Name:

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ESC101 Fundam. of Comp.
Midsem Set A
Date: February 23, 2018

Instructions:

Total: **20 X 6 = 120 marks**

1. This question paper contains a total of 15 pages (15 sides of paper). Please verify.
2. Write your name, roll number, department, section on **every side of every sheet** of this booklet
3. Write final answers **neatly with a pen** in the given boxes.
4. Do not give derivations/elaborate steps unless the question specifically asks you to provide these.

C Precedence Table:

Operator Category	Operators	Associativity
unary operators	- ++ −− ! `sizeof` (`type`)	Right to Left
arithmetic multiply, divide and remainder	∗ / %	Left to Right
arithmetic add and subtract	+ −	Left to Right
relational operators	< ≤ > ≥	Left to Right
equality operators	== !=	Left to Right
logical *and*	&&	Left to Right
logical *or*	||	Left to Right
conditional operator	? :	Right to Left
assignment operators	= += −= *= /= %=	Right to Left

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Problem 1 (Role Reversal: 3 + 17 = 20 marks).

1. Preetam is given an assignment in the C programming language. He has to provide the outputs for the given *printf* statements. Following are the questions from Preetam's assignment and the answers that he provided. You have to help the instructor grade the assignment. For each of the following simply write **T** if the print statement matches the output, else write **F** in the box.(3 X 1 = 3)

(a) **T** **printf("%.1f", 5.36);** *Output:* **5.4**
(b) **F** **printf("%d", 1.73);** *Output:* **1**
(c) **T** **printf("%c", (int)98.6);** *Output:* **b** *(NOTE: ASCII value of character **a** is 97)*

2. Sagar has written the following programs and is a bit confused as to what their output will be. Help clear his confusion by providing the outputs of each of his programs. If he has made an error due to which a program does not compile or crashes while running, tell him where he has made an error. If the program is correct, write its output in the corresponding space provided, else write *'ERROR'* and explain briefly why it occurred. (5 + 3 + 4 + 5 = 17)

(a)

```
1 #include<stdio.h>
2
3 #define SCANF "%s,Hello World
     !\n"
4
5 int main(){
6     printf(SCANF,SCANF);
7     return 0;
8 }
```

```
1 %s, Hello World!
2 , Hello World!
```

(b)

```
1 #include <stdio.h>
2
3 int main(){
4     printf("happy \new year!!"
     );
5     return 0;
6 }
```

```
1 happy
2 ew year!!
```

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(c)

```
1  #include<stdio.h>
2  #define MAX 10
3
4  int main(){
5      int MAX = 3;
6      if(MAX == 3)
7          printf("%d", MAX);
8      else printf("MAX is 10");
9      return 0;
10 }
```

```
1  ERROR.
2  Since MAX will be replaced by 10
     before compilation. Hence, line
      5 would become 10 = 3, which
     will result in an error.
```

(d) The input given to the program is **ESC 101**(NOTE: There is a space between C and 1, scanf returns the number of items successfully read):

```
1  #include <stdio.h>
2
3  int main(){
4      char a;
5      while(scanf("%c", &a)){
6          if(a == '1'){
7              break;
8              printf("The End!")
       ;
9          }
10         printf("%c1",a);
11     }
12     return 0;
13 }
```

```
1  E1S1C1 1
```

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Problem 2 (: 6 + 14 = 20 marks)**.** Give your answers in the space provided only.

1. **Write T or F in the box for True and False respectively**(6 X 1 = 6)

   1. **F** The % operator works on floating point numbers and represents modulo operation
   2. **F** If the first argument in an OR condition evaluates to false, the second is not evaluated due to short-circuit evaluation
   3. **F** A "float" variable can be safely converted into an "integer" variable without loss of data
   4. **T** The largest positive number stored in an unsigned int variable using 6 bits is $2^6 - 1$
   5. **F** The expression $(a = b)$ evaluates to true irrespective of what values a and b are
   6. **F** The sizeof operator returns the number of bits occupied in memory by a variable

2. **Write output in the box provided**(4 + 5 + 5 = 14)

   Please ensure you take care of newline characters in the output by correctly putting answers in different lines. If you think the **code will not compile**, please write `Compile time error` and a brief explanation. If you think during the execution of any line, the program **will face an error**, please write `Run time error` and a brief explanation. If you think a **garbage value will be printed**, please write (−**42**) for every such instance.

