```
################################################################

  Block Cipher Modes of Operation

      Electronic Codebook (ECB)

Plaintext is
    6BC1BEE2 2E409F96 E93D7E11 7393172A
    AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51
    30C81C46 A35CE411 E5FBC119 1A0A52EF
    F69F2445 DF4F9B17 AD2B417B E66C3710

################################################################

ECB-AES128 (Encryption)
----------------------------------------------------------------

Key is
    2B7E1516 28AED2A6 ABF71588 09CF4F3C

Plaintext is
    6BC1BEE2 2E409F96 E93D7E11 7393172A
    AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51
    30C81C46 A35CE411 E5FBC119 1A0A52EF
    F69F2445 DF4F9B17 AD2B417B E66C3710

KeyAddition   40BFABF4 06EE4D30 42CA6B99 7A5C5816

Round = 1
  Substitution  090862BF 6F28E304 2C747FEE DA4A6A47
  ShiftRow      09287F47 6F746ABF 2C4A6204 DA08E3EE
  MixColumn     529F16C2 978615CA E01AAE54 BA1A2659
  KeyAddition   F265E8D5 1FD2397B C3B9976D 9076505C

Round = 2
  Substitution  894D9B03 C0B51221 2E56883C 6038534A
  ShiftRow      89B5884A C0565303 2E389B21 604D123C
  MixColumn     0F31E929 319A3558 AEC95893 39F04D87
  KeyAddition   FDF37CDB 4B0C8C1B F7FCD8E9 4AA9BBF8

Round = 3
  Substitution  540D10B9 B3FE64AF 68B0611E D6D3EA41
  ShiftRow      54FE6141 B3B0EAB9 68D310AF D60D641E
  MixColumn     9151ABE1 E5541CFD 014A713E DA7E3134
  KeyAddition   ACD1EC9C A242E2C3 1F690F7A B704B90F
```

```
Round = 4
  Substitution  913ECEDE 3A2C982E C0F976DA A9F25676
  ShiftRow      912C7676 3AF956DE C0F2CE2E A93E98DA
  MixColumn     4D25CB1E ECF71646 7658C73B 49BCC9E9
  KeyAddition   A2616E5F 44A54D39 C029E200 92B764E9

Round = 5
  Substitution  3AEF9FCF 1B06E312 BAA59863 4FA9431E
  ShiftRow      3A06981E 1BA543CF BAA99F12 4FEFE363
  MixColumn     F89B35EC 4E40724E 025B00C7 34D7D81B
  KeyAddition   2C4AF314 32C3EFC9 C8A9B87B 252ECDA7

Round = 6
  Substitution  71D60DFA 232EDFDD E8D36C21 3F31BD5C
  ShiftRow      712E6C5C 23D3BDFA E8310DDD 3FD6DF21
  MixColumn     A0C56369 6FB884E4 4840BFBE E1D32F0A
  KeyAddition   CD4DC013 7EB3BA19 93B939FF 2BD3BCF7

Round = 7
  Substitution  BDE3BA7D F36DF4D4 DC561216 F1666568
  ShiftRow      BD6D1268 F356657D DC66BAD4 F1E3F416
  MixColumn     AC394C73 1F8DE8C7 6711B210 253DDB33
  KeyAddition   E26DBB7D 40D22134 E3B7FDA2 6B9B077C

Round = 8
  Substitution  983CEAFF 09B5FD18 11A9543A 7F14C510
  ShiftRow      98B55410 09A9C5FF 1114EA18 7F3CFD3A
  MixColumn     AB05B572 C8EB2B92 EC04E2FD 7D21EC34
  KeyAddition   41D7C653 7D669140 DD2F179D 02ACC51B

Round = 9
  Substitution  830EB4ED FF338109 C115F05E 7791A6AF
  ShiftRow      8333F0AF FF15A6ED C191B409 770E815E
  MixColumn     1741A118 91C99168 8C36386F 23AD82AA
  KeyAddition   BB36C7EB 88334D49 A4E7112E 74F182C4

Substitution  EA05C6E9 C4C3E33B 49948231 92A1131C
ShiftRow      EAC3821C C49413E9 49A1C63B 9205E331
KeyAddition   3AD77BB4 0D7A3660 A89ECAF3 2466EF97

KeyAddition   85539F41 36AD7E3A 35407A24 4C60C16D

Round = 1
  Substitution  97EDDB83 0595F380 9609DA36 29D0783C
  ShiftRow      9795DA3C 05097883 96D0DB80 29EDF336
  MixColumn     77EFE995 EA1C6263 07DB70B1 BBD06309
```

```
  KeyAddition   D7151782 62484ED2 24784988 91BC150C

Round = 2
  Substitution  0E59F013 AA522FB5 36BC3BC4 816559FE
  ShiftRow      0E523BFE AABC5913 3665F0B5 81592FC4
  MixColumn     2F19339C DA319126 86426CBE 1986D17D
  KeyAddition   DDDBA66E A0A72865 DF77ECC4 6ADF2702

Round = 3
  Substitution  C1B9249F E05C344D 9EF5CE1C 029ECC77
  ShiftRow      C15CCE77 E0F5CC9F 9E9E244D 02B9341C
  MixColumn     C4478324 8CC12C27 F7989F99 FC2BF7B3
  KeyAddition   F9C7C459 CBD7D219 E9BBE1DD 91517F88

Round = 4
  Substitution  99C61CCB 1F0EB5D4 1EEAF8C1 81D1D2C4
  ShiftRow      990EF8C4 1FEAD2CB 1ED11CD4 81C6B5C1
  MixColumn     07522BD5 02760C94 9C57905C 3C136E72
  KeyAddition   E8168E94 AA2457EB 2A26B567 E718C372

Round = 5
  Substitution  9B471922 AC365BE9 E5F7D585 94AD2E40
  ShiftRow      9B36D540 ACF72E22 E5AD19E9 94475B85
  MixColumn     E2D3DCD5 4D096172 CD665A49 2472F1AA
  KeyAddition   36021A2D 318AFCF5 0794E2F5 358BE416

Round = 6
  Substitution  0577A2D8 C77EB0E6 C52298E6 963D6947
  ShiftRow      057E9847 C72269D8 C53DA2E6 9677B0E6
  MixColumn     570D9967 42E044B2 92A4961C F855ABB1
  KeyAddition   3A853A1D 53EB7A4F 495D105D 3255384C

Round = 7
  Substitution  809780A4 EDE9DA84 3B4CCA4C 23FC0729
  ShiftRow      80E9CA29 ED4C07A4 3BFC8084 2397DA4C
  MixColumn     D8259DEA B6D85834 6DC74B22 722FCFB0
  KeyAddition   96716AE4 E98791C7 E9610490 3C8913FF

Round = 8
  Substitution  90A30269 1E1781C6 1EEFF260 EBA77D16
  ShiftRow      9017F216 1EEF7D69 1EA702C6 EBA38160
  MixColumn     E6A54262 0235B062 0A8BEC10 D24EF1C4
  KeyAddition   0C773143 B7B80AB0 3BA01970 ADC3D8EB

Round = 9
  Substitution  FEF5C71A A96C67E7 E2E0D451 952E61E9
```

```
  ShiftRow      FE6CD4E9 A9E0611A E22EC7E7 95F56751
  MixColumn     6EA80168 09CBA555 8D0B6B01 039C5D94
  KeyAddition   C2DF679B 10317974 A5DA4240 54C05DFA

Substitution  259E8514 CAC7B692 06572C09 20BA4C2D
ShiftRow      25C72C2D CA574C14 06BA8592 209EB609
KeyAddition   F5D3D585 03B9699D E785895A 96FDBAAF

KeyAddition   1BB60950 8BF236B7 4E0CD491 13C51DD3

Round = 1
  Substitution  AF4E0153 3D8905A9 2FFE4881 7DA6A466
  ShiftRow      AF894866 3DFEA453 2FA601A9 7D4E0581
  MixColumn     EB181CE7 947E65BB 07D26B9F AC6FA1D5
  KeyAddition   4BE2E2F0 1C2A490A 247152A6 8603D7D0

Round = 2
  Substitution  B398988C 9CE53B67 36A30024 447B0E70
  ShiftRow      B3E50070 9CA30E8C 367B9867 44983B24
  MixColumn     3912C6CB 5F5FAC11 1E14CF77 2406C627
  KeyAddition   CBD05339 25C91552 47214F0D 575F3058

Round = 3
  Substitution  1F70ED12 3FDD5900 A0FD84D7 5BCF046A
  ShiftRow      1FDD846A 3FFD0412 A0CFED00 5B7059D7
  MixColumn     AC436FAC 74C0FC9C FC09AED9 A887FB71
  KeyAddition   91C328D1 33D602A2 E22AD09D C5FD734A

Round = 4
  Substitution  812E343E C3F6773A 98E5705E A6548FD6
  ShiftRow      81F670D6 C3E58F3E 9854343A A62E775E
  MixColumn     BE30F6A9 18A66148 D956EAA7 0C3D8414
  KeyAddition   517453E8 B0F43A37 6F27CF9C D7362914

Round = 5
  Substitution  D192ED9B E7BF809A A8CC8ADE 0E05A5FA
  ShiftRow      D1BF8AFA E7CCA59B A805ED9A 0E9280DE
  MixColumn     13CB74B2 A40BCC76 3314D924 EF74FEA7
  KeyAddition   C71AB24A D88851F1 F9E66198 FE8DEB1B

Round = 6
  Substitution  C6A237D6 61C4D1A1 998EEF46 BB5DE9AF
  ShiftRow      C6C4EFAF 618EE9D6 995D37A1 BBA2D146
  MixColumn     80D02D3F 74904773 58DB5283 07CA6A29
  KeyAddition   ED588E45 659B798E 8322D4C2 CDCAF9D4
```

```
Round = 7
  Substitution  556A196E 4D14B619 EC934825 BD749948
  ShiftRow      55144848 4D93996E EC741919 BD6AB625
  MixColumn     96ED0933 C3AE4501 5F368170 4C8DCF4A
  KeyAddition   D8B9FE3D 9CF18CF2 DB90CEC2 022B1305

Round = 8
  Substitution  6156BB27 DEA16489 B9608B25 77F17D6B
  ShiftRow      61A18B6B DE607D27 B9F1BB89 77566425
  MixColumn     DAD5705F 5DBE2D2A 531FA593 555286E1
  KeyAddition   3007037E E83397F8 623450F3 2ADFAFCE

Round = 9
  Substitution  04C57BF3 9BC38841 AA18530D E59E798B
  ShiftRow      04C3538B 9B1879F3 AA9E7B41 E5C5880D
  MixColumn     8EE7E791 8FD37F2A CC410182 00FA3C63
  KeyAddition   22908162 9629A30B E49028C3 57A63C0D

Substitution  93600CAA 90A50A2B 6960342E 5B24EBD7
ShiftRow      93A534D7 9060EBAA 69240C2B 5B600A2E
KeyAddition   43B1CD7F 598ECE23 881B00E3 ED030688

KeyAddition   DDE13153 F7E149B1 06DC54F3 EFA3782C

Round = 1
  Substitution  C1F8C7ED 68F83BC8 6F86200D DF0ABC71
  ShiftRow      C1F82071 6886BCED 6F0AC7C8 DFF83B0D
  MixColumn     DB3BEA62 104DA143 CFE1B3F7 807446A3
  KeyAddition   7BC11475 98198DF2 EC428ACE AA1830A6

Round = 2
  Substitution  2178FA9D 46D45D89 CE2C7E8B ACAD0424
  ShiftRow      21D47E24 462C049D CEADFA89 AC785D8B
  MixColumn     7F346581 618FDEC3 18130C17 1D30E8C7
  KeyAddition   8DF6F073 1B196780 41268C6D 6E691EB8

Round = 3
  Substitution  5D428C8F AFD485CD 83F7643C 9FF9726C
  ShiftRow      5DD4646C AFF7728F 83F98CCD 9F42853C
  MixColumn     D52EF58F BA43366A 4C28356A 5AB38805
  KeyAddition   E8AEB2F2 FD55C854 520B4B2E 37C9003E

Round = 4
  Substitution  9BE43789 54FCE820 002BB331 9ADD63B2
  ShiftRow      9BFCB3B2 542B6389 00DD3720 9AE4E831
  MixColumn     3304D786 3F2E39BD 6BD8D3AA C15BE6DB
```

```
  KeyAddition   DC4072C7 977C62C2 DDA9F691 1A504BDB

Round = 5
  Substitution  860940C6 8810AA25 C1D34281 A253B3B9
  ShiftRow      861042B9 88D3B3C6 C1534025 A209AA81
  MixColumn     DCD9C2AA 103D7774 09827D01 6FD47C47
  KeyAddition   08080452 6CBEEAF3 C370C5BD 7E2D69FB

Round = 6
  Substitution  3030F200 50AE870D 2E51A67A F3D8F90F
