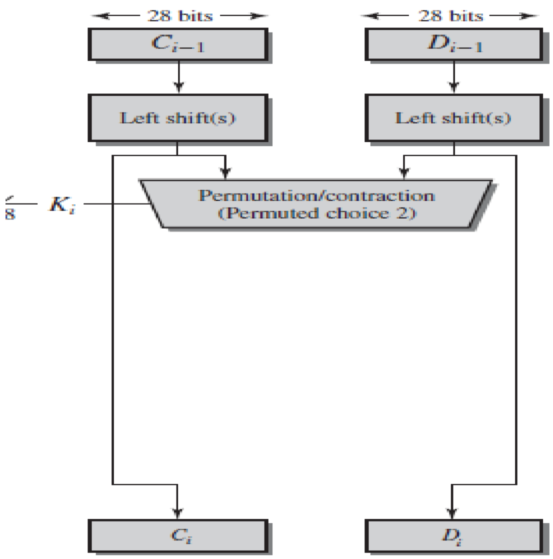
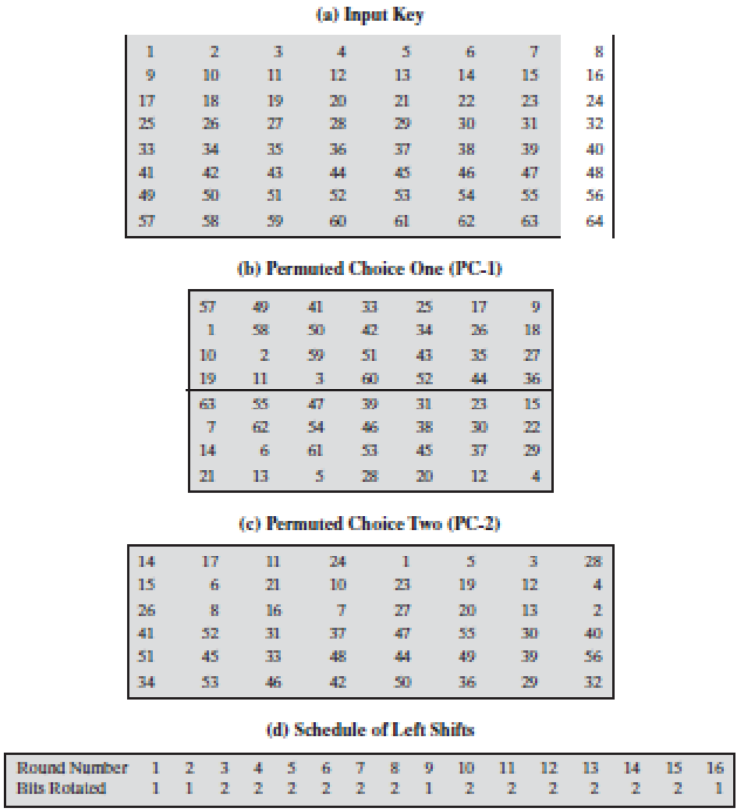


Figure: DES key Schedule Calculation



(a) Input Key

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

(b) Permuted Choice One (PC-1)

57	49	41	33	25	17	9
1	58	50	42	34	26	18
10	2	59	51	43	35	27
19	11	3	60	52	44	36
63	55	47	39	31	23	15
7	62	54	46	38	30	22
14	6	61	53	45	37	29
21	13	5	28	20	12	4

(c) Permuted Choice Two (PC-2)

14	17	11	24	1	5	3	28
15	6	21	10	23	19	12	4
26	8	16	7	27	20	13	2
41	52	31	37	47	55	30	40
51	45	33	48	44	49	39	56
34	53	46	42	50	36	29	32

