

Program Development Life Cycle/ Programming Process

Program: A Program consists of a series of instructions that a computer processes to perform the required operation. In order to design a program, a programmer must determine three basic rudiments:

- The instructions to be performed
- The order in which those instructions are to be performed.
- The data required to perform those instructions.

Program Development Cycle/ Problem Solving Strategies:

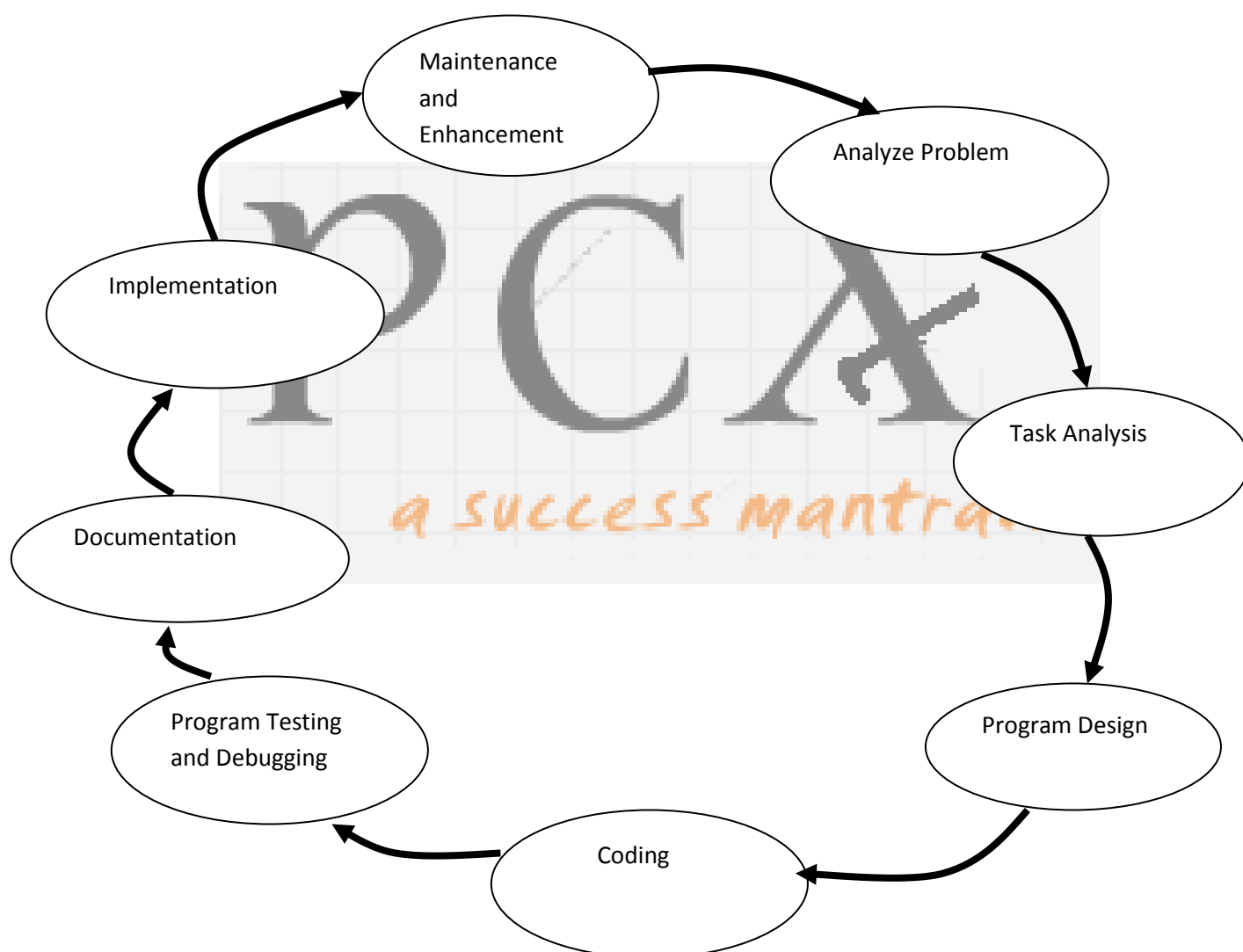
1. **Analyze/ Define the Problem:** In this phase, the problem is analysed precisely and completely. Based on his understanding, the developer knows about the scope within which the problem needs to be developed. It includes the specification of inputs and outputs processing requirements, system constraints (execution time, accuracy, response time), and error handling methods. This is the most critical phase as inadequate recognition of a problem is the key element responsible for poor performance of computers.
2. **Task Analysis:** After analyzing the problem, the developer needs to develop various solutions to solve the given problem. From these solutions, the optimum solution is chosen, which can solve the problem comfortably and economically.
3. **Program Design:** After selecting the appropriate solution, the next stage is Program Design. Various programming tools are used to develop the basic logic of the selected solution also known as basic programming constructs. These tools are:
 - Algorithms
 - Flowcharts
 - Pseudo codes
 - Decision Table
4. **Coding the Solution:** After meeting all the design considerations, the actual coding of the program takes place in the chosen programming language. Depending upon application domain and available resources, a program can be written by using computer languages of different levels such as machine, assembly or high –level languages.
5. **Program Testing and Debugging:** - Testing is the process of checking whether the program performs the intended tasks, and debugging is the process of locating and eliminating bugs in the program. Generally, there are two types of error in the program:
 - **Syntax Error:** when the rules or syntax of the programming language are not followed such as incorrect punctuation, incorrect word sequence, undefined terms etc.
 - **Logical Errors:** - errors in planning the program's logic.

