Introduction to Computing (CS101)

Set B

Mid-semester Examination (36 Questions, Max Marks: 50) **IIT Guwahati, India**

Time: 14:00–16:00 (2 hours) **Pages: 4** **25 Feb 2019 (Monday)**

Roll No.:	Name:	Signature of Invigilator:

INSTRUCTIONS

1. Write the final answers in the space provided after each questions. **2. No clarification will be entertained during examination.**	**3. Rough/Supplementary sheets will not be evaluated.** **4. No partial marks will be awarded for any question.**

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1. [1 Mark]Write Linux command to generate object code from C source code (of test.c) using **gcc**.

   gcc -c test.c

2. [1 Mark]Which symbol is used for input or output in the flow chart?
   parallelogram or **graphical parallelogram symbol**

3. [1 Mark]Convert the binary number $(0110101100000011)_2$ to octal number.

   $(0, 110, 101, 100, 000, 011)_2 = (65403)_8$

4. [1 Mark]What is the decimal equivalent number of the largest n digits octal number?
   $7.8^{n-1} + 7.8^{n-2} + .. + 7.8^1 + 7.8^0 =$
   $7.(8^{n-1}+8^{n-2}+..+8^1+8^0) = 7.\frac{1-8^n}{1-8} = 8^n - 1$

5. [1 Mark]What is the binary equivalent of the decimal number $(54.625)_{10}$? $(110110.101)_2$

6. [2 Marks]Convert $(54.625)_{10}$ into IEEE 754 single precision floating point format. Write the value of sign bit, exponent bits (8 bits:MSB to LSB) and mantissa bits (23 bits:MSB to LSB) in binary bits.

   Sign: 0 **Exp: 1000 0100**
   Mantissa:1011 0101 0000 0000 0000 000

   Also correct: Sign: 0 **Exp: 132**
   Mantissa: 1011 0101

7. [2 Marks]In IEEE single precision floating point (SPFP) number format 1 bit, 8 bits and 23 bits are used for sign, exponent and mantissa respectively. What are the largest and second largest SPFP expressible numbers?

   Largest: sign (+), mansissa (7FFFFF), exponent (FE)
   $= +1.7FFFFF \times 2^{254-127}$
   $=$ **1.111 1111 1111 1111 1111 1111** $\times 2^{127}$
   $= 3.4028235 \times 10^{38}$
   2nd Largest: sign (+), mansissa (7FFFFE), exponent (FE)
   $=+1.7FFFFE \times 2^{254-127}$
   $=$ **1.111 1111 1111 1111 1111 1110** $\times 2^{127}$
   $=3.402823 \times 10^{38}$

8. [1 Mark]What is the output of the following program segment?

```
int a=1, b=2, c=3, d=72021, e=3;
e += a = d + a * b + d % c * a;
printf("%d", e);
```

   Ans:72026

9. [1 Mark]What is the value assigned to the variable X if b is 7?

```
X = b>8 ? b <<3 : b>4 ? b>>1:b;
```

   Ans:3

10. [2 Marks]What is the output of the following program segment?

```
int i=4,j=3,k=2,w=1;
i += j += k += w;
printf("%d %d %d %d\n", i, j, k, w);
```

    Ans: 10 6 3 1

11. [1 Mark]Suppose variable `d` is double precision type and `f` single precision type. What will be the value of the Boolean test `(d+f)-d == f`, when `f` is 2.4e-8 and `d` = 2^{40}?
Ans: False
Small number f get absorb in big number d, result of d+f will be d and d-d will be 0, so will not be equal to f

12. [1 Mark]What is the value of the expression `9/2 - 9/3 % 9/4` in integer domain?
Ans: 4
As */% have same prepeferece, will be evaluated from left to right and evaluated as (9/2) - (((9/3) % 9)/4) =4-(3%9)/4=4-3/4=4

13. [1 Mark]What will be the output of the following program?
```
int x = 6;
switch(x){
      default : x += 2;
      case 4  : x =4;
      case 5  : x++; break;
  }
  printf("%d", x);
```
Ans: 5

14. [2 Marks]What is the output of the following program segment?
```
int x=1,y=0;
if ("False")
     if (y=0) {
          if (x=1) printf("X1Y0\n"); }
        else printf("X1Y1\n");
     else
          printf("X0Y*\n");
```
Ans: X1Y1

15. [1 Mark]What is the output of the following program segment?
```
char str[]="In CS101, I score \0 Marks";
printf("%s\n", str);
```
Ans: In CS101, I score

16. [1 Mark]How many times the statement S will be executed in the following nested for loops?
```
int i, j;
for (i=0; i<n-1; i++)
  for(j=i+1; j<n; j++) S;
```
Ans: (n-1)+(n-2)+(n-1)+..+1 = (n)(n-1)/2

17. [2 Marks]Write a useful loop invariant properties for the following code, which calculates X^n.
```
int i=0, P=1;
for(i=1;i<=n;i++) P=P*X;
```
Ans: at the begining of every ierative step $X^i.X^{n-i} = X^n$

18. [2 Marks]Write loop bound function for the code given in the previous question.
Ans: Loop bound function : (n+1)-i

LBF decreases in every iteration and when it reaches 0 loop exit

19. [1 Mark]What is the output of the following program fragment.
```
int a[8]={1,2,4,9,25,36,49,84}, j;
for (j=1; j<8; j++) a[j] += a[j-1];
for (j=0; j<8; j++) printf("%d ",a[j]);
```
Ans: 1 3 7 16 41 77 126 210

20. [1 Mark]What is the output of the following program segment?
```
int a[5]={20,25,30};
printf("%d    %d\n", a[2], a[3]);
```
Ans: 30 0

21. [1 Mark]A two dimensional array A[m][n] is mapped to an one dimensional array B[$m \times n$] in row major order. What will be the accessing function, i.e., the index k of B[k] for the element A[i][j]?