  ShiftRow      30AEA60F 5051F900 2ED8F20D F330877A
  MixColumn     2089D846 AAE2E858 D0851E42 507B584D
  KeyAddition   4D017B3C BBE9D6A5 0B7C9803 9A7BCBB0

Round = 7
  Substitution  E37C21EB EA1EF606 2B10467B B8211FE7
  ShiftRow      E31E46E7 EA101FEB 2B212106 B87CF67B
  MixColumn     5EF243B3 0B00E2E7 120C4271 623ABEAF
  KeyAddition   10A6B4BD 545F2B14 96AA0DC3 2C9C62E0

Round = 8
  Substitution  CA248D7A 20CFF1FA 90ACD72E 71DEAAE1
  ShiftRow      CACFD7E1 20ACAA7A 90DE8DFA 7124F12E
  MixColumn     F3CC8884 7FFC4D92 35415A17 511FDE1A
  KeyAddition   191EFBA5 CA71F740 046AAF77 2E92F735

Round = 9
  Substitution  D4720F06 74A36809 F20279F5 314F6896
  ShiftRow      D4A37996 74026806 F24F0F09 317268F5
  MixColumn     A294248A 80CEACFA 2874B85F 699897B8
  KeyAddition   0EE34279 993470DB 00A5911E 3EC497D6

Substitution  AB112CB6 EE1851B9 63068172 B21C88F6
ShiftRow      AB1881F6 EE0688B6 631C2CB9 B2115172
KeyAddition   7B0C785E 27E8AD3F 82232071 04725DD4


Ciphertext is
    3AD77BB4 0D7A3660 A89ECAF3 2466EF97
    F5D3D585 03B9699D E785895A 96FDBAAF
    43B1CD7F 598ECE23 881B00E3 ED030688
    7B0C785E 27E8AD3F 82232071 04725DD4

================================================================

ECB-AES128 (Decryption)
```

```
------------------------------------------------------------

Key is
    2B7E1516 28AED2A6 ABF71588 09CF4F3C

Ciphertext is
    3AD77BB4 0D7A3660 A89ECAF3 2466EF97
    F5D3D585 03B9699D E785895A 96FDBAAF
    43B1CD7F 598ECE23 881B00E3 ED030688
    7B0C785E 27E8AD3F 82232071 04725DD4

KeyAddition   EAC3821C C49413E9 49A1C63B 9205E331
Substitution  BB3311C4 88E782EB A4F1C749 74364D2E
ShiftRow      BB36C7EB 88334D49 A4E7112E 74F182C4
Round = 9
  KeyAddition   1741A118 91C99168 8C36386F 23AD82AA
  InvMixColumn  8333F0AF FF15A6ED C191B409 770E815E
  Substitution  4166171B 7D2FC553 DDACC640 02D7919D
  ShiftRow      41D7C653 7D669140 DD2F179D 02ACC51B
Round = 8
  KeyAddition   AB05B572 C8EB2B92 EC04E2FD 7D21EC34
  InvMixColumn  98B55410 09A9C5FF 1114EA18 7F3CFD3A
  Substitution  E2D2FD7C 40B7077D E39BBB34 6B6D21A2
  ShiftRow      E26DBB7D 40D22134 E3B7FDA2 6B9B077C
Round = 7
  KeyAddition   AC394C73 1F8DE8C7 6711B210 253DDB33
  InvMixColumn  BD6D1268 F356657D DC66BAD4 F1E3F416
  Substitution  CDB339F7 7EB9BC13 93D3C019 2B4DBAFF
  ShiftRow      CD4DC013 7EB3BA19 93B939FF 2BD3BCF7
Round = 6
  KeyAddition   A0C56369 6FB884E4 4840BFBE E1D32F0A
  InvMixColumn  712E6C5C 23D3BDFA E8310DDD 3FD6DF21
  Substitution  2CC3B8A7 32A9CD14 C82EF3C9 254AEF7B
  ShiftRow      2C4AF314 32C3EFC9 C8A9B87B 252ECDA7
Round = 5
  KeyAddition   F89B35EC 4E40724E 025B00C7 34D7D81B
  InvMixColumn  3A06981E 1BA543CF BAA99F12 4FEFE363
  Substitution  A2A5E2E9 4429645F C0B76E39 92614D00
  ShiftRow      A2616E5F 44A54D39 C029E200 92B764E9
Round = 4
  KeyAddition   4D25CB1E ECF71646 7658C73B 49BCC9E9
  InvMixColumn  912C7676 3AF956DE C0F2CE2E A93E98DA
  Substitution  AC420F0F A269B99C 1F04ECC3 B7D1E27A
  ShiftRow      ACD1EC9C A242E2C3 1F690F7A B704B90F
Round = 3
  KeyAddition   9151ABE1 E5541CFD 014A713E DA7E3134
```

```
  InvMixColumn  54FE6141 B3B0EAB9 68D310AF D60D641E
  Substitution  FD0CD8F8 4BFCBBDB F7A97C1B 4AF38CE9
  ShiftRow      FDF37CDB 4B0C8C1B F7FCD8E9 4AA9BBF8
Round = 2
  KeyAddition   0F31E929 319A3558 AEC95893 39F04D87
  InvMixColumn  89B5884A C0565303 2E389B21 604D123C
  Substitution  F2D2975C 1FB950D5 C376E87B 9065396D
  ShiftRow      F265E8D5 1FD2397B C3B9976D 9076505C
Round = 1
  KeyAddition   529F16C2 978615CA E01AAE54 BA1A2659
  InvMixColumn  09287F47 6F746ABF 2C4A6204 DA08E3EE
  Substitution  40EE6B16 06CA58F4 425CAB30 7ABF4D99
  ShiftRow      40BFABF4 06EE4D30 42CA6B99 7A5C5816
KeyAddition   6BC1BEE2 2E409F96 E93D7E11 7393172A

KeyAddition   25C72C2D CA574C14 06BA8592 209EB609
Substitution  C23142FA 10DA5D9B A5C06774 54DF7940
ShiftRow      C2DF679B 10317974 A5DA4240 54C05DFA
Round = 9
  KeyAddition   6EA80168 09CBA555 8D0B6B01 039C5D94
  InvMixColumn  FE6CD4E9 A9E0611A E22EC7E7 95F56751
  Substitution  0CB819EB B7A0D843 3BC331B0 AD770A70
  ShiftRow      0C773143 B7B80AB0 3BA01970 ADC3D8EB
Round = 8
  KeyAddition   E6A54262 0235B062 0A8BEC10 D24EF1C4
  InvMixColumn  9017F216 1EEF7D69 1EA702C6 EBA38160
  Substitution  968704FF E96113E4 E9896AC7 3C719190
  ShiftRow      96716AE4 E98791C7 E9610490 3C8913FF
Round = 7
  KeyAddition   D8259DEA B6D85834 6DC74B22 722FCFB0
  InvMixColumn  80E9CA29 ED4C07A4 3BFC8084 2397DA4C
  Substitution  3AEB104C 535D381D 49553A4F 32857A5D
  ShiftRow      3A853A1D 53EB7A4F 495D105D 3255384C
Round = 6
  KeyAddition   570D9967 42E044B2 92A4961C F855ABB1
  InvMixColumn  057E9847 C72269D8 C53DA2E6 9677B0E6
  Substitution  368AE216 3194E42D 078B1AF5 3502FCF5
  ShiftRow      36021A2D 318AFCF5 0794E2F5 358BE416
Round = 5
  KeyAddition   E2D3DCD5 4D096172 CD665A49 2472F1AA
  InvMixColumn  9B36D540 ACF72E22 E5AD19E9 94475B85
  Substitution  E824B572 AA26C394 2A188EEB E7165767
  ShiftRow      E8168E94 AA2457EB 2A26B567 E718C372
Round = 4
  KeyAddition   07522BD5 02760C94 9C57905C 3C136E72
  InvMixColumn  990EF8C4 1FEAD2CB 1ED11CD4 81C6B5C1
```

```
  Substitution  F9D7E188 CBBB7F59 E951C419 91C7D2DD
  ShiftRow      F9C7C459 CBD7D219 E9BBE1DD 91517F88
Round = 3
  KeyAddition   C4478324 8CC12C27 F7989F99 FC2BF7B3
  InvMixColumn  C15CCE77 E0F5CC9F 9E9E244D 02B9341C
  Substitution  DDA7EC02 A077276E DFDFA665 6ADB28C4
  ShiftRow      DDDBA66E A0A72865 DF77ECC4 6ADF2702
Round = 2
  KeyAddition   2F19339C DA319126 86426CBE 1986D17D
  InvMixColumn  0E523BFE AABC5913 3665F0B5 81592FC4
  Substitution  D748490C 62781582 24BC17D2 91154E88
  ShiftRow      D7151782 62484ED2 24784988 91BC150C
Round = 1
  KeyAddition   77EFE995 EA1C6263 07DB70B1 BBD06309
  InvMixColumn  9795DA3C 05097883 96D0DB80 29EDF336
  Substitution  85AD7A6D 3640C141 35609F3A 4C537E24
  ShiftRow      85539F41 36AD7E3A 35407A24 4C60C16D
KeyAddition   AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51

KeyAddition   93A534D7 9060EBAA 69240C2B 5B600A2E
Substitution  2229280D 96903C62 E4A6810B 5790A3C3
ShiftRow      22908162 9629A30B E49028C3 57A63C0D
Round = 9
  KeyAddition   8EE7E791 8FD37F2A CC410182 00FA3C63
  InvMixColumn  04C3538B 9B1879F3 AA9E7B41 E5C5880D
  Substitution  303350CE E834AF7E 62DF03F8 2A0797F3
  ShiftRow      3007037E E83397F8 623450F3 2ADFAFCE
Round = 8
  KeyAddition   DAD5705F 5DBE2D2A 531FA593 555286E1
  InvMixColumn  61A18B6B DE607D27 B9F1BB89 77566425
  Substitution  D8F1CE05 9C90133D DB2BFEF2 02B98CC2
  ShiftRow      D8B9FE3D 9CF18CF2 DB90CEC2 022B1305
Round = 7
  KeyAddition   96ED0933 C3AE4501 5F368170 4C8DCF4A
  InvMixColumn  55144848 4D93996E EC741919 BD6AB625
  Substitution  ED9BD4D4 6522F945 83CA8E8E CD5879C2
  ShiftRow      ED588E45 659B798E 8322D4C2 CDCAF9D4
Round = 6
  KeyAddition   80D02D3F 74904773 58DB5283 07CA6A29
  InvMixColumn  C6C4EFAF 618EE9D6 995D37A1 BBA2D146
  Substitution  C788611B D8E6EB4A F98DB2F1 FE1A5198
  ShiftRow      C71AB24A D88851F1 F9E66198 FE8DEB1B
Round = 5
  KeyAddition   13CB74B2 A40BCC76 3314D924 EF74FEA7
  InvMixColumn  D1BF8AFA E7CCA59B A805ED9A 0E9280DE
  Substitution  51F4CF14 B02729E8 6F365337 D7743A9C
```

```
  ShiftRow      517453E8 B0F43A37 6F27CF9C D7362914
Round = 4
  KeyAddition   BE30F6A9 18A66148 D956EAA7 0C3D8414
  InvMixColumn  81F670D6 C3E58F3E 9854343A A62E775E
  Substitution  91D6D04A 332A73D1 E2FD28A2 C5C3029D
  ShiftRow      91C328D1 33D602A2 E22AD09D C5FD734A
Round = 3
  KeyAddition   AC436FAC 74C0FC9C FC09AED9 A887FB71
  InvMixColumn  1FDD846A 3FFD0412 A0CFED00 5B7059D7
  Substitution  CBC94F58 25213039 475F5352 57D0150D
  ShiftRow      CBD05339 25C91552 47214F0D 575F3058
Round = 2
  KeyAddition   3912C6CB 5F5FAC11 1E14CF77 2406C627
  InvMixColumn  B3E50070 9CA30E8C 367B9867 44983B24
  Substitution  4B2A52D0 1C71D7F0 2403E20A 86E249A6
  ShiftRow      4BE2E2F0 1C2A490A 247152A6 8603D7D0
Round = 1
  KeyAddition   EB181CE7 947E65BB 07D26B9F AC6FA1D5
  InvMixColumn  AF894866 3DFEA453 2FA601A9 7D4E0581
  Substitution  1BF2D4D3 8B0C1D50 4EC509B7 13B63691
  ShiftRow      1BB60950 8BF236B7 4E0CD491 13C51DD3
KeyAddition   30C81C46 A35CE411 E5FBC119 1A0A52EF

KeyAddition   AB1881F6 EE0688B6 631C2CB9 B2115172
Substitution  0E3491D6 99A59779 00C442DB 3EE3701E
ShiftRow      0EE34279 993470DB 00A5911E 3EC497D6
Round = 9
  KeyAddition   A294248A 80CEACFA 2874B85F 699897B8
  InvMixColumn  D4A37996 74026806 F24F0F09 317268F5
  Substitution  1971AF35 CA6AF7A5 0492FB40 2E1EF777
  ShiftRow      191EFBA5 CA71F740 046AAF77 2E92F735
Round = 8
