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CSE-B

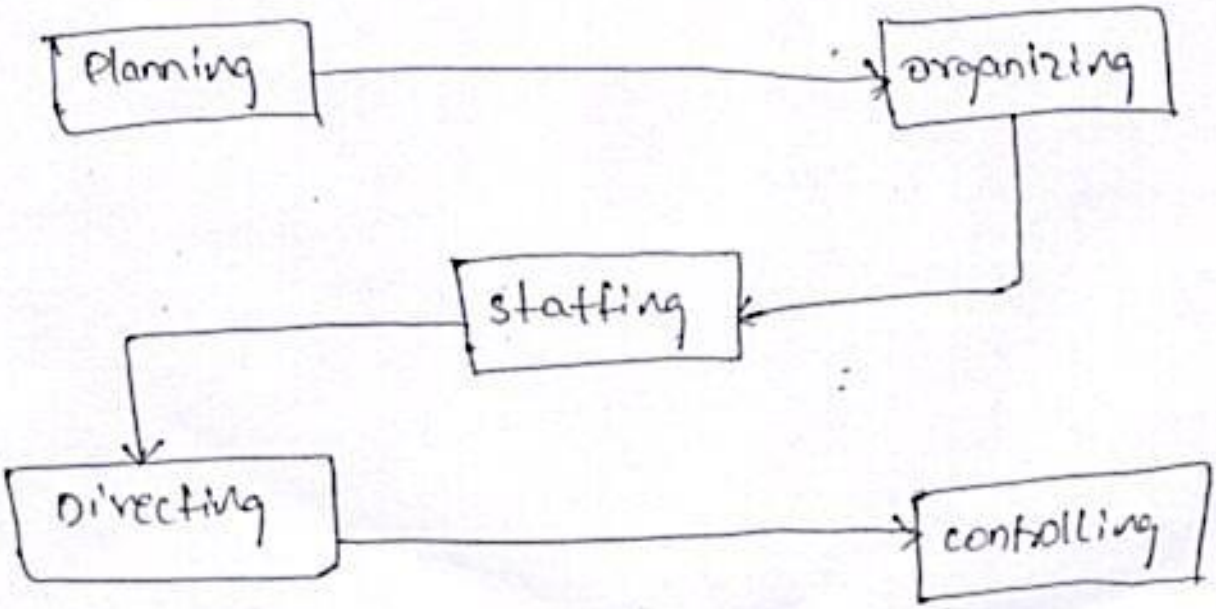
MOB Assignment-1 & 2 MOB-A-1

1) Define the management? Explain the management levels and functions.

A. Management: Mary parker defines the term management as- the art of getting things done through others

Functions of management:-
As indicated earlier, management is the process of planning, organizing, staffing directing and controlling the efforts of organization members in utilizing all resources organization objectives and mission management is a process as it operates the activities systematically.

The management process:



Planning:-
- Planning consist of the activities involved in choosing course of action to achieve organizational objectives
- both long-term and short term plan are necessary to achieve goals.

Organizing!-

- Organizing involves the grouping of jobs into framework for coordination and direction.
- Formal organization may be portrayed by use of an organization chat
- The matrix structure has evolved as a result of complex environments, markets and technology.

Staffing!-

Staffing is planning directing and controlling of procurement development, compensation, integration and maintenance and of people for the purpose of contributing to individual organizational and social goals

Directing!-

- Tapping the maximum potentialities of the people is possible through and command
- Thus direction is an important managerial function in securing employee's contribution.

Controlling!-

- After planning, organizing, staffing and directing the various activities the performance is to be verified in order to know whether the activities are performed in conformity with the plan and objectives or not

2) Explain the Fayal's principle of nargement.

A) In addition fayola listed out fourteen principles of nanagement They are

1. Division of labaor:-
the nore people specialize the nore efficienty they can perform their work This principle is epitomized by the modern assembly line.

2. Authority:- Managers must give orders so that they can get things done. while their formal authority give them the right to command, managers will not always compel obedience unless they have pesonal authority.

3. Discipline:- Members in an organization need to respect the rules and agreements that govern the organization To Fayola, discipline results from good leadership at all levels of the organization fair agreements

4. Unity of command:- Each employee must receive instructions from oly one person. Fayola belied that when an employee reported to nore than one manager conflicts in instruction and confusion of authority could ultimately result

5. Unity of direction:
Those operation within the organization that have the same objective should be directed by only one manager using one plan.

6. Subordination of individual interest to the common goal.
In any undertaking the interest of employee should not take precedence over the interest of the organization As a whole

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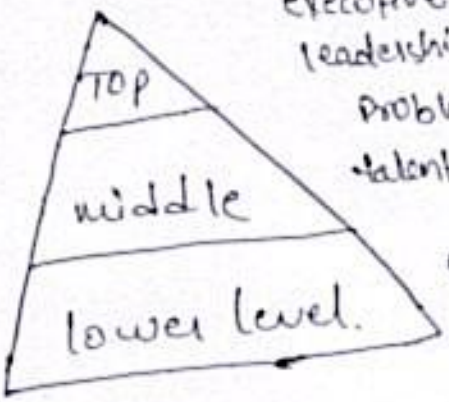
Management levels:



executive coaching, change management leadership, empowerment etc.
Problem achieving, team building talent development, performance.

emaotional intelligence & coaching for performance etc.

1. Top level management:

It consist of board of elements, directors, cheif executive or managing director. The top management is the ultimate source of authority and it manage goals and policies for an enterprise. It devote more time on planning and coordinating functions.

2. Middle level management:

The branch managers and departemental managers constitute middle level. They are responsible to the top management for the functioning of their department. They devote more time to organizational and directional functions.

3. Low level management:

Low level is also know as supervisory (operative level of management. It consist of supervisors foreman, section offer, superintendent etc. According to R C. Davis - supervisory management refers to those executives whose work to be largely with personal oversight and direction of operative employees.

3. What is HRM? write objectives, Scope and importance of HRM?

Human resource management:

HRM focuses on all issues related to people in the organizatio
The people in an organization are the most important asset.
Managing human resources is one of the key function of
business organizations. The people in the organization instrumental
to success, so managing people in an efficient and effective
way is essential.

objectives of HRM:-

* The object of HRM is to ensure the availability of competent and willing work force to an organization

* Societal objectives:-

To be ethically and socially responsible to the needs and challenges of the society while minimizing the negative impact of such demands upon the organization.

* Organizational objectives:-

To recognize the role of HRM in bringing about organizational effectiveness. It is only a means to assist the organization with its primary objectives. simply stated, the department exists to serve the rest of the organization.

* Functional objectives:-

To maintain the department contribution at a level appropriate to the organization's needs. the department level of service must be tailored to fit the organization it services.

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7. Remenoration:- compensation for work done should be fair to both employees and employers.

8. Centralization:- Decreasing the role of subordinates in decision making is centralization, increasing their roles is decentralization.

9. order: materials and people should be in the right place at the right time. people in particular should be in the jobs or position in which they are most suited.

10. equity: managers should be both friendly and fair to the subordinates

11. stability of staff: A high employee turnover rate undermines the efficient functioning of an organization.

12. initiative: subordinates should be given the freedom to conceive and carry out their plans, even though some mistake may result

13. Esprit de crops: promoting team spirit will give the organization a sense of unity.

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Personal objectives:-

to assist employee in achieving personal objectives of emp. at least inorder all these goals enhance the individual contributed to the organization. personal objectives of employees must be met if workers are to be maintained retained and motivated.

Scope of HRM:-

HRM in personnel management: This is typically direct man power management that involves man power planning hiring, training and development, induction and orientation transfer, promotion, compensation, layoff and retrenchment. employee productivity. the overall objective here is to ascertain individual growth development and effectiveness which indirectly contribute

HRM in employee welfare: this particular aspect of HRM deals with working conditions and amenities at workplace. this includes a wide array of responsibilities and services such as safety, services, health services, welfare funds, social security and medical services.

Significance of HRM:-

Achieving objective:- HRM helps a company to achieve from its objective from time to time by creating a positive attitude among workers. Reducing wastage and making maximum use of resources etc.

Facilities professional growth:- Due to proper HR policies employees are trained well and this makes them ready for future promotions.

Helps an individual to work in team:

HRM in employee welfare: The

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Management Organization & Behaviour

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CSE-A

ASSIGNMENT-IV 2

1. Define Management? Explain the management levels & functions.

Management :- The art of getting things through others.

Mancenich, Donelly & Gibson defines, the term Management as the process undertaken by one or more persons to coordinate the activites of other persons to achieve results not attainable by any one perso acting alone.

Management levels:-

1. Top level of Management :- It consists of board of directors, chief of executive or Managing director. It is the ultimate source of authority & it Manages goals & polices for an enterprise.

a. Top mgmt lays down the objectives & board policies of the enterprise.

b. It prepares strategic plans & policies for the enterprise.

c. It appoints the executive for middle level.

d. It Controls & Coordinates the activites of all the departments.

e. It is also responsible for Maintaining a contact with the outside world

f. It Provides guidance & direction

g. It issues necessary instructions for preparation of department budgets, Procedues, schedules etc..

2. Middle level of Management :- The branch Manager & departmental Manager constitute middle level. They are responsible to the top Manag

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ment for the functioning of their dept.

a. They make plans for the Subunits of the organization.

b. They participate in employment & training of lower level managen ent.

c. They interpret & explain policies from top level mgmt to lower le

d. They are responsible for coordinating the activites within the division or department

e. It also Sends important reports & other important data to top level mgmt

f. They evaluate performance of junior manages.

3. Lower level of Management :- It is also known as Supervisory / oper -e level of mgmt. It Consists of Supervisors, foreman, Section office Superintendent etc.

a. Assigning of jobs & tasks to Various workers.

b. They guide & instruct workers for day to day activites.

c. They are responsible for the quality as well as quantity of production.

d. They help to solve the grievances of the workers

e. They supervise & guide the sub ordinates

f. They are responsible for providing training to the workers.

g. They arrange necessary materials, machines, tools etc for gettir the things done.

h. They prepare periodical reports about the performance of the workers.

i. They ensure discipline in the enterprise.

j. They motivate Workers.

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Q. Explain the Fayal's Principles of Managements.

A:- 1. Division of labour:- The more People specialize, the more efficiently they are perform their work. This principle is epitomized by the modern assembly line.

2. Authority:- Managers must give orders so that they can get thing done. While their formal authority gives them the right to comman managers will not always compel obedience unless they have Authority

3. Discipline:- Members in an organization need to respect the rules & agreements that govern the organization.

4. Unity of Command:- Each employee must receive instructions fro only one Person.

5. Unity of direction:- Those operations within the organization that have the same objective should be directed by only one manager using

6. Subordination of individual interest to the common goal:- the interest of employees should not take precedence over the interest of the organization.

7. Remuneration:- Compensation for work done should be fair to both employees and employers.

8. Centralization:- Decreasing the role of subordinates in decision making is Centralization, increasing their roles is decentralization.

9. The Hierarchy:- The lines of authority in an oraganization are often represented today by the neat boxes & lines of the org chart

10. Order:- Materials & People should be in the right place at the right time. People in Particular, should be in the jobs or positions in which they are most suited.

11. Equity:- Manager should be both friendly & fair to their subordi

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18. Stability of staff:- A high employee turnover rate Undermines the efficient functioning of an organization.

13. Initiative:- Subordinates should be given the freedom to conceive & carry out their plans, even though some mistakes may result

14 Esprit de Corps:- Promoting team spirit will give the organisation a sense of unity

3. What is HRM? Write objectives, Scope & importance of HRM

A:- Human Resource Management "The planning, organizing, directing & Controlling of the various aspects of human resources to the end the individual, organizational & Social objectives are accomplished"

Objectives:- The Primary object of HRM is to ensure the availability of component & willing work force to an oraganization. HRM objectives are 4 ford Societal, organizational, functional & personal.

1. Social objectives:- To be ethically & Socially responsible to the needs & challenges of the Society while minimizing the negative impact of such demands the failure of oraganizations to use their resources for the society's benefit Unethical ways leads to restrict

2. Organizational objectives:- To recognize the role of HRM in (ir -g about organizational effectiveness. the dept exists to serve th rest of the oragnization.

3. Functional Objectives:- To maintain the department's contributi at a level appropriate to the oraganization's needs. The dept's level of service must be tailored to fit the organization it serv

4. Personal objectives:- To assist employees is achieving their Personal goals, at least insofar as these goals enhance the individual's contributed to the organization.

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Scope of HRM:-

·HRM in Personnel Management:- This is typically direct manpower mngt that involves manpower planning, hiring, training & developmen t. The overall objective here is to ascertain individual growth, devel. opment & effectiveness.

·HRM in Employee Welfare:- This particular aspect of HRM deals with working Conditions and amenities at workplace. It also relates to Supervision, employee Counseling, establishing harmonious relationships with employees, education & training.

·HRM in Industrial Relations:- Since it is a highly sensitive area it needs careful interactions with labor or employee Unions. It is the art & science of Understanding the employment relations & main, settlement of disputes.

Importance | Advantages of HRM:-

1. Achieving Objective:- HRM helps a Company to achieve from its objective from time-to-time by creating a positive attitude among workers.

2. Facilites Professional Growth:- Due to proper HR policies employees are trained well & this makes them ready for future promotions

3. Better Relationships b|w Union & Mgnt:- Healthy HRM practices can help the organization to maintain co-ordinal relationship with the Unions

4. Helps an individual to work in a team | Group:- effective HR practices tech individuals team work & adjustment. The individual are now very comfortable while working in team thus work

4 & Allocating the jobs to the Right Person :- If proper recruitment & Selection methods are followed, the company will be able to select the right people for the right job.

19/01/23

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MOB Assignment-3&4

1) What is strategic management explain the process of strategic management?

Ans:- Strategic management refers to a branch of management that deals with an organization's strategic objectives. This may include the development of the organization's vision, outlining its operational objectives and coming up with and implementing the organization's strategies.

Let's take a look at the essential steps in the strategic management process.

1) Goal Setting:-

The strategic management process is all about creating a road map to help you achieve your vision. So before you go any further, you need to clarify what your company wants to achieve. Many companies kick off the strategic management process by writing a vision statement. A vision statement communicates where you want to be in the future.

For ex:- growing revenue or improving customer service could be goals at this point

2) Environmental Scanning and analysis:-

You need to know where you stand currently. That includes internal factors like your location, structure, and talent, as well as external factors like your competition and market forces.

The stronger the foundation of your strategic plan, Here are some tips for conducting an analysis.

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1) Solicit feedback:-

Employee surveys, interviews, and discussion groups can be used to learn about the perspectives of everyone in the company.

2) Learn about your customers:-

You can survey your existing customers or email list to learn more about how your customers and prospects feel. You'll learn about new product features they want, and you can plan to develop them.

3) Research the competitive environment:-

You can use Miro's competitor analysis template to analyze and evaluate the competitive landscape for products, services, and companies.

4) Consider your resources:-

Having a clear idea of your resources from the start will help you set realistic objectives.

5) Conduct a SWOT analysis:-

SWOT stands for Strengths, weakness, opportunities, and Threats. you can organize your SWOT analysis visually by using Miro's SWOT analysis template

3) Strategy formulation:-

It's finally time to write your strategic plan. In addition to your mission and vision statements, a strategic plan has a few key components.

1) Strategic objectives.

2) Tactics

3) Metrics.

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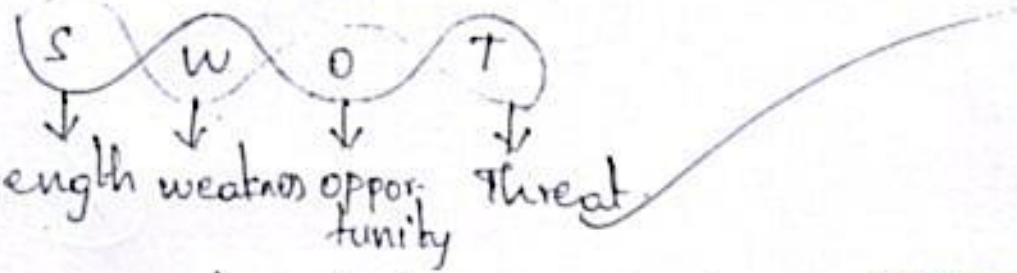
4) Strategy Implementation:-
You determined your organization's strategy, but the work has just begun. Now you need to make a plan for implementing your strategic objectives
→ Secure any resources you need.
→ Delegate the work.
→ Launch the plan.
→ Offer training.
→ Make a plan to share your progress

5) Strategy evaluation:-
Most strategic plans cover the next three to five years But that doesn't mean you can't adjust your strategies along the way.

