



COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra.)

End Semester Examination

Programme: B.Tech.

Semester: II

Course Code: CT-20008

Course Name: Principles of Programming Languages

Branch: Computer Engineering

Academic Year: 2022-23

Duration: 3 Hour

Max Marks: 60

Student PRN No.	1	1	2	1	0	3	0	6	9	
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Instructions:

- Figures to the right indicate the full marks.
- Mobile phones and programmable calculators are strictly prohibited.
- Writing anything on question paper is not allowed.
- Exchange/Sharing of stationery, calculator etc. not allowed.
- Write your PRN Number on Question Paper.
- Assume suitable data where necessary.

Q 1 A There are various types of pens. The purpose of pen is to write on the given surface. The [5] Plastic Ballpoint pen is a type of pen which consists of main parts oil-based ink, oil ink refill, plastic body and cap. The Gel Pen is a type of pen which consists of Gel based ink, Gel ink refill, plastic body and cap. There is also a Steel Ballpoint pen with same properties as that mentioned for Ballpoint pen apart from plastic parts. Its body is Steel body. It has two variety namely with cap and without cap. The Steel Ballpoint pen without cap consists of a spring assembly which can be used to open the nozzle of pen through which the refill point will come out after pressing the button on the top of the pen. Fountain Pen is a type of pen which uses water based ink which is delivered through nib. The body of Fountain pen is typically plastic. The fountain pens may either consist of a permanent built-in refill or disposable refill. Ballpens are used by local people in society, school & college students, teachers and government officials. Gel pens are used by typically students and academicians. Fountain pens are used typically by few government officials, school students, architects and writers.

CO – PO -
2, 5 1, 2, 3
, 4 , 5
, 6 , 8

Draw class diagram for the given scenario. Show and explain relation between them. Also write down which will be interfaces for each of the class?

B Explain design issues in exception handling [5] CO – PO -
3, 4 1, 2, 3

OR

, 4 , 5
, 6 , 8

What is difference between a function and an exception.

Q 2 A Software is to be developed for air traffic control. Which programming paradigm/s and [5] Language/s will be preferred at front-end and back-end of the software?

CO – PO -
2, 5 1, 2, 3
, 4 , 5
, 6 , 8



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- B** State and explain in detail "simplicity, readability and correctness" attribute of a [5] CO - PO -
programming language. 2, 3 1, 2, 3
, 4, 5
, 6, 8
- Q 3 A** Write the statements which create spaghetti code. Explain for each statement, how spaghetti [5] CO - PO -
is created. 2, 3 1, 2, 3
, 4, 5
, 6, 8
- B** Write note on coercion, narrowing and widening. [5] CO PO -
[5] CO PO -
fact = fact*i; 1, 2, 3 1, 2, 3
, 4, 5
, 6, 7,
8
- Q 4 A** For the given statement, enlist the lexemes and tokens : [5] CO PO -
fact = fact*i; 1, 2, 3 1, 2, 3
, 4, 5
, 6, 7,
8
- B** For a integer array of 10 numbers in C, draw and explain dope vector. What will be l-value [5] CO PO -
of 10th element in the array? 1, 2, 3 1, 2, 3
, 4, 5
, 6, 7,
8
- Q 5 A** For the statement : [5] CO PO -
int *p = &a; 1, 2, 3 1, 2, 3
, 4, 5
, 6, 7,
8
- Comment on storage and binding of the tokens in the above statement. Also mention the binding times.
- B** Following are the statements in LISP. Explain how the memory is allocated for these [5] CO 3 PO -
statements if executed in sequence. Assume upper limit of memory space as 5 units.
1. '(A B '(C) D E) 1, 2, 3
2. (* 10 (+ 3 4)) , 4, 5
, 6, 8
- Q 6 A** Can event driven programming used to check errors and validate data in software? Support [5] CO PO -
your answer with a suitable example. 1, 2, 3 1, 2, 3
, 4, 5
, 6, 7,
8
- B** Prof ABC teach PPL. Prof PQR teach DC while Prof LMN teach DSA. Students Sachin, [5] CO PO -
Mahendra and Ravi have registered all courses while Rahul, Mahima and Shreya have 2, 3, 5 1, 2, 3
registered only PPL and DC. Write down the facts, relations and query in Prolog to get , 4, 5
answers for following : , 6, 7,
8
1. Who teach PPL course?
 2. Name of students enrolled for all courses
 3. Name of students enrolled for DSA



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Test 2 Examination

Programme: B.Tech.

Semester: II

Course Code: CT-20008

Course Name: Principles of Programming Languages

Branch: Computer Engineering

Academic Year: 2022-23

Duration: 1 Hour

Max Marks: 20

Student PRN No.	i	1	2	1	0	3	0	9	6	
--------------------	---	---	---	---	---	---	---	---	---	--

Instructions:

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- Write your PRN Number on Question Paper.
- Assume suitable data where necessary.

Q 1 A software system is build to introduce various pet animals to kids. Enlist 5 [5] animals with their attributes and behaviour in order to perform abstraction and encapsulation of the animals.

Q 2 For given grammar,

[5]

<program> -> <stmts>

<stmts> -> <stmt> | <stmt> ; <stmts>

<stmt> -> <var> = <expr>

<var> -> a | b | c | d

<expr> -> <term> + <term> | <term> - <term>

<term> -> <var> | const

Derive the program with statement : a = b + const

Draw parse tree for the same.



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Q 3 Syntax rule: $\langle \text{expr} \rangle \rightarrow \langle \text{var} \rangle[1] + \langle \text{var} \rangle[2]$

[5]

Semantic rules:

$\langle \text{expr} \rangle.\text{actual_type} \rightarrow \langle \text{var} \rangle[1].\text{actual_type}$

Predicate:

$\langle \text{var} \rangle[1].\text{actual_type} == \langle \text{var} \rangle[2].\text{actual_type}$

$\langle \text{expr} \rangle.\text{expected_type} == \langle \text{expr} \rangle.\text{actual_type}$

Syntax rule: $\langle \text{var} \rangle \rightarrow \text{id}$

Semantic rule:

$\langle \text{var} \rangle.\text{actual_type} \rightarrow \text{lookup } (\langle \text{var} \rangle.\text{string})$

With the above rules, explain with appropriate diagram, type checking for statement : $a = "Hello" + 1$

Q 4 Draw and explain activation record for the following program. Assume [5]
initial values of $\text{rsp} = 100d$ and $\text{rbp} = 0d$.

```
int add(int a ,int b ) {
```

```
    int c = a + b;
```

```
    return c;
```

```
}
```

```
int main () {
```

```
    int i,j,k;
```

```
    i = 1;
```

```
    j = 2;
```

```
    k = add(i,j);
```

```
    return 0;
```

```
}
```



COLLEGE OF ENGINEERING, PUNE
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Test 1 Examination

Programme: B.Tech.

Semester: II

Course Code: CT-20008

Course Name: Principles of Programming Languages

Branch: Computer Engineering

Academic Year: 2022-23

Duration: 1 Hour

Max Marks: 20

Student PRN No.	1	1	2	1	0	3	6	6	9	
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Instructions:

1. Figures to the right indicate the full marks.
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4. Exchange/Sharing of stationery, calculator etc. not allowed.
5. Write your PRN Number on Question Paper.
6. Assume suitable data where necessary.

Q 1

- a** Software for "Diabetes Diagnosis Decision System" is to be developed. [5]

Which programming paradigm/s and Language/s will be preferred at front-end and back-end of the software?

- b** State and explain with at least two examples of "orthogonality" attribute of [5] a programming language

Q 2 Draw control flow graph for the following code fragments.

With proper justification :

i) State whether the program is proper or not?

ii) State whether the code is spaghetti or not?



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```
a    do {  
        if ( a != 1 || b == 9 && c > 0) {  
            d = 100;  
            break;  
        }  
        else {  
            d = 10;  
        }  
    } while (a <= b);
```

[5]

```
b #include <string.h>  
void function (char *str) {  
    char buffer [8];  
    strcpy(buffer,str);  
}  
void main () {  
    char chars[256];  
    int i;  
  