  KeyAddition   F3CC8884 7FFC4D92 35415A17 511FDE1A
  InvMixColumn  CACFD7E1 20ACAA7A 90DE8DFA 7124F12E
  Substitution  105F0DE0 54AA62BD 969CB414 2CA62BC3
  ShiftRow      10A6B4BD 545F2B14 96AA0DC3 2C9C62E0
Round = 7
  KeyAddition   5EF243B3 0B00E2E7 120C4271 623ABEAF
  InvMixColumn  E31E46E7 EA101FEB 2B212106 B87CF67B
  Substitution  4DE998B0 BB7CCB3C 0B7B7BA5 9A01D603
  ShiftRow      4D017B3C BBE9D6A5 0B7C9803 9A7BCBB0
Round = 6
  KeyAddition   2089D846 AAE2E858 D0851E42 507B584D
  InvMixColumn  30AEA60F 5051F900 2ED8F20D F330877A
  Substitution  08BEC5FB 6C706952 C32D04F3 7E08EABD
  ShiftRow      08080452 6CBEEAF3 C370C5BD 7E2D69FB
```

```
Round = 5
  KeyAddition   DCD9C2AA 103D7774 09827D01 6FD47C47
  InvMixColumn  861042B9 88D3B3C6 C1534025 A209AA81
  Substitution  DC7CF6DB 97A94BC7 DD5072C2 1A406291
  ShiftRow      DC4072C7 977C62C2 DDA9F691 1A504BDB
Round = 4
  KeyAddition   3304D786 3F2E39BD 6BD8D3AA C15BE6DB
  InvMixColumn  9BFCB3B2 542B6389 00DD3720 9AE4E831
  Substitution  E8554B3E FD0B00F2 52C9B254 37AEC82E
  ShiftRow      E8AEB2F2 FD55C854 520B4B2E 37C9003E
Round = 3
  KeyAddition   D52EF58F BA43366A 4C28356A 5AB38805
  InvMixColumn  5DD4646C AFF7728F 83F98CCD 9F42853C
  Substitution  8D198CB8 1B261E73 4169F080 6EF6676D
  ShiftRow      8DF6F073 1B196780 41268C6D 6E691EB8
Round = 2
  KeyAddition   7F346581 618FDEC3 18130C17 1D30E8C7
  InvMixColumn  21D47E24 462C049D CEADFA89 AC785D8B
  Substitution  7B198AA6 98423075 EC1814F2 AAC18DCE
  ShiftRow      7BC11475 98198DF2 EC428ACE AA1830A6
Round = 1
  KeyAddition   DB3BEA62 104DA143 CFE1B3F7 807446A3
  InvMixColumn  C1F82071 6886BCED 6F0AC7C8 DFF83B0D
  Substitution  DDE1542C F7DC7853 06A331B1 EFE149F3
  ShiftRow      DDE13153 F7E149B1 06DC54F3 EFA3782C
KeyAddition   F69F2445 DF4F9B17 AD2B417B E66C3710


Plaintext is
    6BC1BEE2 2E409F96 E93D7E11 7393172A
    AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51
    30C81C46 A35CE411 E5FBC119 1A0A52EF
    F69F2445 DF4F9B17 AD2B417B E66C3710

************************************************************
```

```
################################################################

  Block Cipher Modes of Operation

      Electronic Codebook (ECB)

Plaintext is
    6BC1BEE2 2E409F96 E93D7E11 7393172A
    AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51
    30C81C46 A35CE411 E5FBC119 1A0A52EF
    F69F2445 DF4F9B17 AD2B417B E66C3710

################################################################

================================================================

ECB-AES192 (Encryption)
----------------------------------------------------------------

Key is
    8E73B0F7 DA0E6452 C810F32B 809079E5
    62F8EAD2 522C6B7B

Plaintext is
    6BC1BEE2 2E409F96 E93D7E11 7393172A
    AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51
    30C81C46 A35CE411 E5FBC119 1A0A52EF
    F69F2445 DF4F9B17 AD2B417B E66C3710

KeyAddition   E5B20E15 F44EFBC4 212D8D3A F3036ECF

Round = 1
  Substitution  D937AB59 BF2F0F1C FDD85D80 0D7B9F8A
  ShiftRow      D92F5D8A BFD89F59 FD7BAB1C 0D370F80
  MixColumn     0FEAC90D D0F7A92F DBF1EFF4 CCF2BF34
  KeyAddition   6D1223DF 82DBC254 25FD7E03 E8F04A91

Round = 2
  Substitution  3CC9269E 13B92520 3F54F37B 9B8CD681
  ShiftRow      3CB9F381 1354D69E 3F8C2620 9BC9257B
  MixColumn     DADAE017 92444990 F7769FAB 330695AC
  KeyAddition   36C8E699 FEC636FB F90C0A12 6F506B6E

Round = 3
  Substitution  05E88EEE BBB4050F 99FE67C9 A8537F9F
  ShiftRow      05B4679F BBFE7FEE 99538E0F A8E805C9
```

```
  MixColumn     3540C5F9 E5339290 5DB9DC73 A4A50A87
  KeyAddition   78F77144 8C86D388 D81E9BE5 4D80327A

Round = 4
  Substitution  BC68A31B 644466C4 617214D9 E3CD23DA
  ShiftRow      BC4414DA 6472231B 61CDA3C4 E36866D9
  MixColumn     61D2A520 66FE7DCB E9DAA65E DA403799
  KeyAddition   868D0864 DDF72E4D A1805609 FBAF86D6

Round = 5
  Substitution  445D3043 C16831E3 32CDB101 0F7944F6
  ShiftRow      4468B1F6 C1CD4443 327930E3 0F5D3101
  MixColumn     77AA54E2 D2CF4157 3C7315C2 C9E7337F
  KeyAddition   D3E2A23B 9FA28F73 964176A2 D8DC0399

Round = 6
  Substitution  66983AE2 DB3A738F 9083383A 61867BEE
  ShiftRow      663A38EE DB837BE2 90863A8F 6198733A
  MixColumn     54B4056F AAA99351 1F46E812 38E5513C
  KeyAddition   F6EA7BBA 29185CCB 38BFD151 5271A65B

Round = 7
  Substitution  428721F4 A5AD4A1F 07083ED1 00A32439
  ShiftRow      42AD3E39 A50824F4 07A3211F 00874AD1
  MixColumn     6F78D827 992DE22B CE26C7B5 091A7B74
  KeyAddition   AFDE4C20 48B046CA 2231415E 66BC3205

Round = 8
  Substitution  791D29B7 52E75A74 93C78358 3365236B
  ShiftRow      79E7836B 52C723B7 93652974 331D5A58
  MixColumn     28593E39 62151167 CF56380A 43BF72A2
  KeyAddition   60064E0B 40DE9632 2D3B2B58 704FC511

Round = 9
  Substitution  D06F2F2B 091D9023 D8E2F16A 5184A682
  ShiftRow      D01DF182 09E2A62B D8842F23 516F906A
  MixColumn     EF60A998 A20CC109 3099679E E94EBBD8
  KeyAddition   AFDE42B0 8D146350 57DEB5F5 ACC2EEE6

Round = 10
  Substitution  791D2CE7 5DFAFB53 5B1DD5E6 9125288E
  ShiftRow      79FAD58E 5D1D28E7 5B252C53 911DFBE6
  MixColumn     BC7CBBA3 52F82207 A636D342 035B5099
  KeyAddition   1B9DFDCF C6E9D3D8 2429A648 AE5C87CA

Round = 11
```

```
  Substitution  AF5E548A B41E6661 36A52452 E44A1774
  ShiftRow      AF1E2474 B4A5178A 364A5461 E45E6652
  MixColumn     378B6538 1A56BA7A 873F7786 05A080AB
  KeyAddition   FDCB6000 959AEA7C AF1261EC B99C671E

Substitution  541FD063 2AB88710 79C9EFCE 56DE8572
ShiftRow      54B8EF72 2AC98563 79DED010 561F87CE
KeyAddition   BD334F1D 6E45F25F F712A214 571FA5CC

KeyAddition   205E3AA0 C40DC8CE 56A79C87 C53FF7B4

Round = 1
  Substitution  B75880E0 1CD7E88B B15CDE17 A675688D
  ShiftRow      B7D7DE8D 1C5C68E0 B175808B A658E817
  MixColumn     44F64BCA 54FCABCB ED4B5930 40220C6F
  KeyAddition   260EA118 06D0C0B0 1347C8C7 6420F9CA

Round = 2
  Substitution  F7AB32AD 6F70BAE7 7DA0E8C6 43B79974
  ShiftRow      F770E874 6FA099AD 7DB732E7 43ABBAC6
  MixColumn     F940D072 11290AC9 EDB99CD7 1C1DD643
  KeyAddition   1552D6FC 7DAB75A2 E3C3096E 404B2881

Round = 3
  Substitution  5900F6B0 FF629D3A 112E019F 09B3340C
  ShiftRow      5962010C FF2E34B0 11B3F63A 09009D9F
  MixColumn     19922D90 134F727B 20571B02 102A92A3
  KeyAddition   5425992D 7AFA3363 A5F05C94 F90FAA5E

Round = 4
  Substitution  203FEED8 DA2DC3FB 068C4A22 9976AC58
  ShiftRow      202D4A58 DA8CACD8 0676EEFB 993FC322
  MixColumn     25FC71B7 54EE66FE 8338A17F 899B5D08
  KeyAddition   C2A3DCF3 EFE73578 CB625128 A874EC47

Round = 5
  Substitution  250A860D DF9496BC 1FAAD134 C292CEA0
  ShiftRow      2594D1A0 DFAACE0D 1F9286BC C20A9634
  MixColumn     9CDEF371 83D4E504 A90D4556 2343A3A9
  KeyAddition   389605A8 CEB92B20 033F2636 3278934F

Round = 6
  Substitution  07906BC2 8B56F1B7 7B75F705 23BCDC84
  ShiftRow      0756F784 8B75DCC2 7BBC6BB7 2390F105
  MixColumn     872D33BB 8CDC00B0 F512D32F 1915450E
  KeyAddition   25734D6E 0F6DCF2A D2EBEA6C 7381B269
```

```
Round = 7
  Substitution  3F8FE39F 763C8AE5 B5E98750 8F0C37F9
  ShiftRow      3F3C87F9 76E9379F B50CE3E5 8F8F8A50
  MixColumn     442C0613 64794B61 637650FA 555FFF2F
  KeyAddition   848A9214 B5E4EF80 8F61D611 3AF9B65E

Round = 8
  Substitution  5F7E4FFA D569DFCD 73EFF682 80994E58
  ShiftRow      5F69F658 D5EF4EFA 73994FCD 807EDF82
  MixColumn     ABD429CE 2F38B32A D44638C2 C484C625
  KeyAddition   E38B59FC 0DF3347F 362B2B90 F7747196

Round = 9
  Substitution  113DCBB0 D70D18D2 05F1F160 6892A390
  ShiftRow      110DF190 D7F1A3B0 0592CBD2 683D1860
  MixColumn     54934EF4 AE60B04B BEAE77E9 EF5AC55D
  KeyAddition   142DA5DC 81781212 D9E9A582 AAD69063

Round = 10
  Substitution  FAD80686 0CBCC9C9 351E0613 ACF660FB
  ShiftRow      FABC06FB 0C1E6086 35F606C9 ACD8C913
  MixColumn     CD685C42 DC16437D A4018F26 EA54C8D8
  KeyAddition   6A891A2E 4807B2A2 261EFA2C 47531F8B

Round = 11
  Substitution  02A7A231 52C5373A F7722D71 A0EDC03D
  ShiftRow      02C52D3D 5272C031 F7EDA23A A0A73771
  MixColumn     40D9DA94 C3DCE826 41F10B39 EFDDFA89
  KeyAddition   8A99DFAC 4C10B820 69DC1D53 53E11D3C

Substitution  7EEE9E91 29CA6CB7 F986A4ED EDF8A4EB
ShiftRow      7ECAA4EB 2986A491 F9F89EB7 EDEE6CED
KeyAddition   97410484 6D0AD3AD 7734ECB3 ECEE4EEF

KeyAddition   BEBBACB1 79528043 2DEB3232 9A9A2B0A

Round = 1
  Substitution  AEEA91C8 B600CD1A D8E92323 B8B8F167
  ShiftRow      AE002367 B6E9F1C8 D8B8911A B8EACD23
  MixColumn     03AC4104 6EBFE552 F301776E A018B6B2
  KeyAddition   6154ABD6 3C938E29 0D0DE699 841A4317

Round = 2
  Substitution  EF2062F6 EBDC19A5 D7D78EEE 5FA21AF0
  ShiftRow      EFDC8EF0 EBD71AF6 D7A262A5 5F2019EE