   (a)

```
1  #include <stdio.h>
2
3  int main()
4  {
5
6    int a, b, c;
7    a = 10;
8    b = 1;
9    c = 15;
10
11   if(c > a > b)
12     printf("First\n");
13   if( b && a)
14     printf("Second\n");
15   else if(a < c)
16     printf("Third\n");
17
18   printf("%.2f\n", (float) ( a / c ));
19   printf("%.2f\n", ( a / (float) c ));
20   printf("%d", c / a);
21
22   return 0;
23 }
```

```
1 Second
2 0.00
3 0.67
4 1
```

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(b)

```
1  #include <stdio.h>
2
3  int main()
4  {
5
6    int i, j, k;
7    i = 1;
8    j = 2;
9    k = (i = j)? 3 : 0;
10
11   printf("%d\n", k);
12   printf("%d\n", i++);
13   printf("%d\n", i + k);
14   printf("%c", 'A' + ++j + k);
15
16   return 0;
17 }
```

```
1  3
2  2
3  6
4  G
```

(c)

```
1  #include <stdio.h>
2
3  int main()
4  {
5
6    int i, j, k;
7    i = 1;
8    j = 2;
9
10   k=(i == 1 || i == 2 && j == 1)?1:0;
11   printf("%d\n", k);
12   printf("%d\n", i + - j);
13   printf("%d\n", j / 3 * 3);
14   j *= i + 3;
15   printf("%d", j);
16   return 0;
17 }
```

```
1  1
2  -1
3  0
4  8
```

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Problem 3 (: 3 X 4 + 8 = 20 marks)**. Write the output or "compiler error" in the blank box.**

(a)

```
1  #include<stdio.h>
2  int main()
3  {
4    int pi = -22/(float)7;
5    switch(pi)
6    {
7      case -4: printf("c1\n");
8      default: printf("D\n");
9      case -22/7: printf("c2\n"); break;
10   }
11   return 0;
12 }
```

1 c2

(b)

```
1  #include<stdio.h>
2  int main()
3  {
4    int yes = 0;
5    switch(++yes)
6    {
7      case yes: yes++;
8                printf("%d\n",yes);
9                break;
10     default: printf("%d\n",yes);
11               break;
12   }
13   return 0;
14 }
```

1 compiler error

(c)

```
1  #include<stdio.h>
2  int main()
3  {
4    float unbelievable = 4.3;
5    if (!0)
6    if(unbelievable = 4.2? 1 - 1 : 0)
7       printf("broke\n");
8    else
9       printf("leg\n");
10   else
11       printf("help\n");
12   return 0;
13 }
```

1 leg

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(d)

```
1  #include<stdio.h>
2  int main()
3  {
4    int tyme = 3;
5    if (tyme - 1)
6     tyme++;
7    if(tyme = 4)
8       tyme--;
9    else if(tyme == 3)
10     printf("tyme\n");
11   else
12       printf("running\n");
13   else
14       printf("out\n");
15
16   return 0;
17 }
```

```
1 compiler error
```

(e)

```
1  #include<stdio.h>
2  #define mid 30
3  #define T thesis
4  int main()
5  {
6    int days_left = 60;
7    int work = 0;
8    int thesis;
9    for (T = 0; T < days_left; ++work)
10   {
11     ++T;
12     if(thesis % 11 == 0)
13       continue;
14     switch(thesis)
15     {
16       case mid: break; break;
17       case 10: printf("No work\n");
18                printf("But a X\n");
19       default: ++work;
20     }
21   }
22   if(thesis < 60)
23     printf("finish early! %d\n", T);
24   printf("work is %d\n", work);
25   return 0;
26 }
```

```
1 No work
2 But a X
3 work is 114
```

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Problem 4 (: 3+5+5+7 = 20 marks)**.** Give your answers in the space provided only.