    for (i=0;i<255;i++)  
        chars[i] = 'A';  
    function(chars);  
}
```

[5]



College of Engineering Pune

(An Autonomous Institute of Govt. of Maharashtra)

(MA-20001) Ordinary Differential Equations and Multivariate Calculus

Program : S.Y.B.Tech. Sem. III (All Branches)

Academic Year : 2022-23

Examination : End Semester Examination

Maximum Marks : 60

Date : 29/01/2023

Time : 02.30 pm to 05.30 pm

Student MIS Number :

1	1	2	1	0	3	0	9	6
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Instructions :

1. Write your MIS Number on Question Paper.
2. Writing anything on question paper is not allowed.
3. Mobile phones and programmable calculators are strictly prohibited.
4. Exchange/Sharing of stationery, calculator etc. is not allowed.
5. Figures to the right indicate the course outcomes and maximum marks.
6. Unless otherwise mentioned symbols and notations have their usual standard meanings.
7. Any essential result, formula or theorem assumed for answering questions must be clearly stated.

Q.1 Attempt the following:

(i) Solve $x \frac{dy}{dx} = (y - x)^3 + y$. (CO2)[1.5]

(ii) Say true or false and justify your answer : The integrating factor of a differential equation is unique. (CO4)[1]

(iii) Find the Laplace transform of $f(t) = e^{-t} \sinh 4t$. (CO2)[1]

(iv) Find the Laplace transform of $f(t) = \sin^4 t$. (CO3)[2]

OR

Find the Laplace transform of $f(t) = te^{-t} \cos t$. (CO3)[2]

(v) Find the inverse Laplace transform of $\sum_{k=1}^4 \frac{(k+1)^2}{s+k^2}$ (CO5)[2]

- (vi) Find the domain and the range of the function $f(x, y) = 4 - \sqrt{x^2 + y^2}$. Sketch the surface $z = f(x, y)$ and the level curve $f(x, y) = -3$. (CO3)[3]

- (vii) State two path test for non-existence of limit of a function of two variables.

Find the following limit, if it exists:

$$\lim_{(x,y) \rightarrow (0,0)} \left(\frac{-x}{\sqrt{x^2 + y^2}} \right) \quad (\text{CO1, CO3})[3] \quad (\text{viii})$$

- (viii) Let $f(x, y) = \frac{x^2 - y^2}{x^2 + y^2}$ for $(x, y) \neq (0, 0)$. Is it possible to define $f(0, 0)$ in a way that makes f continuous at the origin? Why? (CO3)[1.5] (i)

Q.2 Attempt the following:

- (i) State giving reason whether the functions $\cos^2 x, \sin^2 x$ and $\cos 2x$ are linearly independent or dependent. (CO2)[1]

- (ii) Using the method of reduction of order, determine $y_2(x)$, the other linearly independent solution of $(1 + x^2)y'' - 2xy' + 2y = 0$, if $y_1(x) = x$ is one solution. (CO3)[1.5]

- (iii) Using appropriate properties /theorems of Laplace transforms, evaluate

$$\int_0^\infty e^{-\sqrt{3}t} \left\{ \frac{\sin t}{t} \right\} dt \quad (\text{CO3})[2] \quad (\text{i})$$

- (iv) Find the inverse Laplace transform of $\tan^{-1} \left(\frac{2}{s^2} \right)$. (CO4)[3]

OR

$$\text{Find the inverse Laplace transform of } \ln \left(\frac{s^2 + s - 6}{s^2 + s + 1} \right). \quad (\text{CO4})[3] \quad (\text{i})$$

- (v) If the partial derivatives f_x, f_y of a function $f(x, y)$ exist over an open region R then the function $f(x, y)$ is differentiable at every point of R . State true or false using appropriate result. (CO1)[2]

- (vi) Calculate $\lim_{(x,y) \rightarrow (1,1)} f(x, y)$, if it exists, where (CO3)[3]

$$f(x, y) = \begin{cases} x & , xy \neq 1 \\ x^2 + y^2 & , xy = 1 \end{cases}$$

(vii) If $z = f(x, y)$, $x = g(t, s)$ and $y = h(t, s)$ then draw the branch/tree diagram and write the chain rule for $\frac{\partial z}{\partial t}$. (CO2)[1.5]

(viii) Find $\frac{\partial f}{\partial x}$ at $(-2, 1)$ if $f(x, y) = \tan^{-1} \left(\frac{y}{x} \right)$. (CO2)[1]

Q.3 Attempt the following:

(i) A force of 400N stretches a spring 2 meters. A mass of 50 kg is attached to the end of the spring and is initially released from the equilibrium position with an upward velocity of 10m/s. Find the equation of motion. Also determine the natural frequency, period and amplitude. (CO4)[3]

OR

A large tank is initially filled with $100L$ of brine in which $1kg$ of salt is dissolved. Brine containing $0.5kg$ of salt per Liter is pumped into the tank at a rate of $6L/min$. The well-mixed brine is pumped out of the tank at a slower rate of $4L/min$. Assuming that the tank does not overflow, find the amount of salt in the tank after t minutes. Give your answer to the nearest gram. (CO4) [3]

(ii) Use properties of Laplace transform to find :

a) $\mathcal{L}\{f(t)\delta(t) + \sin(5t - 5)u(t - 1)\}$. (CO2)[2]

b) $\mathcal{L}^{-1}\left\{e^{-3s} \frac{s+1}{s^2+2s+2}\right\}$. (CO3)[2]

c) Find $\mathcal{L}\{f(t) = t^2; 0 < t < 2\}$, $f(t)$ is periodic with period 2. (CO2)[2]

(iii) Prove: If $F(x, y)$ is differentiable and the equation $F(x, y) = 0$ defines y implicitly as a differentiable function of x then, at any point where $F_y \neq 0$,

$$\frac{dy}{dx} = -\frac{F_x}{F_y}.$$

Hence find $\frac{dy}{dx}$ at the point $(0, \ln 2)$ if $xe^y + \sin(xy) + y = \ln 2$. (CO3)[3]

(iv) Let $T(x, y, z) = x^2 + 2y^2 + 2z^2$ be a function which gives the temperature at any point in space. Let $P = (1, 1, 1)$. Find : (CO3)[3]

a) grad T at the point P ,



- b) the directional derivative of T at the point P in the direction of $\bar{v} = 2\hat{j} + \hat{j} + 2\hat{k}$,
- c) In which direction should you go to get the most rapid decrease in T at the point P ? What is the directional derivative in this direction?

Q.4 Attempt the following:

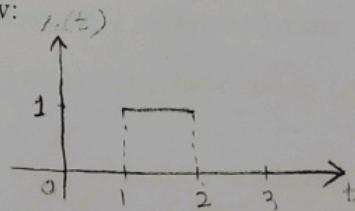
(a) Solve any one: (CO3)[2.5]

- (i) Find the solution of $(D^3 - 2D^2 - 9D + 18I)y = e^{2x}$ using the method of undetermined coefficients.
- (ii) If $y'' + p(x)y' + q(x)y = r(x)$ then prove that $y_p = -y_1 \int \frac{y_2 r}{W} dx + y_2 \int \frac{y_1 r}{W} dx$ is a solution where y_1 and y_2 are linearly independent solutions of $y'' + p(x)y' + q(x)y = 0$ and $W = y_1 y_2' - y_2 y_1'$.

(b) Solve the following:

- (i) Find Laplace transform of the convolution of $f(t)$ and $g(t)$ where $f(t) = \cos \omega t$ and $g(t) = e^{-at}$ (CO2)[1]

- (ii) Determine the response of the damped mass spring system under a square wave modeled by the equation $y'' + 3y' + 2y = r(t)$ where $r(t)$ is as shown below:



and the initial conditions $y(0) = y'(0) = 0$

(CO5)[4]

(c) Solve any three: (CO3)[7.5]

- (i) Find all local maxima, minima and saddle points for the function $f(x, y) = e^{2x} \cos y$.
- (ii) Find the coldest and the hottest point(s) on a circular plate $x^2 + y^2 \leq 1$ if the temperature at any point (x, y) is given by $T(x, y) = x^2 + 2y^2 - x$.
- (iii) Find the points lying on the curve $x^2 + xy + y^2 = 1$ in the xy plane that are closest and farthest from the origin.
- (iv) Discuss the local extrema at $(0, 0)$ for different values of k for the function $f(x, y) = x^2 + kxy + y^2$.



EndSem Examination

Programme: B.Tech

Course Code:

Branch: Computer Engineering

Duration: 3 hours

Student PRN No.

Semester: III

Course Name: DSA I

Academic Year: 2022- 2023

Max Marks: 60

1	1	2	1	0	3	1	0	3
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Instructions: For programming questions, define only the expected function(s)

Use C Programming Language for all answers.

Write all answers of a section together. Clearly mention Section name on the top.

SECTION A

CO PO

1. a. If an array, of size n, is already sorted what will be the complexity of sorting it using Bubble Sort, Selection Sort, Quick Sort, and Merge Sort? 2 3 1
2

- b. The equation for time taken by this code is: 2 3 1

```
int f(int x, int y) {  
    while(x) {  
        y = x;  
        while(y) {  
            y = y - x;  
            y = y / 2;  
        }  
        x--;  
    }  
}
```

- c. Let P be a quicksort program to sort numbers in ascending order using the first element as the pivot. Let t_1 and t_2 be the number of comparisons made by P for the inputs [1, 2, 3, 4, 5] and [4, 1, 5, 3, 2] respectively. Which one of the following hold? Explain. 2 3 1

- i. $t_1 = t_2$
- ii. $t_1 > t_2$
- iii. $t_1 < t_2$
- iv. Not related

- d. Will the code segment given below result to a segmentation fault? Explain your answer with the help of a memory diagram. 2 2 1
2

```
int *p, *q;  
p = (int *)malloc(sizeof(int) * 3);  
q = p;  
p = p + 2;  
p[-2] = q - p;  
q = p + p[-2];  
q[-1] = --p - q;
```

- e. Write the output of the following code: 2 3 1
2 2

```
int main() {  
    stack t;
```



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```
int no, i;
init(&t);
for(i = 0; i < 7; i++) {
    if(i % 2)
        push(&t, i + 1);
    if(i % 5 == 2 && !isempty(&t))
        push(&t, pop(&t) + 1);
    if(i % 4 == 0 && !isempty(&t))
        pop(&t);
}
while(!isempty(&t))
    printf("%d\t", pop(&t));
return 0;
}
```

- f. The given code represents which data structure: Array/Stack/Queue/Singly Linked List/Doubly Linked List or something else? Explain.

2 2 1
3 2

```
#define MAX 5
typedef struct rec {
    int array[MAX];
    int i;
}something;
void init(something *d) {
    d->i = 0;
}
int empty(something *d) {
    return d->i == 0;
}
int full(something *d) {
    return d->i == MAX;
}
void store(something *d, int val) {
    d->array[d->i] = val;
    d->i++;
}
int retrieve(something *d) {
    int val = d->array[0];
    int i;
    for(i = 0; i < d->i; i++)
        d->array[i] = d->array[i + 1];
    d->i--;
    return val;
}
```

2. Assume you are provided an ADT Stack of integers implemented using an array.
Define a function with the given prototype:

6 1 1
4 3
5

void Sort(Stack *S);
The function sorts the content of the stack in ascending order (with the smallest element on the top) without using any additional array.

(4 marks)
(2 marks)

3. A queue is implemented using a doubly linked list as shown in the diagram below:

6 2 1

(2)



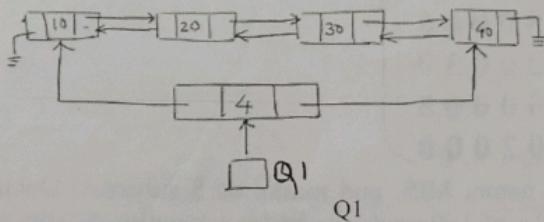
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Where Q1 is a variable of type Queue, that maintains address of the first and last nodes in the queue and also the count of number of elements in the queue.

3

- a. Write the typedef for Queue and each node in the Queue. (2 marks)
b. Write Enqueue and Dequeue functions for this queue. (2 marks each)



4. Write a function having following prototype:

void printPostfix(char *in_fix, int n);

6 1 1
2 3

The function accepts an infix arithmetic expression having digits 0 – 9 and operators (+, -, *, /, ^) as argument along with the size of the expression. The function prints the equivalent postfix expression.

Note: Assume you are provided with the required data structures.

SECTION B

- 5 Which of the following data structures can be used for parentheses matching?

1 3 1,
4

- a) linked list
- b) queue
- c) array
- d) stack

- 6 In a stack, if a user tries to remove data from an empty stack it is called _____

1 2 1

- a) Underflow
- b) Empty top
- c) Overflow
- d) Garbage top

- 7 a. Convert given infix expression $(P + Q) * (R * S - T) * U / V$ into postfix using stack. 6 4 3

- b. What is the value of the postfix expression $7 8 5 1 + - *$ using stack?

2 2 1

- 8 Queue _____

- a. is FIFO
- b. has two ends, front and rear
- c. is non-linear data structure

- d. is LIFO

- 9 Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. To simulate the system, implement the operations enqueue() and dequeue() performed by queue ADT using Linked List.