(d) Schedule of Left Shifts

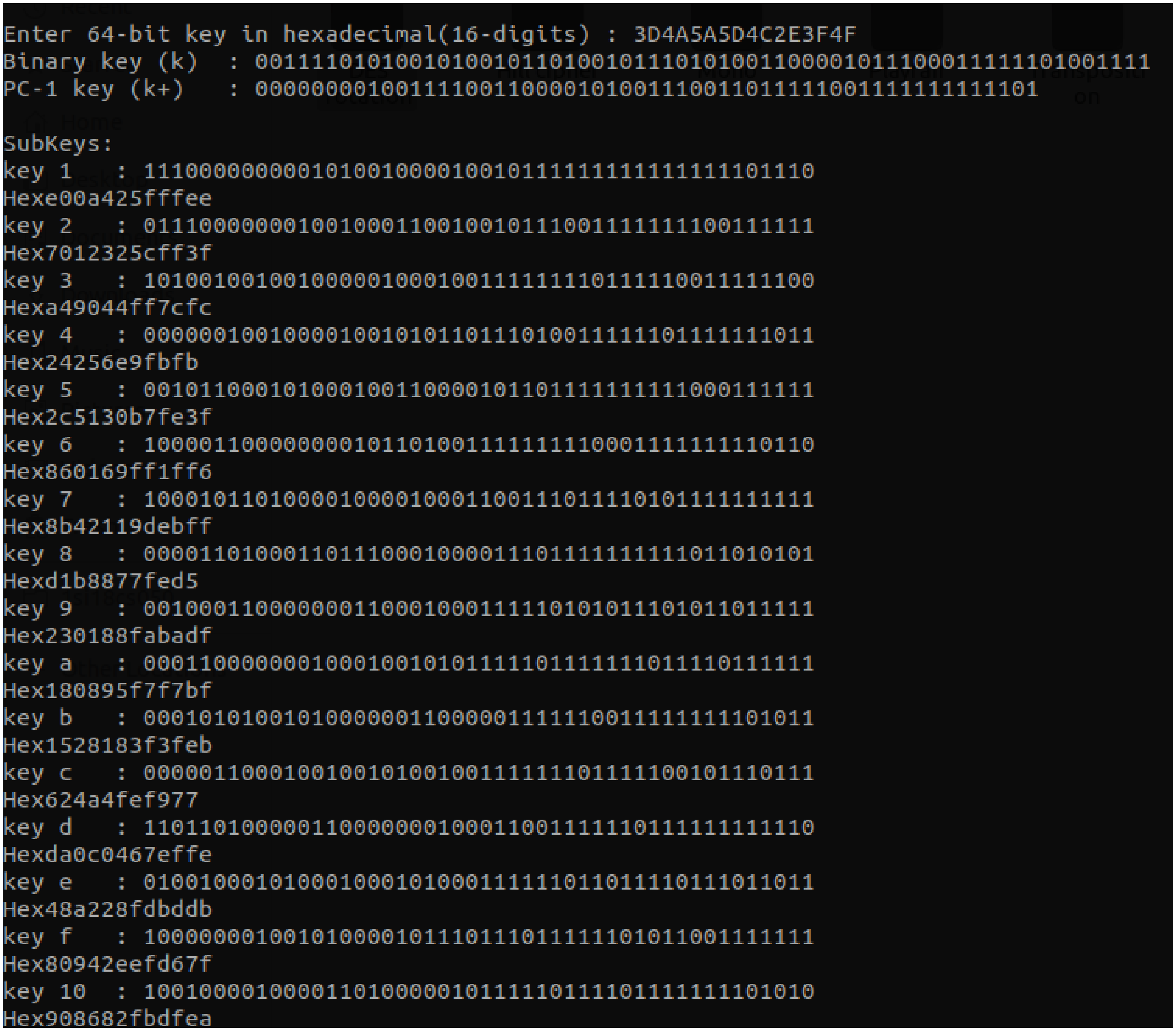
Round Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bits Rotated	1	1	2	2	2	2	2	2	1	2	2	2	2	2	2	1