6) Explain Swort analysis.
Swort stands for strengths, weaknesses, opportunities and threats. Swot analysis helps you get a deeper understanding of the business, which will help you again better results and overcome any threats to the business.



→ SWOT analysis helps you analyse your external internal influences and external influences which will help you execute ideas in abetter way.

1) Strength:- strength is the first factor in SWOT analysis, which analysis essential success factors and strength of the business. There may be some part of your business that is performing well, which could be implemented in your mobile application to proliferable your online sales.

2) Weakness:- weakness prior helps you to prevent loss and business failure in the future. Finding out your weakness before building a mobile app for your businesses help know what to add and what not to add to your app to avoid failure.

3) oppurtunities:- you can convert your weakness and strengths into new opportunities for your mobile app idea. By finding out your strengths and weakness, utilizing them the right way and using other oppurtunities, you give your app idea a significant advantage

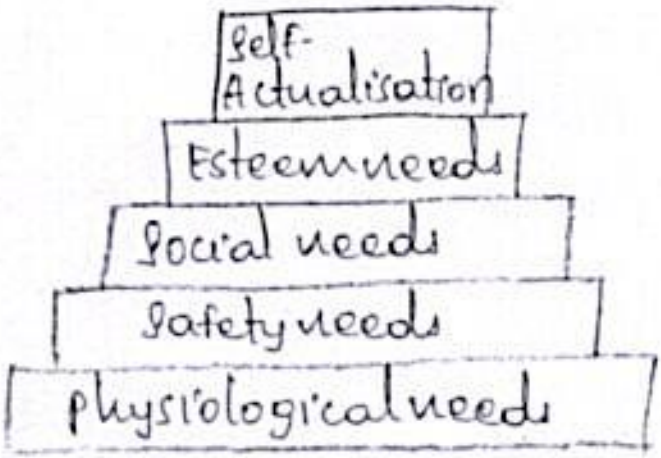
4) Threats:- There are numerous threats to business that need to be identified and worked to prevent. Observe your competitors how they overcome these threats.

3) Explain the theories of motivation (Maslow's theory of human needs)

Maslow's Need Hierarchy Theory:-

It is probably safe to say that the most well-known theory of motivation is Maslow's need hierarchy theory Maslow's theory is based on the human needs into a hierarchical manner from the lower

Maslow identified five levels in his need hierarchy as show in figure.



1) Physiological Needs:-

These needs are basic to human life and hence include food, clothing, shelter, air, water and necessities of life. These needs relate to the survival and maintenance of human life. once physiological needs are satisfied, they no longer motivate the man

2) Safety Needs:- After satisfying the physiological needs, the find expression in such desires as economic security and protection from physical dangers like physiological needs, these become inactive once they are satisfied.

3) Social Needs:-

Man is a social being. He is, therefore interested in social interaction, companionship, belongingness etc. It is this socialising and belongingness why individuals prefer to work in groups and especially older people go to work.

4) Esteem Needs:-
These needs refer to self-esteem and self-respect. They include such needs which indicate self-confidence, achievements, competence, knowledge and independence. However, inability to fulfill these needs results in feeling like inferiority, weakness and helplessness

5) Self-Actualisation Needs:-
This level represents the culmination of all the lower, intermediate, and higher needs of human beings. In other words the final step under the need hierarchy model is the need for self actualization. These refers to fulfillment.

CSE IV/II
'B' sec
II - Assignment

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Optimization in Operations Research

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CSE-B
III^rd YEAR

Assignment - I

1) Find optimal point of the function $f(x) = x^3 - 15x^2 + 10x + 100$

Sol: Given

$$f(x) = x^3 - 15x^2 + 10x + 100$$

$$f'(x) = 3x^2 - 30x + 10$$

$$f'(x) = 0$$

$$3x^2 - 30x + 10 = 0$$

$$x = 5 \pm \frac{\sqrt{195}}{3}$$

$$x_1 = 9.65$$

$$x_2 = 0.34$$

$$f''(x) = 6x - 30 \quad \text{——} \quad ①$$

put $x_1 = 9.65$ in eq-①

$$f''(9.65) = 6(9.65) - 30$$

$$\boxed{f''(9.65) = 27.9}$$

$f''(965)$ is +ve local minima

$$f''(0.34) = 6(0.34) - 30$$

$$\boxed{f''(0.34) = -27.96}$$

$f''(0.34)$ is -ve local maxima.

Local Minima → 27.9

Local Maxima → -27.96

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② Multi-Variable Optimization With Un-Constraint

(1) $f(x_1, x_2, x_3) = x_1^2 + 2x_2^2 + x_3^2 + x_1x_2 - 2x_3 - 7x_1 + 12$

Sol Given

$$f(x_1, x_2, x_3) = x_1^2 + 2x_2^2 + x_3^2 + x_1x_2 - 2x_3 - 7x_1 + 12$$

$$\frac{\partial f}{\partial x_1} = 2x_1 + x_2 - 7$$

$$\frac{\partial f}{\partial x_1} = 0$$

$$\boxed{2x_1 + x_2 - 7 = 0} \quad \text{——} \ (1)$$

$$\frac{\partial f}{\partial x_2} = 4x_2 + x_1$$

$$\frac{\partial f}{\partial x_2} = 0$$

$$\boxed{4x_2 + x_1 = 0} \quad \text{——} \ (2)$$

$$\frac{\partial f}{\partial x_3} = 2x_3 - 2$$

$$\frac{\partial f}{\partial x_3} = 0$$

$$\boxed{2x_3 - 2 = 0} \quad \text{——} \ (3)$$

From (1) & (2) & (3)

We get

$$\boxed{x_1 = 4}, \ \boxed{x_2 = -1}, \ \boxed{x_3 = 1}$$

$2(4) + (-1) - 7 = 0$

$8 - 1 - 7 = 0$

$8 - 8 = 0$

$\boxed{0 = 0}$

The extreme points $(x_1, x_2, x_3) = (4, -1, 1)$

$$\frac{\partial^2 f}{\partial x_1^2} = 2 \qquad \frac{\partial^2 f}{\partial x_1 \partial x_2} = 1 \qquad \frac{\partial^2 f}{\partial x_1 \partial x_3} = 0 \qquad \frac{\partial^2 f}{\partial x_3 \partial x_1} = 0 \qquad \frac{\partial^2 f}{\partial x_3 \partial x_2} = 0$$

$$\frac{\partial^2 f}{\partial x_2 \partial x_1} = 1 \qquad \frac{\partial^2 f}{\partial x_2^2} = 4 \qquad \frac{\partial^2 f}{\partial x_2 \partial x_3} = 0 \qquad \frac{\partial^2 f}{\partial x_3^2} = 2$$

$$H = \begin{bmatrix} \frac{\partial^2 f}{\partial x_1^2} & \frac{\partial^2 f}{\partial x_1 \partial x_2} & \frac{\partial^2 f}{\partial x_1 \partial x_3} \\ \frac{\partial^2 f}{\partial x_2 \partial x_1} & \frac{\partial^2 f}{\partial x_2^2} & \frac{\partial^2 f}{\partial x_2 \partial x_3} \\ \frac{\partial^2 f}{\partial x_3 \partial x_1} & \frac{\partial^2 f}{\partial x_3 \partial x_2} & \frac{\partial^2 f}{\partial x_3^2} \end{bmatrix}$$

$$H = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 4 & 0 \\ 0 & 0 & 2 \end{bmatrix}$$

$H_1 = 8 > 0 \ (+ve)$

$$H_2 = \begin{bmatrix} 4 & 0 \\ 0 & 2 \end{bmatrix} = 8 > 0 \ (+ve)$$

$$H_3 = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 4 & 0 \\ 0 & 0 & 2 \end{bmatrix}$$

H is +ve definite

$f(x_1, x_2, x_3)$ is local minima at $(4, -1, 1)$

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3) Multi-Variable Optimization with equal Constraints Substitution method.

(i) $\text{Min } z = x_1^2 + (x_2+1)^2 + (x_3-1)^2$

S.t $\Rightarrow x_1 + 5x_2 - 3x_3 = 6$

Sol:- Given

$$\text{Min } z = x_1^2 + (x_2+1)^2 + (x_3-1)^2$$

Given Variable is multi-Variant Optimization.

$n = 3$, $m = 1$

$n - m = 3 - 1$

$= 2$ Variables

$$-3x_3 = 6 - x_1 - 5x_2$$

$$x_3 = \frac{-6 + x_1 + 5x_2}{3}$$

$$\boxed{x_3 = \frac{x_1 + 5x_2 - 6}{3}}$$

$$\Rightarrow x_1^2 + (x_2+1)^2 + \left(\frac{x_1+5x_2-6}{3} - 1\right)^2$$

$$x_1^2 + (x_2+1)^2 + \left(\frac{x_1+5x_2-9}{3}\right)^2$$

~~a^2+1~~

$$\frac{\partial f}{\partial x_1} = 2x_1 + \frac{2}{9}(x_1+5x_2-9)(1)$$

$$= 2x_1 + \frac{2}{9}(x_1+5x_2-9)$$

$$\frac{\partial f}{\partial x_2} = 2(x_2+1)(1) + \frac{2}{9}(x_1+5x_2-9)(5)$$

$$= 2(x_2+1) + \frac{10}{9}(x_1+5x_2-9)$$

$$\frac{\partial f}{\partial x_1} = 0$$

$$2x_1 + \frac{2}{9}(x_1+5x_2-9) = 0$$

$$2x_1 + \frac{2}{9}x_1 + \frac{10}{9}x_2 - 2 = 0 \Rightarrow \boxed{\frac{20}{9}x_1 + \frac{10}{9}x_2 - 2 = 0} \quad \text{---} \textcircled{1}$$

$$\frac{\partial f}{\partial x_2} = 0$$

$$2(x_2+1) + \frac{10}{9}(x_1+5x_2-9) = 0$$

$$2x_2 + \frac{10}{9}x_1 + \frac{50}{9}x_2 - 8 = 0$$

$$\boxed{\frac{10}{9}x_1 + \frac{68}{9}x_2 - 8 = 0} \quad \text{---} \textcircled{2} \times \underline{2}$$

Solving ① & ②

$$\frac{20}{9}x_1 + \frac{10}{9}x_2 - 2 = 0$$

$$\frac{20}{9}x_1 + \frac{136}{9}x_2 - 16 = 0$$

$$- \quad - \quad +$$

$$-\frac{126}{9}x_2 + 14 = 0$$

$$-126x_2 = -126$$

$$\boxed{x_2 = 1}$$

Sub x_2 in Value in ①

$$\frac{20}{9}x_1 + \frac{10}{9}(1) - 2 = 0$$

$$\boxed{x_1 = 2/5}$$

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Sub x_1, x_2 in $\frac{x_1 + 5x_2 - 6}{3}$ to get Value of x_3

$$x_3 = \frac{\frac{2}{5} + 5 - 6}{3}$$

$$x_3 = \frac{\frac{2}{5} - 1}{3}$$

$$\boxed{x_3 = -1/5}$$

$$\frac{\partial^2 f}{\partial x_1^2} = 2 + \frac{2}{9} = \frac{18+2}{9} = \frac{20}{9} = \underline{20}$$

$$\frac{\partial^2 f}{\partial x_2^2} = 68 \qquad \frac{\partial^2 f}{\partial x_1 \partial x_2} = 10 \qquad \frac{\partial^2 f}{\partial x_2 \partial x_1} = 10$$

$$H = \begin{bmatrix} 20 & 10 \\ 10 & 68 \end{bmatrix}$$

$H_1 = 2070$ (+ve)

$H_2 = 126070$ (+ve)

H is +ve definite

$\boxed{f(x) \text{ is Local Minima}}$

$$\min z = x_1^2 + (x_2+1)^2 + (x_3-1)^2$$

$$= \left(\frac{2}{5}\right)^2 + (1+1)^2 + \left(\frac{-1}{5}-1\right)^2$$

$$= \frac{4}{25} + 4 + \left(\frac{-6}{5}\right)^2$$

$$= \frac{4+100+36}{25} = \frac{140}{25} = \boxed{\frac{28}{5}}$$

---

a) Find Langrange Method $\min z = x_1^2 + x_2^2 + x_3^2$

Subjective Constraints: $x_1 + x_2 + 3x_3 = 2$

$5x_1 + 2x_2 + x_3 = 5$

$x_1, x_2, x_3 \geq 0$

Sol: Given Variable is Multi-Variant Optimization with equal Constraints

$$L[x_1, x_2, x_3, \lambda_1, \lambda_2] = x_1^2 + x_2^2 + x_3^2 + \lambda_1 (x_1 + x_2 + 3x_3 - 2) + \lambda_2 (5x_1 + 2x_2 + x_3 - 5) = 0$$

$$\frac{\partial L}{\partial x_1} = 0 \Rightarrow 2x_1 + \lambda_1 + 5\lambda_2 = 0 \Rightarrow 2x_1 = -\lambda_1 - 5\lambda_2$$

$$\boxed{x_1 = \frac{-\lambda - 5\lambda_2}{2}}$$

$$\frac{\partial L}{\partial x_2} = 0 \Rightarrow 2x_2 + \lambda_1 + 2\lambda_2 = 0 \Rightarrow 2x_2 = -\lambda_1 - 2\lambda_2$$

$$\boxed{x_2 = \frac{-\lambda_1 - 2\lambda_2}{2}}$$

$$\frac{\partial L}{\partial x_3} = 0 \Rightarrow 2x_3 + 3\lambda_1 + \lambda_2 = 0 \Rightarrow 2x_3 = -3\lambda_1 - \lambda_2$$

$$\boxed{x_3 = \frac{-3\lambda_1 - \lambda_2}{2}}$$

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$$\frac{\partial L}{\partial \lambda_1} = 0 \Rightarrow x_1 + x_2 + 3x_3 - 2 = 0 \quad \text{——①}$$

$$\frac{\partial L}{\partial \lambda_2} = 0 \Rightarrow 5x_1 + 2x_2 + x_3 - 5 = 0 \quad \text{——②}$$

Sub x_1, x_2, x_3 in ① & ②

① ⇒ $-\frac{\lambda - 5\lambda_2}{2} + \left(\frac{-\lambda_1 - 2\lambda_2}{2}\right) + 3\left(\frac{-3\lambda_1 - \lambda_2}{2}\right) - 2$

$-\lambda_1 - 5\lambda_2 - \lambda_1 - 2\lambda_2 - 9\lambda_1 - 3\lambda_2 - 4 = 0$

$\boxed{4\lambda_1 + 10\lambda_2 + 4 = 0}$ —— ③

② ⇒ $5\left(\frac{-\lambda_1 - 5\lambda_2}{2}\right) + 2\left(\frac{-\lambda_1 - 2\lambda_2}{2}\right) + \left(\frac{-3\lambda_1 - \lambda_2}{2}\right) - 5 = 0$

$-5\lambda_1 - 25\lambda_2 - 2\lambda_1 - 4\lambda_2 - 3\lambda_1 - \lambda_2 - 10 = 0$

$\boxed{\lambda_1 + 3\lambda_2 + 1 = 0}$ —— ④

Solving ③ & ④

$\boxed{\lambda_1 = \frac{-2}{23}}$, $\boxed{\lambda_2 = \frac{-7}{23}}$

Sub λ_1, λ_2 in x_1, x_2, x_3

$x_1 = \frac{-\left(\frac{-2}{23}\right) - 5\left(\frac{-7}{23}\right)}{2}$

$\boxed{x_1 = \frac{37}{46}}$

$x_2 = \frac{-\left(\frac{-2}{23}\right) - 2\left(\frac{-7}{23}\right)}{2}$

$\boxed{x_2 = \frac{16}{46}}$

$x_3 = \frac{-3\left(\frac{-2}{23}\right) - \left(\frac{-7}{23}\right)}{2}$

$\boxed{x_3 = \frac{13}{46}}$

$\frac{\partial^2 L}{\partial x_1^2} = 2 \qquad \frac{\partial^2 L}{\partial x_2^2} = 2 \qquad \frac{\partial^2 L}{\partial x_3^2} = 2$

$\frac{\partial^2 L}{\partial x_1 \partial x_2} = 0 \qquad \frac{\partial^2 L}{\partial x_2 \partial x_3} = 0 \qquad \frac{\partial^2 L}{\partial x_3 \partial x_1} = 0$

$\frac{\partial^2 L}{\partial x_1 \partial x_3} = 0 \qquad \frac{\partial^2 L}{\partial x_2 \partial x_3} = 0 \qquad \frac{\partial^2 L}{\partial x_3 \partial x_2} = 0$