6 5 3,
4

- 10 How many pointers are contained as data members in the nodes of a circular doubly linked list of integers with six nodes? 2 3 1



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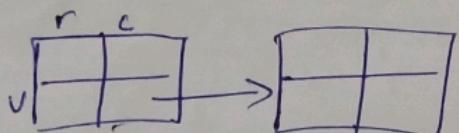
11 Explain best-case and worst-case complexity of Linear Search and Binary Search 4 3 7

12 For given matrix, find linked list representation of the transpose of given sparse 2 4 1, matrix. 7

$$\begin{pmatrix} 0 & 0 & 1 & 0 & 0 \\ 5 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 0 & 8 \\ 0 & 2 & 0 & 0 & 0 \end{pmatrix}$$

13 You have a structure student having name, MIS, and marks of 5 subjects. Declare 6 1 3 array of student structure to store marks of 150 students. Write a function to sort this array based on total marks of all subjects and display names of first 5 students.

row
col
val { }





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END Semester Examination

Programme: B.Tech

Semester: III

Course Code:

Course Name: Feedback Control System

Branch: Computer

Academic Year: 2022-23

Duration: 3 hours

Max Marks: 60

Student PRN No.

1	1	2	1	0	3	1	0	3
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Instructions:

1. Figures in the Column M indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of stationery, calculator etc. not allowed.
5. Write your PRN Number on Question Paper.
6. Perform all calculations up to 4 decimal points
7. Solve any Five questions out of six.

M CO PO
Q 1 A i. What mathematical model permits easy interconnection of physical systems? 6 1 1

- ii. Define the transfer function.
- iii. What do we call the mechanical equations written in order to evaluate the transfer function?
- iv. If we understand the form the mechanical equations, what step do we avoid in evaluating the transfer function?
- v. Why do transfer functions for mechanical networks look identical to transfer functions for electrical networks?
- vi. Instability is attributable to what part of the total response

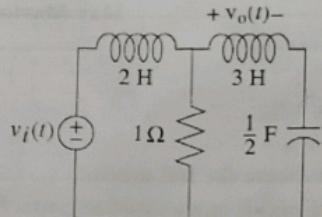
B Compare the open loop control system and closed loop control system on the basis of following points 6 1 1

- i. Accuracy
- ii. Power consumption
- iii. Complexity
- iv. Response to external disturbances
- v. Stability
- vi. Cost

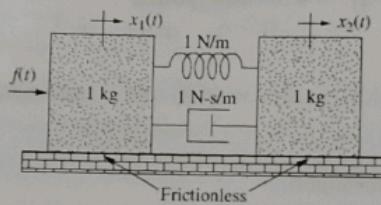


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Q 2 A Find the transfer function, $G(s) = \frac{v_o(s)}{v_i(s)}$, for following network. Solve the problem using mesh analysis. 6 2 2,3



Q 2 B Find the transfer function, $G(s) = \frac{x_2(s)}{F(s)}$, for the translational mechanical network shown in Figure. 6 2 2,3



Q 3 A Consider a unity feedback system with closed transfer function 3 3 1,2

$$\frac{C(s)}{R(s)} = \frac{Ks + b}{s^2 + as + b}$$

Determine the open loop transfer function $G(s)$. Find static error constant and steady state error for unit ramp input.

Q 3 B A unity feedback system is characterised by an open loop transfer function 5 3 1,2

$$G(s) = \frac{K}{s(s + 10)}$$

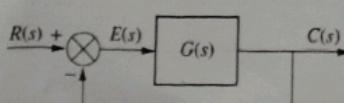
Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K determine the settling time, peak overshoot and time to peak overshoot for unit step input

Q 3 C For the unity feedback system shown in Figure, where 4 3 1,2

$$G(s) = \frac{450(s + 8)(s + 12)(s + 15)}{s(s + 38)(s^2 + 2s + 28)}$$

Find the steady-state errors for the following test inputs:

$25 u(t)$, $37 t u(t)$, and $47t^2 u(t)$.





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- Q 4 A By means of Routh criterion, determine the stability of the system represented by the following characteristics equations. For system found to be unstable, determine the number of roots of the characteristics equation in the right half of the s plane. 4 3 1,2

$$s^6 + 2s^5 + s^4 + 2s^3 + 3s^2 + 4s + 5 = 0.$$

- B Determine the stability of system using Routh-Hurwitz criteria having 5 3 1,2 characteristic equation

$$s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0.$$

Also find the closed loop poles.

- C Determine the range of K for the system to be stable using Routh criterion. 3 3 1,2
 $s^3 + 3Ks^2 + (K + 2)s + 4 = 0.$

- Q 5 A Sketch the root locus for 8 4 1,2

$$G(s)H(s) = \frac{K}{(s+2)(s+1)(s+8)}$$

Find K for stability

- B Find K for the above system (described in Q 5 A) when it is operating with 4 4 1,2 damping factor 0.6.

- Q 6 A Sketch the root locus for 8 4 1,2

$$G(s)H(s) = \frac{K(s+3)}{s^2(s+9)}$$

Find K for stability

- B Find dominant pole for the above system (described in Q 6 A) when the 4 4 1,2 system is operating with 0.5 damping factor.



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END Semester Examination

Programme: B.Tech

Semester: III

Course Code: CT-16006

Course Name: Discrete Structures and Graph Theory

Branch: CE and IT

Academic Year: 2022-23

Duration: 3 Hr

Max Marks: 60

Student MIS No.

/PRN

1	1	2	1	0	3	1	0	3
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Instructions:

1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of stationery, calculator etc. not allowed.
5. Write your PRN Number on Question Paper.

Section A

Q1 Attempt All of the following

Marks CO PO

- a Let the universe be a social club, and let x and y range over the members of the club. Define the predicate $P(x, y)$ as $P(x, y) := x \text{ likes } y$. Translate the following quantified predicates into English sentences
- i. $\forall x \forall y P(x, y)$
 - ii. $\exists x \exists y P(x, y)$
 - iii. $\forall x \exists y P(x, y)$
 - iv. $\exists x \forall y P(x, y)$

4 1 1

- b Prove following by using Mathematical induction such that for all $n \geq 1$, the sum of the squares of the first $2n$ positive integers is given by the formula

3 1 2

$$1^2 + 2^2 + 3^2 + \dots + (2n)^2 = \frac{n(2n+1)(4n+1)}{3}$$

OR

- b Solve the following recurrence relation $a_r = 6a_{r-1} - 8a_{r-2}$

3 2 2

- c Consider Premises: If Kiran has wide support, then he'll be asked to run for the senate. If Kiran yells "Eureka" in Iowa, he will not be asked to run for the senate. Kiran yells "Eureka" in Iowa. Conclusion: Kiran does not have wide support. Determine whether the conclusion follows logically from the premises. Explain by representing the statements symbolically and using rules of inference.

3 2 1

- d Let $A = \{1, 2, 3, 4, 5\}$ and let M_R and M_S be the matrices of the relations R and S on A. Compute

4 2 1

- i. $M_R \circ M_S$
- ii. $M_R \circ M_R$



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$$M_R = \begin{bmatrix} 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix} \text{ and } M_S = \begin{bmatrix} 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 0 \end{bmatrix}$$

- Q 2 a** You decide to have a dinner party. Even though you are incredibly popular and have 14 different friends, you only have enough chairs to invite 6 of them.

2,3 1

- i. How many choices do you have for which 6 friends to invite?
- ii. What if you need to decide not only which friends to invite but also where to seat them along your long table? How many choices do you have then?

2
2

- b** If 30 dictionaries in library contain a total number of 61,327 pages then find out minimum number of pages in one of the dictionaries must have in it.

2 3 4

- c** Solve and answer the following using Binomial Coefficients for the equation as $(2x - 5y)^6$

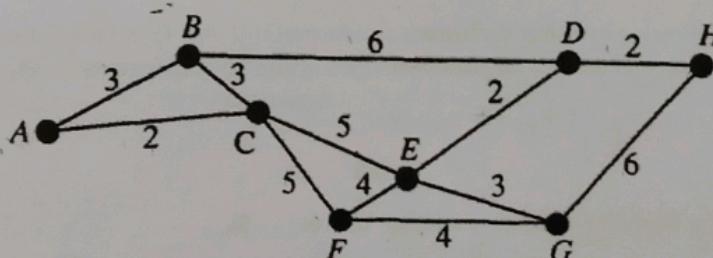
3 1

- i. Value of coefficient of the last term.
- ii. Find the 5th term.
- iii. Determine the pascal's triangle for all powers of given equation.

1
2
3

- Q 3 a** The small town of social circle maintains a system of walking between the recreational areas in town. The system is modelled by the weighted graph in following figure, where the weights represent the distances in kilometres between sites.

4 1



- i. Find out minimum spanning tree using Prim's Algorithm.
- ii. What will be the total weight of the minimum spanning tree using Breadth first search if we start with A. Draw tree.

3
3

OR

- a** For the same graph in above question, answer the following:

4 1

- i. Find out minimum spanning tree using Kruskal's Algorithm.
- ii. What will be the total weight of the ~~minimum~~ spanning tree using Depth first search if we start with A. Draw tree.

3
3

- b** A tropical fish hobbist had six different types of fish: Alphas, Betas, Certas, Deltas, Epsalas and Fetas which are designated by A, B, C, D, E and F respectively. Because of water conditions and size only some types of fishes can survive with some other types of fishes in the same tank. The following table

4 12



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gives information about fishes that cannot be together

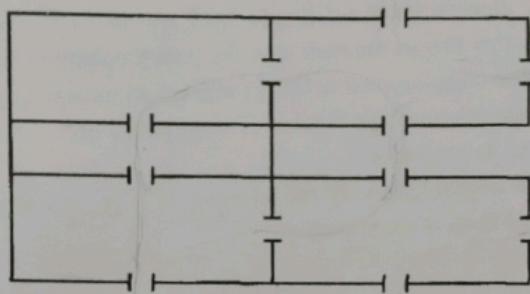
Type	A	B	C	D	E	F
Cannot be with	B,C	A,C	A,B,D,E	B,C	C,F	E

Our task is to arrange the fishes in a minimum number of tanks

- i. Draw a graph for the fishes can survive together as from the above table
ii. Find out minimum number of tanks required to arrange the fishes based on above situation

- c An art museum has arranged its current exhibition in the five rooms shown in below diagram.