Tables: DES key Schedule Calculation

PROGRAM:

```
#include <bits/stdc++.h>
#include <cstring>
using namespace std;

int permChoiceOne[] = {
                            57, 49, 41, 33, 25, 17, 9 ,
                            1 , 58, 50, 42, 34, 26, 18,
                            10, 2 , 59, 51, 43, 35, 27,
                            19, 11, 3 , 60, 52, 44, 36,
                            63, 55, 47, 39, 31, 23, 15,
                            7 , 62, 54, 46, 38, 30, 22,
                            14, 6 , 61, 53, 45, 37, 29,
                            21, 13, 5 , 28, 20, 12, 4 };

int permChoiceTwo[] = {
                            14, 17, 11, 24, 1 , 5 , 3 , 28,
                            15, 6 , 21, 10, 23, 19, 12, 4 ,
                            26, 8 , 16, 7 , 27, 20, 13, 2 ,
                            41, 52, 31, 37, 47, 55, 30, 40,
                            51, 45, 33, 48, 44, 49, 39, 56,
                            34, 53, 46, 42, 50, 36, 29, 32 };

int leftShiftTable[] = {1, 1, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 1};

string rotateSubKey(string s , int rot)
{
    return s.substr(rot, s.length()-rot) + s.substr(0, rot) ;
}

string firstPermute(string input)
{
    string res = "" ;
    for(int i=0 ; i<56 ; i++)
    {
      res += input[permChoiceOne[i]-1];
    }
    return res ;
}

string secondPermute(string input)
{
    string res = "" ;
    for(int i=0 ; i<48 ; i++)
    {
      res += input[permChoiceTwo[i]-1];
    }
    return res ;
}

void genKeys(string left, string right)
{
    ofstream fout ;
    fout.open("keygen.txt");
    for (int i=0; i<16; i++)
    {
      left = rotateSubKey(left , leftShiftTable[i]);
      right = rotateSubKey(right, leftShiftTable[i]);
      string key = secondPermute(left+right);
      cout << "key " << i+1 << " \t: " << key << endl;
      unsigned long long res= bitset<48>(key).to_ulong();
      cout<<"Hex"<<hex<<res<<endl;
      fout << key << endl;
    }
}

int main()
{
    unsigned long long hexkey;
    cout << "\nEnter 64-bit key in hexadecimal(16-digits) : " ;
    cin >> hex >> hexkey;

    string key = bitset<64>(hexkey).to_string();
    cout << "Binary key (k) \t: " << key << endl;

    key = firstPermute(key) ;
    cout << "PC-1 key (k+) \t: " << key << endl;

    cout << "\nSubKeys: " << endl;
    genKeys(key.substr(0,28) , key.substr(28,28));

    cout<<endl<<endl ;

    return 0;
}
```

OUTPUT:



```
Enter 64-bit key in hexadecimal(16-digits) : 3D4A5A5D4C2E3F4F
Binary key (k)  : 0011110101001010010110100101110101001100001011100011111101001111
PC-1 key (k+)   : 00000000100111100110000101001110011011111001111111111101

SubKeys:
key 1   : 111000000000101001000010010111111111111111101110
Hexe00a425fffee
key 2   : 011100000001001000110010010111001111111100111111
Hex7012325cff3f
key 3   : 101001001001000001000100111111110111110011111100
Hexa49044ff7cfc
key 4   : 000000100100001001010110111010011111101111111011
Hex24256e9fbfb
key 5   : 001011000101000100110000101101111111111000111111
Hex2c5130b7fe3f
key 6   : 100001100000000101101001111111110001111111110110
Hex860169ff1ff6
key 7   : 100010110100001000010001100111011110101111111111
Hex8b42119debff
key 8   : 000011010001101110001000011101111111111011010101
Hexd1b8877fed5
key 9   : 001000110000000110001000111110101011101011011111
Hex230188fabadf
key a   : 000110000000100010010101111101111111011110111111
Hex180895f7f7bf
key b   : 000101010010100000011000001111110011111111101011
Hex1528183f3feb
key c   : 000001100010010010100100111111101111100101110111
Hex624a4fef977
key d   : 110110100000110000000100011001111110111111111110
Hexda0c0467effe
key e   : 010010001010001000101000111111011011110111011011
Hex48a228fdbddb
key f   : 100000001001010000101110111011111101011001111111
Hex80942eefd67f
key 10  : 100100001000011010000010111110111101111111101010
Hex908682fbdfea
```