Hessian Matrix

$$H = \begin{bmatrix} \frac{\partial^2 L}{\partial x_1^2} & \frac{\partial^2 L}{\partial x_1 \partial x_2} & \frac{\partial^2 L}{\partial x_1 \partial x_3} \\ \frac{\partial^2 L}{\partial x_2 \partial x_1} & \frac{\partial^2 L}{\partial x_2^2} & \frac{\partial^2 L}{\partial x_2 \partial x_3} \\ \frac{\partial^2 L}{\partial x_3 \partial x_1} & \frac{\partial^2 L}{\partial x_3 \partial x_2} & \frac{\partial^2 L}{\partial x_3^2} \end{bmatrix}$$

$$H = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$$

$H_1 = 270$ (+ve)

$H_2 = 470$ (+ve)

$H_3 = 870$ (+ve)

H is +ve definite

f(x) is local Minima

$\text{Min } z = x_1^2 + x_2^2 + x_3^2 = \left(\frac{37}{46}\right)^2 + \left(\frac{16}{46}\right)^2 + \left(\frac{13}{46}\right)^2$

$= \boxed{\frac{39}{46}}$

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5) K.K.T

$Max\ Z = -x_1^2 - x_2^2 - x_3^2 + 4x_1 + 6x_2$

Subjective Constraint $x_1 + x_2 \leq 2$

$2x_1 + 3x_2 \leq 12$

$x_1, x_2 \geq 0$

Sol: The given objective function is Multi-Variant Optimization in inequality Constraints

$$L = 4x_1 + 6x_2 - x_1^2 - x_2^2 - x_3^2 - \lambda_1 (x_1 + x_2 - 2) - \lambda_2 (2x_1 + 3x_2 - 12) = 0$$

$$\frac{\partial L}{\partial x_1} = 4 - 2x_1 - \lambda_1 - 2\lambda_2 = 0 \quad \text{——} (1)$$

$$\frac{\partial L}{\partial x_2} = 6 - 2x_2 - \lambda_1 - 2\lambda_2 = 0 \quad \text{——} (2)$$

$$\frac{\partial L}{\partial x_3} = -2x_3 = 0 \quad \text{——} (3)$$

$$\lambda_1 (x_1 + x_2 - 2) = 0 \quad \text{——} (4)$$

$$\lambda_2 (2x_1 + 3x_2 - 12) = 0 \quad \text{——} (5)$$

$$\lambda_1 \geq 0,\ \lambda_2 \geq 0 \quad \text{——} (6)$$

$$x_1 + x_2 \leq 2 \quad \text{——} (7)$$

$$2x_1 + 3x_2 \leq 12 \quad \text{——} (8)$$

$$x_1 \geq 0,\ x_2 \geq 0,\ x_2 \geq 0 \quad \text{——} (9)$$

Case (i) $\lambda_1 = 0,\ \lambda_2 = 0$

(1) $\Rightarrow 4 - 2x_1 - 0 - 0 = 0$

$\boxed{x_1 = 2}$

(2) $\Rightarrow 6 - 2x_2 - 0 - 0 = 0$

$\boxed{x_2 = 3}$

(3) $\Rightarrow \boxed{x_3 = 0}$

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eq ④ ⇒ $x_1 = 2 \geq 0$ $x_2 = 3 \geq 0$, $x_3 = 0 \geq 0$

eq ⑧ ⇒ $2x_1 + 3x_2 \leq 12$

$13 \leq 12$

Condition fails go to Case ②

Case ① $\lambda_1 = 0$, $\lambda_2 \neq 0$

put $\lambda_1 = 0$ in eq ⑤

$4 - 2x_1 - 0 - 2\lambda_2 = 0$

$\boxed{x_1 + \lambda_2 = 2}$ —— ⑩

put $\lambda_1 = 0$ in eq ⑥

$6 - 2x_2 - 0 - 3\lambda_2 = 0$

$6 - 2x_2 - 3\lambda_2 = 0$

$\boxed{2x_2 + 3\lambda_2 = 6}$ —— ⑪

Solving ⑩ & ⑪

$\boxed{x_1 = \frac{2x_2}{3}}$, $\boxed{x_2 = \frac{36}{13}}$

from $x_1 = \frac{2x_2}{3}$, $x_2 = \frac{36}{13}$

$\boxed{x_1 = \frac{24}{13}}$

⑨ ⇒ $x_1 = \frac{24}{13} > 0$, $x_2 = \frac{36}{13} > 0$, $x_3 = 0 \geq 0$

⑧ ⇒ $2x_1 + 3x_2 \leq 12$

$2\left(\frac{24}{13}\right) + 3\left(\frac{36}{13}\right) \leq 12$

$12 \leq 12$

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(7) ⇒ $x_1 + x_2 \leq 2$

$\frac{24}{13} + \frac{36}{13} \leq 2$

$\frac{60}{13} \leq 2$

Condition fails go to Case-(3)

Case-(3) $\lambda_1 \neq 0, \lambda_2 \neq 0$

(4) ⇒ $x_1 + x_2 - 2 = 0$

(5) ⇒ $2x_1 + 3x_2 - 12 = 0$

By Solving we get

$\boxed{x_2 = 8}$

$\boxed{x_1 = -6}$

Condition fails go to Case-(4)

Case-(4) $\lambda_1 \neq 0, \lambda_2 = 0$

(1) ⇒ $4 - 2x_1 - \lambda_1 = 0$

$\boxed{2x_1 + \lambda_1 = 4}$

(2) ⇒ $6 - 2x_2 - \lambda_1 - 3\lambda_2 = 0$

$6 - 2x_2 - \lambda_1 = 0$

$6 - 2x_2 - \lambda_1 = 0$

$\boxed{2x_2 + \lambda_1 = 6}$

By Solving we get

$\boxed{x_1 = 1/2}$

$\boxed{\lambda_2 = 3/2}$

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(9) → $x_1 = \frac{1}{2} \geq 0$, $x_2 = \frac{3}{2} \geq 0$, $x_3 = 0 \geq 0$

(8) → $2x_1 + 3x_2 \leq 12$

$2\left(\frac{1}{2}\right) + 3\left(\frac{3}{2}\right) \leq 12$

$\frac{11}{2} \leq 12$

(7) → $x_1 + x_2 \leq 2$

$\frac{1}{2} + \frac{3}{2} \leq 2$

$\frac{4}{2} \leq 2$

$2 \leq 2$

(6) → put $x_1 = \frac{1}{2}$, $x_2 = \frac{3}{2}$, $x_3 = 0$ in (1)

$4 - 2\left(\frac{1}{2}\right) - \lambda_1 - 2\lambda_2 = 0$

$3 - \lambda_1 - 2\lambda_2 = 0$

$\lambda_1 + 2\lambda_2 - 3 = 0$

put $x_1 = \frac{1}{2}$, $x_2 = \frac{3}{2}$, $x_3 = 0$ in (2)

$6 - 2\left(\frac{3}{2}\right) - \lambda_1 - 2\lambda_2 = 0$

$\lambda_1 + 3\lambda_2 - 3 = 0$

$\lambda_1 + 2\lambda_2 = 3$

$\lambda_1 + 3\lambda_2 = 3$

$- \quad - \quad -$

$\lambda_2 = 0$

$\lambda_1 = 3$

$\lambda_1 \geq 0, \lambda_2 \geq 0$

$\text{Max } z = 4x_1 + 6x_2 - x_1^2 - x_2^2 - x_3^2$

$= 4\left(\frac{1}{2}\right) + 6\left(\frac{3}{2}\right) - \left(\frac{1}{2}\right)^2 - \left(\frac{3}{2}\right)^2 - 0$

$= 17/2$

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OR Assignment-3.

1. Find optimum solution to the given transportation Problem.

	D_1	D_2	D_3	Supply
S_1	9	15	12	25
S_2	6	8	13	15
S_3	9	3	11	20
Demand	21	14	25	

Sol:-

Step-1:-

	D_1	D_2	D_3	Penality
S_1	9	15	12	3
S_2	6	8	13	2
S_3	9	3	11	6
	21	14	25	

→

	D_1	D_2	D_3	
S_1	9	15	12	25
S_2	6	8	13	15
S_3	9	3	11	20-14=6
	21	14-14 =0	25	

Penality 3 5 1

Step-2:-

	D_1	D_3	
S_1	9	12	25
S_2	6	13	15
S_3	9	11	6
	21	25	

Penality: 3, 7, 3

→

	D_1	D_3	
S_1	9	12	25
~~S_2~~	~~6~~	~~13~~	15-15=0
S_3	9	11	6
	21-15 =6	25	

Penality 3 1

Step-3:-

	D_1	D_3	
S_1	9	12	25
S_3	9	11	6
	6	25	

Penality: 3, 2

→

	D_1	D_3	
S_1	~~9~~	12	25-6=19
S_3	9	11	6
	6-6 =0	25	

Penality :- 0 1

Step-4:-

	D_3		
S_1	12	19	12
S_3	11	6	11
	25		

→

	D_3	
~~S_1~~	~~12~~	19-19=0
S_3	11	6
	25-19=6	

Penality 1

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Step-5:-

	D_3	
S_3	[11]	6
	6	

Penality 11 → S_3 [11] 6-6=0; 6-6=0

Penality 11:

$M+n-1 = 3+3-1 = 6-1 = 5$

IBFS

	D_1	D_2	D_3	
S_1	[6] 9	15	[19] 12	25
S_2	[15] 6	8	13	15
S_3	9	[14] 13	[5] 11	20
	21	14	25	

IBFS $= 6\times9 + 19\times12 + 15\times6 + 14\times3 + 6\times11$

$= 54 + 228 + 90 + 42 + 66$

$= \boxed{480}$

Optimum solution is

	D_1	D_2	D_3	
S_1	[6] 9	15	[19] 12	$u_1=0$
S_2	[15] 6	8	13	$u_2=0$
S_3	9	[14] 3	[5] 11	$u_3=-1$

For basic cells $u_i+u_j = u_j$

$u_1+v_1 = 6 \Rightarrow v_1 = 6$

$u_1+v_3 = 12 \Rightarrow v_3 = 12$

$u_2+v_1 = 6 \Rightarrow u_2 = 0$

$u_3+v_2 = 3 \Rightarrow v_2 = 4$

$u_3+v_3 = 11 \Rightarrow u_3 = -1$

For Non-basic cells.

$\overline{c_{ij}} = c_{ij} - u_i - v_j$

$\overline{c_{12}} = c_{12} - u_1 - v_2 = 15 - 0 - 4 \Rightarrow 11$

$\overline{c_{22}} = c_{22} - u_2 - v_2 = 8 - 0 - 4 \Rightarrow 4$

$\overline{c_{23}} = c_{23} - u_2 - v_3 = 18 - 0 - 12 \Rightarrow 1$

$\overline{c_{31}} = c_{31} - u_3 - v_1 = 9 - (-1) - 6 \Rightarrow 4$

All non-basic cells are positive we stop the process

	D_1	D_2	D_3	
S_1	[6] 9	15	[19] 12	25
S_2	[15] 6	8	13	15
S_3	9	[14] 3	[5] 11	20
	21	14	25	

IBFS $= 6\times9 + 19\times12 + 15\times6 + 14\times3 + 6\times11 = \boxed{460}$

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Find optimum solution to the given transportation problem.

	D_1	D_2	D_3	D_4	
S_1	6	8	8	5	30
S_2	5	11	9	7	40
S_3	8	9	7	13	50
	35	25	35	25	

Sol:-

Step 1:-

	D_1	D_2	D_3	D_4		Penality
S_1	6	8	8	5	30	1
S_2	5	11	9	7	40	2
S_3	8	9	7	13	50	1

→

	D_1	D_2	D_3	D_4	
S_1	6	8	8	5	30
S_2	35	11	9	7	40-35=5
S_3	8	9	7	13	50
	35-35 =0	25	35	25	

Penality 1 1 1 2

Step-2:-

	D_2	D_3	D_4		Penality
S_1	8	8	5	30	3
S_2	11	9	7	5	2
S_3	9	7	13	50	2

→

	D_2	D_3	D_4	
S_1	8	8	25 5	30-25=5
S_2	11	9	7	5
S_3	9	7	13	50
	25	35	25-25 =0	

Penality 11 2

Step-3:-

	D_2	D_3		Penality
S_1	8	8	5	0
S_2	11	9	5	2
S_3	9	7	50	2

→

	D_2	D_3	
S_1	8	8	5
S_2	11	9	5
S_3	9	35 50	50-35=15
	25	35-35 =0	

Penality 1 1

Step-4:-

	D_2		Penality
S_1	8	5	8
S_2	11	5	11
S_3	9	15	9

→

S_1	8	5
S_2	11	5-5=0
S_3	9	15
	25-5 =20	

Penality 1

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Step 5:

	D_2		Penality
S_1	8	5	8
S_3	9	15	9

→

S_1	8	5
S_3	9	15-5=0

Penality 1

Step-6:

	D_2		Penality
S_1	8	5	8

→

	D_2	
S_1	8	5-5=0
	5-5=0	

Penality 8.

$M+n-1 = 3+4-1 = 7-1 \Rightarrow \boxed{6}$

IBFS

	D_1	D_2	D_3	D_4	
S_1	6	5 8	8	25 5	30
S_2	25 5	5 11	9	7	40
S_3	8	15 9	35 7	13	50
	35	25	35	25	

IBFS $= (5\times8)+(25\times5)+(35\times5)+(5\times11)+(5\times9)+(35\times7)$

$= \boxed{775}$

Optimum soln P_3

	D_1	D_2	D_3	D_4	
S_1	6	5 8	8	25 5	$u_1 = 8$
S_2	30 5	5 11	9	7	$u_2 = 11$
S_3	8	0 9	30 7	13	$u_3 = 9$

For Basic cells:

$u_i + v_j = c_{ij}$

$u_1 + v_2 = 8 \Rightarrow u_1 + 0 = 8 \Rightarrow u_1 = 8$

$u_1 + v_4 = 5 = 8 + v_4 = 5 \Rightarrow v_4 = -3$

$v_2 + v_1 = 5 = 11 + v_1 = 5 \Rightarrow v_1 = -6$

$u_2 + v_2 = 11 \Rightarrow u_2 + 0 = 11 \Rightarrow u_2 = 11$

$u_3 + v_2 = 9 \Rightarrow u_2 + 0 = 9 \Rightarrow v_3 = 9$

$u_3 + v_3 = 7 \Rightarrow 9 + v_3 = 7 \Rightarrow u_3 = -2$

$\overline{c_{11}} = c_{11} - u_3 - v_1 = 6 - 8 - (-6) = 4$

$\overline{c_{13}} = c_{13} - u_1 - v_3 = 8 - 8(-2) = 2$

$\overline{c_{23}} = c_{23} - v_2 - v_3 = 9 - 11(-2) = 0$

$\overline{c_{24}} = c_{24} - u_2 - v_4 = 7 - 11 - (-3) = -1$

$\overline{c_{31}} = c_{31} - u_3 - v_1 = 8 - 9 - (-6) = 5$

c_{24} having -ve, we got to next Iteration. This loop starts from c_{24} cell.

