

B.Tech - 3rd(CSE/IT)
Data Structure and Algorithm

Full Marks : 70

Time : 3 hours

**Answer Q. No. 1 which is compulsory and
any five from the rest**

The figures in the right-hand margin indicate marks

1. Answer the following questions :

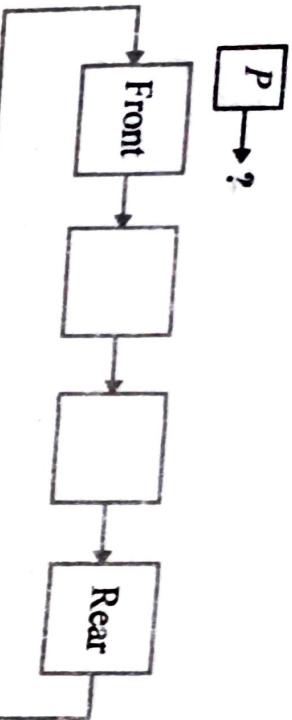
2×10

**2(a) What is a self-referential structure ? What
is their use ?**

**(b) A circularly linked list is used to represent a
Queue (as shown in the fig.) A single variable
P is used to access the Queue. To which of
the four nodes should P point such that both
the operations “Interest” and “Delete” can be
performed in constant time ? Justify your
answer.**

(Turn Over)

(2)



(c)

A priority queue Q is used to implement a stack that stores characters. PUSH (C) is implemented as INSERT (Q, C, K) where K is an appropriate integer key chosen by the implementation. POP is implemented as DELETEMIN(Q). Justify, which of the following is true. For a sequence of operations, the keys chosen are in :

- (i) Non-increasing order
- (ii) Non-decreasing order
- (iii) Strictly increasing order
- (iv) Strictly decreasing order

What do you mean by degree of a vertex in a directed graph ?

What is a binary search tree ? How many different binary search trees can be made with the node values 10, 11 and 12 ?

(3)

Consider the following sequence of integers : 8, 22, 7, 9, 31, 19, 5, 13. How many swaps are required to sort these in ascending order by using quick sort ? Assume 8 as the pivot element ?

(2)

Between insertion sort and selection sort which one is guaranteed to have the minimum time complexity when all cases (best/worst/average) are considered ?

(2)

Consider the two binary operators 'S' and '#' with the precedence of 'S' being lower than the operator '#'. Operator 'S' is left associative while operator '#' is right associative. Draw the expression tree for the expression : (7 # 3 S 4 S 3 # 2).

(i) What do you mean by internal and external path lengths of a strictly binary tree ?

(j) Differentiate between strongly connected, weekly connected and disconnected directed graphs.

(4)

2. (a) What are priority queues ? Discuss with example how a priority queue can be implemented using a single queue ?

- (b) Given the following pre-order and post

-order traversal results of a binary tree.
Construct the binary tree.

Pre-order traversal result : A B D G H K C E F
Post-order traversal result : G K H D B E F C A

3. (a) Write a C function to delete the node after a specific node containing an input data in a single linked list. Calculate the time complexity of the function and express it using the "Big-Oh" notation.

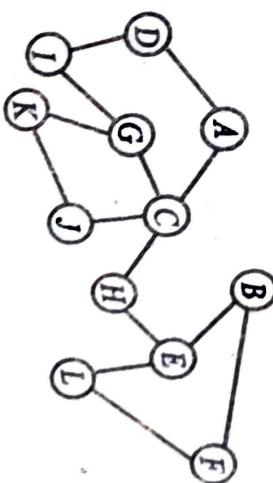
5 (b) Write an algorithm to reverse the node values of a single linked list.

- 5 (c) What is an AVL tree ? How is it better than a binary search tree ? Create an AVL tree using the following node values :
55, 66, 77, 15, 11, 33, 22, 35, 25, 44, 88, 99.

- 5 (d) Write an algorithm for the breadth-first traversal of a graph. Show the breadth-first traversal result of the following graph.