Testing procedure involves running the program to process input test data that will produce known results. Test data includes

- Normal data
 - Unusual but valid data
 - Incorrect, incomplete, or inappropriate data which will test the error handling capabilities of the program.
6. **Program Documentation:** To diagnose any subsequent program errors, modifying or reconstructing a lost program. It includes the following:
 - The Program specification i.e. what the program is supposed to do.
 - The Program descriptions i.e. input, output and file layout plans, flowcharts etc.
 - The test data employed in debugging the program.
 - The operation manual which details the operating instruction for the computer operator.

- The maintenance documentation that is listings of any subsequent amendments to the program.
- 7. Program Implementation:** After performing all the aforesaid steps, the program is installed on the end user's machine. The user is also provided with all the essential documents so that he can understand how the program works. The implementation can be viewed as the final testing because only after using the program, the user can point out the weaknesses, if any, to the developers. Based on the feedback, the programmers can modify or enhance the program.
 - 8. Maintenance and Enhancement:** After the program is implemented (loading and executing the program on user's computer), it should be properly maintained taking care of the changing requirement of its users and system. The program should be regularly enhanced by adding additional capabilities. This phase is also concerned with detecting and fixing these errors, which were missed in testing phase. Since this step generates user feedback, the programming cycle continues as the program is modified or reconstructed to meet the changing needs.

Program Development Life Cycle



Algorithm:

An Algorithm is defined as a finite sequence of explicit instructions that, when provided with a set of input values, produces an output and then terminates. It is a step-by-step description of how to arrive at a particular solution of the given problem.

Characteristics of an Algorithm

1. There should not be any uncertainty about which instruction to be executed next.
2. The description of the algorithm must be finite. An algorithm cannot be open ended.
3. The execution of the algorithm should conclude after a finite no. of steps.
4. The algorithm must be general enough to deal with any contingency.
5. There must be no ambiguity in any instruction.

Flowchart:

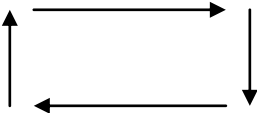
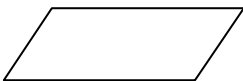
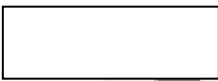
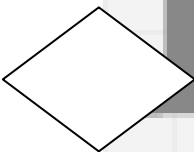
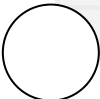
A flowchart is a diagrammatic representation that illustrates the sequence of operations to be performed to get the solution of a problem. Steps are drawn in the form of different shapes of boxes and the logical flow is indicated by interconnecting arrows. The boxes represent operations and the arrows represent the sequence in which the operations are implemented. The primary purpose of the flowchart is to help the programmer in understanding the logic of the program. Therefore, it is always not necessary to include all the required steps in detail. Flowcharts outline the general procedure.