```

```
  MixColumn     C4353F83 4386091C 8F8B45F3 29DA641F
  KeyAddition   2827390D 2F047677 81F1D04A 758C9ADD

Round = 3
  Substitution  34CC12D7 15F238F5 0CA170D6 9D64B8C1
  ShiftRow      34F270C1 15A1B8D7 0C6412F5 9DCC38D6
  MixColumn     D49A7E47 BD48BD93 53074893 808040FF
  KeyAddition   992DCAFA D4FDFC8B D6A00F05 69A57802

Round = 4
  Substitution  EED8742D 4854B03D F6E0766B F906BC77
  ShiftRow      EE547677 48E0BC2D F606743D F9D8B06B
  MixColumn     3AABCFE5 3A61BCDE B45B5F09 41F2E7AE
  KeyAddition   DDF462A1 8168EF58 FC01AF5E 601D56E1

Round = 5
  Substitution  C1BFAA32 0C45DF6A B07C7958 D0A4B1F8
  ShiftRow      C14579F8 0C7CB132 B0A4AA6A D0BFDF58
  MixColumn     D738658F 1F0E5FBD 4C6CE511 E69722BB
  KeyAddition   73709356 52639199 E65E8671 F7AC125D

Round = 6
  Substitution  8F51DCB1 00FB81EE 8E5844A3 6891C94C
  ShiftRow      8FFB444C 0058C9B1 8E91DCEE 685181A3
  MixColumn     1BE228AD 904119E8 9D269503 01F1DE35
  KeyAddition   B9BC5678 13F0D672 BADFAC40 6B652952

Round = 7
  Substitution  5665B1BC 7D8CF640 F49E9109 7F4DA500
  ShiftRow      568C9100 7D9EA5BC F44DB140 7F65F609
  MixColumn     B2FDE3E7 5A126DDF D5E6007B AEBDF600
  KeyAddition   725B77E0 8B8FC93E 39F18690 C11BBF71

Round = 8
  Substitution  4039F5E1 3D73DDB2 12A14460 78AF08A3
  ShiftRow      407344A3 3DA108E1 12AFF5B2 7839DD60
  MixColumn     F2C945AA 6B9DB437 89E18113 061640AC
  KeyAddition   BA963598 49563362 6B8C9241 35E6F71F

Round = 9
  Substitution  F4909646 3BB1C3AA 7F644F83 968E68C0
  ShiftRow      F4B14FC0 3B646846 7F8E96AA 9690C383
  MixColumn     B49C8062 F40D45CD 4B7323D6 DC7005EF
  KeyAddition   F4226B4A DB15E794 2C34F1BD 99FC50D1

Round = 10
```

```
  Substitution  BF937FD6 B9599422 7118A17A EEB0533E
  ShiftRow      BF59A13E B91853D6 71B07F22 EE93947A
  MixColumn     11CBFD5E C4AA662C 74A95918 870EC0DA
  KeyAddition   B62ABB32 50BB97F3 F6B62C12 2A091789

Round = 11
  Substitution  4EE5EA23 53EA880D 424E71C9 E501F0A7
  ShiftRow      4EEA71A7 534EF023 4201EA0D E5E588C9
  MixColumn     6FB5B41C A7E7830D 60689B37 A47E4BD0
  KeyAddition   A5F5B124 282BD30B 48458D5D 1842AC65

Substitution  06E6C836 34F1662B 526E5D4C AD2C914D
ShiftRow      06F15D4D 346E9136 522CC82B ADE6664C
KeyAddition   EF7AFD22 70E2E60A DCE0BA2F ACE6444E

KeyAddition   78EC94B2 0541FF45 653BB250 66FC4EF5

Round = 1
  Substitution  BCCE2237 6B83166E 4DE23753 33B02FE6
  ShiftRow      BC8337E6 6BE22F37 4DB0226E 33CE1653
  MixColumn     2C1E60BC F3F28E1E 1D3E0B99 6ADD242B
  KeyAddition   4EE68A6E A1DEE565 E3329A6E 4EDFD18E

Round = 2
  Substitution  2F8E7E9F 321DD94D 1123B89F 2F9E3E19
  ShiftRow      2F1DB819 32233E9F 119E7E4D 2F8ED99F
  MixColumn     D8DF72E6 A0A9D76E A8F9A449 91C7B203
  KeyAddition   34CD7468 CC2BA805 A68331F0 CD914CC1

Round = 3
  Substitution  18BD9245 4BF1C26B 24ECC78C BD812978
  ShiftRow      18F1C778 4BEC2945 2481926B BDBDC28C
  MixColumn     87CBF4EE D5B63A92 29FB27A9 F30D10A0
  KeyAddition   CA7C4053 BC037B8A AC5C603F 1A28285D

Round = 4
  Substitution  741009ED 657B217E 914AD075 A234344C
  ShiftRow      747BD04C 654A34ED 9134097E A2102175
  MixColumn     F9A560AF CD406B10 129C3569 3B946F26
  KeyAddition   1EFACDEB 76493896 5AC6C53E 1A7BDE69

Round = 5
  Substitution  722DBDE9 383B0790 BEB4A6B2 A2211DF9
  ShiftRow      723BA6F9 38B41DE9 BE21BD90 A22D07B2
  MixColumn     F60C0EE2 43859628 29B0557E 9D434CA8
  KeyAddition   5244F83B 0EE8580C 8382361E 8C787C4E
```

```
Round = 6
  Substitution  001B41E2 AB9B6AFE EC130572 64BC102F
  ShiftRow      009B052F AB1310E2 ECBC41FE 641B6A72
  MixColumn     9C0DE0C0 8A5FA53A A3B2CB35 FD9E3D39
  KeyAddition   3E539E15 09EE6AA0 844BF276 970ACA5E

Round = 7
  Substitution  B2ED0B59 012802E0 5FB38938 88677458
  ShiftRow      B2288958 01B37459 5F670BE0 88ED0238
  MixColumn     D63A7BDC E1B9B176 FC6C1556 1D77291C
  KeyAddition   169CEFDB 30241597 107B93BD 72D1606D

Round = 8
  Substitution  47DEDFB9 04365988 CA21DC7A 403ED03C
  ShiftRow      4736DC3C 0421D0B9 CA3EDF88 40DE597A
  MixColumn     3468965B 02944E94 9A44D2AF DA76A2B3
  KeyAddition   7C37E669 205FC9C1 7829C1FD E9861500

Round = 9
  Substitution  109A8EF9 B7CFDD78 BCA57854 1E445963
  ShiftRow      10CF7863 B7A559F9 BC448E78 1E9ADD54
  MixColumn     717E8A41 21F4B0D7 59C577E5 0019D9CD
  KeyAddition   31C06169 0EEC128E 3E82A58E 45958CF3

Round = 10
  Substitution  C7BAEFF9 ABCEC919 B2130619 6E2A640D
  ShiftRow      C7CE060D AB1364F9 B22AEF19 6EBAC919
  MixColumn     D7471280 E5D86078 F7D5763A D95876F3
  KeyAddition   70A654EC 71C991A7 75CA0330 745FA1A0

Round = 11
  Substitution  512420CE A3DD815C 9D747B04 92CF32E0
  ShiftRow      51DD7BE0 A37432CE 9DCF205C 92248104
  MixColumn     459D418E 3DD3FA3F 1724F6EB D646A300
  KeyAddition   8FDD44B6 B21FAA39 3F09E081 6A7A44B5

Substitution  73C11B4E 37C0AC12 7501E10C 02DA1BD5
ShiftRow      73C0E1D5 37011B4E 75DA1B12 02C1AC0C
KeyAddition   9A4B41BA 738D6C72 FB166916 03C18E0E


Ciphertext is
    BD334F1D 6E45F25F F712A214 571FA5CC
    97410484 6D0AD3AD 7734ECB3 ECEE4EEF
    EF7AFD22 70E2E60A DCE0BA2F ACE6444E
```

```
    9A4B41BA 738D6C72 FB166916 03C18E0E

================================================================

ECB-AES192 (Decryption)
----------------------------------------------------------------

Key is
    8E73B0F7 DA0E6452 C810F32B 809079E5
    62F8EAD2 522C6B7B

Ciphertext is
    BD334F1D 6E45F25F F712A214 571FA5CC
    97410484 6D0AD3AD 7734ECB3 ECEE4EEF
    EF7AFD22 70E2E60A DCE0BA2F ACE6444E
    9A4B41BA 738D6C72 FB166916 03C18E0E

KeyAddition   54B8EF72 2AC98563 79DED010 561F87CE
Substitution  FD9A611E 95126700 AF9C607C B9CBEAEC
ShiftRow      FDCB6000 959AEA7C AF1261EC B99C671E
Round = 11
  KeyAddition   378B6538 1A56BA7A 873F7786 05A080AB
  InvMixColumn  AF1E2474 B4A5178A 364A5461 E45E6652
  Substitution  1BE9A6CA C62987CF 245CFDD8 AE9DD348
  ShiftRow      1B9DFDCF C6E9D3D8 2429A648 AE5C87CA
Round = 10
  KeyAddition   BC7CBBA3 52F82207 A636D342 035B5099
  InvMixColumn  79FAD58E 5D1D28E7 5B252C53 911DFBE6
  Substitution  AF14B5E6 8DDEEEB0 57C24250 ACDE63F5
  ShiftRow      AFDE42B0 8D146350 57DEB5F5 ACC2EEE6
Round = 9
  KeyAddition   EF60A998 A20CC109 3099679E E94EBBD8
  InvMixColumn  D01DF182 09E2A62B D8842F23 516F906A
  Substitution  60DE2B11 403BC50B 2D4F4E32 70069658
  ShiftRow      60064E0B 40DE9632 2D3B2B58 704FC511
Round = 8
  KeyAddition   28593E39 62151167 CF56380A 43BF72A2
  InvMixColumn  79E7836B 52C723B7 93652974 331D5A58
  Substitution  AFB04105 48313220 22BC4CCA 66DE465E
  ShiftRow      AFDE4C20 48B046CA 2231415E 66BC3205
Round = 7
  KeyAddition   6F78D827 992DE22B CE26C7B5 091A7B74
  InvMixColumn  42AD3E39 A50824F4 07A3211F 00874AD1
  Substitution  F618D15B 29BFA6BA 38717BCB 52EA5C51
  ShiftRow      F6EA7BBA 29185CCB 38BFD151 5271A65B
Round = 6
```

```
  KeyAddition   54B4056F AAA99351 1F46E812 38E5513C
  InvMixColumn  663A38EE DB837BE2 90863A8F 6198733A
  Substitution  D3A27699 9F41033B 96DCA273 D8E28FA2
  ShiftRow      D3E2A23B 9FA28F73 964176A2 D8DC0399
Round = 5
  KeyAddition   77AA54E2 D2CF4157 3C7315C2 C9E7337F
  InvMixColumn  4468B1F6 C1CD4443 327930E3 0F5D3101
  Substitution  86F756D6 DD808664 A1AF084D FB8D2E09
  ShiftRow      868D0864 DDF72E4D A1805609 FBAF86D6
Round = 4
  KeyAddition   61D2A520 66FE7DCB E9DAA65E DA403799
  InvMixColumn  BC4414DA 6472231B 61CDA3C4 E36866D9
  Substitution  78869B7A 8C1E3244 D8807188 4DF7D3E5
  ShiftRow      78F77144 8C86D388 D81E9BE5 4D80327A
Round = 3
  KeyAddition   3540C5F9 E5339290 5DB9DC73 A4A50A87
  InvMixColumn  05B4679F BBFE7FEE 99538E0F A8E805C9
  Substitution  36C60A6E FE0C6B99 F950E6FB 6FC83612
  ShiftRow      36C8E699 FEC636FB F90C0A12 6F506B6E
Round = 2
  KeyAddition   DADAE017 92444990 F7769FAB 330695AC
  InvMixColumn  3CB9F381 1354D69E 3F8C2620 9BC9257B
  Substitution  6DDB7E91 82FD4ADF 25F02354 E812C203
  ShiftRow      6D1223DF 82DBC254 25FD7E03 E8F04A91
Round = 1
  KeyAddition   0FEAC90D D0F7A92F DBF1EFF4 CCF2BF34
  InvMixColumn  D92F5D8A BFD89F59 FD7BAB1C 0D370F80
  Substitution  E54E8DCF F42D6E15 21030EC4 F3B2FB3A
  ShiftRow      E5B20E15 F44EFBC4 212D8D3A F3036ECF
KeyAddition   6BC1BEE2 2E409F96 E93D7E11 7393172A

KeyAddition   7ECAA4EB 2986A491 F9F89EB7 EDEE6CED
Substitution  8A101D3C 4CDC1DAC 69E1DF20 5399B853
ShiftRow      8A99DFAC 4C10B820 69DC1D53 53E11D3C
Round = 11
  KeyAddition   40D9DA94 C3DCE826 41F10B39 EFDDFA89
  InvMixColumn  02C52D3D 5272C031 F7EDA23A A0A73771
  Substitution  6A07FA8B 481E1F2E 26531AA2 4789B22C
  ShiftRow      6A891A2E 4807B2A2 261EFA2C 47531F8B
Round = 10