1. In the space given, write down the output of the program when it is given "36" as input.

```
1  #include<stdio.h>
2  #include<math.h>
3  int main(void){
4      int n;
5      scanf("%d",&n);
6      for(int i=1;i<sqrt(n);i++){
7          if(!(n%i))
8              printf("%d %d\n",i,n/i);
9      }
10 }
```

```
1 1 24
2 2 12
3 3 8
4 4 6
```

2. In the space given, write down the output of the program given below.

```
1  #include <stdio.h>
2  int main(void) {
3    int i=0,j=0;
4    for( i=0;i<5;j++,printf("%d\n",i)){
5      printf("%d",j);
6      for(j=0;j<2;i++)
7        printf("%d",j++);
8    }
9    return 0;
10 }
```

```
1 0012
2 3014
3 3016
```

3. In the space given, write down the output of the program when it is given "15 7" as input.

```
1  #include<stdio.h>
2  int fun(int n,int m){
3      int x=2,result=1;
4      while(n){
5          if(n%2){
6              result=(result*x)%m;
7          }
8          x=(x*x)%m;
9          n/=2;
10     }
11     return result;
12 }
13 int main(void){
14     int n,m;
15     scanf("%d %d",&n,&m);
16     printf("%d\n",fun(n,m));
17 }
```

```
1 1
```

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4. Fill in the blanks in the program below to print sum following series upto n terms.
(**Do not** use conditionals or loops in any of the blanks)

$$1 - \frac{(1*2)}{(1*3)} + \frac{(1*2*3)}{1*3*5} - \frac{1*2*3*4}{1*3*5*7}.....$$

```
1  #include <stdio.h>
2  double sumSer(int n){
3    //the sum of the series is stored in result
4    double result=0;
5    //declare/initialize a variable named "temp"
6    double temp=1;
7    int sign=1;
8    for(int i=1;i<=n;i++){
9      //modify the value of "temp" as required
10     temp=(temp*i)/(2*i-1);
11     //update result to contain the correct value after i terms
12     result+=temp*sign;
13     sign*=-1;
14   }
15   return result;
16 }
17 int main(void) {
18   int n;
19   scanf("%d",&n);
20   //print the soltion using the function sumSer
21   printf("%lf",sumSer(n));
22   return 0;
23 }
```

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Problem 5 (: 4 + 6 + 10 = 20 marks)**.**

1. For each of the following simply write **T** or **F** in the box.(4 X 1 = 4)

1. **F** A function can be defined inside another function.
2. **F** A function can return more than one values.
3. **F** Every function must return a value.
4. **F** Two functions can have same name but different return type in same C program.

2. **Everything is made of PRIMES**
In the space given, write down the output of the program given below if following input is given:
3 4 9 15
Assume isPrime function is declared.
isPrime(int num) is a function which will return 1 if integer given in the argument is prime else it will return 0.

```
1  #include <stdio.h>
2  int isPrime(int num);
3  int primeSum(int A){
4      int i=2 , static count = 0;
5      for(i=2;i<=A/2;i++)
6      {
7          if(isPrime(i)&&isPrime(A-i))
8          {
9            count++;
10         }
11         if(i!=2)
12             i++;
13     }
14     return count;
15 }
16 int main(){
17   int t;
18   scanf("%d",&t);
19   while(t--){
20     int n ;
21     scanf("%d",&n);
22     printf("%d\n",primeSum(n));
23   }
24
25   return 0;
26 }
```

```
1  1
2  2
3  3
```

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3. **A Guess 'Function': PRIME love**
Write the output of the following program in the box if following input is given: 5 7 21 33 133 1982
Assumptions:

- isPrime and lengthInt functions are declared.
- isPrime(int num) is a function which will return 1 if integer given in the argument is prime else it will return 0.
- lengthInt(int num) is a function which will return the length of the integer e.g if argument is 124 it will return 3.

```
1  #include <stdio.h>
2  #include <math.h>
3  int isPrime(int n);
4  int lengthInt(int n);
5  int guessFunction(int n){
6    if(isPrime(n) == 0){
7      return 0;
8    }
9    else{
10     int length = lengthInt(n);
11     for(int i = 0 ; i < length - 1 ;++i){
12       int temp_num = n , first_digit;
13       first_digit = n/((int)(pow(10,length-1)));
14       temp_num = n%((int)(pow(10,length-1)));
15       temp_num = temp_num*10 + first_digit;
16       if(isPrime(temp_num) == 0) return 0;
17     }
18     return 1;
19   }
20
21 }
22 int main(){
23   int t;
24   scanf("%d",&t);
25   while(t--){
26     int number;
27     scanf("%d",&number);
28     if(guessFunction(number) == 1){
29       printf("%d\n" , number);
30     }
31     else{
32       printf("ESC-101\n");
33     }
34   }
35
36   return 0;
37 }
```

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```
7
ESC-101
ESC-101
ESC-101
ESC-101
```

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Problem 6 (: 3 X 4 + 8 = 20 marks)**.** Give your answers in the space provided only.

1. ***Write the output of following program and What does the following fun() do in general? in the blank box***

```
1  #include<stdio.h>
2
3  int fun(int a, int b)
4  {
5     if (b == 0)
6         return 0;
7     if (b % 2 == 0)
8         return fun(a+a, b/2);
9
10    return fun(a+a, b/2) + a;
11 }
12
13 int main()
14 {
15   printf("%d", fun(4, 3));
16   getchar();
17   return 0;
18 }
```

```
1  Output = 12
2  fun(int a, int b) computes a*b
```

2. ***In question 1, if we replace + with * and replace return 0 with return 1 in fun() , then what does the changed function do?***

```
1  fun(int a, int b) will now compute a^b i.e. a to the power b
```

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3. ***Write the output of the program in the blank box***

```
1  #include<stdio.h>
2  int fun(int count)
3  {
4      if(count < 3)
5      {
6          printf("%d", count);
7          fun(fun(fun(++count)));
8      }
9      return count;
10 }
11
12 int main()
13 {
14     fun(1);
15     return 0;
16 }
```

```
1  12
```

4. ***In Question 3, What will be the output of the program if we change ++count to count++***

```
1  Infinite Loop or 11111...
```

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5. ***Below is a code which finds the length of the longest common subsequence (LCS), The function lcs_length() is incomplete and you have to complete the function. Write your answer in the blank box, there are 8 blanks and each of them carry 1 point (1 X 8 = 8). The answers should be written by specifying the blank number.***
Ex - 1. printf(i);

Subsequence - A subsequence is a sequence that appears in the same relative order, but not necessarily contiguous. For example, abc, abg, bdf, aeg, acefg, .. etc are subsequences of abcdefg.

Common Subsequence - A Common subsequence between two words is the sequence which is present in both the words. For example, **aeg** is a common subsequence for words **abcdefg** and **apexog**

LCS - Longest Common Subsequence is the Common Subsequence of the longest length. For example - LCS for words AGGTAB and GXTXAYB is GTAB of length 4. The function lcs_length() in the code below should compute the length of the Longest Common Subsequence.

```
1  #include<stdio.h>
2
3  int max(int a,int b)
4  {
5      if(a>b)
6          return a;
7      else
8          return b;
9  }
10
11 int lcs_length(char * A, char * B,int A_index, int B_index, int
       A_length, int B_length)
12 {
13     if (A_index == A_length || B_index == B_length )
14       return 0;
15     else if (A[A_index] == B[B_index])
16       return 1 + lcs_length(A,B,A_index+1,B_index+1,A_length,B_length
       );
17     else
18       return max(lcs_length(A,B,A_index+1,B_index,A_length,B_length),
        lcs_length(A,B,A_index,B_index+1,A_length,B_length));
19 }
20
21 int main()
22 {
23     char A[10] = "AGGTAB";
24     char B[10] = "GXTXAYB";
25     int A_index = 0 , B_index = 0, A_length = 6, B_length = 7;
26     printf("%d",lcs_length(A,B,A_index,B_index,A_length,B_length));
27     return 0;
28 }
```