Flowcharts can be compared with the blueprint of the building. Just an architect draws a blueprint before starting construction of a building; a programmer draws a flowchart prior to writing a computer program.

Types of Flowchart:

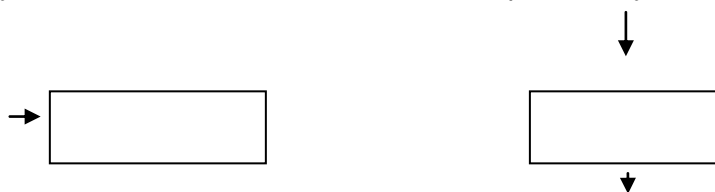
1. **System Outline Charts (Global Map):** These charts merely list the inputs, files processed and outputs without regard to any sequence whatever. For e.g. Sale Order Processing.
2. **System Flowcharts (National Map):** Designed to present an overview of the dataflow through all parts of a data processing system. It represents the flow of documents, the operations or activities performed and the persons or workstations. It also reflects the relationship between inputs, processing and outputs. It basically comprises of following:
 - The sources from which input data is prepared and the medium or device used.
 - The processing steps or sequences of operations involved.
 - The intermediary and final output prepared on the medium and devices used for their storage.
3. **Run Flowcharts (State Map):** These are prepared from the system flowcharts and show the reference of computer operations to be performed. The chart expands the detail of each compute box on the system flowchart showing input files and outputs relevant to each run and the frequency of each run.
4. **Program Flowchart (District Map):** Is the most detailed diagrammatic description of the logical/arithmetic operations on data within the CPU and the flow of data between the CPU on the one hand and the I/O Peripherals on the other.

Flowchart Symbols:

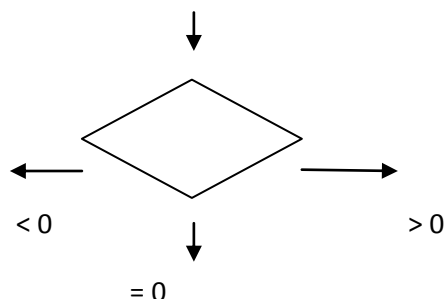
Symbols	Symbol Name	Description
	Flow Lines	Flow Lines are used to connect symbols. These lines indicate the sequence of steps and the direction of flow.
	Terminal	This symbol is used to represent the beginning (start), the termination (end) or halt (pause) in the program logic.
	Input/output	It represents information entering or leaving the system, such as customer order (input) and servicing (output).
	Processing	Process symbol is used for representing arithmetic and data movement instructions. It can represent a single step or an entire sub process with in a larger process.
	Decision	Decision symbol denotes a decision to be made. The program should continue along one of the two routes (IF/ELSE). This symbol has one entry and two exit paths. The path chosen depends on whether the answer to a question is 'yes' or 'no'.
	Connector	Connector symbol is used to join different flow lines.

Guidelines for Preparing Flowcharts:

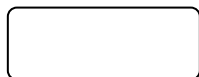
1. The flowchart should be clear, neat and easy to follow.
2. The flowchart must have a logical start and finish.
3. In drawing a proper flowchart, all necessary requirements should be listed in logical order.
4. The direction of the flow of a procedure should always be from left to right or top to bottom.
5. Only one flow line should come out from a process symbol.



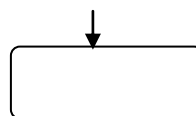
6. Only one flow line should enter a decision symbol. However, two or three flow lines may leave the decision symbol.



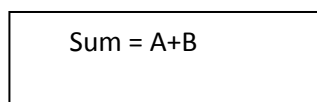
7. Only one flow line is used with a terminal symbol.