  KeyAddition   CD685C42 DC16437D A4018F26 EA54C8D8
  InvMixColumn  FABC06FB 0C1E6086 35F606C9 ACD8C913
  Substitution  1478A563 81E990DC D9D6A512 AA2D1282
  ShiftRow      142DA5DC 81781212 D9E9A582 AAD69063
Round = 9
  KeyAddition   54934EF4 AE60B04B BEAE77E9 EF5AC55D
```

```
  InvMixColumn  110DF190 D7F1A3B0 0592CBD2 683D1860
  Substitution  E3F32B96 0D2B71FC 3674597F F78B3490
  ShiftRow      E38B59FC 0DF3347F 362B2B90 F7747196
Round = 8
  KeyAddition   ABD429CE 2F38B32A D44638C2 C484C625
  InvMixColumn  5F69F658 D5EF4EFA 73994FCD 807EDF82
  Substitution  84E4D65E B561B614 8FF99280 3A8AEF11
  ShiftRow      848A9214 B5E4EF80 8F61D611 3AF9B65E
Round = 7
  KeyAddition   442C0613 64794B61 637650FA 555FFF2F
  InvMixColumn  3F3C87F9 76E9379F B50CE3E5 8F8F8A50
  Substitution  256DEA69 0FEBB26E D2814D2A 7373CF6C
  ShiftRow      25734D6E 0F6DCF2A D2EBEA6C 7381B269
Round = 6
  KeyAddition   872D33BB 8CDC00B0 F512D32F 1915450E
  InvMixColumn  0756F784 8B75DCC2 7BBC6BB7 2390F105
  Substitution  38B9264F CE3F93A8 03780520 32962B36
  ShiftRow      389605A8 CEB92B20 033F2636 3278934F
Round = 5
  KeyAddition   9CDEF371 83D4E504 A90D4556 2343A3A9
  InvMixColumn  2594D1A0 DFAACE0D 1F9286BC C20A9634
  Substitution  C2E75147 EF62ECF3 CB74DC78 A8A33528
  ShiftRow      C2A3DCF3 EFE73578 CB625128 A874EC47
Round = 4
  KeyAddition   25FC71B7 54EE66FE 8338A17F 899B5D08
  InvMixColumn  202D4A58 DA8CACD8 0676EEFB 993FC322
  Substitution  54FA5C5E 7AF0AA2D A50F9963 F9253394
  ShiftRow      5425992D 7AFA3363 A5F05C94 F90FAA5E
Round = 3
  KeyAddition   19922D90 134F727B 20571B02 102A92A3
  InvMixColumn  5962010C FF2E34B0 11B3F63A 09009D9F
  Substitution  15AB0981 7DC328FC E34BD6A2 4052756E
  ShiftRow      1552D6FC 7DAB75A2 E3C3096E 404B2881
Round = 2
  KeyAddition   F940D072 11290AC9 EDB99CD7 1C1DD643
  InvMixColumn  F770E874 6FA099AD 7DB732E7 43ABBAC6
  Substitution  26D0C8CA 0647F918 1320A1B0 640EC0C7
  ShiftRow      260EA118 06D0C0B0 1347C8C7 6420F9CA
Round = 1
  KeyAddition   44F64BCA 54FCABCB ED4B5930 40220C6F
  InvMixColumn  B7D7DE8D 1C5C68E0 B175808B A658E817
  Substitution  200D9CB4 C4A7F7A0 563F3ACE C55EC887
  ShiftRow      205E3AA0 C40DC8CE 56A79C87 C53FF7B4
KeyAddition   AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51

KeyAddition   06F15D4D 346E9136 522CC82B ADE6664C
```

```
Substitution  A52B8D65 2845AC24 4842B10B 18F5D35D
ShiftRow      A5F5B124 282BD30B 48458D5D 1842AC65
Round = 11
  KeyAddition   6FB5B41C A7E7830D 60689B37 A47E4BD0
  InvMixColumn  4EEA71A7 534EF023 4201EA0D E5E588C9
  Substitution  B6BB2C89 50B61732 F609BBF3 2A2A9712
  ShiftRow      B62ABB32 50BB97F3 F6B62C12 2A091789
Round = 10
  KeyAddition   11CBFD5E C4AA662C 74A95918 870EC0DA
  InvMixColumn  BF59A13E B91853D6 71B07F22 EE93947A
  Substitution  F415F1D1 DB34504A 2CFC6B94 9922E7BD
  ShiftRow      F4226B4A DB15E794 2C34F1BD 99FC50D1
Round = 9
  KeyAddition   B49C8062 F40D45CD 4B7323D6 DC7005EF
  InvMixColumn  F4B14FC0 3B646846 7F8E96AA 9690C383
  Substitution  BA56921F 498CF798 6BE63562 35963341
  ShiftRow      BA963598 49563362 6B8C9241 35E6F71F
Round = 8
  KeyAddition   F2C945AA 6B9DB437 89E18113 061640AC
  InvMixColumn  407344A3 3DA108E1 12AFF5B2 7839DD60
  Substitution  728F8671 8BF1BFE0 391B773E C15BC990
  ShiftRow      725B77E0 8B8FC93E 39F18690 C11BBF71
Round = 7
  KeyAddition   B2FDE3E7 5A126DDF D5E6007B AEBDF600
  InvMixColumn  568C9100 7D9EA5BC F44DB140 7F65F609
  Substitution  B9F0AC52 13DF2978 BA655672 6BBCD640
  ShiftRow      B9BC5678 13F0D672 BADFAC40 6B652952
Round = 6
  KeyAddition   1BE228AD 904119E8 9D269503 01F1DE35
  InvMixColumn  8FFB444C 0058C9B1 8E91DCEE 685181A3
  Substitution  7363865D 525E1256 E6AC9399 F7709171
  ShiftRow      73709356 52639199 E65E8671 F7AC125D
Round = 5
  KeyAddition   D738658F 1F0E5FBD 4C6CE511 E69722BB
  InvMixColumn  C14579F8 0C7CB132 B0A4AA6A D0BFDF58
  Substitution  DD68AFE1 810156A1 FC1D6258 60F4EF5E
  ShiftRow      DDF462A1 8168EF58 FC01AF5E 601D56E1
Round = 4
  KeyAddition   3AABCFE5 3A61BCDE B45B5F09 41F2E7AE
  InvMixColumn  EE547677 48E0BC2D F606743D F9D8B06B
  Substitution  99FD0F02 D4A078FA D6A5CA8B 692DFC05
  ShiftRow      992DCAFA D4FDFC8B D6A00F05 69A57802
Round = 3
  KeyAddition   D49A7E47 BD48BD93 53074893 808040FF
  InvMixColumn  34F270C1 15A1B8D7 0C6412F5 9DCC38D6
  Substitution  2804D0DD 2FF19A0D 818C3977 7527764A
```

```
  ShiftRow      2827390D 2F047677 81F1D04A 758C9ADD
Round = 2
  KeyAddition   C4353F83 4386091C 8F8B45F3 29DA641F
  InvMixColumn  EFDC8EF0 EBD71AF6 D7A262A5 5F2019EE
  Substitution  6193E617 3C0D43D6 0D1AAB29 84548E99
  ShiftRow      6154ABD6 3C938E29 0D0DE699 841A4317
Round = 1
  KeyAddition   03AC4104 6EBFE552 F301776E A018B6B2
  InvMixColumn  AE002367 B6E9F1C8 D8B8911A B8EACD23
  Substitution  BE52320A 79EB2BB1 2D9AAC43 9ABB8032
  ShiftRow      BEBBACB1 79528043 2DEB3232 9A9A2B0A
KeyAddition   30C81C46 A35CE411 E5FBC119 1A0A52EF

KeyAddition   73C0E1D5 37011B4E 75DA1B12 02C1AC0C
Substitution  8F1FE0B5 B20944B6 3F7A4439 6ADDAA81
ShiftRow      8FDD44B6 B21FAA39 3F09E081 6A7A44B5
Round = 11
  KeyAddition   459D418E 3DD3FA3F 1724F6EB D646A300
  InvMixColumn  51DD7BE0 A37432CE 9DCF205C 92248104
  Substitution  70C903A0 71CAA1EC 755F54A7 74A69130
  ShiftRow      70A654EC 71C991A7 75CA0330 745FA1A0
Round = 10
  KeyAddition   D7471280 E5D86078 F7D5763A D95876F3
  InvMixColumn  C7CE060D AB1364F9 B22AEF19 6EBAC919
  Substitution  31ECA5F3 0E828C69 3E95618E 45C0128E
  ShiftRow      31C06169 0EEC128E 3E82A58E 45958CF3
Round = 9
  KeyAddition   717E8A41 21F4B0D7 59C577E5 0019D9CD
  InvMixColumn  10CF7863 B7A559F9 BC448E78 1E9ADD54
  Substitution  7C5FC100 20291569 7886E6C1 E937C9FD
  ShiftRow      7C37E669 205FC9C1 7829C1FD E9861500
Round = 8
  KeyAddition   3468965B 02944E94 9A44D2AF DA76A2B3
  InvMixColumn  4736DC3C 0421D0B9 CA3EDF88 40DE597A
  Substitution  1624936D 307B60DB 10D1EF97 729C15BD
  ShiftRow      169CEFDB 30241597 107B93BD 72D1606D
Round = 7
  KeyAddition   D63A7BDC E1B9B176 FC6C1556 1D77291C
  InvMixColumn  B2288958 01B37459 5F670BE0 88ED0238
  Substitution  3EEEF25E 094BCA15 840A9EA0 97536A76
  ShiftRow      3E539E15 09EE6AA0 844BF276 970ACA5E
Round = 6
  KeyAddition   9C0DE0C0 8A5FA53A A3B2CB35 FD9E3D39
  InvMixColumn  009B052F AB1310E2 ECBC41FE 641B6A72
  Substitution  52E8364E 0E827C3B 8378F80C 8C44581E
  ShiftRow      5244F83B 0EE8580C 8382361E 8C787C4E
```

```
Round = 5
  KeyAddition   F60C0EE2 43859628 29B0557E 9D434CA8
  InvMixColumn  723BA6F9 38B41DE9 BE21BD90 A22D07B2
  Substitution  1E49C569 76C6DEEB 5A7BCD96 1AFA383E
  ShiftRow      1EFACDEB 76493896 5AC6C53E 1A7BDE69
Round = 4
  KeyAddition   F9A560AF CD406B10 129C3569 3B946F26
  InvMixColumn  747BD04C 654A34ED 9134097E A2102175
  Substitution  CA03605D BC5C2853 AC28408A 1A7C7B3F
  ShiftRow      CA7C4053 BC037B8A AC5C603F 1A28285D
Round = 3
  KeyAddition   87CBF4EE D5B63A92 29FB27A9 F30D10A0
  InvMixColumn  18F1C778 4BEC2945 2481926B BDBDC28C
  Substitution  342B31C1 CC834C68 A6917405 CDCDA8F0
  ShiftRow      34CD7468 CC2BA805 A68331F0 CD914CC1
Round = 2
  KeyAddition   D8DF72E6 A0A9D76E A8F9A449 91C7B203
  InvMixColumn  2F1DB819 32233E9F 119E7E4D 2F8ED99F
  Substitution  4EDE9A8E A132D16E E3DF8A65 4EE6E56E
  ShiftRow      4EE68A6E A1DEE565 E3329A6E 4EDFD18E
Round = 1
  KeyAddition   2C1E60BC F3F28E1E 1D3E0B99 6ADD242B
  InvMixColumn  BC8337E6 6BE22F37 4DB0226E 33CE1653
  Substitution  7841B2F5 053B4EB2 65FC9445 66ECFF50
  ShiftRow      78EC94B2 0541FF45 653BB250 66FC4EF5
KeyAddition   F69F2445 DF4F9B17 AD2B417B E66C3710


Plaintext is
    6BC1BEE2 2E409F96 E93D7E11 7393172A
    AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51
    30C81C46 A35CE411 E5FBC119 1A0A52EF
    F69F2445 DF4F9B17 AD2B417B E66C3710

************************************************************
```

```
################################################################

  Block Cipher Modes of Operation

      Electronic Codebook (ECB)

Plaintext is
    6BC1BEE2 2E409F96 E93D7E11 7393172A
    AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51
    30C81C46 A35CE411 E5FBC119 1A0A52EF
    F69F2445 DF4F9B17 AD2B417B E66C3710

################################################################

================================================================

ECB-AES256 (Encryption)
----------------------------------------------------------------

Key is
    603DEB10 15CA71BE 2B73AEF0 857D7781
    1F352C07 3B6108D7 2D9810A3 0914DFF4

Plaintext is
    6BC1BEE2 2E409F96 E93D7E11 7393172A
    AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51
