Experiment Name:

Write a program that lets the user enter time in seconds, up to 65535 and outputs the time as hours: minutes: seconds format. Use INDEC and OUTDEC to do the I/O.

Theory:

The objective of this program is to show a number in hours: minutes: seconds format. INDEC and OUTDEC are needed to perform the I/O operation. For this program in assembly, While loop, CMP, Stack, INDEC, OUTDEC were used as well as the required instructions and some registers to execute the solution.

Code:

```
.MODEL SMALL
.STACK 100H

.DATA
   P1  DB  'Enter the time in seconds (0 to 65535) = $'
   P2  DB  0DH,0AH,'Time in hh:mm:ss format= $'
   COLON DB  ' : $'

.CODE
MAIN PROC
   MOV AX, @DATA
   MOV DS, AX

   LEA DX, P1
   MOV AH, 9
   INT 21H

   CALL INDEC

   PUSH AX

   LEA DX, P2
   MOV AH, 9
   INT 21H

   POP AX

   XOR DX, DX
   MOV CX, 3600
   DIV CX

   CMP AX, 10
   JGE @HOURS

   PUSH AX
```

```
MOV AX, 0
CALL OUTDEC

POP AX

@HOURS:
   CALL OUTDEC

   MOV AX, DX

   PUSH AX

   LEA DX, COLON
   MOV AH, 9
   INT 21H

   POP AX
   XOR DX, DX

   MOV CX, 60
   DIV CX

   CMP AX, 10
   JGE @MINUTES

   PUSH AX

   MOV AX, 0
   CALL OUTDEC

   POP AX

@MINUTES:
   CALL OUTDEC

   MOV BX, DX

   LEA DX, COLON
   MOV AH, 9
   INT 21H

   MOV AX, BX

   CMP AX, 10
   JGE @SECONDS

   PUSH AX

   MOV AX, 0
   CALL OUTDEC

   POP AX

@SECONDS:
   CALL OUTDEC
```

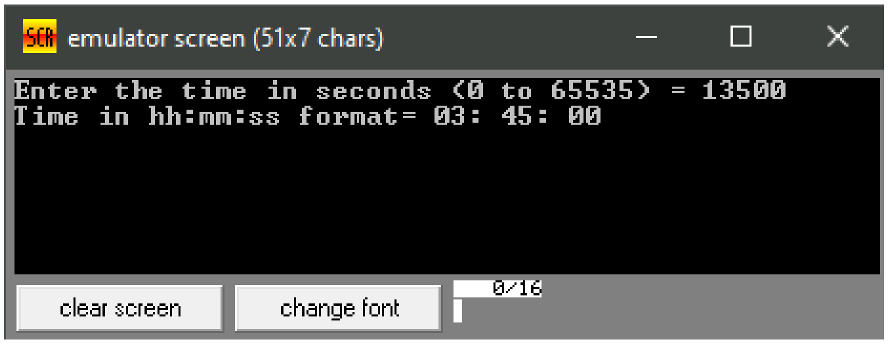
```
    MOV AH, 4CH
    INT 21H
    MAIN ENDP



INDEC PROC

   PUSH BX
   PUSH CX
   PUSH DX

   JMP @READ

   @SKIP_BACKSPACE:
   MOV AH, 2
   MOV DL, 20H
   INT 21H

   @READ:
   XOR BX, BX
   XOR CX, CX
   XOR DX, DX

   MOV AH, 1
   INT 21H

   CMP AL, "-"
   JE @MINUS

   CMP AL, "+"
   JE @PLUS

   JMP @SKIP_INPUT

   @MINUS:
   MOV CH, 1
   INC CL
   JMP @INPUT

   @PLUS:
   MOV CH, 2
   INC CL

   @INPUT:
     MOV AH, 1
     INT 21H

     @SKIP_INPUT:

     CMP AL, 0DH
     JE @JUMP_TO_END_INPUT

     CMP AL, 8H
     JNE @NOT_BACKSPACE
```

```
CMP CH, 0
JNE @CHECK_REMOVE_MINUS

CMP CL, 0
JE @SKIP_BACKSPACE
JMP @MOVE_BACK

@JUMP_TO_END_INPUT:

JMP @END_INPUT

@CHECK_REMOVE_MINUS:

CMP CH, 1
JNE @CHECK_REMOVE_PLUS

CMP CL, 1
JE @REMOVE_PLUS_MINUS

@CHECK_REMOVE_PLUS:

CMP CL, 1
JE @REMOVE_PLUS_MINUS
JMP @MOVE_BACK

@REMOVE_PLUS_MINUS:
  MOV AH, 2
  MOV DL, 20H
  INT 21H

  MOV DL, 8H
  INT 21H

  JMP @READ

@MOVE_BACK:

MOV AX, BX
MOV BX, 10
DIV BX

MOV BX, AX

MOV AH, 2
MOV DL, 20H
INT 21H

MOV DL, 8H
INT 21H

XOR DX, DX
DEC CL

JMP @INPUT
```

```
 @NOT_BACKSPACE:

 INC CL

 CMP AL, 30H
 JL @ERROR

 CMP AL, 39H
 JG @ERROR

 AND AX, 000FH

 PUSH AX

 MOV AX, 10
 MUL BX
 MOV BX, AX

 POP AX

 ADD BX, AX
 JC @ERROR

 CMP CL, 5
 JG @ERROR
JMP @INPUT

@ERROR:

MOV AH, 2
MOV DL, 7H
INT 21H

XOR CH, CH

@CLEAR:
 MOV DL, 8H
 INT 21H

 MOV DL, 20H
 INT 21H

 MOV DL, 8H
 INT 21H
LOOP @CLEAR

JMP @READ

@END_INPUT:

CMP CH, 1
JNE @EXIT
NEG BX

@EXIT:
  MOV AX, BX

  POP DX
  POP CX
  POP BX

  RET
INDEC ENDP



OUTDEC PROC

  PUSH BX
  PUSH CX
  PUSH DX

  CMP AX, 0
  JGE @START

  PUSH AX

  MOV AH, 2
  MOV DL, "-"
  INT 21H

  POP AX

  NEG AX

  @START:

  XOR CX, CX
  MOV BX, 10

  @OUTPUT:
    XOR DX, DX
    DIV BX
    PUSH DX
    INC CX
    OR AX, AX
  JNE @OUTPUT

  MOV AH, 2

  @DISPLAY:
    POP DX
    OR DL, 30H
    INT 21H
  LOOP @DISPLAY

  POP DX
  POP CX
  POP BX

  RET
```

```
 OUTDEC ENDP

END MAIN
```

Output:



```
Enter the time in seconds (0 to 65535) = 13500
Time in hh:mm:ss format= 03: 45: 00
```

Discussion:

In the above program, a number was taken as input from the user and then INDEC was called which is a procedure. The functionality of INDEC procedure is to take the input and process it like a decimal number. As in earlier assembly codes, multi-digit number was considered as an array of digit. Now using INDEC procedure, it works like a number to process with. After that, the number was pushed to the stack and then it was divided by 3600 using DIV to get the hour and if hour was greater than 9 then OUTDEC procedure was called to process that 2 digit hour and return to the output console. The above steps were repeated for both minutes and seconds also. In minutes option, it was divided by 60 using DIV. Thus in the output, using a colon(:) hours: minutes: seconds was printed on the console.