OR



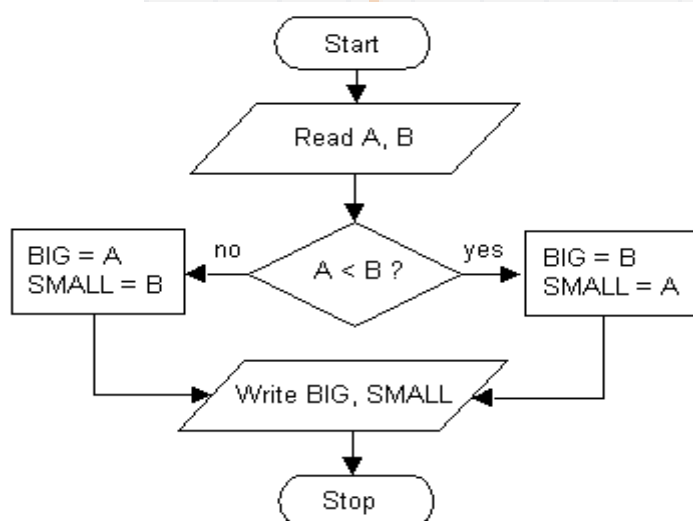
8. With in standard symbols, write briefly. If necessary, use the annotation symbol to describe data or process more clearly.



This process will add two no's and store the

9. In case of Complex flowcharts, connector symbols are used to reduce the no. of flow lines.
 10. Intersection of flow lines should be avoided to make it a more effective and better way of representing communication.
 11. It is useful to test the validity of the flowchart by passing through it with normal/unusual test data.

The example below shows the flowchart for a program that reads two numbers and displays the numbers read in decreasing order:



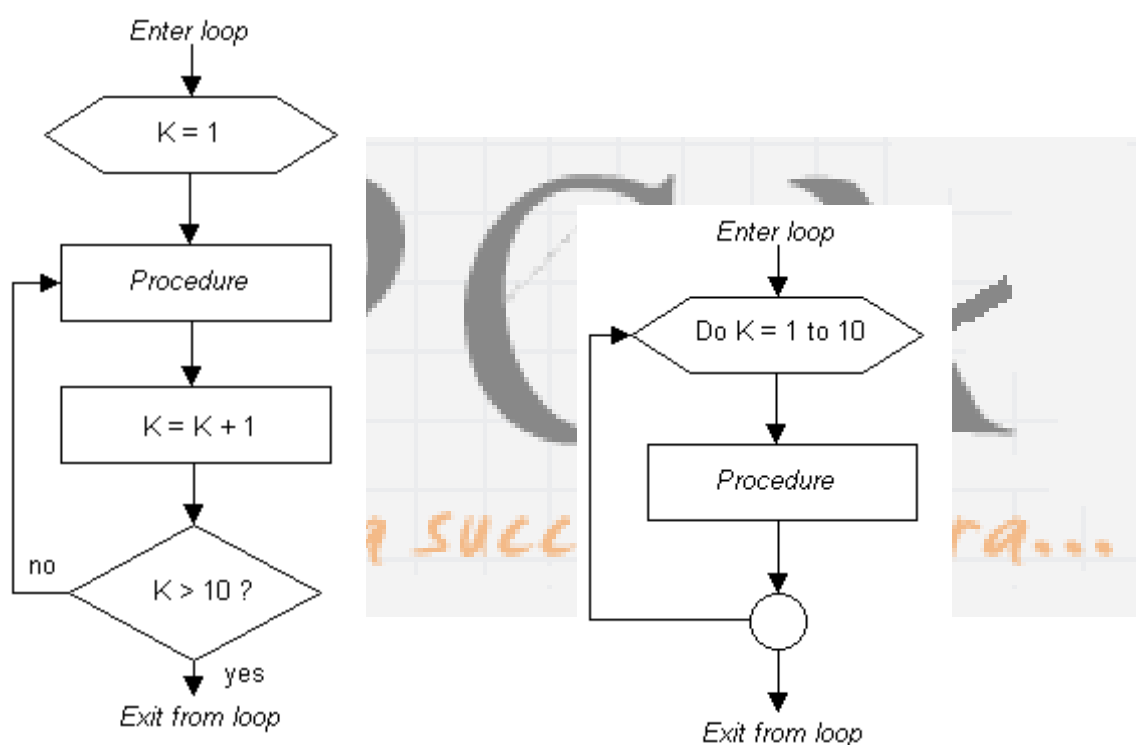
Loops:

Most programs involve repeating a series of instructions over and over until some event occurs. For example, if we wish to read ten numbers and compute the average, we need a loop to count the number of numbers we have read.