4 12



- i. Is there a way to tour the exhibit so that you pass through each door exactly once?
ii. Determine which type of tour it is ?
iii. Give a sketch of your tour in a graph , where each open door is considered as a vertex

1

1

1

- Q 4 a If $6x \equiv 23 \pmod{31}$,

3 1

- i. Calculate multiplicative inverse for 6 mod 31 using extended Euclidean algorithm (bezout's coefficient)
ii. Find value of x
iii. Find set of different values that x can have

2

1

1

- b A bag has some pens, If these pens were equally distributed to

4 3 1

- Three students, then two pens left in the bag,
- Five students, then four pens left in the bag,
- Seven students, then five pens left in the bag.

Find the minimum number of pens in the bag.

- c Find integers p and q such that $1124p + 84q$ also find the $\text{GCD}(1124, 84)$ using extended Euclidian algorithm.

4 3 4

- Q 5 a Complete the given table so that the binary operation * is associative. Show the associative property is true for all elements in this table.

2 5 4

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*	a	b	c	d
a	a · b	c	d	
b	b	a	c	d
c				
d	d	c	c	d

- b If an algebraic structure is defined on a set of positive integers N with respect to binary operation $a*b=\text{lcm}(a,b)$, $\forall a,b \in N$. 5 1
- Whether the algebra holds closure, associative property? If yes explain
 - If exists, find out the identity element for the algebra
- c Consider the algebra on a set $S = \{1,3,6,9,12\}$ is $\text{GCD}(a,b)$, where $a,b \in S$ 2 1 5 1
determine whether the set together with the binary operation is
- Determine composition table for the algebra on the operation GCD
 - Determine whether the algebra is semigroup, or a monoid, or both with respect to its properties?
 - If it is a monoid, specify the identity, If it is a semigroup or monoid, determine if its is commutative?

---*---All the best---*---



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EndSem Examination

Programme: B.Tech

Course Code:

Branch: Computer Engineering

Duration: 3 hours

Student PRN No.

Semester: III

Course Name: DSA I

Academic Year: 2022- 2023

Max Marks: 60

1	1	2	1	0	3	0	6	9
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Instructions: For programming questions, define only the expected function(s)

Use C Programming Language for all answers.

Write all answers of a section together. Clearly mention Section name on the top.

SECTION A

CO PO

1. a. If an array, of size n, is already sorted what will be the complexity of sorting it using Bubble Sort, Selection Sort, Quick Sort, and Merge Sort? 2 3 1
2

- b. The equation for time taken by this code is: 2 3 1

```
int f(int x, int y) {
    while(x) {
        y = x;
        while(y) {
            y = y - x;
            y = y / 2;
        }
        x--;
    }
}
```

- c. Let P be a quicksort program to sort numbers in ascending order using the first element as the pivot. Let t_1 and t_2 be the number of comparisons made by P for the inputs [1, 2, 3, 4, 5] and [4, 1, 5, 3, 2] respectively. Which one of the following hold? 2 3 1

Explain.

- i. $t_1 = t_2$
- ii. $t_1 > t_2$
- iii. $t_1 < t_2$
- iv. Not related

- d. Will the code segment given below result to a segmentation fault? Explain your answer with the help of a memory diagram. 2 2 1
2

```
int *p, *q;
p = (int *)malloc(sizeof(int) * 3);
q = p;
p = p + 2;
p[-2] = q - p;
q = p + p[-2];
q[-1] = --p - q;
```

- e. Write the output of the following code: 2 3 1
2 2

```
int main() {
    stack t;
```



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```
int no, i;
init(&t);
for(i = 0; i < 7; i++) {
    if(i % 2)
        push(&t, i + 1);
    if(i % 5 == 2 && !isempty(&t))
        push(&t, pop(&t) + 1);
    if(i % 4 == 0 && !isempty(&t))
        pop(&t);
}
while(!isempty(&t))
    printf("%d\t", pop(&t));
return 0;
}
```

- f. The given code represents which data structure: Array/Stack/Queue/Singly Linked List/Doubly Linked List or something else? Explain.

2 2 1
3 2