    30C81C46 A35CE411 E5FBC119 1A0A52EF
    F69F2445 DF4F9B17 AD2B417B E66C3710

KeyAddition   0BFC55F2 3B8AEE28 C24ED0E1 F6EE60AB

Round = 1
  Substitution  2BB0FC89 E27E2834 252F70F8 4228D062
  ShiftRow      2B7E7062 E22FD089 2528FC34 42B028F8
  MixColumn     C62513B7 F75EF6CB FA5EB2D3 9FB9B1B5
  KeyAddition   D9103FB0 CC3FFE1C D7C6A270 96AD6E41

Round = 2
  Substitution  35CA75E7 4B75BB9C 0EB43A51 90959F83
  ShiftRow      35753A83 4BB49FE7 0E95759C 90CABB51
  MixColumn     4C12AA0D 2965E823 513CCED1 9498C478
  KeyAddition   D7B1FE1C A70CCD8C F426458E B4FF38A6

Round = 3
  Substitution  0EC8BB9C 5CFEBD64 BFF76E19 8D160724
  ShiftRow      0EFE6E24 5CF7079C BF16BB64 8DC8BD19
```

```
  MixColumn     4F7F40CA 213C1A37 802168BF E6C30FCB
  KeyAddition   E7CFDCD0 B2ED8EFA 3E68ECD1 519E5451

Round = 4
  Substitution  948A8670 3755192D B245CE3E D10B20D1
  ShiftRow      9455CED1 37452070 B20B862D D18A193E
  MixColumn     D3A62E85 F1ADA2DC C918D91A 1BCB2B87
  KeyAddition   063CC23D AA5E6BCB 37F19B52 C5459511

Round = 5
  Substitution  6FEB2527 AC587F1F 9AA11400 A66E2A82
  ShiftRow      6F581482 ACA12A27 9A6E251F A6EB7F00
  MixColumn     A06182E2 B6AC302A A7369FC0 0EEAB365
  KeyAddition   15C8B068 90D4966D 3F07BDE9 2186CAD6

Round = 6
  Substitution  59E8E745 6048903C 75C57A1E FD4474F6
  ShiftRow      59487AF6 60C57445 7544E73C FDE8901E
  MixColumn     E6B1E42E A528829B FDF3A044 4C830C58
  KeyAddition   679D6583 7FF7CA21 D9C5AAB6 B63BB83C

Round = 7
  Substitution  855E4DEC D26874FD 35A6AC4E 4EE26CEB
  ShiftRow      8568ACEB D2A66CEC 35E24DFD 4E5E744E
  MixColumn     EE51889D CEDD8364 E7C05111 44202A64
  KeyAddition   76943754 70609AEA C14C6AB6 4DC06870

Round = 8
  Substitution  38229A20 51D0B887 7829024E E3BA4551
  ShiftRow      38D00251 51294520 78BA9A87 E322B84E
  MixColumn     48D41F38 BCEC92DF 38257FBD 4D3A7838
  KeyAddition   20D46494 0E33A1C9 AECC4659 216BF5B8

Round = 9
  Substitution  B7484322 ABC332DD E44B5ACB FD7FE66C
  ShiftRow      B7C35A6C AB4BE622 E47F43DD FD4832CB
  MixColumn     1DA87483 542E510F CC0261AA C0F097EB
  KeyAddition   D5BC9687 2287AA85 9C27A187 993515D2

Round = 10
  Substitution  03659017 9317AC97 DECC3217 EE9659B5
  ShiftRow      031732B5 93CC5917 DE969097 EE65AC17
  MixColumn     B8CEB451 3CECD415 01D5D14A D3DCF1CE
  KeyAddition   66DDDD36 50208E64 FBF0B2DF 45A81FDB

Round = 11
```

```
  Substitution  33C1C105 53B71943 0F8C379E 6EC2C0B9
  ShiftRow      33B737B9 538CC005 0FC2C143 6EC1199E
  MixColumn     2AA63ABC EC0E4BB3 C18B9194 0342244D
  KeyAddition   7220F0E1 C2217A64 BF81606E 248D578E

Round = 12
  Substitution  40B78CF8 25FDDA43 080CD09F 365D5B19
  ShiftRow      40FDD019 250C5BF8 085D8C43 36B7DA9F
  MixColumn     55D32DDF FD288CD3 387E934F EBA99412
  KeyAddition   214F6A74 E5789109 DA0BED00 9FA80448

Round = 13
  Substitution  FD840292 D9BC8101 572B5563 DBC2F252
  ShiftRow      FDBC5552 D92BF292 57C20201 DB848163
  MixColumn     39331D51 B410A096 F0CF923B D833E3B5
  KeyAddition   F3C9B7B2 50C53BA2 6A10F8F5 6523FAB8

Substitution  0DDDA937 53A6E23A 02CA41E6 4D262D6C
ShiftRow      0DA6416C 53CA2D37 0226A93A 4DDDE2E6
KeyAddition   F3EED1BD B5D2A03C 064B5A7E 3DB181F8

KeyAddition   CE106147 0BC9DD22 B5C4C15C C0D2F9D0

Round = 1
  Substitution  8BCAEFA0 2BDDC193 D51C784A BAB59970
  ShiftRow      8BDD7870 2B1C99A0 D5B5EF93 BACAC14A
  MixColumn     79D236C3 4B03E5A3 091D0B03 A127374A
  KeyAddition   66E71AC4 7062ED74 24851BA0 A833E8BE

Round = 2
  Substitution  3394A21C 51AA5592 3697AFE0 C2C39BAE
  ShiftRow      33AAAFAE 51979B1C 36C3A292 C29455E0
  MixColumn     82383517 87CECFC7 02C40704 8DEEC747
  KeyAddition   199B6106 09A7EA68 A7DE8C5B AD893B99

Round = 3
  Substitution  D414EF6F 015C8745 5C1D6439 95A7E2EE
  ShiftRow      D45C64EE 011DE26F 5CA7EF45 95148739
  MixColumn     DD2E6998 A8697222 E066F126 B316DF45
  KeyAddition   759EF582 3BB8E6EF 5E2F7548 044B84DF

Round = 4
  Substitution  9D0BE613 E26C8EDF 58159D52 F2B35F9E
  ShiftRow      9D6C9D9E E2155F13 58B3E6DF F20B8E52
  MixColumn     9667696A AC3A7C51 47CB4618 3E3F082C
  KeyAddition   43FD85D2 F7C9B546 B9220450 E0B1B6BA
```

```
Round = 5
  Substitution  1A5497B5 68DDD55A 5693F253 E1C84EF4
  ShiftRow      1ADDF2F4 68934EB5 56C8975A E154D553
  MixColumn     4E423FF2 8532A314 22254511 A37EF11F
  KeyAddition   FBEB0D78 A34A0553 BA146738 8C1288AC

Round = 6
  Substitution  0FE9D7BC 0AD66BED F4FA8507 64C9C491
  ShiftRow      0FD68591 0AFAC4BC F4C9D7ED 64E96B07
  MixColumn     6BBD607B 790EBC43 89F2A4D8 84175220
  KeyAddition   EA91E1D6 A3D1F4F9 ADC4AE2A 7EAFE644

Round = 7
  Substitution  8781F8F6 0A3EBF99 951CE4E5 F3798E1B
  ShiftRow      873EE41B 0A1C8EF6 9579F899 F381BFE5
  MixColumn     A8D7477E 484D107B DBEDB70C 3FD523E1
  KeyAddition   3012F8B7 F6F009F5 FD618CAB 363561F5

Round = 8
  Substitution  04C941A9 428C01E6 54EF6462 0596EFE6
  ShiftRow      048C64E6 42EFEFA9 549641E6 05C90162
  MixColumn     054D7133 E804888F AE4671FC 29ED6803
  KeyAddition   6D4D0A9F 5ADBBB99 38AF4818 45BCE583

Round = 9
  Substitution  3CE367DB BEB9EAEE 077952AD 6E65D9EC
  ShiftRow      3CB952EC BE79D9DB 076567EE 6EE3EAAD
  MixColumn     164F0E6C EEE718D4 288A85CC A53BAEFA
  KeyAddition   DE5BEC68 984EE35E 78AF45E1 FCFE2CC3

Round = 10
  Substitution  1D39CE45 462F1158 BC796EF8 B0BB712E
  ShiftRow      1D2F6E2E 46797145 BCBBCE58 B03911F8
  MixColumn     0BDF9C3A 33621248 23C0681A D909B808
  KeyAddition   D5CCF55D 5FAE4839 D9E50B8F 4F7D561D

Round = 11
  Substitution  034BE64C CFE45212 35D92B73 84FFB1A4
  ShiftRow      03E42BA4 CFD9B14C 35FFE612 844B5273
  MixColumn     BE094699 08E2BBBA 84F32B62 EF97FE68
  KeyAddition   E68F8CC4 26CD8A6D FAF9DA98 C8588DAB

Round = 12
  Substitution  8E73641C F7BD7E3C 2D995746 E86A5D62
  ShiftRow      8EBD5762 F7995D1C 2D6A643C E8737E46
```

```
  MixColumn     EE743BA7 0425F0FE BC69CB01 66CAADA2
  KeyAddition   9AE87C0C 1C75ED24 5E1CB54E 12CB3DF8

Round = 13
  Substitution  B89B10FE 9C9D5536 589CD52F C91F2741
  ShiftRow      B89DD541 9C9C27FE 581F1036 C99B552F
  MixColumn     43BC5719 452857E3 B7603D8B 453489D0
  KeyAddition   8946FDFA A1FDCCD7 2DBF5745 F82490DD

Substitution  A75A542D 32544B0E D8085B6E 413660C1
ShiftRow      A7545BC1 3208602D D836540E 415A4B6E
KeyAddition   591CCB10 D410ED26 DC5BA74A 31362870

KeyAddition   50F5F756 B69695AF CE886FE9 9F77256E

Round = 1
  Substitution  53E668B1 4E902A79 8BC4A81E DBF53F9F
  ShiftRow      5390A89F 4EC43FB1 8BF56879 DBE62A1E
  MixColumn     3A1432E8 452D3C50 18BB25E9 A86C4B86
  KeyAddition   25211EEF 7E4C3487 3523354A A1789472

Round = 2
  Substitution  3FFD72DF F3291817 962696D6 32BC2240
  ShiftRow      3F299640 F32622DF 96BC7217 32FD18D6
  MixColumn     D38CE17E 6A06EBAF 8D74F741 B62D9E04
  KeyAddition   482FB56F E46FCE00 286E7C1E 964A62DA

Round = 3
  Substitution  5215D5A8 69A88B63 349F1072 90D6AA57
  ShiftRow      52A81057 699FAAA8 34D6D563 90158B72
  MixColumn     007E23E0 6A015AC5 BF84F699 FD4E1ED1
  KeyAddition   A8CEBFFA F9D0CE08 01CD72F7 4A13454B

Round = 4
  Substitution  C28B082D 99708B30 7CBD4068 D67D6EB3
  ShiftRow      C27040B3 99BD6E2D 7C7D0830 D68B8B68
  MixColumn     FC51FC10 B6678F39 47AE4191 D235E8B1
  KeyAddition   29CB10A8 ED94462E B94703D9 0CBB5627

Round = 5
  Substitution  A51FCAC2 55225A31 56A07B35 FEEAB1CC
  ShiftRow      A5227BCC 55A0B1C2 56EACA31 FE1F5A35
  MixColumn     80A03E2E 2204D171 72ED60B8 A91B0A36
  KeyAddition   35090CA4 047C7736 EADC4291 86777385

Round = 6
```

```
  Substitution  9601FE49 F210F505 87862C81 44F58F97
  ShiftRow      96102C97 F2868F49 87F5FE05 4401F581
  MixColumn     BC557CA8 A826AA96 EA6A9A93 FFC32C21
  KeyAddition   3D79FD05 72F9E22C CE5C9061 057B9845

Round = 7
  Substitution  27B6546B 40999871 8B4A60EF 6B21466E
  ShiftRow      2799606E 404A466B 8B215471 6BB698EF
  MixColumn     F0C0CC4C 73753B1A 4B449111 6040DC56
  KeyAddition   68057385 CDC82294 6DC8AAB6 69A09E42

Round = 8
  Substitution  456B8F97 BDE89322 3CE8AC4E F9E00B2C
  ShiftRow      45E8AC2C BDE80B97 3CE08F22 F96B934E
  MixColumn     294D9AD3 DEFCE10A EE4FBF6F 89CF7D74
  KeyAddition   414DE17F 6C23D21C 78A6868B E59EF0F4

Round = 9
  Substitution  83E3F8D2 5026B59C BC24443D D90B8CBF
  ShiftRow      832644BF 50248CD2 BC0BF89C D9E3B53D
  MixColumn     8CBCF799 92451AE7 1A25E30F 1FFD0C5C
  KeyAddition   44A8159D E4ECE16D 4A002322 46388E65

Round = 10
  Substitution  1BC2595E 69CEF83C D6632693 5A07194D
  ShiftRow      1BCE264D 6963195E D607593C 5AC2F893
  MixColumn     14BB4E5F 30DADA7D DB0F2747 8245DDE9
  KeyAddition   CAA82738 5C16800C 212A44D2 143133FC