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- 5 (e) A two dimensional array A [50] [30] is represented in column-measure order in memory. Assuming that the matrix is floating point type and its base address is at 4700, calculate the address of the element A [36][21]. What would be the address of the same element if the matrix is represented in row-measure order ?



(5)

10 (a) Discuss the array representation of a stack. Write C functions to push an element into the stack, to pop the stack top, and to traverse the stack when the stack is implemented as an array.

10

5 (b)

5 (c)

5 (d)

5 (e)

(Set-K)

Total Pages - 7

array of elements by using the following method : 9, 6, 8, 7, 21, 14, 15, 19, 13, 12, 10

Heap-Sort

(a) What is hashing ? Explain the different hashing techniques used.

(b) What is dynamic memory management

functions available in 'C' to support dynamic memory management.

8. Write short notes on any two :

- (i) B + trees
(ii) Warshall's algorithm
(iii) Merge sort.

5 x 2

Time : 3 hours

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How is it performed ? Discuss the built-in

memory management.

The figures in the right-hand margin indicate marks
2 x 10

1. Answer all questions :

(a) C++ is portable or not ? Justify your answer.

(b) What do you mean by typecasting ? Describe

(a) its types.

(b) Define Polymorphism. How it is implemented
in C++ ?

(c) Write the objectives of super keyword.

(d) What is the difference between Exception
and Exception handling ?

B.Tech-3rd (CE/CSciIT/Chem) Object Oriented Programming

Full Marks : 70

(2)

What is the output of following program ?

```
#include<iostream.h>
static int b = 0;
void DisplayData(int *x int *y = &b)
{
    cout<< *x << " " << *y;
}
int main()
{
    int a = 10, b = 20;
    DisplayData(&a, &b);
    return 0;
}
```

What is the output of following program ?

```
#include<iostream.h>
#include<iostream.h>
struct MyData
{
public:
    int Addition(int a, int b = 10)
    {
        return (a += b + 2);
    }
}
```

(3)

float Addition(int a, float b);

```
float Addition(int a, float b);
{
    MyData data;
    cout<<data.Addition(1)<<" ";
    cout<<data.Addition(3, 4);
    cout<<data.Addition(3);
    return 0;
}
```

What is the output of the following program
(h) What is the output ?
with justification

```
#include<iostream.h>
typedef void(*FunPtr)(int);
int Look(int = 10, int = 20);
void Note(int);
int main()
{
    FunPtrptr = Note;
    (*ptr)(30);
    return 0;
}
```

(4)

```
int Look(int x, int y)
{
    return(x + y % 20);
}

void Note(int x)
{
    cout << Look(x) << endl;
}
```

Q Define Namespace. What is the need of namespace?

Q What is dynamic initialization of objects ? Why is it needed ?

Q Define class and describe its structure. An

electricity board charges the following rates to domestic users to discourage large consumption.

For the first 100 units — 50 P per unit
Beyond 300 units — 60 P per unit
If the total cost is more than Rs. 250.00 then an additional surcharge of 15% is added on the difference. Define a class Electricity in which

(5)

the function Bill computes the cost. Define a derived class More_Electricity and override Bill to add the surcharge.

Q Define inheritance and describe its types briefly ? Develop a program in C++ to create a database of the following items of the derived class. Name of the patient, sex, age, ward number, bed number, nature of illness, date of admission. Design a base class consisting of data members : name of the patient, sex and age; and another base class consisting of the data members: bed number and nature of the illness. The derived class consists of the data member, date of admission. Program should carry out the following methods :

- (i) Add a new entry
- (ii) List the complete record
- (iii) Delete one existing entry.

10

4. Q What is the difference between class and object ? Write a C++ Program to compute following using class :

$$1 - x^2/2! + x^4/4! - x^6/6! + x^8/8! - x^{10}/10! + \dots$$

(6)

✓(b)

What do you mean by method overloading?
Write a C++ program to print following:

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4 5 6

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✓(c)

What is friend function? What is the

difference between function and friend
function? Write a C++ program to overload

friend

operator using friend function.

Ans

Write a C++ program to overload

Read the text from the file in the file.