```
#define MAX 5
typedef struct rec {
    int array[MAX];
    int i;
}something;
void init(something *d) {
    d->i = 0;
}
int empty(something *d) {
    return d->i == 0;
}
int full(something *d) {
    return d->i == MAX;
}
void store(something *d, int val) {
    d->array[d->i] = val;
    d->i++;
}
int retrieve(something *d) {
    int val = d->array[0];
    int i;
    for(i = 0; i < d->i; i++)
        d->array[i] = d->array[i + 1];
    d->i--;
    return val;
}
```

2. Assume you are provided an ADT Stack of integers implemented using an array. Define a function with the given prototype:

6 1 1
4 3
5

void Sort(Stack *S);
The function sorts the content of the stack in ascending order (with the smallest element on the top) without using any additional array.
Analyse the time complexity of your function. (4 marks)
(2 marks)

3. A queue is implemented using a doubly linked list as shown in the diagram below:

6 2 1

(2)

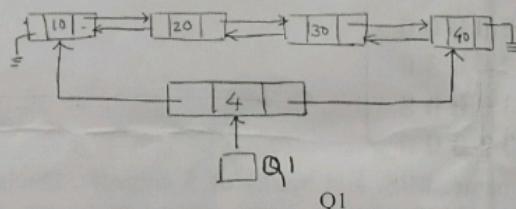


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Where Q1 is a variable of type Queue, that maintains address of the first and last nodes in the queue and also the count of number of elements in the queue. 3

- Write the typedef for Queue and each node in the Queue. (2 marks)
- Write Enqueue and Dequeue functions for this queue. (2 marks each)



4. Write a function having following prototype:

void printPostfix(char *in_fix, int n);

6 1 1
2 3

The function accepts an infix arithmetic expression having digits 0 – 9 and operators (+, -, *, /, ^) as argument along with the size of the expression. The function prints the equivalent postfix expression.

Note: Assume you are provided with the required data structures.

SECTION B

- 5 Which of the following data structures can be used for parentheses matching? 1 3 1,

- a) linked list
- b) queue
- c) array
- d) stack

4

- 6 In a stack, if a user tries to remove data from an empty stack it is called _____ 1 2 1

- a) Underflow
- b) Empty top
- c) Overflow
- d) Garbage top

1 2 1

- 7 a. Convert given infix expression $(P + Q)^* (R * S - T)^* U / V$ into postfix using stack. 3 4 3

- b. What is the value of the postfix expression $7\ 8\ 5\ 1\ +\ -\ *$ using stack?

2 2 1

- 8 Queue _____

- a. is FIFO
- b. has two ends, front and rear
- c. is non-linear data structure

is LIFO

2 2 1

- 9 Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. To simulate the system, implement the operations enqueue() and dequeue() performed by queue ADT using Linked List. 6 5 3,
4

- 10 How many pointers are contained as data members in the nodes of a circular doubly linked list of integers with six nodes? 2 3 1

(3)



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-
- 11 Explain best-case and worst-case complexity of Linear Search and Binary Search 4 3 7
- 12 For given matrix, find linked list representation of the transpose of given sparse matrix. 2 4 1,
7

$$\begin{pmatrix} 0 & 0 & 1 & 0 & 0 \\ 5 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 0 & 8 \\ 0 & 2 & 0 & 0 & 0 \end{pmatrix}$$

- 13 You have a structure student having name, MIS, and marks of 5 subjects. Declare array of student structure to store marks of 150 students. Write a function to sort this array based on total marks of all subjects and display names of first 5 students. 6 1 3



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END Semester Examination

Programme: B.Tech

Semester: III

Course Code: CT-16006

Course Name: Discrete Structures and Graph Theory

Branch: CE and IT

Academic Year: 2022-23

Duration: 3 Hr

Max Marks: 60

Student MIS No.

/PRN

1	1	2	1	0	3	0	6	9
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Instructions:

- Figures to the right indicate the full marks.
- Mobile phones and programmable calculators are strictly prohibited.
- Writing anything on question paper is not allowed.
- Exchange/Sharing of stationery, calculator etc. not allowed.
- Write your PRN Number on Question Paper.

Section A

Marks CO PO

Q1 Attempt All of the following

- a Let the universe be a social club, and let x and y range over the members of the club. Define the predicate $P(x, y)$ as $P(x, y) := x \text{ likes } y$. Translate the following quantified predicates into English sentences

4 1 1

- $\forall x \forall y P(x, y)$
- $\exists x \exists y P(x, y)$
- $\forall x \exists y P(x, y)$
- $\exists x \forall y P(x, y)$

- b Prove following by using Mathematical induction such that for all $n \geq 1$, the sum of the squares of the first $2n$ positive integers is given by the formula

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$$1^2 + 2^2 + 3^2 + \dots + (2n)^2 = \frac{n(2n+1)(4n+1)}{3}$$

OR

- b Solve the following recurrence relation $a_r = 6a_{r-1} - 8a_{r-2}$

3 2 2

- c Consider Premises: If Kiran has wide support, then he'll be asked to run for the senate. If Kiran yells "Eureka" in Iowa, he will not be asked to run for the senate. Kiran yells "Eureka" in Iowa. Conclusion: Kiran does not have wide support. Determine whether the conclusion follows logically from the premises. Explain by representing the statements symbolically and using rules of inference.

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- d Let $A = \{1, 2, 3, 4, 5\}$ and let M_R and M_S be the matrices of the relations R and S on A. Compute

4 2 1

- $M_R \circ M_S$
- $M_R \circ M_R$

A¹

A²

B¹

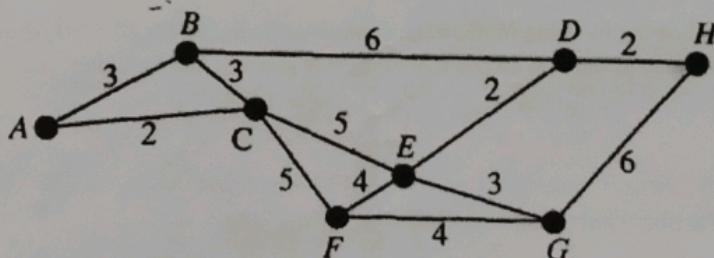


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$$M_R = \begin{bmatrix} 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix} \text{ and } M_S = \begin{bmatrix} 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 0 \end{bmatrix}$$

- Q 2 a** You decide to have a dinner party. Even though you are incredibly popular and have 14 different friends, you only have enough chairs to invite 6 of them. 2,3 1
- i. How many choices do you have for which 6 friends to invite? 2
 - ii. What if you need to decide not only which friends to invite but also where to seat them along your long table? How many choices do you have then? 2
- b** If 30 dictionaries in library contain a total number of 61,327 pages then find out minimum number of pages in one of the dictionaries must have in it. 2 3 4
- c** Solve and answer the following using Binomial Coefficients for the equation as $(2x - 5y)^6$ 3 1
- i. Value of coefficient of the last term. 1
 - ii. Find the 5th term. 2
 - iii. Determine the pascal's triangle for all powers of given equation. 3

- Q 3 a** The small town of social circle maintains a system of walking between the recreational areas in town. The system is modelled by the weighted graph in following figure, where the weights represent the distances in kilometres between sites. 4 1



- i. Find out minimum spanning tree using Prim's Algorithm. 3
- ii. What will be the total weight of the **minimum** spanning tree using Breadth first search if we start with A. Draw tree. 3

OR

- a** For the same graph in above question, answer, the following: 4 1
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gives information about fishes that cannot be together

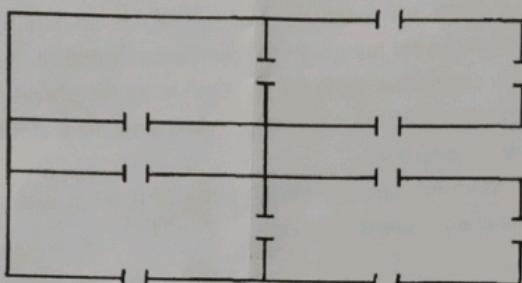
Type	A	B	C	D	E	F
Cannot be with	B,C	A,C	A,B,D,E	B,C	C,F	E

Our task is to arrange the fishes in a minimum number of tanks

- i. Draw a graph for the fishes can survive together as from the above table
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4 12



- i. Is there a way to tour the exhibit so that you pass through each door exactly once?
- ii. Determine which type of tour it is ?
- iii. Give a sketch of your tour in a graph , where each open door is considered as a vertex

1

1

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3 1

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- iii. Find set of different values that x can have

2

1

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4 3 1

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- Three students, then two pens left in the bag,
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Find the minimum number of pens in the bag.

- c Find integers p and q such that $1124p + 84q$ also find the GCD(1124, 84) using extended Euclidian algorithm.

4 3 4

- Q 5 a Complete the given table so that the binary operation * is associative. Show the associative property is true for all elements in this table.

2 5 4



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(An Autonomous Institute of Government of Maharashtra.)

*	a	b	c	d
a	a	b	c	d
b	b	a	c	d
c				
d	d	c	c	d

- b If an algebraic structure is defined on a set of positive integers N with respect to binary operation $a*b=\text{lcm}(a,b)$, $\forall a,b \in N$.
- Whether the algebra holds closure, associative property? If yes explain
 - If exists, find out the identity element for the algebra
- c Consider the algebra on a set $S = \{1,3,6,9,12\}$ is $\text{GCD}(a,b)$, where $a,b \in S$ determine whether the set together with the binary operation is
- Determine composition table for the algebra on the operation GCD
 - Determine whether the algebra is semigroup, or a monoid, or both with respect to its properties?
 - If it is a monoid, specify the identity, If it is a semigroup or monoid, determine if its is commutative?

5 1

2

1

5 1

1

2

2

---*---All the best---*---

at w



College of Engineering Pune

(An Autonomous Institute of Govt. of Maharashtra)

(MA-20001) Ordinary Differential Equations and Multivariate Calculus

Program : S.Y.B.Tech. Sem. I (All Branches)

Academic Year : 2022-23

Examination : Internal Test 1

Maximum Marks : 20

Date : 11/11/2022

Time : 4.30 pm to 5.30 pm

Student MIS Number :

1	1	2	1	0	3	0	6	9
---	---	---	---	---	---	---	---	---

Instructions :

1. Write your MIS Number on Question Paper.
2. Writing anything on question paper is not allowed.
3. Mobile phones and programmable calculators are strictly prohibited.
4. Exchange/Sharing of stationery, calculator etc. is not allowed.
5. Figures to the right indicate the course outcomes and maximum marks.
6. Unless otherwise mentioned symbols and notations have their usual standard meanings.
7. Any essential result, formula or theorem assumed for answering questions must be clearly stated.

Q.I) Solve the following:

(a) $3x(xy - 2)dx + (x^3 + 2y)dy = 0$ [CO 2] [2]
(b) $(2\cos y + 4x^2)dx - x\sin y dy = 0$ [CO 3] [3]

Q.II) Find a homogeneous linear second order ordinary differential equation whose solution is the set of all straight lines in the xy -plane. [CO 1] [1]

Q.III) State whether the following differential equations are linear or nonlinear, justify and solve:

(a) $xy' + 2y = \frac{e^{3x}}{x}$, $x > 0$ with $y(1) = 1 + \frac{e^3}{3}$. [CO 2] [2]
(b) $x^2y\frac{dy}{dx} - xy^2 = 1$. [CO 2] [2]

Q.IV) If x^2 and 1 are solutions of $yy'' - xy' = 0$ then so is any linear combination of these. State true or false and justify. [CO 4] [2]

Q.V) Find a linear ordinary differential equation for which the functions $e^{-x}\cos 2x$ and $e^{-x}\sin 2x$ are linearly independent solutions. [CO 3] [3]

Q.VI) A tank contains 200 liters of mixture of water and fertilizer (in the ratio 10 to 1) which is diluted by adding a similar mixture (in the ratio 19 to 1) at a rate of 2 liters per minute. The mixture in the tank is kept uniform by stirring and the solution is sprayed on plants at the same rate. What is the amount of fertilizer in the tank after 5 minutes? [CO 3] [3]

Q.VII) Prove that the family of curves $x^2 = 4c(y + c)$ is its own orthogonal trajectory. In other words prove that it is self orthogonal. [CO 4] [2]

MIS: 112103069

College of Engineering, Pune
Department of Computer Science and IT

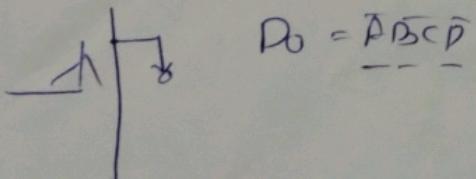
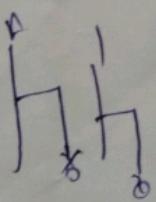
S.Y. B. Tech. (Computer Engineering)
 End Semester Examination 2022-23
 Sub: Digital Logic Design

Duration: Three Hours

Max Marks: 60

(All questions are Compulsory)

- | Q.1 | Convert the following decimal numbers in to binary | Marks |
|------|---|-------|
| | a) 561.125 b) 6531 | 04 |
| Q.2 | Minimize following Boolean expressions to minimum number of literals using Boolean identities. | |
| | a) $xy + x(wz + wz')$ b) $ABC + A'B + ABC'$ | 04 |
| Q.3 | Derive the circuits from truth table and K-map minimization for a three bit parity generator and four bit parity checker using an even parity bit | 08 |
| Q.4 | Design a full adder from the truth table and K map minimization. Implement the full adder using two half adders and an OR gate. | 06 |
| Q.5 | Design a combinational circuit that converts a four bit binary to a BCD using K-maps. Draw the logic diagram. | 08 |
| Q.6 | Draw the function table, graphic symbol, characteristic table & excitation table for positive edge triggered JK flipflop. Design JK flipflop using a D flipflop and gates. | 06 |
| Q.7 | Draw the diagram & explain the operation of Basic Cell of memory using a SR latch. Design a 4x4 bit memory using Basic Cells & a 2 to 4 decoder for address generation. | 06 |
| Q.8 | Draw four bit updown binary synchronous counter using positive edge triggered T type Flipflops. Draw the waveforms of outputs in response to the clock. | 04 |
| Q.9 | Consider the sequential circuit with two D flipflops whose output Q is named as A and B respectively and one input x and one output y. The Following are the state equations:
$A(t+1) = Ax + Bx, \quad B(t+1) = A'x \quad y = Ax' + Bx'$
a) Find the state table for the above defined sequential circuit with JK flipflops
b) Draw the logic diagram and the state diagram of the circuit | 08 |
| Q.10 | Write short notes on: (ANY TWO) | 06 |
| | a) Algorithmic State Machine
b) Register Transfer Level (RTL) notation
c) Memory cycle timing waveforms | |



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Test 1 Examination

Programme: B.Tech.

Semester: II

Course Code: CT-20008

Course Name: Principles of Programming Languages

Branch: Computer Engineering

Academic Year: 2022-23

Duration: 1 Hour

Max Marks: 20

Student PRN No.	112103096
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Instructions:

1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of stationery, calculator etc. not allowed.
5. Write your PRN Number on Question Paper.
6. Assume suitable data where necessary.

Q 1

- a Software for "Diabetes Diagnosis Decision System" is to be developed. [5]

Which programming paradigm/s and Language/s will be preferred at front-end and back-end of the software?

- b State and explain with at least two examples of "orthogonality" attribute of [5] a programming language

Q 2 Draw control flow graph for the following code fragments.

With proper justification :

i) State whether the program is proper or not?

ii) State whether the code is spaghetti or not?



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a do { [5]

```
if ( a != 1 || b == 9 && c > 0 ) {
    d = 100;
    break;
}
else {
    d = 10;
}
} while (a <= b);
```

b #include <string.h> [5]

```
void function (char *str) {
char buffer [8];
strcpy(buffer,str);
}

void main () {
char chars[256];
int i;

for (i=0;i<255;i++)
    chars[i] = 'A';
function(chars);
}
```



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EndSem Examination

Programme: B.Tech

Course Code:

Branch: Computer Engineering

Duration: 3 hours

Student PRN No.

Semester: III

Course Name: DSA I

Academic Year: 2022- 2023

Max Marks: 60

1	1	2	1	0	3	0	9	6
---	---	---	---	---	---	---	---	---

Instructions: For programming questions, define only the expected function(s)

Use C Programming Language for all answers.

Write all answers of a section together. Clearly mention Section name on the top.

SECTION A

CO PO

1. a. If an array, of size n, is already sorted what will be the complexity of sorting it using Bubble Sort, Selection Sort, Quick Sort, and Merge Sort? 2 3 1
2

- b. The equation for time taken by this code is: 2 3 1
2

```
int f(int x, int y) {
    while(x) {
        y = x;
        while(y) {
            y = y - x;
            y = y / 2;
        }
        x--;
    }
}
```

- c. Let P be a quicksort program to sort numbers in ascending order using the first element as the pivot. Let t_1 and t_2 be the number of comparisons made by P for the inputs [1, 2, 3, 4, 5] and [4, 1, 5, 3, 2] respectively. Which one of the following hold? Explain. 2 3 1

- i. $t_1 = t_2$
- ii. $t_1 > t_2$
- iii. $t_1 < t_2$
- iv. Not related

- d. Will the code segment given below result to a segmentation fault? Explain your answer with the help of a memory diagram. 2 2 1
2

```
int *p, *q;
p = (int *)malloc(sizeof(int) * 3);
q = p;
p = p + 2;
p[-2] = q - p;
q = p + p[-2];
q[-1] = --p - q;
```

- e. Write the output of the following code: 2 3 1
2 2

```
int main() {
    stack t;
```



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```
int no, i;
init(&t);
for(i = 0; i < 7; i++) {
    if(i % 2)
        push(&t, i + 1);
    if(i % 5 == 2 && !isempty(&t))
        push(&t, pop(&t) + 1);
    if(i % 4 == 0 && !isempty(&t))
        pop(&t);
}
while(!isempty(&t))
    printf("%d\t", pop(&t));
return 0;
}
```

- f. The given code represents which data structure: Array/Stack/Queue/Singly Linked List/Doubly Linked List or something else? Explain.