(3)

	D_1	D_2	D_3	D_4
S_1	0	5 8	8	35 5
S_2	35 5	5 11	9	7
S_3	8	25 9	25 7	13

we select value 0 from the allocation with $(5,25) = 5$

$0 = 5$ (assume)

6	10 8	8	20 5	$u_1 = 0$
35 5	11	9	5 7	$u_2 = 2$
8	10 9	35 7	13	$u_3 = 1$
$v_1 = 3$	$v_2 = 8$	$v_3 = 6$	$v_4 = 5$	

We assume $u_1 = 0$

for basic cells $u_i + v_j = c_{ij}$

$u_1 + u_2 = 5 = 0 + u_2 = 6 \Rightarrow u_2 = 8$

$u_1 + v_4 = 5 = 0 + v_4 = 5 = v_4 = 5$

$u_2 + v_1 = 5 = 2 + v_1 = 5 = v_1 = 3$

$u_2 + u_1 = 7 = u_2 + 5 = 7 = u_2 = 2$

$u_3 + u_2 = 9 = u_3 + 8 = 9 = u_3 = 1$

$u_3 + v_3 = 7 = 1 + v_3 = 7 = v_3 = 6$

for non-Basic cells $\overline{ij} = u_i - \overline{u_j} - \overline{v_i} - \overline{v_j}$

$\overline{41} = u_1 - v_1 - v_1 = 60 - 3 = 3$

$\overline{u_3} = u_3 - u_1 - v_3 = 8 - 0 - 6 = 2$

$\overline{u_2} = c_{21} - u_2 - u_2 = 11 - 2 - 8 = 1$

$\overline{c_{13}} = c_{23} - u_2 - u_3 = 9 - 2 - 6 = 1$

$\overline{c_{51}} = c_{31} - u_3 - u_1 = 8 - 1 - 3 = 4$

$\overline{c_{34}} = c_{34} - u_3 - v_4 = 13 - 1 - 6 = 7$

All the non basic cells are positive we stop the process

S_1	6	10 8	8	20 5	30
S_2	35 5	11	9	5 7	40
S_3	8	5 9	35 7	13	50
	35	25	35	25	

IBFS $= (10 \times 8) + (20 \times 5) + (35 \times 5) +$
$(5 \times 7) + (15 \times 9) + (35 \times 7)$
$= \boxed{770}$

3. Obtain an initial basic feasible solution to following transportation problem using least cost method, Vogel's approximation method

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	D_1	D_2	D_3	D_4	supply
S_1	2	3	11	7	6
S_2	1	5	6	1	4
S_3	5	8	15	9	10
Demand	8	6	13	3	

Least cost method:

Step 1:-

	D_1	D_2	D_3	D_4	
S_1	2	3	11	7	6
S_2	[4] 1	5	6	1	4-4=0
S_3	5	8	15	9	10
	8-4 =4	6	3	3	

Step-2:-

	D_1	D_2	D_3	D_4	
S_1	[4] 2	3	11	7	6-4=2
S_3	5	8	15	9	10
	4-4 =0	6	3	3	

Step-3:-

	D_2	D_3	D_4	
S_1	[2] 3	11	7	2-2=0
S_3	8	15	9	10
	6-2 =4	3	3	

Step 4:-

	D_2	D_3	D_4	
S_3	[4] 8	15	9	10-4=6
	4-4 =0	3	3	

Step 5:-

	D_3	D_4	
S_3	15 [3]	9	6-3=3
	3	3-3 =0	

Step-6:

	D_3	
~~S_3~~	[3] 15	3-3=0
	3-3=0	

$M+n-1 = 3+4-1 = 7-1 = 6$

	D_1	D_2	D_3	D_4	
S_1	[2] 2	[2] 3	11	7	6
S_2	[4] 1	5	6	1	4
S_3	5	[4] 5	[3] 15	[3] 9	10
	8	6	3	3	

$$\text{IBFS} = 4\times2 + 3\times2 + 4\times1 + 4\times5 + 3\times15 + 3\times9$$

$$= 8+6+4+32+45+27$$

$$= \boxed{122}$$

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(4)

Vogel's approximation method (VAM)

Step-1:

	D_1	D_2	D_3	D_4	
S_1	2	3	11	7	6
S_2	1	5	6	1	4
S_3	5	8	15	9	10
	8	6	3	3	

Penality: 1, 0, 3

→

	D_1	D_2	D_3	D_4	
S_1	2	3	11	7	6
S_2	1	5	6	1	4-3=1
S_3	5	8	15	9	10
	8	6	3	3-3=0	

Penality: 1 2 5 6

Step-2:-

	D_1	D_2	D_3	
S_1	2	3	11	6
S_2	1	5	6	1
S_3	5	8	15	10

Penality: 1, 0, 3

→

	D_1	D_2	D_3	
S_1	2	3	11	6
S_2	1	5	6	1-1=0
S_3	5	8	15	10
	8	6	3-1=2	

Penality: 1 2 5

Step-3:

	D_1	D_2	D_3	
S_1	2	3	11	6
S_3	5	8	15	10

Penality: 1, 3

→

	D_1	D_2	D_3	
S_1	2	3	11	6-6=0
S_3	5	8	15	10
	8	6-6=0	2	

Penality: 3 5 4

Step-4:

	D_1	D_3	
S_3	5	15	10

Penality: 10

→

	D_1	D_3	
S_3	5	15	10-2=8
	8	2-2=0	

Penality 5 15

step-5:-

	D_1	
S_3	5	8-8=0

Penality: 5

Penality 5

Table:

	D_1	D_2	D_3	D_4
S_1	2	3	11	7
S_2	1	5	6	1
S_3	5	8	15	9

$M+n-1 = 3+4-1 = 1-1 = 6 \neq 5$

Degeneracy existed in this problem. we add a dummy allocation

ϵ In the table.

we add a Dummy Allocation ϵ at position (2,1)

	D_1	D_2	D_3	D_4	
S_1	2	[6] 3	11	7	6
S_2	[ϵ] 1	5	[1] 6	[3] 1	4
S_3	[8] 5	8	[2] 15	9	10
	8	6	3	3	

$IBFS = 6\times3 + \epsilon\times1 + 1\times6 + 3\times1 + 8\times5 + 15\times2$

$= 18+6+3+40+30$

$= \boxed{97}$

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UML
Assignment-2

D. Abhinash
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1) Use Case Diagram

→ In UML, use case diagrams model the behaviour of a system & help to capture the requirement of the system
→ Use case diagram describe the high-level functions and scope of a system
→ these diagrams also identify the interactions blw the system and its actors
→ the in use cases and actors in usecase diagrams describe what the system does & how the actors use it, but not how the system operates internally
→ Use case diagram illustrate and define the context & requirement of either an entire system or the important part of the system you can model a complex system with a single use case or create many use case diagram to model the components of the system

Purpose:-
- Used to gather the requirement of a system
- Used to get an outside view of a system
- Identify the external & internal factors influencing the system
- show the interaction among the requirements are actors

How to draw:-
→ Use case diagram are considered for high level requirements of a system. when the requirements of a system are analyzed the functionalities are captured in use cases.
→ Actors can be defined as something that interacts with the system.

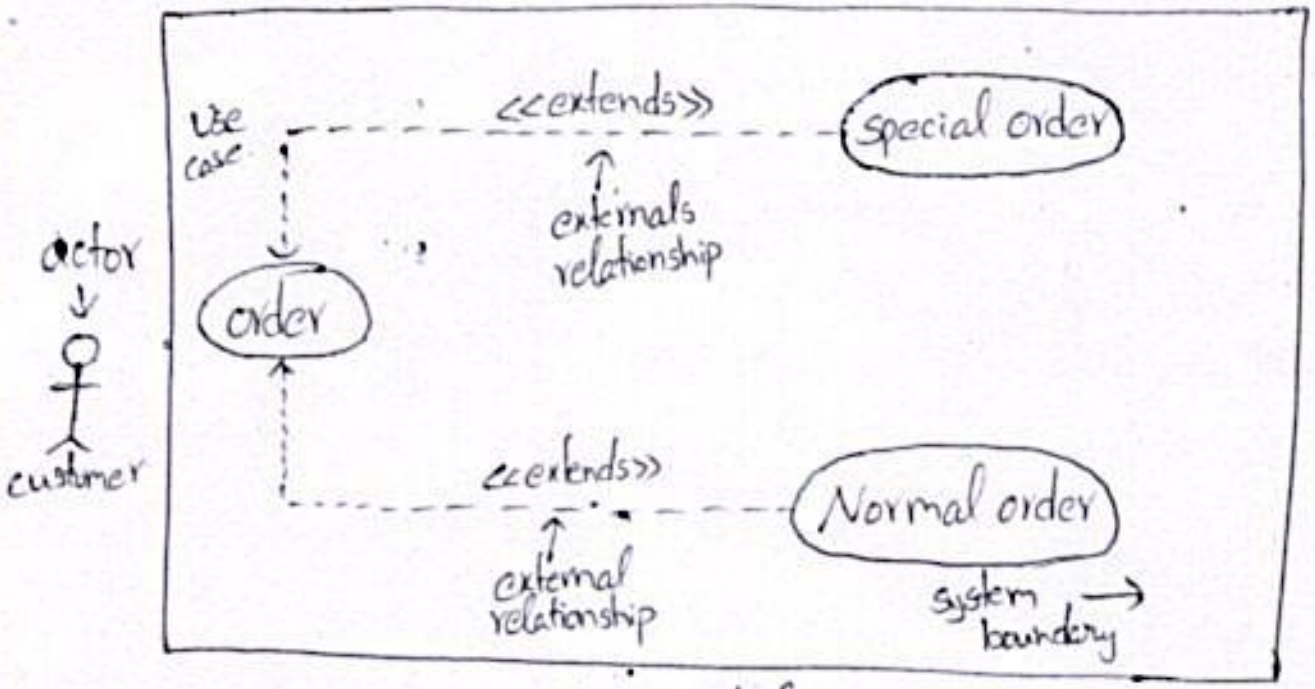
→ Actors can be a human user, some interal application, or may be some external applications

→ we should have the following items:

- Functionalities to be represented
- Actors
- Relationship among the use cases & actors

Example:

Use case diagram of an order management system



Use-case diagrams can be used for:

- Requirement analysis & high level design
- Model the context of a system
- Reverse engineering
- Forward engineering

2) Interaction Diagram:

→ From the term interaction, it is clear that the diagram is used to describe some type of interactions among the different elements in the model.

→ Sequence diagram emphasizes on time sequence of message. is collaboration diagram emphaze on the structural organizatio of the object that send & received message.

Purpose:-

→ The Purpose of interaction diagram is to visualize the interactive behaviour of the system

→ Visualizing the interaction is a difficult task.

→ Hence, the solution is to use different types of models to capture the different aspects of the interactions

Purpose:-

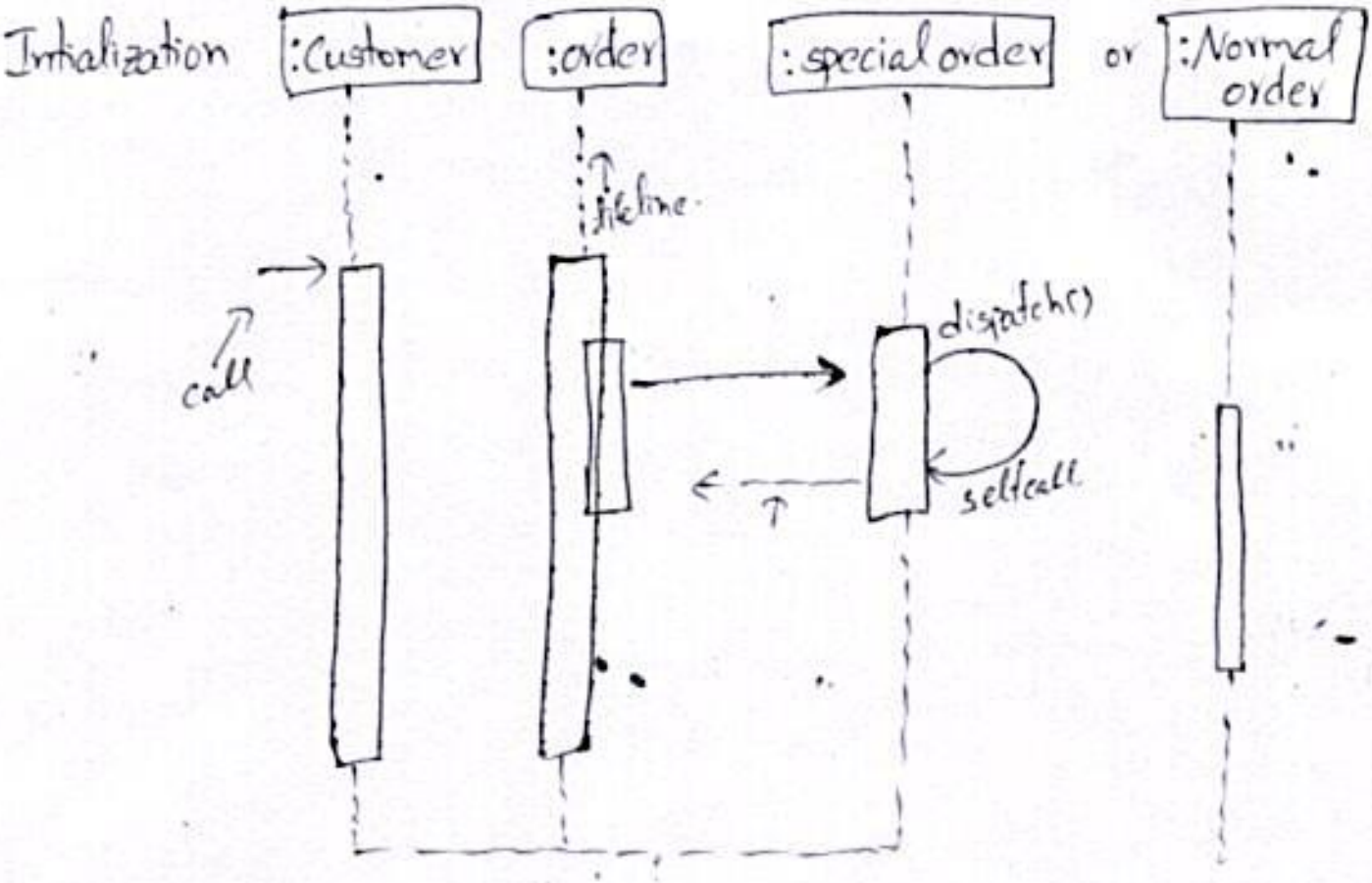
- To capture the dynamics behaviour of a system.
- To describe the message flow in the system
- To describe the interaction among object.

How to Draw:-

- things to be follow while drawing
  - objects taking part in the interaction.
  - message flow among the objects
  - the sequence in which the message are flowing
  - object organisation.

Sequence Diagram

→ It has 4 objects
- customer
- order
- special order
- Normal order.



Collobration Diagram-

→ It shows the object organisation as seen in the following diagram

→ the method call sequence is indicated by some unmbering technique

→ the number indicates how the methods are called one after another.

→ Method calls are similar to that of a 'sequence diagram'

→ To choose blw these diagrams, emphasis is placed on the object organisation

→ If the time sequence is imp, then 'sequence diagram'

→ If organisation is required then 'collabration'

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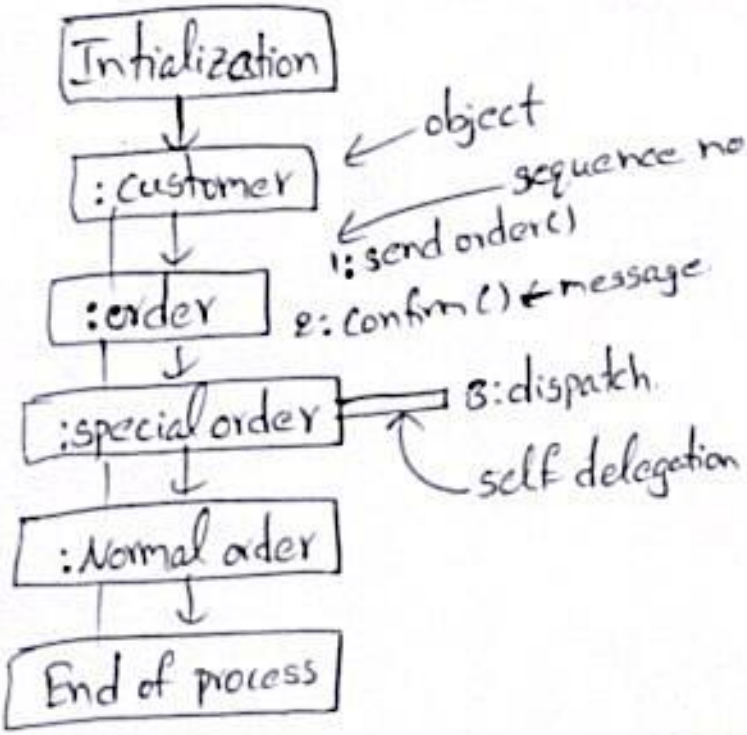
Example:-