Display the contents of the file in reverse order.

(a) Give a function template SEARCH that can

be used to search an array of elements of any

5

(7)

throws keyword? Give one example for each.

if found. Give both the function prototype and the function definition for the template.

Assume a class template Array <T> is available.

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(b) What is a command line argument? Write a

C++ program to swap two numbers using command line arguments and inline function.

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(c) What is the difference between throw and throws keyword? Give one example for each.

(b) What is containership? How does it differ from inheritance?

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⑧ (d) Write short notes on any two :

5 x 2

✓(i) Function overriding

(ii) Trigraph sequence character

(iii) Copy Constructor

(iv) Hybrid inheritance.

Total Pages—5

(Set-K)

B.Tech-3 (All Br.)
Mathematics-III

Full Marks : 70

Time : 3 hours

Answer six questions including Q.No.1
which is compulsory.

The figures in the right-hand margin indicate marks.

Symbols carry usual meaning.

1. Answer all questions : 2×10

- ① (a) In which direction from the point $(1, 3, 2)$,
the directional derivative of $\phi(x, y) = 2zx - y^2$,
is maximum.
- ② (b) State the Dirichlet's conditions for $f(x)$ so
that it can be expanded as a Fourier series.

(c) Choosing a proper coordinate transfor-
mation to find Jacobian, and using formula
for volume of a sphere, evaluate the volume

$$\text{of } \frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1 .$$

(Turn Over)

(2)

1-2

(a) Define error function. Prove that

$$\operatorname{erf}(-x) = -\operatorname{erf}(x).$$

b (e) Express x^2 as a sum of Legendre polynomials.

(f) Evaluate $\int_0^{\infty} x^6 e^{-2x} dx$.

(g) Derive the condition for a fluid field to be irrotational and incompressible in nature.

(h) Prove that $\operatorname{div} \operatorname{Curl}(\vec{f}) = 0$.

(i) State Stokes theorem, and derive Green's theorem as a particular case.

(j) State Convolution theorem.

2 (a) Verify Divergence theorem:

$$\iint_S (7x_i^i - zk) dA$$

over the Sphere: $x^2 + y^2 + z^2 = 4$.

5

$$2^3$$

$$\iint_S (7x_i^i - zk) dA$$

B.Tech-3(AII Br)/Math-II(SET-K)

(3)

2-3

(b) Evaluate the double integral $\iint_R (x^2 + y^2) dx dy$

over a region R : square with vertices $(0,0), (1,1), (2,0), (1, -1)$ by proper transformation of variables and using Jacobian.

3. (a) Write Parseval's identity for $f(x) = x, 0 < x < 2$ using cosine series of $f(x)$. Also prove that,

$$\text{for odd } n, \sum_1^{\infty} \frac{1}{n^4} = \frac{\pi^4}{96} \quad 5$$

(b) Find the Fourier series of $f(x) = \begin{cases} 0, & -\pi < x < 0 \\ \sin x, & 0 < x < \pi \end{cases}$

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4. (a) Starting from Cartesian coordinate derive the expression for gradient, divergence, curl in term of spherical polar coordinate.

(b) Prove that

$$J\left(\frac{x, y}{u, v}\right) \times J\left(\frac{u, v}{r, \theta}\right) = J\left(\frac{x, y}{r, \theta}\right)$$

6

where $x, y = f(u, v)$ and $u, v = g(r, \theta)$.

4

(Continued)

B.Tech-3(AII Br)/Math-II(SET-K)

(Turn Over)

(4)

(5)

5. (a) Define Beta and Gamma functions, Also derive

$$\text{the relation } \beta(m, n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}.$$

(b) Prove that

$$\int_{-1}^1 P_n(x)P_m(x)dx = 0, \quad n \neq m \quad \textcircled{L}$$

where $P_n(x)$ and $P_m(x)$ are Legendre polynomials.

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6. (a)

$$\bar{F}(x, y, z) = 2xyz^2\hat{i} + (x^2z^2 + z\cos(yz))\hat{j} + (2x^2yz + y\cos(yz))\hat{k}$$

is conservative or not. If yes, find a scalar potential for it.

