[A] Answer the following:

(a) The information about colors is to be stored in bits of a **char** variable called **color**. Bit numbers 0 to 6, each represent 7 colors of a rainbow, i.e., bit 0 represents violet, 1 represents indigo, and so on. Write a program that asks the user to enter a number and based on this number it reports which colors in the rainbow do the number represents.

(b) In an inter-college competition, various sports like cricket, basketball, football, hockey, lawn tennis, table tennis, carom and chess are played between different colleges. The information regarding the games won by a particular college is stored in bit numbers 0, 1, 2, 3, 4, 5, 6, 7 and 8, respectively of an integer variable called **game**. The college that wins in 5 or more than 5 games is awarded the Champion of Champions trophy. If a number representing the bit pattern mentioned above is entered through the keyboard then write a program to find out whether the college won the Champion of the Champions trophy or not, along with the names of the games won by the college.

(c) An animal could be a canine (dog, wolf, fox, etc.), a feline (cat, lynx, jaguar, etc.), a cetacean (whale, narwhal, etc.) or a marsupial (koala, wombat, etc.). The information whether a particular animal is canine, feline, cetacean, or marsupial is stored in bit number 0, 1, 2 and 3, respectively of a integer variable called **type**. Bit number 4 of the variable **type** stores the information about whether the animal is Carnivore or Herbivore.

For the following animal, complete the program to determine whether the animal is a herbivore or a carnivore. Also determine whether the animal is a canine, feline, cetacean or a marsupial.

```
struct animal
{
    char name[ 30 ]; int type;
}
struct animal  a = { "OCELOT", 18 };
```

(d) The time field in a structure is 2 bytes long. Distribution of different bits which account for hours, minutes and seconds is given in Figure 21.7. Write a function that would receive the 2-byte time and return to the calling function, the hours, minutes and seconds.
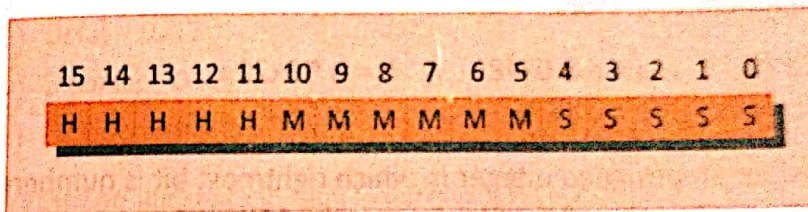
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
H	H	H	H	H	M	M	M	M	M	M	S	S	S	S	S

Figure 21.7

(e) In order to save disk space, information about student is stored in an integer variable. If bit number 0 is on then it indicates I^{st} year student, bit number 1 to 3 stores IInd year, IIIrd year and IVth year student respectively. Bits 4 to 7 store the stream Mechanical, Chemical, Electronics and CS. Rest of the bits store room number. Such data for 4 students is stored in the following array:

```
int data[  ] = { 273, 548, 786, 1096 };
```

Write a program that uses this data and displays the information about the student.

(f) What will be the output of the following program:

```
# include <stdio.h>
int main( )
{
    int i = 32, j = 65, k, l, m, n, o, p;
    k = i | 35;
    l = ~k;
    m = i & j;
    n = j ^ 32;
    o = j << 2;
    p = i >> 5;
```

```
        printf ( "k = %d l = %d m = %d\n", k, l, m );
        printf ( "n = %d o = %d p = %d\n", n, o, p );
        return 0;
    }
```

[B] Answer the following:

(a) What is hexadecimal equivalent of the following binary numbers:

01011010
11000011
1010101001110101
1111000001011010

(b) Rewrite the following expressions using bitwise compound assignment operators:

a = a | 3   a = a & 0x48   b = b ^ 0x22
c = c << 2   d = d >> 4

(c) Consider an unsigned integer in which rightmost bit is numbered as 0. Write a function **checkbits (x, p, n)** which returns true if all "n" bits starting from position "p" are turned on. For example, **checkbits (x, 4, 3)** will return true if bits 4, 3 and 2 are 1 in number x.

(d) Write a program to scan a 8-bit number into a variable and check whether its 3rd, 6th and 7th bit is on.

(e) Write a program to receive an unsigned 16-bit integer and then exchange the contents of its 2 bytes using bitwise operators.

(f) Write a program to receive a 8-bit number into a variable and then exchange its higher 4 bits with lower 4 bits.

(g) Write a program to receive a 8-bit number into a variable and then set its odd bits to 1.

(h) Write a program to receive a 8-bit number into a variable and then check if its 3rd and 5th bit are on. If these bits are found to be on then put them off.

(i) Write a program to receive a 8-bit number into a variable and then check if its 3rd and 5th bit are off. If these bits are found to be off then put them on.

(j) Rewrite the **showbits( )** function used in this chapter using the _BV macro.