Note: Sequence is indicated by numbering the msg/method calls

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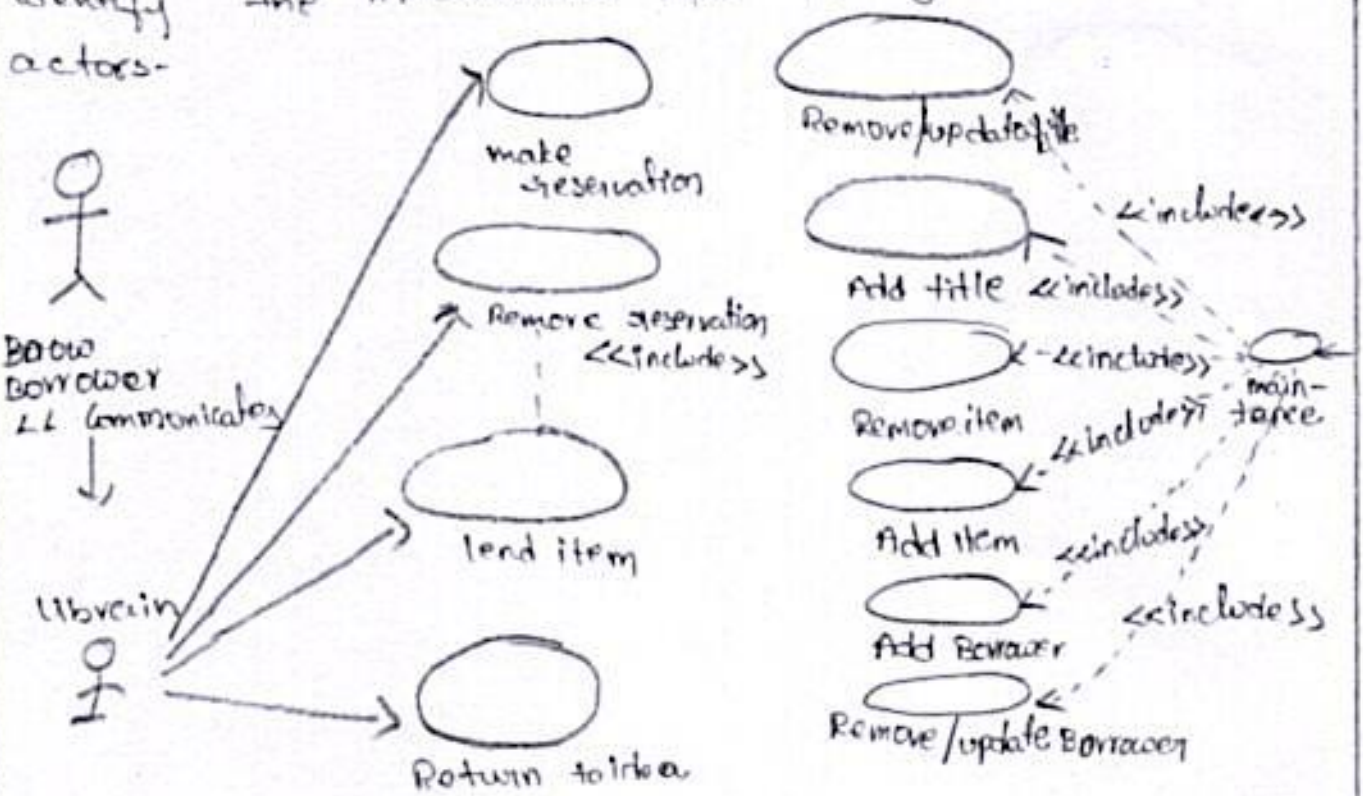
UML- Assignment-3

1. UML diagram for library management system.

UML diagram:

Use case diagram:

In UML, use case diagram model the behavioral of System and help to capture the requirements of the Systems. Use case diagrams describe the high level functions & scope of a system. Use diagram the identify the interactions b/w the system and its actors-



class diagram are the blue prints of your system (or) subsystem you can use class diagram to model the objects that makeup the system, to display the relationships b/w the objects and to describe what those objects do and the services that they provide class diagrams are useful in many stage of system aka design.

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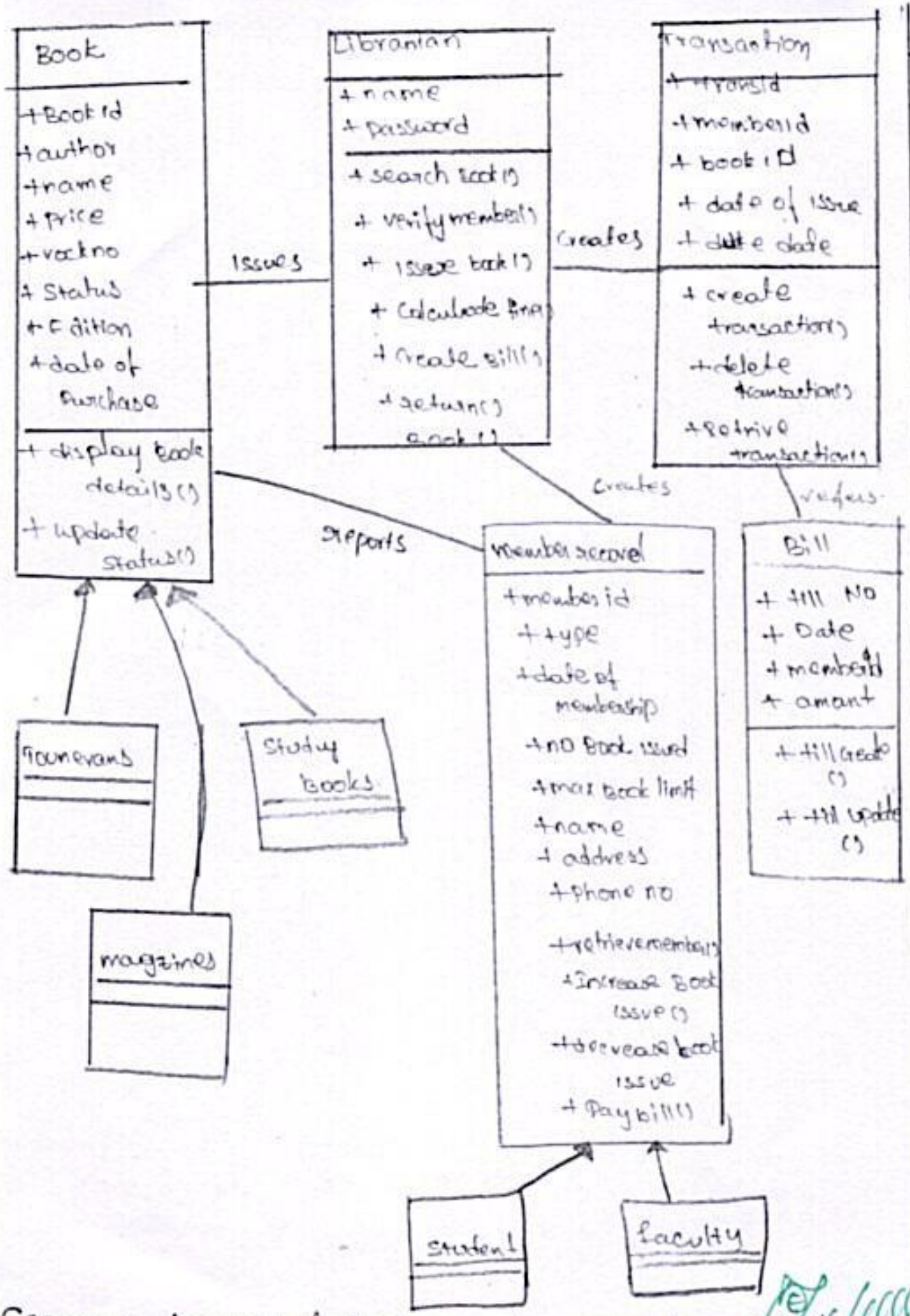
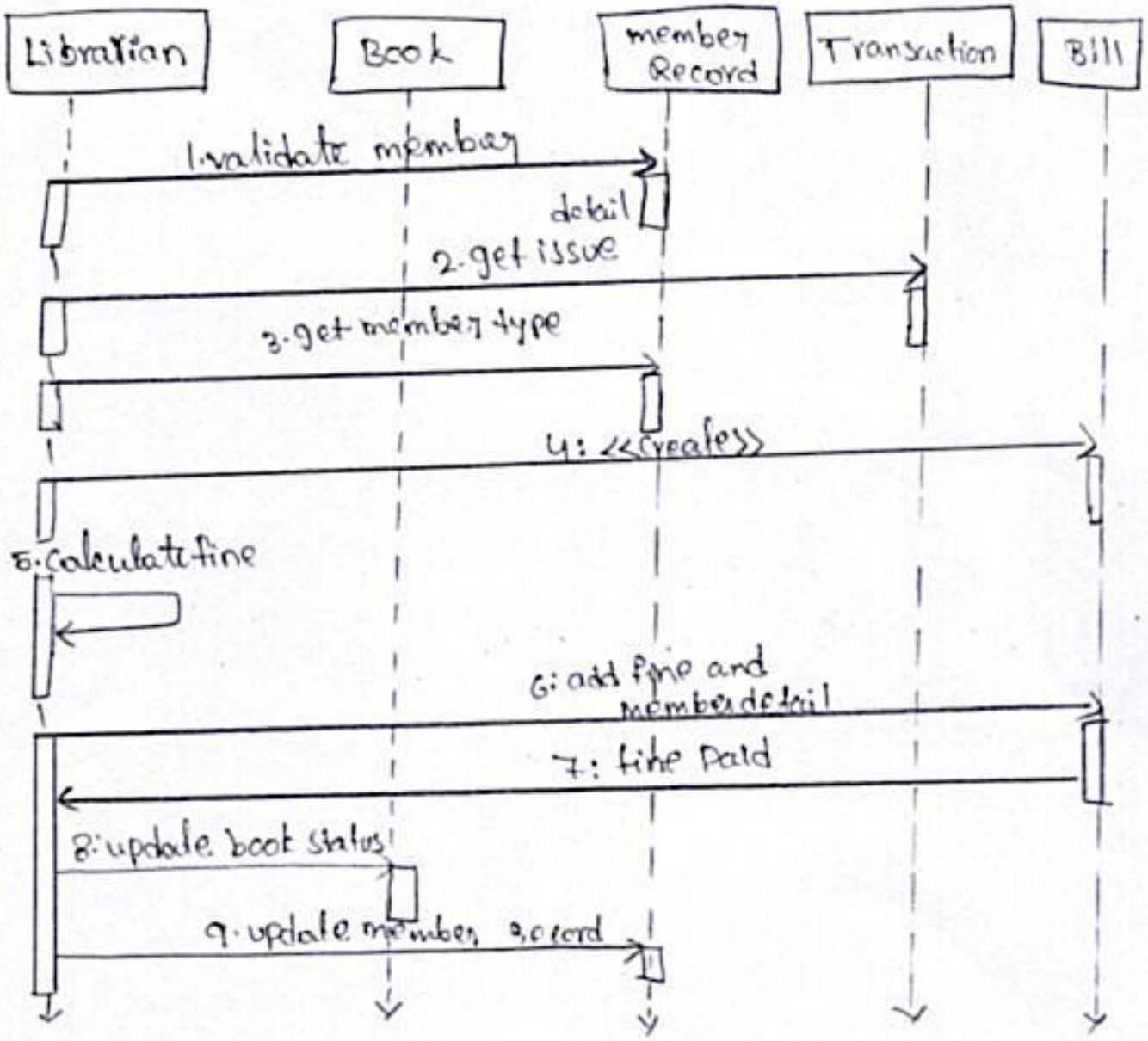


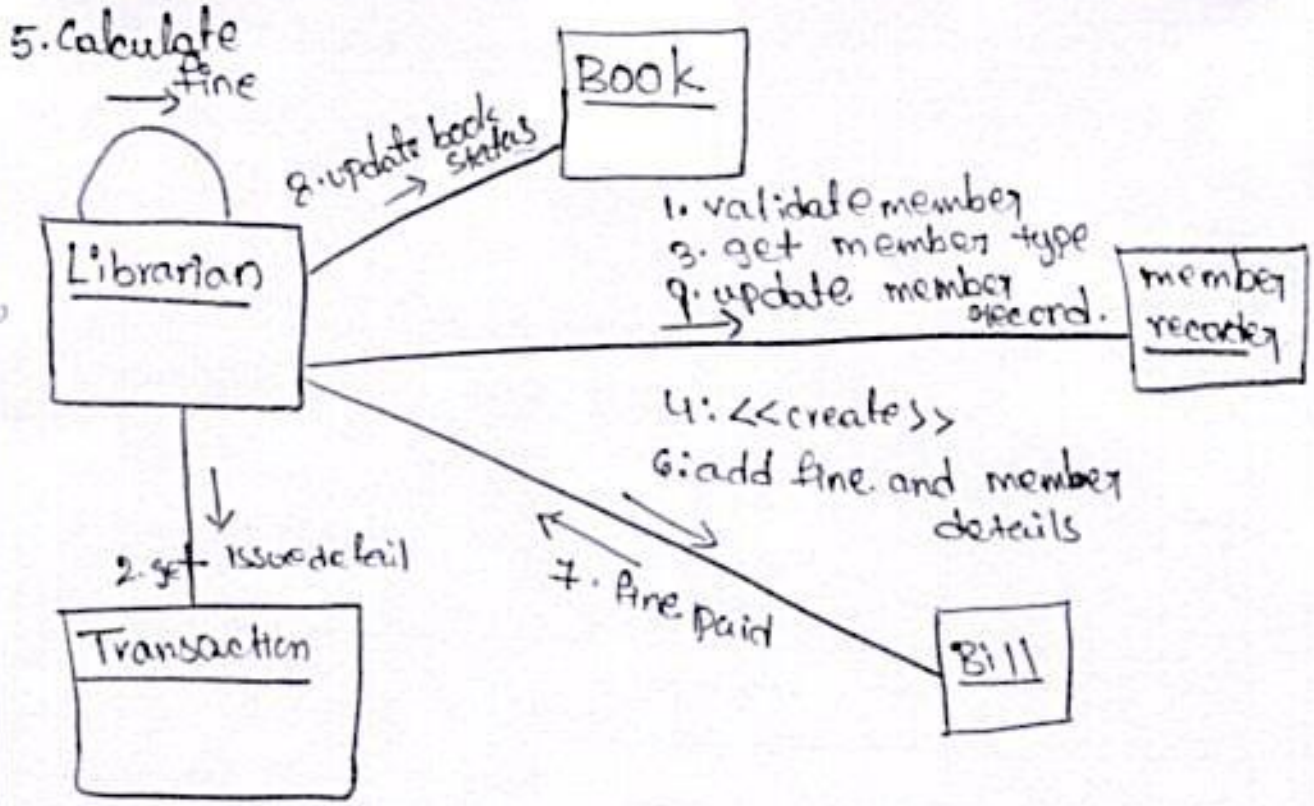
Sequence diagram: A sequence diagram is one of the unified modelling language diagram that illustrated the sequence of msg flow between obj in

an interaction. A sequence diagram consists of a grap of objects that aya represented by lifelins and the msg that they exchange over time during the interaction.



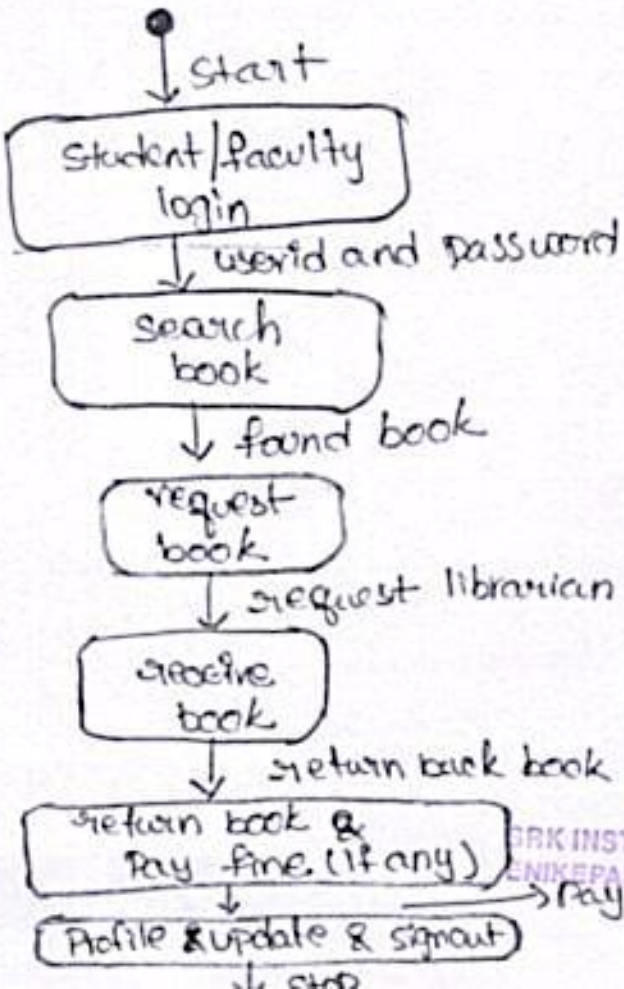
Collaboration diagram:

A collaboration diagram also known as a Communication diagram, is an illustration of the relationships & interactions among software objects in the Unified modeling language (UML). These diagrams can be used to portray the dynamic behaviour of a particular use case and defines the role of each object.