2 2 1
3 2

```
#define MAX 5
typedef struct rec {
    int array[MAX];
    int i;
}something;
void init(something *d) {
    d->i = 0;
}
int empty(something *d) {
    return d->i == 0;
}
int full(something *d) {
    return d->i == MAX;
}
void store(something *d, int val) {
    d->array[d->i] = val;
    d->i++;
}
int retrieve(something *d) {
    int val = d->array[0];
    int i;
    for(i = 0; i < d->i; i++)
        d->array[i] = d->array[i + 1];
    d->i--;
    return val;
}
```

2. Assume you are provided an ADT Stack of integers implemented using an array.
Define a function with the given prototype:

6 1 1
4 3
5

void Sort(Stack *S);
The function sorts the content of the stack in ascending order (with the smallest element on the top) without using any additional array.
Analyse the time complexity of your function.

(4 marks)
(2 marks)

3. A queue is implemented using a doubly linked list as shown in the diagram below:

6 2 1

(2)



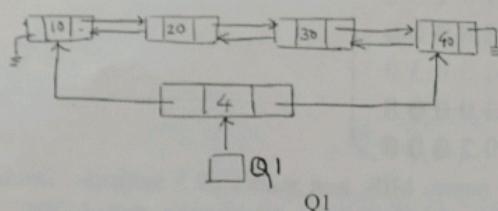
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Where Q1 is a variable of type Queue, that maintains address of the first and last nodes in the queue and also the count of number of elements in the queue.

3

- a. Write the typedef for Queue and each node in the Queue. (2 marks)
- b. Write Enqueue and Dequeue functions for this queue. (2 marks each)



4. Write a function having following prototype:

6 1 1
2 3

`void printPostfix(char *in_fix, int n);`
The function accepts an infix arithmetic expression having digits 0 – 9 and operators (+, -, *, /, ^) as argument along with the size of the expression. The function prints the equivalent postfix expression.

Note: Assume you are provided with the required data structures.

SECTION B

- 5 Which of the following data structures can be used for parentheses matching?

1 3 1,
4

- a) linked list
- b) queue
- c) array
- d) stack

- 6 In a stack, if a user tries to remove data from an empty stack it is called _____

1 2 1

- a) Underflow
- b) Empty top
- c) Overflow
- d) Garbage top

- 7 a. Convert given infix expression $(P + Q) * (R * S - T) * U / V$ into postfix using stack. 6 4 3

- b. What is the value of the postfix expression $7\ 8\ 5\ 1\ +\ -\ *$ using stack?

- 8 Queue _____ 2 2 1

- a. is FIFO
- b. has two ends, front and rear
- c. is non-linear data structure

is LIFO

- 9 Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. To simulate the system, implement the operations enqueue() and dequeue() performed by queue ADT using Linked List.

6 5 3,
4

- 10 How many pointers are contained as data members in the nodes of a circular doubly linked list of integers with six nodes? 2 3 1

(3)



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-
- 11 Explain best-case and worst-case complexity of Linear Search and Binary Search 4 3 7
- 12 For given matrix, find linked list representation of the transpose of given sparse 2 4 1,
matrix. 7
- $$\begin{pmatrix} 0 & 0 & 1 & 0 & 0 \\ 5 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 0 & 8 \\ 0 & 2 & 0 & 0 & 0 \end{pmatrix}$$
- 13 You have a structure student having name, MIS, and marks of 5 subjects. Declare 6 1 3
array of student structure to store marks of 150 students. Write a function to sort this
array based on total marks of all subjects and display names of first 5 students.



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T2 Examination

Programme: B.Tech

Course Code:

Branch: Computer Engineering

Duration: 1 hour

Student PRN No.

Semester: III

Course Name: DSA I

Academic Year: 2022- 2023

Max Marks: 20

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Instructions: For Programming questions, define only the expected function(s)

Use C Programming Language for all answers.

Write all answers of a section together. Clearly mention Section name on the top.

SECTION A		
1	Which Sorting Algorithm(s) use(s) Divide-and-Conquer technique? [1] Merge Sort [2] Selection Sort [3] Insertion Sort [4] Bubble Sort [5] Quick Sort	1
2	Write the contents of array after every pass of Insertion Sort. How many passes will it have? A[] = { 38, 12, 16, 10, 25, 8, 15, 9}	2
3	Draw the neat memory allocation diagram for the give code segment: <pre>#define MALLOCSTRUCT() (test *)malloc(sizeof(test)) int main() { typedef struct test { int x; struct test *p, *q; }test; test a, b, *t; a.p = &b; b.p = MALLOCSTRUCT(); b.q = MALLOCSTRUCT(); b.q->p = &a; b.q->q = MALLOCSTRUCT(); a.q = MALLOCSTRUCT(); a.q->p = b.q->q; a.q->q = MALLOCSTRUCT(); a.q->q->p = a.q; a.q->q->q = b.q->q; a.x = 20; b.x = 30; a.p->p->x = 40; a.q->q->x = 50; b.q->q->x = 60; b.p->x = 70; return 0;</pre>	3



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	}	
4	<p>Assume a number is broken into digits and each digit is stored in a node of a Singly Linked List in reverse.</p> <p>Eg: Number 5431 is stored as:</p> <p>L1 → 1→3→4→5→NULL</p> <p>Write a function that accepts two such lists as parameters and returns the sum of numbers represented in the same form.</p> <p>INPUT:</p> <p>L1 → 1→3→4→5→NULL</p> <p>L2 → 3→7→6→NULL</p> <p>Returned List</p> <p>L3 → 4→0→1→6→NULL</p>	4

SECTION B

5	<p>Consider the following code snippet:</p> <pre>p = (int *)malloc(sizeof(int)); q = &p; r = &q;</pre> <p>Write the data types of q, and r.</p>	1
6	<p>Which of the following gives the value stored at the address pointed to by pointer a?</p> <ul style="list-style-type: none"> a. &a b. val(a) c. a d. *a 	1
7	<p>What will be the output of the program?</p> <pre>#include <stdio.h> int main(){ int arr[] = {1, 2, 3, 4, 5}; int *p = arr; ++*p; p += 2; printf("%d", *p); return 0; }</pre>	2
8	<p>Fill in the blank for given code of insertion at position function of SLL. (start is a 1st node of SLL and newnode will be the node to be insert in SLL)</p> <pre>struct node {</pre>	2