Round = 11
  Substitution  74C2CC07 4A47CDFE FDE51BB5 FAC7C3B0
  ShiftRow      74471BB0 4AE5C307 FDC7CCFE FAC2CDB5
  MixColumn     8A67CEBB 64C23BF6 81D9A0F0 CA9C7D6B
  KeyAddition   D2E104E6 4AED0A21 FFD3510A ED530EA8

Round = 12
  Substitution  B5F8F28E D65567FD 1666D167 55EDABC2
  ShiftRow      B555D1C2 D666AB8E 16EDF2FD 55F86767
  MixColumn     9DB504DF 387274AB 0F2718C4 B970CAAE
  KeyAddition   E9294374 20226971 ED52668B CD715AF4

Round = 13
  Substitution  1EA51A92 B793F9A3 5500333D BDA3BEBF
  ShiftRow      1E9333BF B700BE92 55A31AA3 BDA5F93D
  MixColumn     1EC931E7 59FC7D43 ED853C1B 51C1B6FA
  KeyAddition   D4339B04 BD29E677 775A56D5 ECD1AFF7
```

```
Substitution  48C314F2 7AA58EF5 F5BEB103 CE3E7968
ShiftRow      48A5B168 7ABE79F2 F53E14F5 CEC38E03
KeyAddition   B6ED21B9 9CA6F4F9 F153E7B1 BEAFED1D

KeyAddition   96A2CF55 CA85EAA9 8658EF8B 63114091

Round = 1
  Substitution  903A8AFC 749787D3 446ADF3D FB820981
  ShiftRow      9097DF81 746A09FC 44828AD3 FB3A873D
  MixColumn     C75E3AFA A347131C 4C0DA779 192093D1
  KeyAddition   D86B16FD 98261BCB 6195B7DA 10344C25

Round = 2
  Substitution  617F4754 46F7AF1F EF2AA957 CA18293F
  ShiftRow      61F7A93F 462A2954 EF18471F CA7FAF57
  MixColumn     564B9E83 8F3DC261 B509584B F689093B
  KeyAddition   CDE8CA92 0154E7CE 1013D314 D6EEF5E5

Round = 3
  Substitution  BD9B744F 7C20948B CA7D66FA F628E6D9
  ShiftRow      BD2066D9 7C7DE64F CA28748B F69B94FA
  MixColumn     BE8E2133 D6F80781 088D8C14 2F864BE1
  KeyAddition   163EBD29 4529934C B6C4087A 98DB107B

Round = 4
  Substitution  47B27AA5 6EA5DC29 4E1C30DA 46B9CA21
  ShiftRow      47A53021 6E1CCAA5 4EB97A29 46B2DCDA
  MixColumn     6B67E11E 97B60935 1F807843 479C220B
  KeyAddition   BEFD0DA6 CC45C022 E1693A0B 99129C9D

Round = 5
  Substitution  AE54D724 4B6EBA93 F8F9802B EEC9DE5E
  ShiftRow      AE6E805E 4BF9DE24 F8C9D793 EE54BA2B
  MixColumn     2BB739BB 7CFF79B2 EF802A30 AAB8A891
  KeyAddition   9E1E0B31 5A87DFF5 77B10819 85D4D122

Round = 6
  Substitution  0B722BC7 BE179EE6 F5C830D4 97483E93
  ShiftRow      0B173093 BEC83EC7 F5482BE6 97729ED4
  MixColumn     8CE6D207 DDB058BA E4FEDAB0 E91EA5FD
  KeyAddition   0DCA53AA 076F1000 C0C8D042 13A61199

Round = 7
  Substitution  D774EDAC C5A8CA63 BAE8702C 7D2482EE
  ShiftRow      D7A870EE C5E882AC BA24ED63 7D74CA2C
```

```
  MixColumn     C8E2B67D 9C3FDD7D 8DBDFADA 80FCF261
  KeyAddition   502709B4 2282C4F3 AB31C17D 891CB075

Round = 8
  Substitution  53CC018D 93131C0D 62C778FF A79CE79D
  ShiftRow      5313789D 93C7E78D 629C010D A7CC1CFF
  MixColumn     76600CBF 05B90D8F 774FEB21 F9FF49C7
  KeyAddition   1E607713 B7663E99 E1A6D2C5 95AEC447

Round = 9
  Substitution  72D0F57D A933B2EE F824B5A6 2AE41CA0
  ShiftRow      7233B5A0 A9241C7D F8E4F5EE 2AD0B2A6
  MixColumn     A470CB4B 44B83222 C7C1C4C5 2BFA744B
  KeyAddition   6C64294F 3211C9A8 97E404E8 723FF672

Round = 10
  Substitution  5043A584 2382DDC2 8869F29B 40754240
  ShiftRow      5082F240 23694284 8875A5C2 4043DD9B
  MixColumn     8F02ED00 3BB3595D F354F1CC 03211473
  KeyAddition   51118467 577F032C 09719259 9555FA66

Round = 11
  Substitution  D1825F85 5BD27B71 01A34FCB 2AFC2D33
  ShiftRow      D1D24F33 5BA32D85 01FC5F71 2A827BCB
  MixColumn     A88CC893 E0F43672 3372D042 7973180A
  KeyAddition   F00A02CE CEDB07A5 4D7821B8 5EBC6BC9

Round = 12
  Substitution  8C67778B 8BB9C506 E3BCFD6C 58657FDD
  ShiftRow      8CB9FDDD 8BBC7F8B E3657706 5867C56C
  MixColumn     F324A86A 26E24F48 03B66220 B0AE1A92
  KeyAddition   87B8EFC1 3EB25292 E1C31C6F C4AF8AC8

Round = 13
  Substitution  176CDF78 B237004F F82E9CA8 1C797EE8
  ShiftRow      17379CE8 B22E7E78 F879DF4F 1C6C00A8
  MixColumn     032E2059 0B14E86D F03FF52B 246C9303
  KeyAddition   C9D48ABA EFC17359 6AE09FE5 997C8A0E

Substitution  DD487EF4 DF788FCB 02E1DBD9 EE107EAB
ShiftRow      DD78DBAB DFE17EF4 02107ECB EE488FD9
KeyAddition   23304B7A 39F9F3FF 067D8D8F 9E24ECC7


Ciphertext is
    F3EED1BD B5D2A03C 064B5A7E 3DB181F8
```

```
    591CCB10 D410ED26 DC5BA74A 31362870
    B6ED21B9 9CA6F4F9 F153E7B1 BEAFED1D
    23304B7A 39F9F3FF 067D8D8F 9E24ECC7

================================================================

ECB-AES256 (Decryption)
----------------------------------------------------------------

Key is
    603DEB10 15CA71BE 2B73AEF0 857D7781
    1F352C07 3B6108D7 2D9810A3 0914DFF4

Ciphertext is
    F3EED1BD B5D2A03C 064B5A7E 3DB181F8
    591CCB10 D410ED26 DC5BA74A 31362870
    B6ED21B9 9CA6F4F9 F153E7B1 BEAFED1D
    23304B7A 39F9F3FF 067D8D8F 9E24ECC7

KeyAddition   0DA6416C 53CA2D37 0226A93A 4DDDE2E6
Substitution  F3C5F8B8 5010FAB2 6A23B7A2 65C93BF5
ShiftRow      F3C9B7B2 50C53BA2 6A10F8F5 6523FAB8
Round = 13
  KeyAddition   39331D51 B410A096 F0CF923B D833E3B5
  InvMixColumn  FDBC5552 D92BF292 57C20201 DB848163
  Substitution  2178ED48 E50B0474 DAA86A09 9F4F9100
  ShiftRow      214F6A74 E5789109 DA0BED00 9FA80448
Round = 12
  KeyAddition   55D32DDF FD288CD3 387E934F EBA99412
  InvMixColumn  40FDD019 250C5BF8 085D8C43 36B7DA9F
  Substitution  7221608E C28157E1 BF8DF064 24207A6E
  ShiftRow      7220F0E1 C2217A64 BF81606E 248D578E
Round = 11
  KeyAddition   2AA63ABC EC0E4BB3 C18B9194 0342244D
  InvMixColumn  33B737B9 538CC005 0FC2C143 6EC1199E
  Substitution  6620B2DB 50F01F36 FBA8DD64 45DD8EDF
  ShiftRow      66DDDD36 50208E64 FBF0B2DF 45A81FDB
Round = 10
  KeyAddition   B8CEB451 3CECD415 01D5D14A D3DCF1CE
  InvMixColumn  031732B5 93CC5917 DE969097 EE65AC17
  Substitution  D587A1D2 22271587 9C359685 99BCAA87
  ShiftRow      D5BC9687 2287AA85 9C27A187 993515D2
Round = 9
  KeyAddition   1DA87483 542E510F CC0261AA C0F097EB
  InvMixColumn  B7C35A6C AB4BE622 E47F43DD FD4832CB
  Substitution  203346B8 0ECCF594 AE6B64C9 21D4A159
```

```
  ShiftRow      20D46494 0E33A1C9 AECC4659 216BF5B8
Round = 8
  KeyAddition   48D41F38 BCEC92DF 38257FBD 4D3A7838
  InvMixColumn  38D00251 51294520 78BA9A87 E322B84E
  Substitution  76606A70 704C6854 C1C037EA 4D949AB6
  ShiftRow      76943754 70609AEA C14C6AB6 4DC06870
Round = 7
  KeyAddition   EE51889D CEDD8364 E7C05111 44202A64
  InvMixColumn  8568ACEB D2A66CEC 35E24DFD 4E5E744E
  Substitution  67F7AA3C 7FC5B883 D93B6521 B69DCAB6
  ShiftRow      679D6583 7FF7CA21 D9C5AAB6 B63BB83C
Round = 6
  KeyAddition   E6B1E42E A528829B FDF3A044 4C830C58
  InvMixColumn  59487AF6 60C57445 7544E73C FDE8901E
  Substitution  15D4BDD6 9007CA68 3F86B06D 21C896E9
  ShiftRow      15C8B068 90D4966D 3F07BDE9 2186CAD6
Round = 5
  KeyAddition   A06182E2 B6AC302A A7369FC0 0EEAB365
  InvMixColumn  6F581482 ACA12A27 9A6E251F A6EB7F00
  Substitution  065E9B11 AAF1953D 3745C2CB C53C6B52
  ShiftRow      063CC23D AA5E6BCB 37F19B52 C5459511
Round = 4
  KeyAddition   D3A62E85 F1ADA2DC C918D91A 1BCB2B87
  InvMixColumn  9455CED1 37452070 B20B862D D18A193E
  Substitution  E7EDEC51 B26854D0 3E9EDCFA 51CF8ED1
  ShiftRow      E7CFDCD0 B2ED8EFA 3E68ECD1 519E5451
Round = 3
  KeyAddition   4F7F40CA 213C1A37 802168BF E6C30FCB
  InvMixColumn  0EFE6E24 5CF7079C BF16BB64 8DC8BD19
  Substitution  D70C45A6 A726381C F4FFFE8C B4B1CD8E
  ShiftRow      D7B1FE1C A70CCD8C F426458E B4FF38A6
Round = 2
  KeyAddition   4C12AA0D 2965E823 513CCED1 9498C478
  InvMixColumn  35753A83 4BB49FE7 0E95759C 90CABB51
  Substitution  D93FA241 CCC66EB0 D7AD3F1C 9610FE70
  ShiftRow      D9103FB0 CC3FFE1C D7C6A270 96AD6E41
Round = 1
  KeyAddition   C62513B7 F75EF6CB FA5EB2D3 9FB9B1B5
  InvMixColumn  2B7E7062 E22FD089 2528FC34 42B028F8
  Substitution  0B8AD0AB 3B4E60F2 C2EE5528 F6FCEEE1
  ShiftRow      0BFC55F2 3B8AEE28 C24ED0E1 F6EE60AB
KeyAddition   6BC1BEE2 2E409F96 E93D7E11 7393172A

KeyAddition   A7545BC1 3208602D D836540E 415A4B6E
Substitution  89FD57DD A1BF90FA 2D24FDD7 F846CC45
ShiftRow      8946FDFA A1FDCCD7 2DBF5745 F82490DD
```

```
Round = 13
  KeyAddition   43BC5719 452857E3 B7603D8B 453489D0
  InvMixColumn  B89DD541 9C9C27FE 581F1036 C99B552F
  Substitution  9A75B5F8 1C1C3D0C 5ECB7C24 12E8ED4E
  ShiftRow      9AE87C0C 1C75ED24 5E1CB54E 12CB3DF8
Round = 12
  KeyAddition   EE743BA7 0425F0FE BC69CB01 66CAADA2
  InvMixColumn  8EBD5762 F7995D1C 2D6A643C E8737E46
  Substitution  E6CDDAAB 26F98DC4 FA588C6D C88F8A98
  ShiftRow      E68F8CC4 26CD8A6D FAF9DA98 C8588DAB
Round = 11
  KeyAddition   BE094699 08E2BBBA 84F32B62 EF97FE68
  InvMixColumn  03E42BA4 CFD9B14C 35FFE612 844B5273
  Substitution  D5AE0B1D 5FE5565D D97DF539 4FCC488F
  ShiftRow      D5CCF55D 5FAE4839 D9E50B8F 4F7D561D
Round = 10
  KeyAddition   0BDF9C3A 33621248 23C0681A D909B808
  InvMixColumn  1D2F6E2E 46797145 BCBBCE58 B03911F8