Count loops are loops where the program must count the number of times operations are completed. The flowchart below illustrates a loop that counts from 1 to 10:

Count Loop Flowchart

The Flowchart shown on the left may be simplified to the form shown on the right. While count loops work the exact number of times needed, in many cases we do not know how many times we want to do something. It is often dependent on the data provided to the program. Imagine we change our problem to read and compute the average of a number of numbers. We won't know how many numbers there are but will read numbers until there are no more.



Problems of Flowchart:

1. Draw a flowchart for finding the sum of first 100 odd numbers.
2. Draw a flowchart for finding the factorial of a no.
3. Draw a flowchart for finding the sum of first N multiples of an integer K.
4. Draw a flowchart for finding the largest and smallest among three nos.
5. Draw a flowchart for finding the sum of individual no. of a digit.
6. Draw a flowchart for finding whether a particular no. is Prime or not.
7. Draw a flowchart for finding the sum of squares of first 20 odd no's
8. Draw a flowchart for finding the simple interest given P, R, and T.
9. Draw a flowchart for finding the compound interest.

10. Draw a flowchart for computing the appropriate custom duty acc. to the class of goods and custom duty.

Class No.	Class of Goods	Custom Duty (%) on Values of goods V
1	Foods, Beverages	10
2	Clothing, Footwear	15
3	Heavy Machines	17 1/2
4	Luxury Items	40

Advantages of Flowcharts:

- Quicker grasp of relationship between various elements of application.
- Effective analysis of the problem.
- Best aid in communicating the facts of business problem to those whose skills are needed for arriving at the solution.
- Good approach of documentation.
- Helps in efficient coding.
- Helps in debugging the problem.
- Efficient program maintenance.

Limitations of Flowcharts:

- Complex and clumsy where problem logic is complex.
- Difficult to modify the existing one.
- Requires complete reproduction of the logic.
- Lengthy Procedure.
- No Proper standards are available in designing flowcharts.

Q: Program Debugging? Explain

(1 Marks) (May 2013)

FLOWCHART PRACTICE QUESTIONS

- Q.1 Draw a Flowchart to add 100 odd nos.
- Q.2 Draw a flowchart to add the following series
1, 11, 111, 1111, ----- 10 Numbers
- Q.3 Draw a flowchart to add sum of square of first 20 odd nos.
- Q.4 Draw a flowchart to add following series
2, 5, 10, 17, 26, ----- 10 numbers
- Q. 5 Draw a flowchart to add the following series
1, 1, 2, 3, 5, 8, 13, ----- 10 nos.
This series is known as Fibonacci series.
- Q. 6 Draw a flowchart to print the sum of square of following series.
3, 5, 10, 17, 26, 37, ----- 10 terms
- Q. 7 Draw flowcharts for following series
 $1A + 2A^2 + 3A^3 + 4A^4 + \dots N \text{ Terms}$
- Q. 8 Draw flowcharts for following series
 $1A - 2A^2 + 3A^3 - 4A^4 + \dots N \text{ Terms}$
- Q.9 Draw a Flowchart to sum up the following
 $1.3/2.4.5 + 2.4/3.5.6 + 3.5/4.6.7 + \dots N \text{ terms}$
- Q.10 Draw a Flowchart to find the value of K!
- Q.11 Draw a flowchart of which will calculate the sum of the first N multiples of an integer K
 $1 \times K + 2 \times K + 3 \times K + \dots + N \times K$
- Q.12 Draw a flowchart for finding the amount of an annuity of Rs. A in N years, Rate of Interest = r %, $R = 1 + r$, this amount is given by following series:
 $A + AR + AR^2 + AR^3 + \dots AR^{N-1}$
- Q.13 Draw a flowchart for finding the sum of the following given series.
 $8 \times 5 + 10 \times 8 + 12 \times 11 + 14 \times 14 + \dots$
Add the terms from the above series till the sum value will not exceed 5000. Print the sum and number of terms taken from the series.
- Q. 14 Draw a flowchart for computing and printing the simple interest for 10, 12, 13, and 14 years at the rate of 3% per annum on an investment of Rs. 10,000.