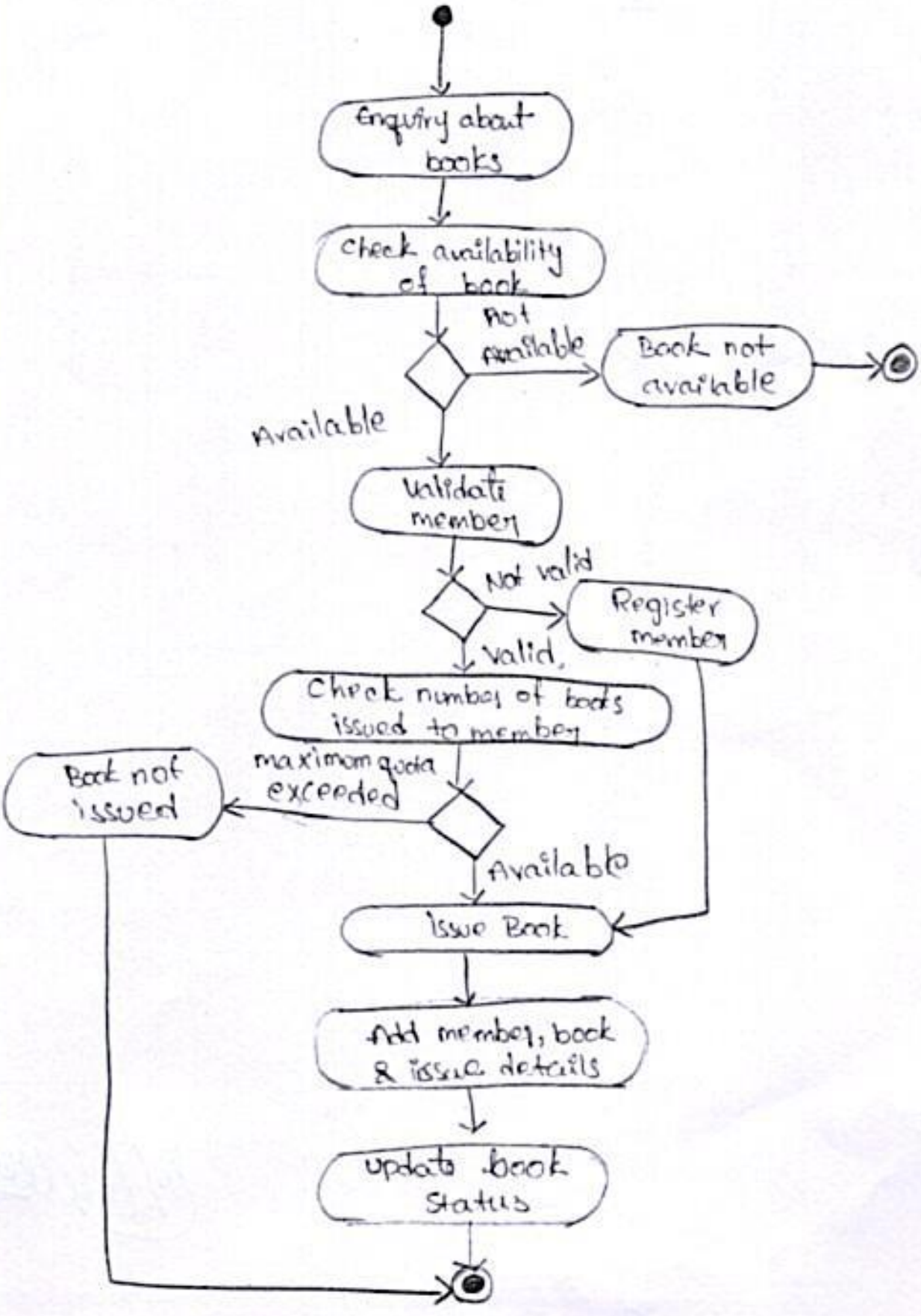
* Statechart diagram:-

A statechart diagram, also known as a state machine diagram or statechart, is an illustration of the states an objects can attain as well as the transitions b/w those states in the UML.



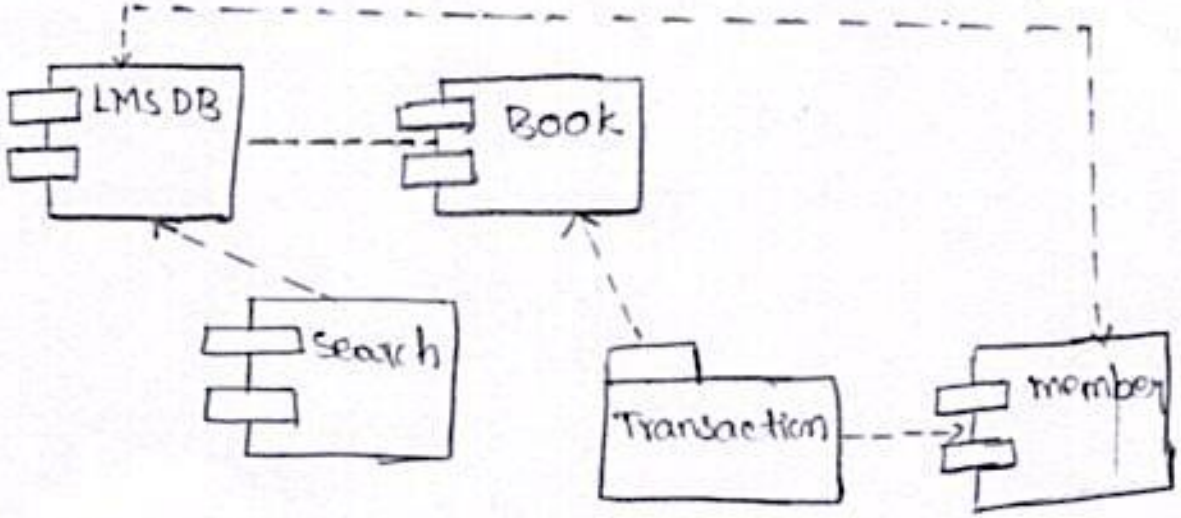
* Activity diagram:

In UML, an activity diagram provides a view of the behaviour of a system by describing the sequence of actions in a process.



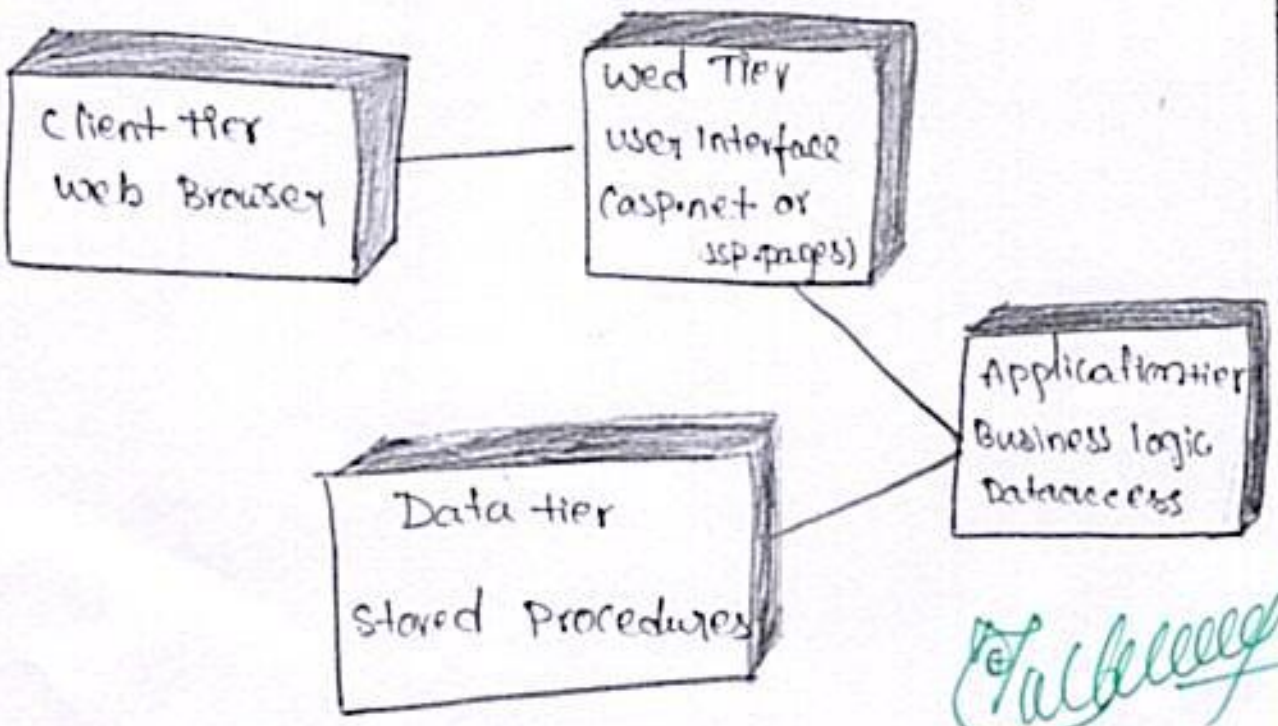
* Component diagram:-

In UML, a component diagram depicts how components are wired together to form larger components or software systems. They are used to illustrate the structure of arbitrarily complex systems.



* Deployment diagram:

In UML, deployment diagram model the physical architecture of a system. Deployment diagram show the relationships b/w the s/w & h/w components in the system & the physical distribution of the processing.



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* Describing Design Patterns:-

The information in a design pattern's documentation will be described as follows

Pattern name and classifications:

The pattern name specifies the essence of the pattern Precisely. A good name is a key as it will

Intent:

Problem the pattern address (short statement) also known as other well known names for patterns, if any.

motivation: The scenario will helps to design problem.

Applicability: This specifies in which situation a design pattern can be applied.

Structure: A graphical representation of class, involved in Pattern following the notations of object modeling techniques

Participats: The classes participating in pattern and this responsibility.

Collaborations: How classes & objects Collaborate to carry out their responsibilities.

Consequences: Any language specific issues.

Sample Code: Code fragments that tell us how to implement the patterns in java.

Catalog of design Patterns:

Abstract factory:

Provides an interface for creating families of related or dependant objects without specifying their concrete classes.

Adapter: lets classes work together that couldn't otherwise because of incompatible interfaces

Bridge: Separate the abstraction from its implementation so that the two can vary independently.

Builder: Hide the Construction Process from its representation so that the same Constructed process can create different representation.

Command: Encapsulate a request as an object which allows us to parametrix the clients with different request & support undoable questions.

Composite: lets clients treat individually objects and Compositions of objects & uniformly.

Facade: Defines a higher level interface to make the Subsystem easier

Flyweight: Use sharing to support large nos of fine grained object efficiently.

Mediator: Define an object that encapsulates how a set of objects interact.

Observer: Defines one to many dependency b/w object so that if one object changes its state it will notify the change to all other objects to update automatically.

Proxy: Provide a placeholders for another object to control access to it.

Singleton: Ensure a class only one object and global point of access to that object.

Template method: Define the skeleton an algorithm in an operation defining some steps to sub classes.

Visitor:

Represent an operation to be performed on the element of an object structure. visitor lets you define new operations without changing the classes of elements on which it operates.

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(5) DIVP Assignment - 4

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3rd year 2 sem

1. Redundancy and their removal methods?

Redundancy: Repeated an duplicated data refers as redundancy. It can be brodly classified into 3 types

1. coding redundancy
2. Irrelevant information
3. Spatial and temporal redundancy

Coding redundancy:

A code is a system of symbols used to present a body of information on set of Events. Each piece of information is assigned to a seaquence of code.

for ex: If we have an 8 bit pixel image that allows 256 gray level values, but actual image contains only 16 gray-level values

Removal method of coding redundancy:-

Let us assume a discrete random variable r_k interval (0, L, -1)

$$Pr(r_k) = \frac{n_k}{MN} \quad - k = 0, 1, 2 \ldots L-1$$

L is no of grey levels

$$L_{avg} = \sum_{k=0}^{L-1} l(r_k)\, Pr(r_k)$$

r_k	$Pr(r_k)$	code	$l(r_k)$	$l_2(r_k)$
0	0.19	000	3	2
1	0.25	001	3	2
2	0.21	010	3	2
3	0.16	011	3	3
4	0.08	100	3	4
5	0.06	101	3	5
6	0.03	110	3	6
7	0.02	111	3	6

$$l' = \sum_{k=0}^{x} l_2(r_k)\, Pr(r_k)$$

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$= 2(0.19) + 2(0.25) + 2(0.21) + 3(0.16) + 4(0.08) + 5(0.06) + 6(0.03) + 6(0.02)$

$= 2.26$ bits

$C = 3/2.7 = 1.11$

$R = 1 - 1/C = 1 - 1/1.11$

$= 0.099$

Spatial and temporal redundancy:

The pixels at most 2D intensity arrays are correlated specially. the information is unnecessary replicated in represent-ations of correlated pixels.

Removal method of spatial & temporal redundancy:

In order to reduce the interpixel redundancies is an image a mapping is said to be reversible if the pixel of original 2-D intensity array can be reconstructed without error from the transformed set

Irrelevant information:

The Most 2-D intensity arrays contain information that is ignored by human visual

Removal method:

The elimination of possible because the information itself is host Essential Irrelevant information also referred as psychovisual redundancy

Redundancy	removal method
coding	Encoder
Spatial & Temporal	mapper
Irrelevant info	quantizer

2) Huffmann Coding :

The Huffman Coding developed by D. Hulfmann in 1952. is a minimum length code. This means for a given image, the Half mann algorithm will generate a code that is as close as possible to the minimum bound.

→ This method results in an unequal length code, where the size of the codewords can varry.

Huffmann algorithm can be described in 5 steps

1. find the gray level probabilities for the image by finding Histogram
2. order the input probabilities for the image by finding Histogram
3. combine the smallest two by addition
4. Go to step 1, until only two probabilites are left
5. By working backword among the three generate code by alternating assignment of '0' & '1'
6. Final code is assign to the grey level which convey.

problem

1. obtain the Huffmann code for the word 'INDIA' where each letter requires 4-bit of memory. Also calculate compression ratio, Entropy, Redundancy & Efficiency.

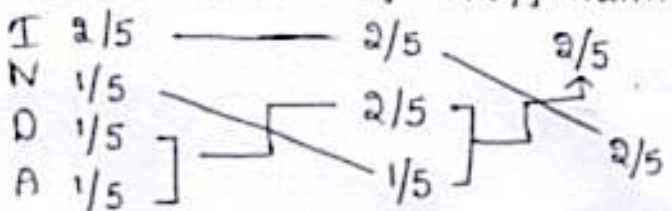
Sol step-1: To find the probabilities

probilities of symbol I = P(I) = 2/5
N = P(N) = 1/5
D = P(D) = 1/5
A = P(A) = 1/5

step-2: Arrange the probabilities in Decending order

SYMBOL	PROBABILITY
I	2/5
N	1/5
D	1/5
A	1/5

Step-3: Construction of Huffmann tree



Step 4: Assigning code words

SYMBOL	Probability	Source reduction with Assignment	Codeword	code length
I	2/5 — 0	2/5 ← 0 → 3/5	0	1
N	1/5 — 01	2/5 ← 11 → 2/5	01	2
D	1/5 — 1111	1/5	111	3
A	1/5 — 011		011	3

To determine the Avg. length

Avg. length before compression

$$L_{Avg} = \sum_{PK} l_K$$

$$= 2/5(4) + 1/5(4) + 1/5(4) + 1/5(4)$$

$$L_{avg} = 4 \text{ bits / symbol}$$

Avg. length after compression $L_{Avg} = \sum P_K l_K$

$$L_{avg} = 2/5(1) + 1/5(2) + 1/5(3) + 1/5(3) = \frac{10}{5} = 2 \text{ bits/ symbol}$$

Compression Ratio $C = \frac{b}{b'} = \frac{L_{avg}}{L'_{Avg}} = \frac{4}{2} = 2:1$

Redundancy $= R = 1 - 1/C$

$$= 1 - 1/2 = 1/2 = 50\%$$

Entropy $H(S) = \sum \cdot \log_2 P_K = \frac{1}{\log_{10} 2} \left[\frac{2}{5} \log_{10} \frac{2}{5} + \frac{3}{5} \log_{10} \frac{1}{5}\right]$

$$= 1.086 \text{ bits / symbol}$$

Efficiency $(\eta) = \frac{H(S)}{L'_{Avg}} = \frac{1.086}{2}$

$$= 54\%.$$

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(MW) (5)

Analog Communications
Assignment - 1

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IInd year II Sem
21X41A0470

1. a.) power relation of a single tone modulation of AM system.