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$$(b) \text{Prove that } \left(J_{\frac{1}{2}}(x) \right)^2 + \left(J_{\frac{-1}{2}}(x) \right)^2 = \frac{2}{\pi x}. \quad \textcircled{L}$$

7. (a) Express Laplaceian by polar coordinate.

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(b) Find Fourier cosine and sine integral of

$$f(x) = e^{-kx}. \quad \textcircled{L}$$

(b) Find the area of a sphere using surface integral.
 from $x = -\pi$ to $x = \pi$. Hence show that

$$\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} \dots = \frac{\pi^2}{12}.$$

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1, 2

8. (a) Find the area of a sphere using surface integral.

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Total Pages—5

(Set-K)

B.Tech - 3 (All Br.)
Engineering Economics

Full Marks : 70

Time : 3 hours

**Answer six questions including Q.No.1
which is compulsory.**

The figures in the right-hand margin indicate marks.

Symbols carry usual meaning.

1. Answer all the questions : 2×10

(a) Why the short-run total cost will exceed the long-run total cost ?

✓(b) What is meant by risk ? How does it differ from uncertainty ?

✓(c) What is the relationship between average cost and marginal cost ?

(d) What is Break-even point ?

(e) Which curve is known as 'planning curve' and why ?

(Turn Over)

(2)

Q) How the job security (\bar{s}) is determined in

managerial enterprise model of Marris ?

② Q) What do you mean by externality ? Give a suitable example of negative externality ?

✓(h) What is the condition for efficiency in production to attain Pareto-efficient situation ?

② ✓(i) What is null hypothesis ?

a suitable example for its use in regression technique.

2. ✓(a) What is production function ? Distinguish between fixed inputs and variable inputs. Is the long run ?

✓(b) Explain the three stages of short run production function with a suitable example.

(a) What is St. Petersburg paradox ? How did Daniel Bernoulli solve it ?

(b) Explain the procedure to construct the Neumann-Morgenstern utility index.

M.Sc-3(AUBr)/E.E.(Set-K)

(3)

4. (a) Given the production function = $100 K^{0.5} L^{0.5}$, cost constraint $C = \text{Rs. } 1200$, wage rate of labour $w = \text{Rs. } 30$ and price per unit of capital $r = \text{Rs. } 40$. Determine the quantity of labour and capital that the firm should use in order to maximise output. What is the level of output ?

(b) Derive the long-run average cost curve from short-run average cost curve.

✓(a) Write short notes on (i) Public goods, (ii) Free-rider problem.

(b) Briefly explain the Baumol's single product model without advertisement for sales revenue maximisation.

⑤

✓(a) Distinguish between :

(i) Indifference curve and Indifference map

(ii) Price Consumption Curve and Income Consumption Curve.

(b) Decompose the price effect into income and substitution effect.

5

(4)

7 (a) The Government of Odisha is planning a hydroelectric project for the river Suktel basin.

In addition to the production of electric power, this project will provide flood control, irrigation and recreation benefits. The estimated benefits and costs that are expected to be derived from the project are listed below :

$$\text{Initial cost} = \text{Rs. } 18,00,00,000$$

$$\text{Annual power sales} = \text{Rs. } 1,20,00,000$$

$$\text{Annual flood control savings} =$$

$$\text{Rs. } 50,00,000$$

$$\text{Annual irrigation benefits} = \text{Rs. } 80,00,000$$

$$=$$

$$\text{Annual operating and Maintenance cost} =$$

$$\text{Rs. } 40,00,000$$

$$\text{Life of the project} = 40 \text{ years.}$$

Check whether the Government of Odisha should implement the project. Assume the rate of interest ($i = 15\%$).

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	Age in years (X)	Mileage in kms (Y)
	2	14
	3	10
	5	18
	6	22
	4	12
	8	10
	1	16
	7	08
	9	14
	12	6

5

8 (a) Explain the Coase bargaining theorem.