  Substitution  DE4E45C3 98AF2C68 78FEEC5E FC5BE3E1
  ShiftRow      DE5BEC68 984EE35E 78AF45E1 FCFE2CC3
Round = 9
  KeyAddition   164F0E6C EEE718D4 288A85CC A53BAEFA
  InvMixColumn  3CB952EC BE79D9DB 076567EE 6EE3EAAD
  Substitution  6DDB4883 5AAFE59F 38BC0A99 454DBB18
  ShiftRow      6D4D0A9F 5ADBBB99 38AF4818 45BCE583
Round = 8
  KeyAddition   054D7133 E804888F AE4671FC 29ED6803
  InvMixColumn  048C64E6 42EFEFA9 549641E6 05C90162
  Substitution  30F08CF5 F66161B7 FD35F8F5 361209AB
  ShiftRow      3012F8B7 F6F009F5 FD618CAB 363561F5
Round = 7
  KeyAddition   A8D7477E 484D107B DBEDB70C 3FD523E1
  InvMixColumn  873EE41B 0A1C8EF6 9579F899 F381BFE5
  Substitution  EAD1AE44 A3C4E6D6 ADAFE1F9 7E91F42A
  ShiftRow      EA91E1D6 A3D1F4F9 ADC4AE2A 7EAFE644
Round = 6
  KeyAddition   6BBD607B 790EBC43 89F2A4D8 84175220
  InvMixColumn  0FD68591 0AFAC4BC F4C9D7ED 64E96B07
  Substitution  FB4A67AC A3148878 BA120D53 8CEB0538
  ShiftRow      FBEB0D78 A34A0553 BA146738 8C1288AC
Round = 5
  KeyAddition   4E423FF2 8532A314 22254511 A37EF11F
  InvMixColumn  1ADDF2F4 68934EB5 56C8975A E154D553
  Substitution  43C904BA F722B6D2 B9B18546 E0FDB550
  ShiftRow      43FD85D2 F7C9B546 B9220450 E0B1B6BA
Round = 4
```

```
  KeyAddition   9667696A AC3A7C51 47CB4618 3E3F082C
  InvMixColumn  9D6C9D9E E2155F13 58B3E6DF F20B8E52
  Substitution  75B875DF 3B2F8482 5E4BF5EF 049EE648
  ShiftRow      759EF582 3BB8E6EF 5E2F7548 044B84DF
Round = 3
  KeyAddition   DD2E6998 A8697222 E066F126 B316DF45
  InvMixColumn  D45C64EE 011DE26F 5CA7EF45 95148739
  Substitution  19A78C99 09DE3B06 A7896168 AD9BEA5B
  ShiftRow      199B6106 09A7EA68 A7DE8C5B AD893B99
Round = 2
  KeyAddition   82383517 87CECFC7 02C40704 8DEEC747
  InvMixColumn  33AAAFAE 51979B1C 36C3A292 C29455E0
  Substitution  66621BBE 7085E8C4 24331A74 A8E7EDA0
  ShiftRow      66E71AC4 7062ED74 24851BA0 A833E8BE
Round = 1
  KeyAddition   79D236C3 4B03E5A3 091D0B03 A127374A
  InvMixColumn  8BDD7870 2B1C99A0 D5B5EF93 BACAC14A
  Substitution  CEC9C1D0 0BC4F947 B5D26122 C010DD5C
  ShiftRow      CE106147 0BC9DD22 B5C4C15C C0D2F9D0
KeyAddition   AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51

KeyAddition   48A5B168 7ABE79F2 F53E14F5 CEC38E03
Substitution  D42956F7 BD5AAF04 77D19B77 EC33E6D5
ShiftRow      D4339B04 BD29E677 775A56D5 ECD1AFF7
Round = 13
  KeyAddition   1EC931E7 59FC7D43 ED853C1B 51C1B6FA
  InvMixColumn  1E9333BF B700BE92 55A31AA3 BDA5F93D
  Substitution  E92266F4 20525A74 ED714371 CD29698B
  ShiftRow      E9294374 20226971 ED52668B CD715AF4
Round = 12
  KeyAddition   9DB504DF 387274AB 0F2718C4 B970CAAE
  InvMixColumn  B555D1C2 D666AB8E 16EDF2FD 55F86767
  Substitution  D2ED51A8 4AD30EE6 FF530421 EDE10A0A
  ShiftRow      D2E104E6 4AED0A21 FFD3510A ED530EA8
Round = 11
  KeyAddition   8A67CEBB 64C23BF6 81D9A0F0 CA9C7D6B
  InvMixColumn  74471BB0 4AE5C307 FDC7CCFE FAC2CDB5
  Substitution  CA1644FC 5C2A3338 2131270C 14A880D2
  ShiftRow      CAA82738 5C16800C 212A44D2 143133FC
Round = 10
  KeyAddition   14BB4E5F 30DADA7D DB0F2747 8245DDE9
  InvMixColumn  1BCE264D 6963195E D607593C 5AC2F893
  Substitution  44EC2365 E4008E9D 4A38156D 46A8E122
  ShiftRow      44A8159D E4ECE16D 4A002322 46388E65
Round = 9
  KeyAddition   8CBCF799 92451AE7 1A25E30F 1FFD0C5C
```

```
  InvMixColumn  832644BF 50248CD2 BC0BF89C D9E3B53D
  Substitution  412386F4 6CA6F07F 789EE11C E54DD28B
  ShiftRow      414DE17F 6C23D21C 78A6868B E59EF0F4
Round = 8
  KeyAddition   294D9AD3 DEFCE10A EE4FBF6F 89CF7D74
  InvMixColumn  45E8AC2C BDE80B97 3CE08F22 F96B934E
  Substitution  68C8AA42 CDC89E85 6DA07394 690522B6
  ShiftRow      68057385 CDC82294 6DC8AAB6 69A09E42
Round = 7
  KeyAddition   F0C0CC4C 73753B1A 4B449111 6040DC56
  InvMixColumn  2799606E 404A466B 8B215471 6BB698EF
  Substitution  3DF99045 725C9805 CE7BFD2C 0579E261
  ShiftRow      3D79FD05 72F9E22C CE5C9061 057B9845
Round = 6
  KeyAddition   BC557CA8 A826AA96 EA6A9A93 FFC32C21
  InvMixColumn  96102C97 F2868F49 87F5FE05 4401F581
  Substitution  357C4285 04DC73A4 EA770C36 86097791
  ShiftRow      35090CA4 047C7736 EADC4291 86777385
Round = 5
  KeyAddition   80A03E2E 2204D171 72ED60B8 A91B0A36
  InvMixColumn  A5227BCC 55A0B1C2 56EACA31 FE1F5A35
  Substitution  29940327 ED4756A8 B9BB102E 0CCB46D9
  ShiftRow      29CB10A8 ED94462E B94703D9 0CBB5627
Round = 4
  KeyAddition   FC51FC10 B6678F39 47AE4191 D235E8B1
  InvMixColumn  C27040B3 99BD6E2D 7C7D0830 D68B8B68
  Substitution  A8D0724B F9CD45FA 0113BF08 4ACECEF7
  ShiftRow      A8CEBFFA F9D0CE08 01CD72F7 4A13454B
Round = 3
  KeyAddition   007E23E0 6A015AC5 BF84F699 FD4E1ED1
  InvMixColumn  52A81057 699FAAA8 34D6D563 90158B72
  Substitution  486F7CDA E46E626F 284AB500 962FCE1E
  ShiftRow      482FB56F E46FCE00 286E7C1E 964A62DA
Round = 2
  KeyAddition   D38CE17E 6A06EBAF 8D74F741 B62D9E04
  InvMixColumn  3F299640 F32622DF 96BC7217 32FD18D6
  Substitution  254C3572 7E2394EF 35781E87 A121344A
  ShiftRow      25211EEF 7E4C3487 3523354A A1789472
Round = 1
  KeyAddition   3A1432E8 452D3C50 18BB25E9 A86C4B86
  InvMixColumn  5390A89F 4EC43FB1 8BF56879 DBE62A1E
  Substitution  50966F6E B6882556 CE77F7AF 9FF595E9
  ShiftRow      50F5F756 B69695AF CE886FE9 9F77256E
KeyAddition   30C81C46 A35CE411 E5FBC119 1A0A52EF

KeyAddition   DD78DBAB DFE17EF4 02107ECB EE488FD9
```

```
Substitution  C9C19F0E EFE08ABA 6A7C8A59 99D473E5
ShiftRow      C9D48ABA EFC17359 6AE09FE5 997C8A0E
Round = 13
  KeyAddition   032E2059 0B14E86D F03FF52B 246C9303
  InvMixColumn  17379CE8 B22E7E78 F879DF4F 1C6C00A8
  Substitution  87B21CC8 3EC38AC1 E1AFEF92 C4B8526F
  ShiftRow      87B8EFC1 3EB25292 E1C31C6F C4AF8AC8
Round = 12
  KeyAddition   F324A86A 26E24F48 03B66220 B0AE1A92
  InvMixColumn  8CB9FDDD 8BBC7F8B E3657706 5867C56C
  Substitution  F0DB21C9 CE786BCE 4DBC02A5 5E0A07B8
  ShiftRow      F00A02CE CEDB07A5 4D7821B8 5EBC6BC9
Round = 11
  KeyAddition   A88CC893 E0F43672 3372D042 7973180A
  InvMixColumn  D1D24F33 5BA32D85 01FC5F71 2A827BCB
  Substitution  517F9266 5771FA67 0955842C 95110359
  ShiftRow      51118467 577F032C 09719259 9555FA66
Round = 10
  KeyAddition   8F02ED00 3BB3595D F354F1CC 03211473
  InvMixColumn  5082F240 23694284 8875A5C2 4043DD9B
  Substitution  6C110472 32E4F64F 973F29A8 7264C9E8
  ShiftRow      6C64294F 3211C9A8 97E404E8 723FF672
Round = 9
  KeyAddition   A470CB4B 44B83222 C7C1C4C5 2BFA744B
  InvMixColumn  7233B5A0 A9241C7D F8E4F5EE 2AD0B2A6
  Substitution  1E66D247 B7A6C413 E1AE7799 95603EC5
  ShiftRow      1E607713 B7663E99 E1A6D2C5 95AEC447
Round = 8
  KeyAddition   76600CBF 05B90D8F 774FEB21 F9FF49C7
  InvMixColumn  5313789D 93C7E78D 629C010D A7CC1CFF
  Substitution  5082C175 2231B0B4 AB1C09F3 8927C47D
  ShiftRow      502709B4 2282C4F3 AB31C17D 891CB075
Round = 7
  KeyAddition   C8E2B67D 9C3FDD7D 8DBDFADA 80FCF261
  InvMixColumn  D7A870EE C5E882AC BA24ED63 7D74CA2C
  Substitution  0D6FD099 07C811AA C0A65300 13CA1042
  ShiftRow      0DCA53AA 076F1000 C0C8D042 13A61199
Round = 6
  KeyAddition   8CE6D207 DDB058BA E4FEDAB0 E91EA5FD
  InvMixColumn  0B173093 BEC83EC7 F5482BE6 97729ED4
  Substitution  9E870822 5AB1D131 77D40BF5 851EDF19
  ShiftRow      9E1E0B31 5A87DFF5 77B10819 85D4D122
Round = 5
  KeyAddition   2BB739BB 7CFF79B2 EF802A30 AAB8A891
  InvMixColumn  AE6E805E 4BF9DE24 F8C9D793 EE54BA2B
  Substitution  BE453A9D CC699CA6 E1120D22 99FDC00B
```

```
  ShiftRow      BEFD0DA6 CC45C022 E1693A0B 99129C9D
Round = 4
  KeyAddition   6B67E11E 97B60935 1F807843 479C220B
  InvMixColumn  47A53021 6E1CCAA5 4EB97A29 46B2DCDA
  Substitution  1629087B 45C41029 B6DBBD4C 983E937A
  ShiftRow      163EBD29 4529934C B6C4087A 98DB107B
Round = 3
  KeyAddition   BE8E2133 D6F80781 088D8C14 2F864BE1
  InvMixColumn  BD2066D9 7C7DE64F CA28748B F69B94FA
  Substitution  CD54D3E5 0113F592 10EECACE D6E8E714
  ShiftRow      CDE8CA92 0154E7CE 1013D314 D6EEF5E5
Round = 2
  KeyAddition   564B9E83 8F3DC261 B509584B F689093B
  InvMixColumn  61F7A93F 462A2954 EF18471F CA7FAF57
  Substitution  D826B725 98954CFD 613416CB 106B1BDA
  ShiftRow      D86B16FD 98261BCB 6195B7DA 10344C25
Round = 1
  KeyAddition   C75E3AFA A347131C 4C0DA779 192093D1
  InvMixColumn  9097DF81 746A09FC 44828AD3 FB3A873D
  Substitution  9685EF91 CA584055 8611CFA9 63A2EA8B
  ShiftRow      96A2CF55 CA85EAA9 8658EF8B 63114091
KeyAddition   F69F2445 DF4F9B17 AD2B417B E66C3710


Plaintext is
    6BC1BEE2 2E409F96 E93D7E11 7393172A
    AE2D8A57 1E03AC9C 9EB76FAC 45AF8E51
    30C81C46 A35CE411 E5FBC119 1A0A52EF
    F69F2445 DF4F9B17 AD2B417B E66C3710

************************************************************
```