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```
int data;  
struct node* next;  
};  
struct node* start = NULL;  
void insertAtPosition()  
{  
    struct node *temp, *newnode;  
    int pos, c, i = 1;  
    newnode = malloc(sizeof(struct node));  
    printf("\n Enter position and data :");  
    scanf("%d %d", &pos, &c);  
    temp = start;  
    newnode->data = c;  
    newnode->next = NULL;  
    while (i < pos - 1) {  
        temp = temp->next;  
        i++;  
    }  
    _____  
    _____  
}
```

- | | | |
|---|---|---|
| 9 | Write a function Selectionsort() that takes an array A, containing n integers as input and uses selection sort to sort the array. | 4 |
|---|---|---|

COEP Technological University, Pune
Department of Computer Engineering and IT
Subject: Digital Logic Design
TEST 2 (Date:

Duration: One hour

Max Marks: 20

Q. 1. Three bits x , y and z constitute the binary message and are input to the digital circuit. The parity bit P is the output. For even parity, the bit P must be generated to make the total number of 1's (including P) even. Design an even parity generator using K map. Draw the logic diagram. **03**

Q.2. Design a Binary Coded Decimal (BCD) to Excess-3 Code Converter for the decimal digits. **04**

Q.3. Design a full adder. Convert the Boolean expression of the full adder to implement the full adder with two half adders and an OR gate. Draw logic diagram. **03**

Q.4. Design a carry look-ahead generator for the four bit binary addition. Redraw the logic diagram of full adder designed in Q.3 above and mark intermediate variables P and G . **03**

Q.5. Draw logic diagram of a four bit binary adder/subtractor using full adders as building block. Explain the operation of v (Overflow) flag. **02**

Q.6. Design a 4:2 bit priority encoder. The priority function should be designed such that if more than one inputs are equal to 1 the input having highest priority will take precedence. Design a third output as valid v bit which is 1 when one or more inputs are 1, 0 otherwise. Draw the logic diagram. **03**

Q.7. Draw function table and logic diagram of positive edge triggered D type of flipflop. Add asynchronous Reset input to it. **02**

College of Engineering, Pune
Department of Computer Science and IT

S.Y. B. Tech. (Computer Engineering)
 End Semester Examination 2022-23

Duration: Three Hours

Sub: Digital Logic Design

Max Marks: 60

(All questions are Compulsory)

- | Q.1 | Convert the following decimal numbers in to binary | Marks |
|------|--|-------|
| | a) 561.125 b) 6531 | 04 |
| Q.2 | Minimize following Boolean expressions to minimum number of literals using Boolean identities. | |
| | a) $xy + x(wz + wz')$ b) $ABC + A'B + ABC'$ | 04 |
| Q.3 | Derive the circuits from truth table and K-map minimization for a three bit parity generator and four bit parity checker using an even parity bit | 08 |
| Q.4 | Design a full adder from the truth table and K map minimization. Implement the full adder using two half adders and an OR gate. | 06 |
| Q.5 | Design a combinational circuit that converts a four bit binary to a BCD using K-maps. Draw the logic diagram. | 08 |
| Q.6 | Draw the function table, graphic symbol, characteristic table & excitation table for positive edge triggered JK flipflop. Design JK flipflop using a D flipflop and gates. | 06 |
| Q.7 | Draw the diagram & explain the operation of Basic Cell of memory using a SR latch. Design a 4x4 bit memory using Basic Cells & a 2 to 4 decoder for address generation. | 06 |
| Q.8 | Draw four bit updown binary synchronous counter using positive edge triggered T type Flipflops. Draw the waveforms of outputs in response to the clock. | 04 |
| Q.9 | Consider the sequential circuit with two D flipflops whose output Q is named as A and B respectively and one input x and one output y. The Following are the state equations:
$A(t+1) = Ax + Bx,$ $B(t+1) = A'x$ $y = Ax' + Bx'$
a) Find the state table for the above defined sequential circuit with JK flipflops/
b) Draw the logic diagram and the state diagram of the circuit | 08 |
| Q.10 | Write short notes on: (ANY TWO) | 06 |
| | a) Algorithmic State Machine | |
| | b) Register Transfer Level (RTL) notation | |
| | c) Memory cycle timing waveforms | |

COEP Technological University, Pune
Department of Computer Engineering and IT
Mid Semester Examination S. Y. B.Tech. (Computer Engineering) 2022-23
Subject: Digital Logic Design (III Semester)

Duration: One hour

Maximum Marks: 20

Q.1 Minimise following Boolean expressions using K map. Draw the logic diagram of minimized Boolean function 09

a) $F(A,B,C) = A'B'C' + B'CD' + A'BCD' + AB'C'$

b) $F(w,x,y,z) = \sum(1,3,10) + \sum_d(0,2,8,12)$; where \sum_d indicate don't care terms

c) $F(A,B,C,D) = \sum(0,2,3,5,7,8,9,10,11,13,15)$

Q.2 Simplify Boolean expressions to minimum number of literals using Boolean identities and draw logic diagram of circuits that implement original and simplified expressions. 06
(Solve any TWO)

a) $ABC + A'B + ABC'$

b) $xy'z + x'y'z + w'xy + wx'y + wxy$

c) $(BC' + A'D)(AB' + CD')$

Q.3 Convert following decimal numbers to binary 02

a) 61.1487

b) 4813

Q.4 Perform subtraction of following binary numbers using 2's compliment of subtrahend. If the result is negative take the 2's compliment of the number and affix the minus sign to it. Prove your answer by appropriate conversions in decimal equivalents 03

a) 1001 - 110101

b) 101000 - 10101



College of Engineering Pune

(An Autonomous Institute of Govt. of Maharashtra)

(MA-20001) Ordinary Differential Equations and Multivariate Calculus

Program : S.Y.B.Tech. Sem. I (All Branches)

Academic Year : 2022-23

Examination : Internal Test 1

Maximum Marks : 20

Date : 11/11/2022

Time : 4.30 pm to 5.30 pm

Student MIS Number :

1	1	2	1	0	3	0	9	6
---	---	---	---	---	---	---	---	---

Instructions :

1. Write your MIS Number on Question Paper.
2. Writing anything on question paper is not allowed.
3. Mobile phones and programmable calculators are strictly prohibited.
4. Exchange/Sharing of stationery, calculator etc. is not allowed.
5. Figures to the right indicate the course outcomes and maximum marks.
6. Unless otherwise mentioned symbols and notations have their usual standard meanings.
7. Any essential result, formula or theorem assumed for answering questions must be clearly stated.

Q.I) Solve the following:

- (a) $3x(xy - 2)dx + (x^3 + 2y)dy = 0$ [CO 2] [2]
(b) $(2\cos y + 4x^2)dx - x\sin y dy = 0$ [CO 3] [3]

Q.II) Find a homogeneous linear second order ordinary differential equation whose solution is the set of all straight lines in the xy -plane. [CO 1] [1]

Q.III) State whether the following differential equations are linear or nonlinear, justify and solve:

- (a) $xy' + 2y = \frac{e^{3x}}{x}$, $x > 0$ with $y(1) = 1 + \frac{e^3}{3}$. [CO 2] [2]
(b) $x^2y\frac{dy}{dx} - xy^2 = 1$. [CO 2] [2]

Q.IV) If x^2 and 1 are solutions of $yy'' - xy' = 0$ then so is any linear combination of these. State true or false and justify. [CO 4] [2]

Q.V) Find a linear ordinary differential equation for which the functions $e^{-x}\cos 2x$ and $e^{-x}\sin 2x$ are linearly independent solutions. [CO 3] [3]

Q.VI) A tank contains 200 liters of mixture of water and fertilizer (in the ratio 10 to 1) which is diluted by adding a similar mixture (in the ratio 19 to 1) at a rate of 2 liters per minute. The mixture in the tank is kept uniform by stirring and the solution is sprayed on plants at the same rate. What is the amount of fertilizer in the tank after 5 minutes? [CO 3] [3]

Q.VII) Prove that the family of curves $x^2 = 4c(y + c)$ is its own orthogonal trajectory. In other words prove that it is self orthogonal. [CO 4] [2]



College of Engineering Pune

(An Autonomous Institute of Govt. of Maharashtra)

(MA-20001) Ordinary Differential Equations and Multivariate Calculus

Program : S.Y.B.Tech. Sem. I (All Branches)

Academic Year : 2022-23

Examination : Internal Test 2

Maximum Marks : 20

Date : 16/12/2022

Time : 3.00 pm to 4.00 pm

Student MIS Number :

1	1	2	1	0	3	0	9	6
---	---	---	---	---	---	---	---	---

Instructions :

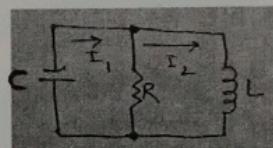
1. Write your MIS Number on Question Paper.
2. Writing anything on question paper is not allowed.
3. Mobile phones and programmable calculators are strictly prohibited.
4. Exchange/Sharing of stationery, calculator etc. is not allowed.
5. Figures to the right indicate the course outcomes and maximum marks.
6. Unless otherwise mentioned symbols and notations have their usual standard meanings.
7. Any essential result, formula or theorem assumed for answering questions must be clearly stated.

Q.1 Solve using method of undetermined coefficients, $y'' - y' = x - \sin 3x$. (CO3) [2.5]

Q.2 Solve using method of variation of parameters, $y'' - 2y' + 2y = e^x \tan x$. (CO3) [2.5]

Q.3 Solve: $(x^2 D^3 + 3xD^2 - 2D)y = 0$ (CO5) [3]

Q.4 Write the system of equations to find currents I_1 and I_2 flowing through the two loops of the following electrical circuit. DO NOT SOLVE IT. (CO3) [2]



Q.5 Give an example of a function which is of exponential order but its derivative is not of exponential order. (CO1) [1]

Q.6 Find:

a) $\mathcal{L}\{\sin^2 t + \sinh 2t + 100 t^2\}$ (CO2) [2]

b) $\mathcal{L}^{-1}\left\{\frac{1}{s^{5/2}} + \frac{1}{(s+2)^2+4} + \frac{1}{s^2-1} + \frac{F(s)}{s}\right\}$. (CO3) [2]

Q.7 If $f(t)$ is defined and piecewise continuous on every finite interval on $t \geq 0$ and satisfies the condition $|f(t)| \leq M e^{kt}$ for all $t \geq 0$ and some constants $M > 0$ and $k \geq 0$, then prove that Laplace transform of $f(t)$ exists for all $s > k$. (CO4) [2]