Q.15 Assume that you opened a savings account with a local bank on 1-1-2004. The annual interest rate is 5%. Interest is compounded at the end of each month. Assuming that your initial deposit is X rupee, draw a flowchart to print out the balance of your account at the end of each month for two years.

Logical Flowcharts:

Q 1. Draw a flowchart to calculate the commission of a sales representative based on the following set of rules.

- (i) If the sales is less than Rs. 5000, there is no commission.
- (ii) If the sales is Rs. 5000 or above but less than Rs. 50000, then the commission is computed @ 10% of the sales.
- (iii) If the sales is Rs. 50000 or above, the commission Rs. 5000 and @ 12% of the sales above Rs. 50000.

Print the sales and commission.

Q 2. The XYZ Company follows the following procedure for dealing with delivery charges for goods sold. For the purpose of determining delivery charges, customer is divided into two categories, those whose sales region code is 30 or above, and those with sales region code of less than 30.

- (A) If the code is less than 30 and invoice amount is less than Rs. 15000, the delivery charge is Rs. 300. If the invoice value is Rs. 15000 or more, the delivery charge is Rs. 150.
- (B) If the sales region code is equal to or greater than 30 and invoice total is less than Rs. 15000/- the delivery charge is Rs. 400/- For invoices totaling Rs. 15000 or more, the delivery charge is Rs. 200/-

Prepare a flow chart to find out and print delivery charges

Q 3. ABC India Ltd. has different types of items to sell to different types of customers. In order to promote its sale, discount is given as per the following procedure. A discount of 12% is allowed on Washing Machines irrespective of the class of customers and value of the order.

- (i) On cooking range, a discount of 12 % is allowed to Dealers and 9% to Retailers irrespective of the value of order.
- (ii) On decorative products, Dealers are allowed a discount of 20% provided the value of order is 10000 or above. Retailers are allowed a discount of 10% irrespective of the value of the order.

Draw a flowchart to calculate discount for above procedure.

Q 4. An electricity distribution company has three categories of consumers.

- (i) Domestic (ii) Commercial (iii) Industry

The charges of per unit consumed by these consumers are Rs. 3, Rs. 4 and Rs.5 respectively. The computer database of company provides following information (Consumer's Name, Category, Units Consumed, Bill Date and Date of Payment). The company processes the bills according to following criterion.

If consumer is domestic and pays his bill within 10 days of bill date 5% discount is given. If he pays within 15 days no discount is given. If he makes the payment after 15 days of bill date, 10% surcharge is levied. For non domestic consumers corresponding percentages are 10%, 0% and 15% respectively.

Draw a flowchart to calculate the Bill Amount, Discount, Surcharge and Net Amount of bill for each consumer and print the same.

Q 5. An Insurance company follows the following rules:

- (i) If a person's health is good and age in between 20 and 40 years and lives in city and sex is male, then the premium is Rs. 20 per thousand and he will be insured for maximum amount of Rs. 10 Lakhs.
- (ii) If a person satisfies all the above conditions, except sex is female, then the premium is Rs. 15 per thousand and maximum insured sum will be Rs. 15.0 Lakhs.
- (iii) If a person's health is poor and age is between 20 and 40 years, but lives in a village. For a male sex premium is Rs. 50 per thousand and maximum insured sum is Rs. 10 Lakh only.
- (iv) In all other cases the person is not to be insured.

Draw a flowchart to find eligibility of person to be insured, premium rate and maximum amount of insurance.