8 (b) A second hand car dealer has 10 cars for sale. She decides to investigate the link between the age of the cars and the mileage. The data collected from the cars are shown in the table below :

	Age in years (X)	Mileage in kms (Y)
	2	14
	3	10
	5	18
	6	22
	4	12
	8	10
	1	16
	7	08
	9	14
	12	6

Find the equation of the least squares regression line in the form $Y = \alpha + \beta X$. Give the values of α and β to 2 decimal places. Also give a practical interpretation of the regression result. Estimate the mileage for a 15 years old car based on the estimated regression coefficients.

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alternative has a life of five years and a negligible salvage value. The MARR = 12%.

Suggest the best alternative to the company based on IRR method.

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(5)

(Set-K)

B.Tech-3 (CS/IT)
Digital Electronics Circuits

Full Marks : 70

Time : 3 hours

**Answer six questions including Q.No.1
which is compulsory.**

*The figures in the right-hand margin indicate marks.
The figures carry usual meaning.*

2×10

1. Answer all the questions :

- ① (a) Convert $(9)_{10}$ into Excess-3 and Gray code.
- ② (b) Convert $(268.75)_{10}$ into Octal and Hexa-decimal.
- ③ (c) What is the output for $A \text{ XOR } A$?
- ④ (d) Simplify $A \text{ XOR } B \text{ XOR } AB$.
- ⑤ (e) What is the dual function of $A(B'C + BC + BC')$?

(Turn Over)

(2)

Q. Differentiate between synchronous and asynchronous circuit.

(g) Differentiate between combinational and sequential circuit.

(g) What is the difference between truth table and excitation table?

(g) What is race-condition?

Q. Differentiate between PAL and PLA.

Q. Simplify the following Boolean expression

$$Y(A, B, C) = \prod M(1, 2, 5, 6, 8, 9, 15)$$

(b) Minimize the following Boolean expression using K-map:

$$Y(A, B, C, D) = (A + B + C)(A' + B + D)$$

3. (a) Reduce the following equation using Quine-McCluskey method of minimization :

$$f(A, B, C, D) = \sum m(0, 1, 3, 4, 5, 7, 10, 13, 14, 15)$$

(b) Using K-map, simplify the equation :

$$F(A, B, C, D) = \sum m(0, 2, 8, 9) + d(3, 7, 10, 11, 14, 15)$$

B.Tech-3(CS/IT)/D.E.S.(Set-K)

(Continued)

(3)

Q. Design a Full Adder using Half Adders.

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Q. (a) Design a Full Adder using Half Adders.

5

Q. (b) A combinational circuit has four inputs and one output. The output is equal to 1 when : (i) all the inputs are equal to 1, (ii) none of the inputs are equal to 1, and (iii) an odd number of inputs are equal to 1. Find the simplified output function in sum of the product form and draw the logic diagram.

Q. (a) Design a 16:1 MUX using 8:1 and 2:1 MUX.

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Q. (b) Design a combinational circuit that compares two 4-bit numbers A and B to check if they are equal. The circuit has one output f , so that $f = 1$, if $A = B$, and $f = 0$ if $A \neq B$.

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Q. (b) Design a 4-bit up/down ripple counter.

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(b) Design a circuit to generate the sequence

$$0 \rightarrow 2 \rightarrow 5 \rightarrow 4 \rightarrow 7 \rightarrow 3$$

5

7. (a) Explain how a JK flip-flop is converted into D flip-flop, and T flip-flop.

5

(b) Draw the logic diagram of the counter that generates the pulse train "10101".

B.Tech-3(CS/IT)/D.E.S.(Set-K)

(Continued)

(4)

A 8. (a) Show the hardware implementation of $D \leftarrow A'$ in RTL notations. Assume all register to be 4-bit.

5

(b) Realize the following function and draw the logic diagram using PAL:

- (i) $F(A, B, C) = \Sigma m(3, 4, 5, 7)$
 - (ii) $G(A, B, C) = \Sigma m(1, 3, 5, 6, 7)$
 - (iii) $H(A, B, C) = \Sigma m(1, 4, 5)$
-