Q.8 Using Laplace transform solve the initial value problem :
 $y'' + y = \sin(2t)$, $y(0) = 3$, $y'(0) = 0$ (CO3) [3]



College of Engineering Pune

(An Autonomous Institute of Govt. of Maharashtra)

(MA-20001) Ordinary Differential Equations and Multivariate Calculus

Program : S.Y.B.Tech. Sem. III (All Branches)

Academic Year : 2022-23

Examination : End Semester Examination

Maximum Marks : 60

Date : 29/01/2023

Time : 02.30 pm to 05.30 pm

Student MIS Number :

1	1	2	1	0	3	0	6	9
---	---	---	---	---	---	---	---	---

Instructions :

1. Write your MIS Number on Question Paper.
2. Writing anything on question paper is not allowed.
3. Mobile phones and programmable calculators are strictly prohibited.
4. Exchange/Sharing of stationery, calculator etc. is not allowed.
5. Figures to the right indicate the course outcomes and maximum marks.
6. Unless otherwise mentioned symbols and notations have their usual standard meanings.
7. Any essential result, formula or theorem assumed for answering questions must be clearly stated.

Q.1 Attempt the following:

(i) Solve $x \frac{dy}{dx} = (y - x)^3 + y$. (CO2)[1.5]

(ii) Say true or false and justify your answer : The integrating factor of a differential equation is unique. (CO4)[1]

(iii) Find the Laplace transform of $f(t) = e^{-t} \sinh 4t$. (CO2)[1]

(iv) Find the Laplace transform of $f(t) = \sin^4 t$. (CO3)[2]

OR

Find the Laplace transform of $f(t) = te^{-t} \cos t$. (CO3)[2]

(v) Find the inverse Laplace transform of $\sum_{k=1}^4 \frac{(k+1)^2}{s+k^2}$ (CO5)[2]

- (vi) Find the domain and the range of the function $f(x, y) = 4 - \sqrt{x^2 + y^2}$. Sketch the surface $z = f(x, y)$ and the level curve $f(x, y) = -3$. (CO3)[3]

- (vii) State two path test for non-existence of limit of a function of two variables.

Find the following limit, if it exists:

$$\lim_{(x,y) \rightarrow (0,0)} \left(\frac{-x}{\sqrt{x^2 + y^2}} \right) \quad (\text{CO1, CO3})[3]$$

- (viii) Let $f(x, y) = \frac{x^2 - y^2}{x^2 + y^2}$ for $(x, y) \neq (0, 0)$. Is it possible to define $f(0, 0)$ in a way that makes f continuous at the origin? Why? (CO3)[1.5] Q.

Q.2 Attempt the following:

- (i) State giving reason whether the functions $\cos^2 x, \sin^2 x$ and $\cos 2x$ are linearly independent or dependent. (CO2)[1]

- (ii) Using the method of reduction of order, determine $y_2(x)$, the other linearly independent solution of $(1 + x^2)y'' - 2xy' + 2y = 0$, if $y_1(x) = x$ is one solution. (CO3)[1.5]

- (iii) Using appropriate properties /theorems of Laplace transforms, evaluate

$$\int_0^\infty e^{-\sqrt{3}t} \left\{ \frac{\sin t}{t} \right\} dt \quad (\text{CO3})[2]$$

- (iv) Find the inverse Laplace transform of $\tan^{-1} \left(\frac{2}{s^2} \right)$. (CO4)[3]

OR

- Find the inverse Laplace transform of $\ln \left(\frac{s^2+s-6}{s^2+s+1} \right)$. (CO4)[3]

- (v) If the partial derivatives f_x, f_y of a function $f(x, y)$ exist over an open region R then the function $f(x, y)$ is differentiable at every point of R . State true or false using appropriate result. (CO1)[2]

- (vi) Calculate $\lim_{(x,y) \rightarrow (1,1)} f(x, y)$, if it exists, where (CO3)[3]

$$f(x, y) = \begin{cases} x & , xy \neq 1 \\ x^2 + y^2 & , xy = 1 \end{cases}$$

(vii) If $z = f(x, y)$, $x = g(t, s)$ and $y = h(t, s)$ then draw the branch/tree diagram and write the chain rule for $\frac{\partial z}{\partial t}$. (CO2)[1.5]

(viii) Find $\frac{\partial f}{\partial x}$ at $(-2, 1)$ if $f(x, y) = \tan^{-1} \left(\frac{y}{x} \right)$. (CO2)[1]

Q.3 Attempt the following:

- (i) A force of 400N stretches a spring 2 meters. A mass of 50 kg is attached to the end of the spring and is initially released from the equilibrium position with an upward velocity of 10m/s. Find the equation of motion. Also determine the natural frequency, period and amplitude. (CO4)[3]

OR

A large tank is initially filled with $100L$ of brine in which $1kg$ of salt is dissolved. Brine containing $0.5kg$ of salt per Liter is pumped into the tank at a rate of $6L/min$. The well-mixed brine is pumped out of the tank at a slower rate of $4L/min$. Assuming that the tank does not overflow, find the amount of salt in the tank after t minutes. Give your answer to the nearest gram. (CO4) [3]

- (ii) Use properties of Laplace transform to find :
- $\mathcal{L} \{ f(t)\delta(t) + \sin(5t - 5)u(t - 1) \}$. (CO2)[2]
 - $\mathcal{L}^{-1} \left\{ e^{-3s} \frac{s+1}{s^2+2s+2} \right\}$. (CO3)[2]
 - Find $\mathcal{L} \{ f(t) = t^2; 0 < t < 2 \}$, $f(t)$ is periodic with period 2. (CO2)[2]

- (iii) Prove: If $F(x, y)$ is differentiable and the equation $F(x, y) = 0$ defines y implicitly as a differentiable function of x then, at any point where $F_y \neq 0$,

$$\frac{dy}{dx} = -\frac{F_x}{F_y}.$$

Hence find $\frac{dy}{dx}$ at the point $(0, \ln 2)$ if $xe^y + \sin(xy) + y = \ln 2$. (CO3)[3]

- (iv) Let $T(x, y, z) = x^2 + 2y^2 + 2z^2$ be a function which gives the temperature at any point in space. Let $P = (1, 1, 1)$. Find : (CO3)[3]

- a) grad T at the point P ,

- b) the directional derivative of T at the point P in the direction of $\bar{v} = 2\hat{j} + \hat{j} + 2\hat{k}$,
- c) In which direction should you go to get the most rapid decrease in T at the point P ? What is the directional derivative in this direction?

Q.4 Attempt the following:

(a) Solve any one:

(CO3)[2.5]

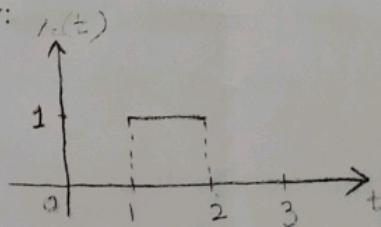
- (i) Find the solution of $(D^3 - 2D^2 - 9D + 18I)y = e^{2x}$ using the method of undetermined coefficients.
- (ii) If $y'' + p(x)y' + q(x)y = r(x)$ then prove that $y_p = -y_1 \int \frac{y_2 r}{W} dx + y_2 \int \frac{y_1 r}{W} dx$ is a solution where y_1 and y_2 are linearly independent solutions of $y'' + p(x)y' + q(x)y = 0$ and $W = y_1 y'_2 - y_2 y'_1$.

(b) Solve the following:

- (i) Find Laplace transform of the convolution of $f(t)$ and $g(t)$ where $f(t) = \cos \omega t$ and
 $g(t) = e^{-at}$

(CO2)[1]

- (ii) Determine the response of the damped mass spring system under a square wave modeled by the equation $y'' + 3y' + 2y = r(t)$ where $r(t)$ is as shown below:



and the initial conditions $y(0) = y'(0) = 0$

(CO5)[4]

(c) Solve any three:

(CO3)[7.5]

- (i) Find all local maxima, minima and saddle points for the function $f(x, y) = e^{2x} \cos y$.
- (ii) Find the coldest and the hottest point(s) on a circular plate $x^2 + y^2 \leq 1$ if the temperature at any point (x, y) is given by $T(x, y) = x^2 + 2y^2 - x$.
- (iii) Find the points lying on the curve $x^2 + xy + y^2 = 1$ in the xy plane that are closest and farthest from the origin.
- (iv) Discuss the local extrema at $(0, 0)$ for different values of k for the function $f(x, y) = x^2 + kxy + y^2$.

Feedback Control System

Test 1

Instructions to candidates:

1. All questions are compulsory.
 2. All questions carry equal marks.
- 1 Using the Laplace transform pairs and the Laplace transform theorems, derive the Laplace transforms for the following time functions. Specify the theorems.
- $e^{-at} \cos(\omega t) u(t)$
 - $t^3 u(t)$
- 2 Find the inverse Laplace transform of

$$F(s) = \frac{(s+3)}{(s+2)^2(s+5)}$$

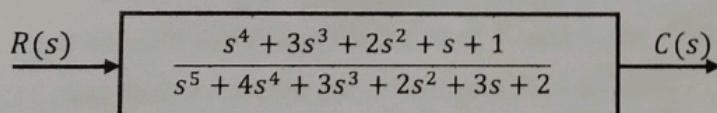
using partial fraction expansion.

- 3 Define the poles and zeros of the system described by the transfer function.
- 4 A system is represented by a relation given below

$$X(s) = R(s) \frac{100}{(s^2 + 2s + 50)}$$

if $r(t) = 1.0$ unit, find the values of $x(t)$ when $t \rightarrow 0$.

- 5 Write the differential equation that is mathematically equivalent to the block diagram as shown. Assume that $r(t) = 3t^3$.



- 6 What are the steps involved in the design of control system?

- 7 Find the transfer function

$$G(s) = \frac{V_L(s)}{V(s)} = \frac{V_L(s)}{V(s)}$$

for network as shown in figure 1

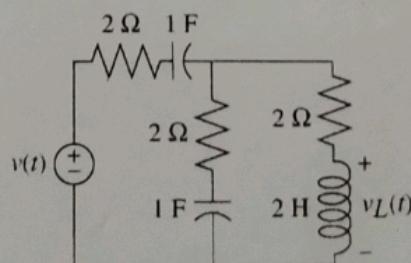


Figure 1

Feedback Control System

Test 1

- 8 Find the transfer function,

$$G(s) = \frac{X(s)}{F(s)}$$

For the translational mechanical system shown in Figure 2

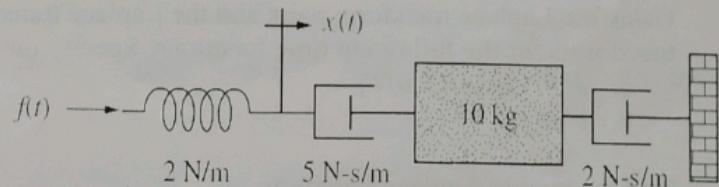


Figure 2

- 9 Find the output response, $c(t)$, for the systems shown in Figure 3.

Also find the time constant, rise time, and settling time.

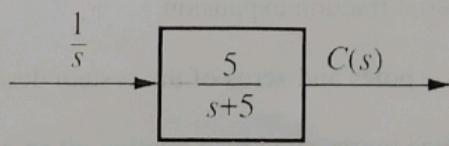
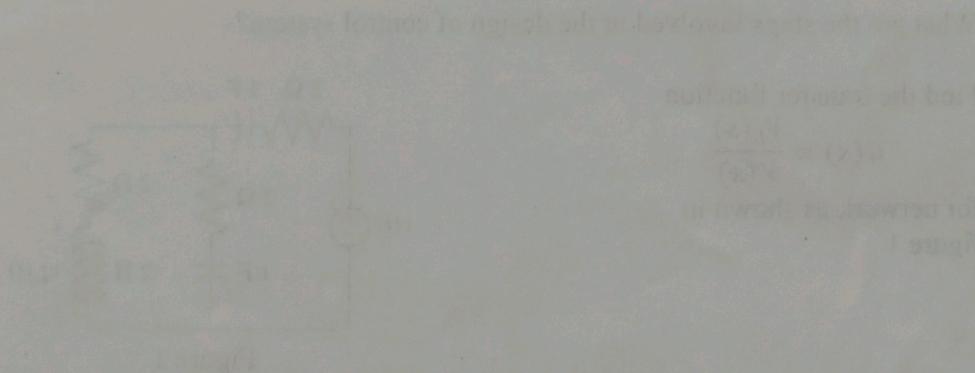
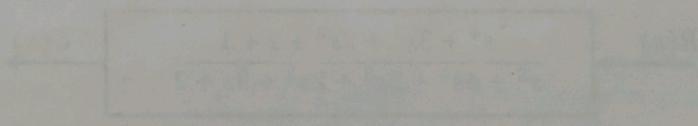


Figure 3

- 10 What is the type and order of following system. Justify your answer.

$$G(s) = \frac{s + 1}{s^2(s + 2)(s + 3)}$$



**SY Computer
Feedback Control System
Test 2**

Instructions to candidates:

1. All questions are compulsory.
2. All questions carry equal marks.
3. Figures to right indicates full marks.

1

- i For a second order underdamped system damping factor $\zeta = 0.5$ and natural frequency $\omega_n = 3$. Show these two factors graphically in s-plane 1
- ii Depending upon damping factor ζ classify the control systems 1
- iii The time response of a control system is the sum of the _____ and the _____. 1
- iv The _____ error is a measure of system accuracy. 1
- v If the characteristic equation of a system is $s^2 + 6s + 8 = 0$, the system is _____ damped. 1

- 2** A unity feedback system whose open loop transfer function is given by $\frac{\kappa}{s(sT+1)}$, when subjected to a unit step input gives underdamped response. If peak overshoot is 25% at 3 second, determine the value of K and T. By what factor K should be multiplied so that peak overshoot amplified from 25% to 75%? 10
- 3** Determine the stability of system using Routh-Hurwitz criteria having characteristic equation $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$. Also find the closed loop pole locations. 5