1. If only one frequency is present in message signal then this modulation is called single tone modulation.

i.e., $m(t) = A_m \cos 2\pi f_m t$

$S_{AM}(t) = A_c (1 + k_a m(t)) \cos 2\pi f_c t \rightarrow ①$

put $m(t)$ value in equation ① then

$S_{AM}(t) = A_c [1 + k_a m(t)] \cos 2\pi f_c t$

Where, modulation index $\mu = k_a A_m$

2. If a message signal has only one frequency then this modulation is called single tone modulation.

3. Standard form of AM $= A_c (1 + k_a m(t)) \cos 2\pi f_c t$

$= A_c \cos 2\pi f_c t + \mu A_c (1 + k_a m(t)) \cos 2\pi f_m t$

$= A_c \cos 2\pi f_c t + \frac{\mu A_c}{2} [\cos 2\pi (f_c + f_m) t + \cos 2\pi (f_c - f_m) t]$

$= A_c \cos 2\pi f_c t + \frac{\mu A_c}{2} \cos 2\pi (f_c + f_m) + \frac{\mu A_c}{2} \cos 2\pi (f_c - f_m) t$

$\cos \omega_c t \longrightarrow \left[\frac{\delta(\omega - \omega_c) + \delta(\omega + \omega_c)}{2}\right]$

$S_{AM}(f) = \frac{A_c}{2} [\delta(f - f_c) + \delta(f + f_c)] + \frac{\mu A_c}{4} [\delta(f - f_c - f_m) + \delta(f + f_c + f_m)] + \frac{\mu A_c}{4} [\delta(f - f_c + f_m) + \delta(f + f_c - f_m)]$

This is the frequency domain representation of AM

LSB = lower side band; USB = upper side band.

Bandwidth

$B.W_{AM} = f_H - f_L = \omega_c + \omega_m - \omega_c + \omega_m = 2\omega_m$ or $2f_m$

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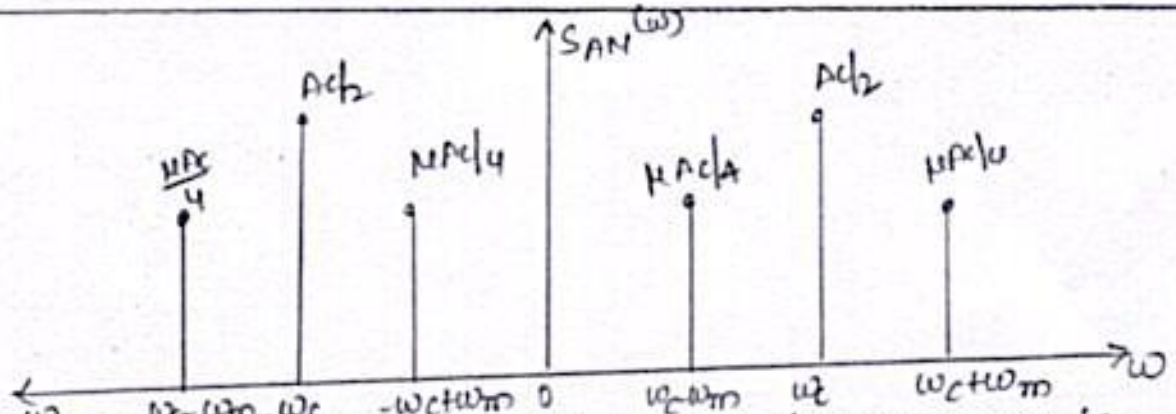
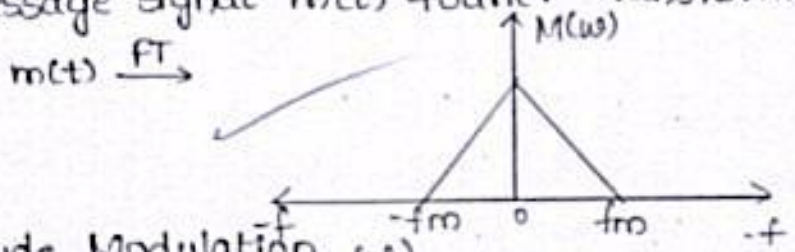
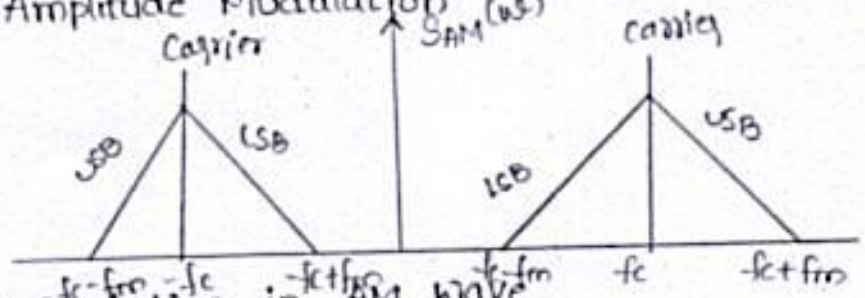


Suppose message signal m(t) -fourier transformers is



Amplitude Modulation



power relation in AM wave

$$S_{AM}(t) = A_c(1+k_a m(t))\cos 2\pi f_c t$$

Standard AM wave

$$S_{AM}(t) = \underbrace{A_c \cos 2\pi f_c t}_{\text{unmodulated carrier}} + \underbrace{\frac{\mu A_c}{2}\cos 2\pi (f_c+f_m)t}_{USB} + \underbrace{\frac{\mu A_c}{2}\cos 2\pi (f_c+f_m)t}_{LSB}$$

$A_c \cos\omega_c t \longrightarrow \frac{A^2}{2R_L}$

after normalization $R_L = 1$

$A \sin\omega_c t \longrightarrow \frac{A^2}{2R_L}$

Total power, $P_T = P_c + P_{USB} + P_{LSB}$

$$= \frac{A_c^2}{2} + \frac{\mu^2 A_c^2}{8} + \frac{\mu^2 A_c^2}{8}$$

$$= \frac{A_c^2}{2} + 2\left(\frac{\mu^2 A_c^2}{8_4}\right)$$

$$= \frac{1}{2}\left(A_c^2 + \frac{\mu^2 A_c^2}{2}\right)$$

$$= \frac{A_c^2}{2}\left(1+\frac{\mu^2}{2}\right)$$

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$$P_c = \frac{A_c^2}{2}$$

$$P_T = P_c\left(1+\frac{H^2}{2}\right)$$

$$P_T = I_T^2 R$$

$$P_c = I_c^2 R$$

$$P_T = \left(1+\frac{H^2}{2}\right) I_c^2 R$$

$$I_T^2 R = I_c^2 R\left(1+\frac{H^2}{2}\right)$$

Power relation in AM wave

$$S_{AM}(t) = A_c(1+k_a m(t))\cos 2\pi f_c t$$

Standard AM wave

$$S_{AM}(t) = \underbrace{A_c \cos 2\pi f_c t}_{\text{unmodulated carrier}} + \underbrace{\frac{HA_c}{2}\cos 2\pi (f_c+f_m)t}_{USB} + \underbrace{\frac{HA_c}{2}\cos 2\pi (f_c+f_m)t}_{LSB}$$

$A\cos\omega t \longrightarrow \frac{A^2}{2R_L}$

after normalization $R_L = 1$

$A\sin\omega t \longrightarrow \frac{A^2}{2R_L}$

Total power, $P_T = P_C + P_{USB} + P_{LSB}$

$$= \frac{A_c^2}{2} + \frac{H^2A_c^2}{8} + \frac{H^2A_c^2}{8}$$

$$= \frac{A_c^2}{2} + 2\left(\frac{H^2A_c^2}{8}\right) = \frac{1}{2}\left(A_c^2 + \frac{H^2A_c^2}{2}\right)$$

$$= \frac{A_c^2}{2}\left(1+\frac{H^2}{2}\right)$$

$$P_c = \frac{A_c^2}{2}$$

$$P_T = P_c\left(1+\frac{H^2}{2}\right)$$

$$P_T = I_T^2 R$$

$$P_c = I_c^2 R$$

$$P_T = \left(1+\frac{H^2}{2}\right) I_c^2 R$$

$$I_T^2 R = I_c^2 R\left(1+\frac{H^2}{2}\right)$$

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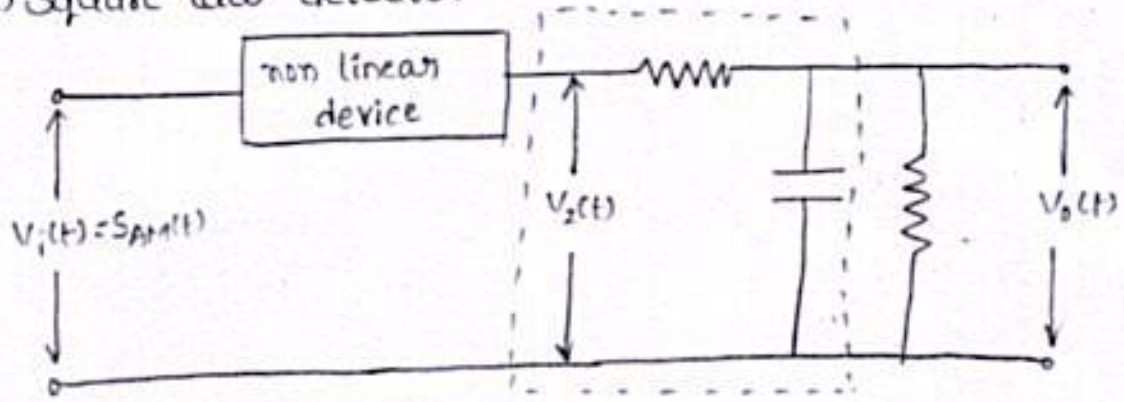
b Demodulation / Detection of AM wave:

(i) Square law detector



$$V_i A_m(t) = A_c(1+k_a m(t))\cos\omega_c t$$

$$V_0 = K_1 V_1 + K_2 V_1^2$$

$$V_0 = K_1[A_c(1+k_a m(t)]\cos\omega_c t + K_2[A_c(1+k_a m(t)\cos\omega_c t]$$

$$= K_1 A_c \cos\omega_c t + K_1 A_c k_a m(t) + K_2(A_c^2(1+k_a^2 m^2(t) + 2k_a m(t)\cos^2\omega_c t]$$

$$V_0 = K_1 A_c \cos\omega_c t + K_1 A_c k_a m(t)\cos\omega_c t + K_2 A_c^2(1+k_a^2 m^2(t) + 2k_a m(t)]\left[\frac{1+\cos 2\omega_c t}{2}\right]$$

So output of LPF is

$$\text{message signal} = \frac{K_2 A_c^2}{2}(2k_a m(t) + k_a^2 m^2(t))$$

Suppose $m^2(t) << m(t)$

$$\text{message signal} = \frac{k_a A_c^2}{2}[2k_a m(t) + k_a^2 m(t)^2]$$

$m(t) = K \cdot m(t)$ K = constant

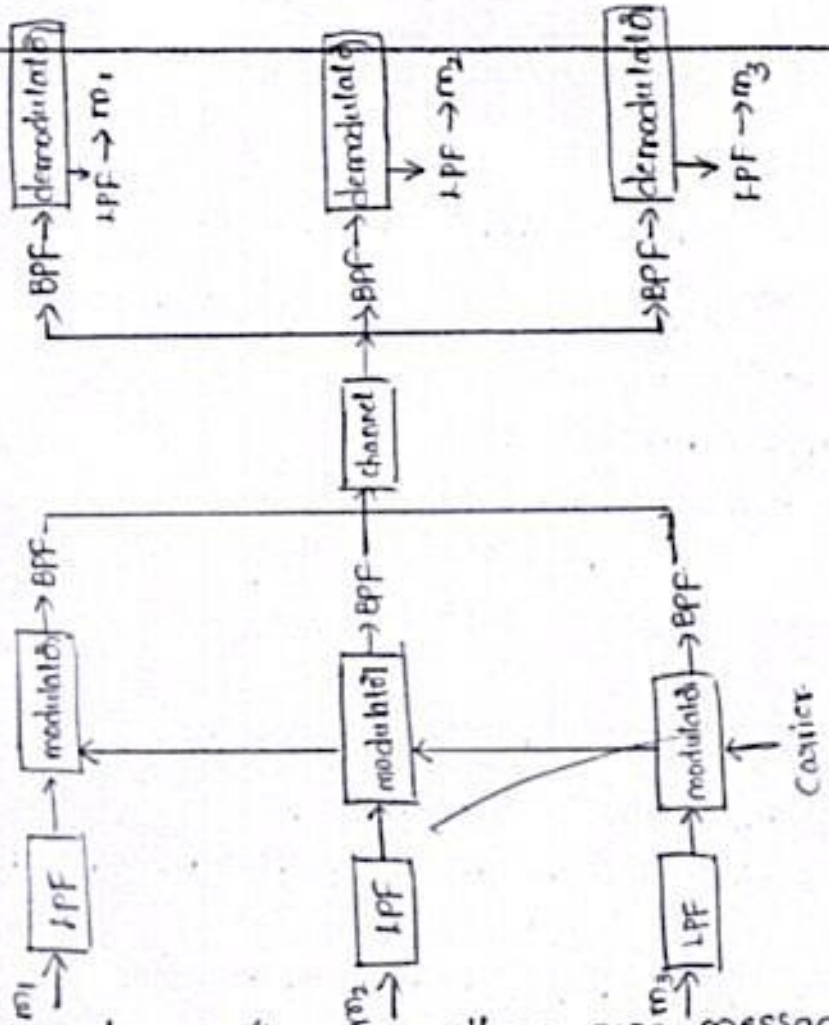
$K = K_2 A_c^2 k_a$

This is message signal detected by square law detected.

2. Defined multiplexing and Explain with a block diagram

1.) Multiplexing is a process in which two or more signals to transmitted simultaneously over same channel.

2.) Multiplexing allows same channel to be used for different signals



3.) A station transmits more than one message on the same carrier and one same channel is known as multiplexing

4.) Mainly there are two types of Multiplexing
(1) FDM (2) TDM

5.) The technique of seperating the signals in time domain is known as TDM. where as the technique of seperating the signals in frequency domain is known as FDM.

6.) low pass filter: Allows low frequency components and rejects high frequency components.

7.) Band pass filter: It is used to restrict the band to its range.

Advantages of FDM:

1.) It consists of only one carrier for multiplng with 'n' number of low frequency signals.

2.) It consists of only one channel for transmission from transmitter to receiver.

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3) It is having the low bandwidth.

Amplitude modulation:

(1) A process in which amplitude of carrier signal is varied in according to the message signal, is called Amplitude modulation.