Q 6. A bank accepts the fixed deposit for a year or more and the policy on interest is as follows. (N03)

- (i) If a deposit is less than Rs. 10000 and for two or more years, the interest rate is 5% compounded annually.
- (ii) If a deposit is Rs. 10000 or more, but less than Rs. 50,000 and for two or more years the interest rate is 7% compounded annually.
- (iii) If deposit is Rs. 50000 or more and is for one year or more the interest rate is 8% compounded annually.
- (iv) On all deposits for 5 years or more interest rate is 10% compounded annually.
- (v) On all other deposits not covered by the above conditions, the interest rate is 3%.
- (vi) If the customer is holder of any type of account for last five years, an additional 1% interest is allowed.

Draw a flowchart to obtain the money in customer's account and interest credited at the time of withdrawal.

Q 7. Draw a flowchart to calculate the net discount allowed (In %) to customers by company based on the following policy.

Quantity Ordered	Normal Discount
1-99	5%
100-200	7%
201-499	9%
500-1000	10%
More than 1000	20%

These discounts are reduced or increased if the customer's account balance is below Rs. 5000 and does not have any balance in the account older than 3 months. If customer does not satisfy both the conditions the discount is reduced by 2%. If one condition is violated, the discounts

are reduced by 1%. If a customer has been trading with the company for over 5 years and conforms to both the above checks, then he is allowed an additional 1% discount.

Q 8. Pepsi India Ltd sells soft drinks to three types of sales outlet

- (a) Super Markets and Large departmental Store (b) Retailers (c) Hotel and Catering Establishments

Depending upon the sales outlet and value of sales, the discounts are offered as per the following chart.

Order Value	Discount Offered		
	Super Market	Retailers	Hotels & Catering
< Rs. 5000	5%	3%	4%
5000 to Less than 10000	8%	7%	7.5%
For Rs. 10000 and above	10%	10%	10%

Prepare a Flowchart to find out and print the discount offered.

Q 9. There are 100 employees working in a company, it is required to prepare a report of people who are likely to retire in the current financial year. The following information will be supplied for each employee of the company (i) Name (ii) Age (iii) Code (Code = 1 if no extension of service is given and code = 2 extension of service is given if person reach at the age of 58).

Any employee who reaches at the age of 58 or more in current financial year will retire subject to above conditions.

Draw a program flowchart to compute and print:

- (a) Name of the employee who is retiring and
(b) Number of employee who will continue in the service for next financial year.

Q 10. The following information will be provided during a program execution for 100 employees.

- (i) Name (ii) Basic Salary (iii) Dearness Allowance (iv) Type of Employee (P for Permanent and T for Temporary employees).

Draw a Flowchart to compute and print the following for each employee,

- (i) Name (ii) Gross Salary (iii) Net Salary

Where Gross Salary = Basic Salary + DA + HRA

HRA = 30 % of Basic Salary

Net Salary = Gross Salary – Deductions

Deductions = PF + TDS, Where PF = 12% of Basic Salary (for Permanent

employee only) TDS is calculated as follows:

Monthly Gross Salary	TDS
upto 10000	Nil
10001 to 15000	5% of Gross Salary
15001 to 25000	10 % of Gross Salary
>25000	20% of Gross Salary

- Q 11.** The Gross monthly remuneration of a Company's salesman comprises a basic salary and certain additional payments and bonuses as follows: Salesman with over 10 years service receive a 10 percent addition to their basic salary each month. Bombay salesmen receive an additional allowance of Rs. 1000/- per month.

Monthly Bonus payments are made and calculated as follows.

Monthly Sales	Bonus as % of monthly sales
Rs. 0-50000	0.5%
50001-100000	1.0%
above Rs. 100000	1.5%

DAF to find out the gross monthly remuneration of a salesman.

- Q 12.** ABC Company has eight sales offices all over Delhi. Each office sells 5 different products of the company. The product master file contains the following information for each product of each sales office.