Ans: $k = i * n + j$ **or B[k]=B[i*n+j]**

22. [1 Mark]What will be the value of b[-3] if we do the following initialization:

```
int a[ ] = {1,2,5,6,9,10};
int *b=&a[4];
```

Ans: 2

23. [1 Mark]What will be the value of `X` after execution of the following program segment?

```
int X;
int A[5][2]={{4,8},{2,1},{9,8},
                    {7,3},{5,6}};
X=A[4][-4];
```

Ans: 9,
X=*(A+4*2+(-4))=*(A+4)=9

24. [1 Mark]What is the output of the following program segment?

```
int i = 5, *j, R;
j = &i; R=i**j*i+*j
printf("%d", R);
```

Ans: 130, or compilation error because of missing semicolon before printf,

25. [2 Marks]What kind of issue will arise in compiling the following code? What is the output of the following program?

```
#include<stdio.h>
int main(){
     int i = 5, *Ptr;  Ptr=i;
     printf("%d", *Ptr);
     return 0;
}
```

Ans: compilation warning: assignment makes pointer from integer without a cast

No output: Segmentation fault (core dumped)

26. [1 Mark]What is the output of the following C program?

```
#include<stdio.h>
void f(){printf("1");}
int main(){
  do{
    void f(){printf("2");}
    f();f();f();
    }while(0);
  f();f();f();
  return 0;
}
```

Ans: 222111

27. [1 Mark]A local copy of each parameter is created when a function is called. When we pass an integer array (`int A[10]`) to a function, how many elements of the same array will be created as local copy when the function is called?
Ans: 0, no element of the array

28. [2 Marks]What is the minimum amount of stack space require for this code fragment to run, when $F(A, 20)$ is invoked.

```
int F(int A[], int n){
  int L1, L2, B[100];
  if(n==0) return 1;
  return F(A,n-1);
}
```

Ans: 20 * {100 for arrayB+1 for L1 +1 for L2 + 1 for return Address, 1 for n, 1 for A}*4
So Ans = 20 *{100+5}*4 =8400 Bytes

29. [1 Mark]Static variables of function get allocated to which section or segment of the memory at the time of program execution?

Ans: Simple ans is Data

zero-initialized static data goes in .BSS (Block Started by Symbol), non zero-initialized data goes in .DATA

30. [2 Marks]How many steps this recursive code will take to find max of an given array A, where $n2 - n1 = N$ is the size of the array.

```
int RMax(int A[], int n1, int n2){
  int L1, L2;
  if(n1==n2) return A[n1];
  L1=Rmax(A, n1,       (n1+n2)/2);
  L2=Rmax(A,(n1+n2)/2, n2);
  if (L1>L2) return L1;
  else return L2;
}
```

Ans: T(N)=2T(N/2)+1=4(T/4)+2+1
=$2^kT(1) + 2^{k-1} + 2^{k-2} + .. + 1$
=$2^{k+1} - 1$, assuming T(1)=1, N=2^k
=2N-1
if we assume T(2)=1, T(N)=$\frac{3*N}{2}$-1

31. [2 Marks]Write a C function that swaps the content of two variables X and Y without using a temporary variable.
Ans: Any one of the following

```
/* using bit wise X-OR or plus-minus or
   mult-div */
void swap1(int *i, int *j){
 *i = *i ^ *j; *j = *i ^ *j; *i = *i ^ *j;
}
void swap2(int *i, int *j){
 *i = *i + *j; *j = *i -*j; *i = *i - *j;
}
void swap3(int *i, int *j){
 *i = *i * *j; *j = *i / *j; *i = *i / *j;
}
```

32. [1 Mark]Why modular code or highly functionalize code take higher amount of time to execute than the monolithic version of the code? Give precise answer with in 5 words.
Ans: function call overhead, stack creation/delection

33. [2 Marks]What will be the value returned by the function **fn(7)**?

```
int fn(int v) {
  if (v==1 || v==0)  return 1;
  if (v%2==0)  return(fn(v/2)+2);
  else return(fn(v-1)+3);
}
```

Ans: 11
As f(7)=f(6)+3=(f(3)+2)+3
=((f(2)+3)+2)+3
=f(1)+2+3+2+3 =11

34. [2 Marks]Write a recursive C function with two integer parameters n and r that computes,

$$\binom{n}{r} = \binom{n-1}{r} + \binom{n-1}{r-1}$$

assuming $n \geq r \geq 0$.

Ans is :

```
int C(int n, int r) {
  if (n==r || r==0)  return 1;
  else return C(n-1,r)+C(n-1,r-1);
}
```

35. [2 Marks]What will be the value returned by the function $G(10, 0, 1)$? What output it will produce for general value of n for invocation of $G(n, 0, 1)$?

```
int G(int n, int a, int b){
  if (n==0) return a;
  if (n==1) return b;
  return G(n-1, b, a+b)
}
```

Ans: 55
2nd Part: Fibonacci Sequence
=0, 1, 1, 2, 3, 5, 8, 13, 21....

36. [2 Marks]What is the return value for call $CSB(32)$? What output it will produce for general value of n?

```
int CSB (int n) {
     static int s = 0;
     if (n == 0) return 0;
     else { s = s + ((n%2)? 1 : 0);
            s=  s + CSB(n/2); }
     return s;
}
```

Ans: 32
If we dont assume s as static answer will be 1
2nd Part: Count Set Bit of a positive number and output result $CSB * 2^k$, where k is minimum number of bit to represent the input number.