(1) Opening Stock (2) Sale (3) Receipt from Factory

Draw a flowchart to Calculate and print

- Total closing stock of each sales office
- Total closing stock of entire company

- Q 13.** A bank has 500 employees. The salary paid to each employee is sum of his Basic Pay, Dearness Allowance and House Rent Allowance. For the purpose computing house rent allowance bank has classified his employees into three classes A, B and C. The House Rent Allowance for each class is computed at the rate of 30 percent, 20 percent and 10 percent of the basic pay respectively. The Dearness Allowance is computed at flat rate of 60% of Basic Pay. Draw a flowchart to determine the percentage of employees falling in the each of following salary slab:

- Above Rs. 30,000
- Rs. 15,001 to Rs. 30,000
- Rs. 8,001 to Rs. 15, 000
- Less than or equal to Rs. 8,000

- Q 14.** The weights of newly born babies in a hospital are input to computer. The hospital in charge is interested to find the maximum, minimum and mean weights of all the weights of babies. Draw a flowchart for this problem and a value of zero for weight can be used as end of flowchart.

Q 15. A company has many customers and for every customer following information is kept in database.

Account No., Name, Age, Sex and Unpaid Balance of Customer.

Draw a flowchart to computer and print the total unpaid balance for Males and Females under following categories.

- (i) Age Under 20
- (ii) 20 to under 30
- (iii) 30 to under 40
- (iv) 40 and over

Q 16. A company has many customers and for every customer following information is kept in database.

Account No., Name, Age, Sex and Unpaid Balance of Customer. Draw a flowchart to computer and print the AVERAGE UNPAID BALANCE for followings

- (i) Male
- (ii) Female Total

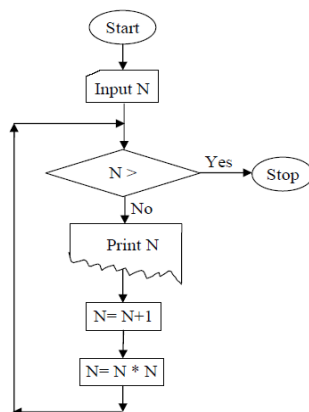
Q 17. A book publisher offers discount to customers on the basis of customer type and no. of copies ordered as shown below:

Customer type	No. of copies ordered	% of Discount
Book Seller	More than 10	25
	Less than or equal to 10	15
Library	More than 5	20
	Less than or equal to 5	10

Customer number, name, type, book number, no. of copies ordered and unit price is given as input. Draw a flowchart to calculate the net amount of the bill for each customer each customer and print it. The above is to be carried for 50 customers.

Q 18. Write the output sequence (at least first five numbers) for the given flowchart, if $N = 0$ is selected as the value for N as input.

(b) If the statement " $N = N * N$ " in the computation box of the flowchart is modified as " $N = N * (N - 1)$ ". Write the output sequence (at least first five numbers) for the flowchart with $N = 0$ as the input value for N .
(10 Marks) (PCC-Nov 2009)



Q 19. A bicycle shop in Delhi hires bicycles by the day at different prices as shown in the table:

Season	Charges per day
Spring	8.00
Summer	9.50
Autumn	5.00
Winter	6.00

To attract his customers, the proprietor also gives a discount on the number of days a bicycle is hired for. If the hire period is more than 10 days, a reduction of 15% is made. For every bicycle hired, a deposit of Rs. 20 must be made. Develop a flowchart to print out the details for each customer such as name of customer, number of days a bicycle is hired for, hire charges and total charges including the deposit for 25 customers.

Q 20. Top down Municipality, is levying house tax, as per following rules :

Size if house in Sq.metre.	House tax rate per sq. metre
Less than 100	Nil
Upto Next 400	` 10
Upto Next 500	` 20
More than 1000	` 25

There is a surcharge of 5% of the value of House tax. Taking in to account the above factors, draw a flowchart to compute appropriate total house tax including surcharge for any one house.
(6 Marks) (IPCC May, 2013)

Q 21. Draw a flowchart to print the square of odd numbers between 10 to 50 and also print the sum of their square.
(8 Marks) (IPCC Nov, 2012)

Regards,
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