(2) carrier signal $c(t) = A_c \cos(2\pi f_c t + \phi)$

where A_c = carrier amplitude

f_c = carrier frequency

ϕ = carrier phase.

in AM $\phi = 0$

message signal $m(t) = A_m \cos 2\pi f_m t$

where, A_m = message amplitude

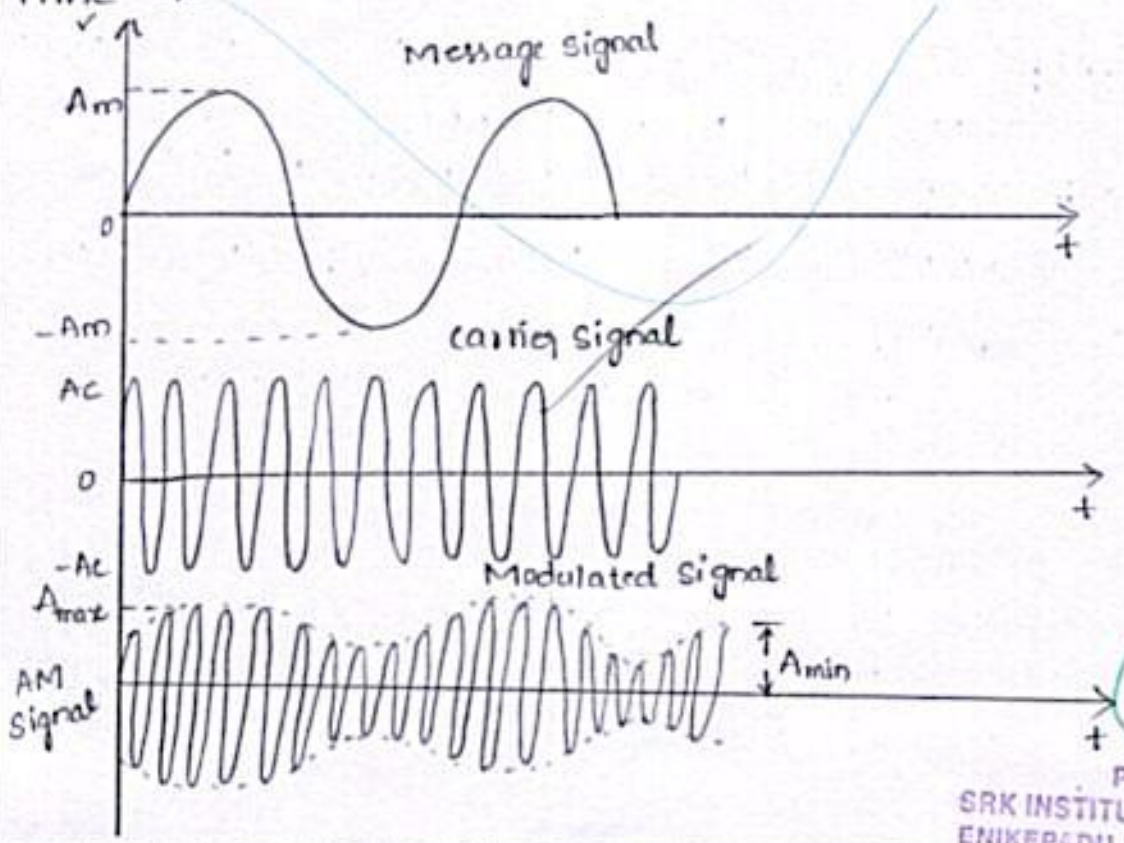
f_m = maximum frequency present in message signal

AM equation, $S_{AM}(t) = A_c(1 + k_a m(t)) \cos 2\pi f_c t$

A_c → carrier amplitude before modulation

$A_c(1 + k_a m(t))$ → carrier amplitude after modulation

Time domain



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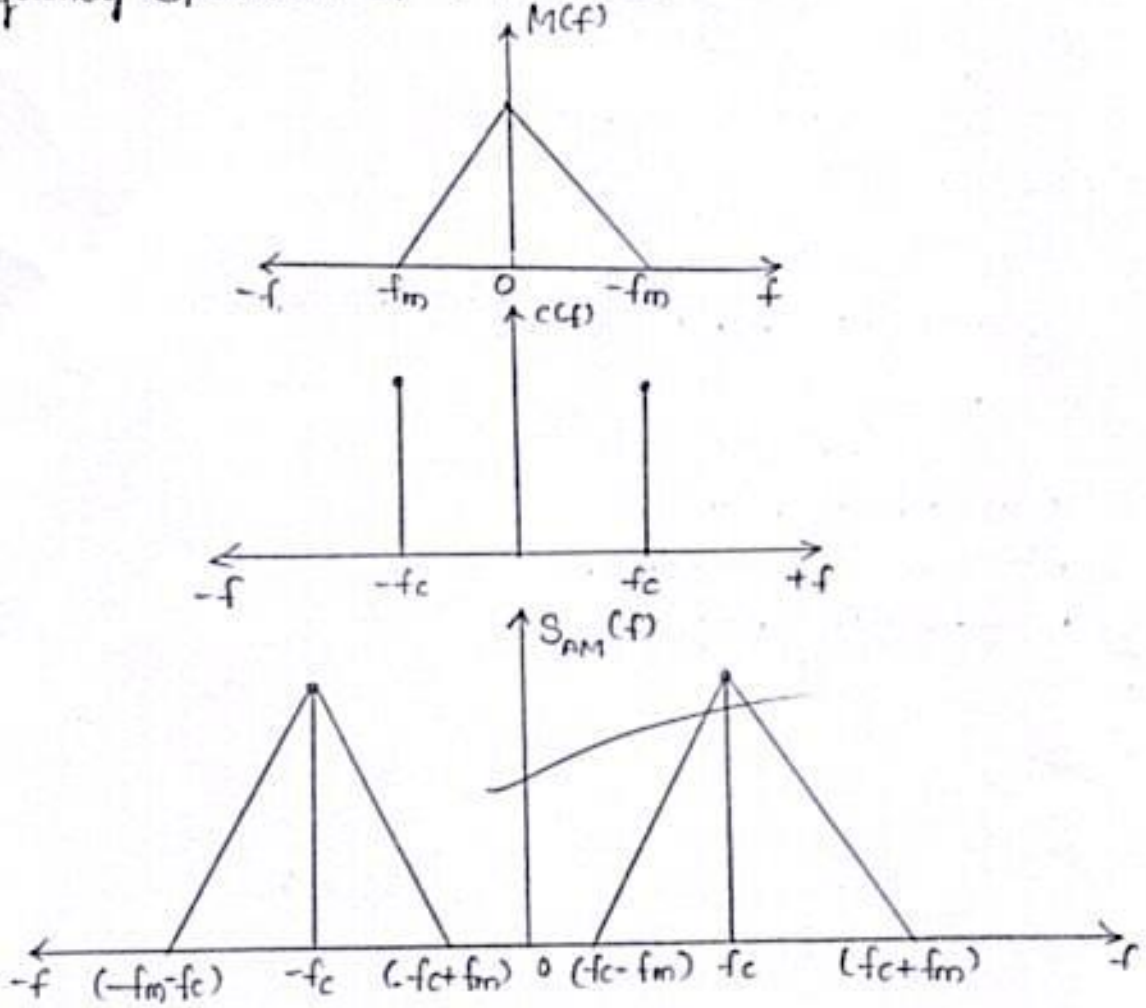
Frequency Spectrum of AM Wave:



Modulation index

$$\mu = \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$$

$\mu < 1$ under modulation

$$S_{AM}(t) = A_c (1 + \mu \cos \omega_m t) \cos \omega_c t$$

(3)(a) Modulation: The process of changing the characteristics of high frequencies (carrier) are veried inaccordance with the instantaneous value of another signal called base band signal or modulating signal or message signal

Need for modulation:

Modulation is done in order to get these things

(1) Reduce the antenna height

(2) Avoids mixing of signals.

(3) Increase the range of communication.

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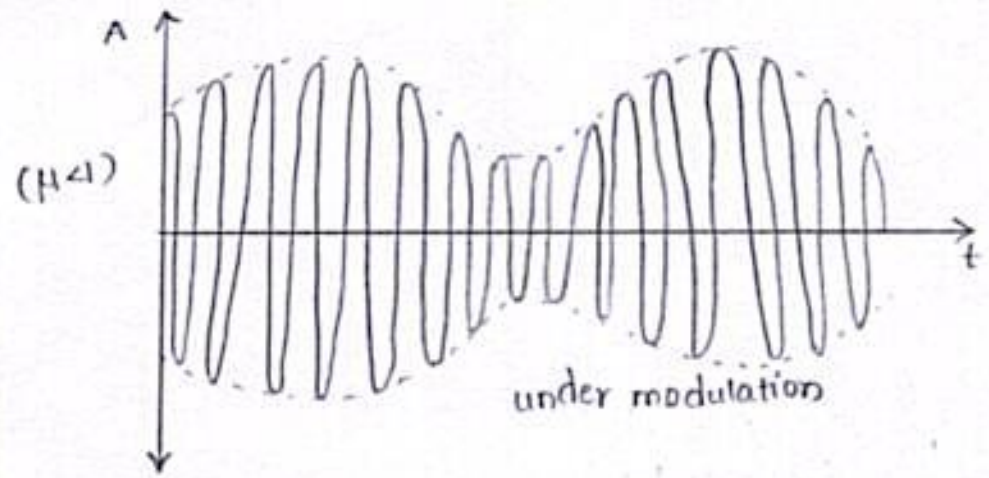
(4) Multiplexing is possible.
(5) Improve quality of reception
(6) Allows adjustment in bandwidth
(7) Avoid the noise in signal.

(3) (b) Modulation Index (μ or m):

It is the ratio of AM and Ac $\mu = \frac{A_m}{A_c}$; $\mu = k_a A_m$

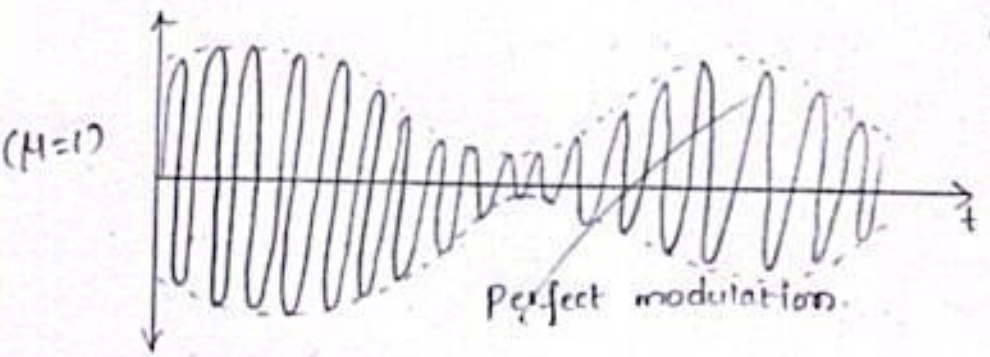
$$\mu = \frac{A_{max} - A_{min}}{A_{max} + -A_{min}}$$

if $\mu < 1$ under modulation
$\mu = 1$ perfect modulation
$\mu > 1$ over modulation



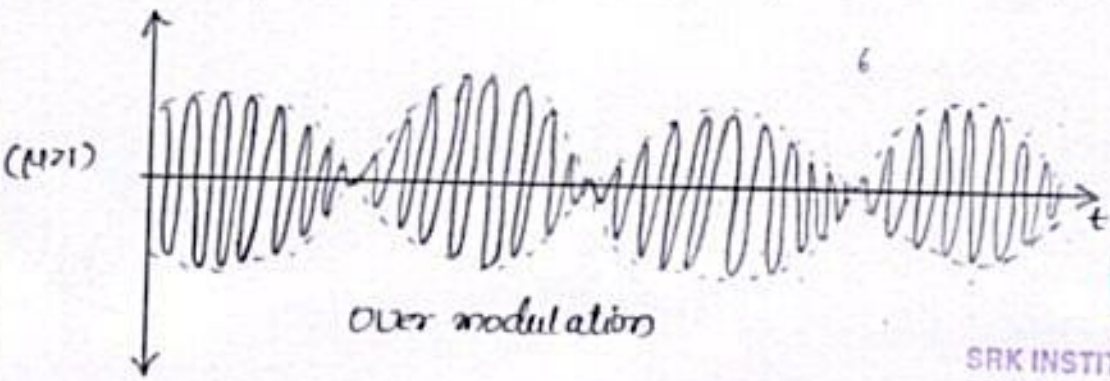
($\mu < 1$)

under modulation



($\mu = 1$)

Perfect modulation.



($\mu > 1$)

over modulation

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(1) It is used to represent the strength of the modulation index.

(2) If strength the modulating signal based on three conditions

(i) $\mu < 1$ under modulation

(ii) $\mu = 1$ perfect modulation

(iii) $\mu > 1$ over modulation.

(3) we have to avoid this condition because it is difficult to reconstruct our original signal.

(1) Reduces the height of antenna.

(1) It is required for transmission and reception of radio waves in ratio transmission it is a function of wavelength

(a) $\lambda = c/f$

(2) if lamda is high the antenna height increases

consideg, $f = 1MHz$

$$h = \lambda/4 = c/4f$$

$$= \frac{3\times10^8}{4\times10\times10^5\times1}$$

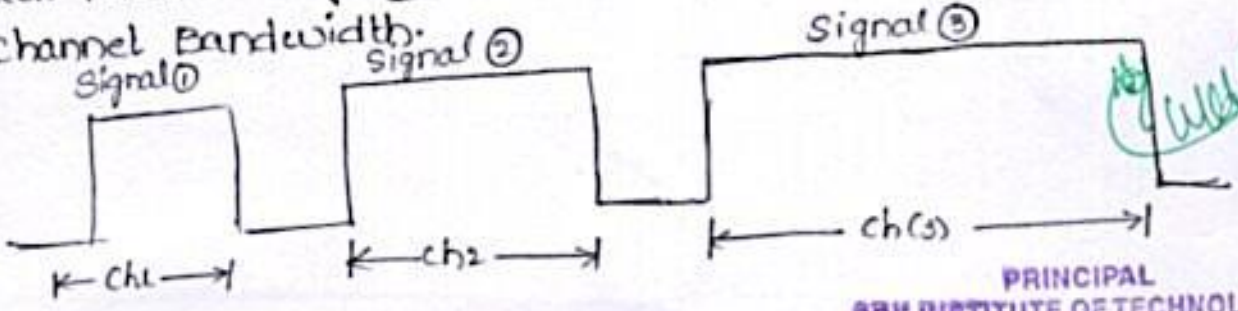
$$h = 75m$$

(3) when frequency is low then the height of an antenna is very high and it is not requirable for transmission and reception of ratio waves.

(2) Avoid of mixing signals.

(1) In order to seperate the various signals it is necessary to translate then in different portions of channels.

(2) Each must be given it's bandwidth, commonly known as channel Bandwidth.



(5) Allows adjustments in bandwidth.

(6) Bandwidth of a modulated signal may be made smaller or larger than original signal.

(7) SNR decreases then improved by proper control of the Bandwidth.

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AICA ASSIGNMENT-1

B. Supriya
20X41A0407
ECE-A

1. Define CMRR, PSRR? (5)

A. CMRR:-

Common Mode Regection Ratio - CMRR

$$A = V_1 A_1 + V_2 A_2 \rightarrow (1)$$

$$V_d = V_1 - V_2 \rightarrow (2)$$

$$A_{CM} = \frac{V_1 + V_2}{2} \rightarrow (3)$$

From eq^n (2) $V_d = V_1 - V_2$

$$V_1 = V_d + V_2 \rightarrow (4)$$

Substitute eq^n (4) in eq^n (3)

$$A_{CM} = \frac{V_d + V_2 + V_2}{2}$$

$$A_{CM} = \frac{V_d + 2V_2}{2}$$

$$2A_{CM} = V_d + 2V_2$$

$$2A_{CM} - V_d = 2V_2$$

$$\frac{2A_{CM} - V_d}{2} = V_2 \rightarrow (5)$$

From eq^n (2) $V_d = V_1 - V_2$

$$V_2 = V_1 - V_d \rightarrow (6)$$

Substitute eq^n (6) in eq^n (1)

$$A_{CM} = \frac{V_1 + V_1 - V_d}{2}$$

$$A_{CM} = \frac{2V_1 - V_d}{2}$$

$$2A_{CM} = 2V_1 - V_d$$

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$$2A_{CM} + V_d = 2V_1$$

$$\frac{2A_{CM}+V_d}{2} = V_1 \rightarrow (2)$$

Substitute eq^n (5) and (2) in eq^n (1)

$$A = A_1\left[\frac{2A_{CM}+V_d}{2}\right] + A_2\left[\frac{2A_{CM}-V_d}{2}\right]$$

$$A = A_1\left[\frac{2A_{CM}}{2} + \frac{V_d}{2}\right] + A_2\left[\frac{2A_{CM}}{2} - \frac{V_d}{2}\right]$$

$$A = A_1\left[A_{CM} + \frac{V_d}{2}\right] + A_2\left[A_{CM} - \frac{V_d}{2}\right]$$

$$A = A_1 A_{CM} + A_1\frac{V_d}{2} + A_2 A_{CM} - A_2\frac{V_d}{2}$$

$$A = A_{CM}[A_1 + A_2] - \frac{V_d}{2}[A_1 + A_2]$$

$$A = A_{CM}[A_1 + A_2] - A_{DM}[A_1 + A_2]$$

A_{CM} : Common mode gain

A_{DM} : Differential mode gain

$$CMRR = \left|\frac{A_{DM}}{A_{CM}}\right|$$

The ratio of differential mode gain and common Mode gain is called CMRR.

→ At UA741 the value of CMRR is 70dB

PSRR:-

PSRR is also called as SVRR

$$\frac{\Delta V_{OOT}}{\Delta V} = \frac{\Delta V_{io}}{\Delta V}\left[1 + \frac{R_F}{R_1}\right] + R_F\frac{\Delta I_{io}}{\Delta V}$$

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$$20 \log \frac{1}{SVRR} = 150\ \mu V/V$$

$$\log \frac{1}{SVRR} = \frac{150}{20}\ \mu V/V$$

$$\log \frac{1}{SVRR} = 7.5\ \mu V/V$$

$$\frac{1}{SVRR} = 10^{7.5}$$

$$SVRR = \frac{10^6}{10^{7.5}}$$

$$SVRR = 3.16$$

$$20 \log \left(\frac{1}{SVRR}\right) = 65\,dB$$

$$\log \left(\frac{1}{SVRR}\right) = \frac{65}{20}$$

$$\log \left(\frac{1}{SVRR}\right) = 3.25$$

$$\frac{1}{SVRR} = 10^{3.25}$$

$$SVRR = \frac{1}{10^{3.25}}$$

$$SVRR = 5.6$$

→ It is defined as the i/p offset voltage is ~~varies~~ varies with the supply voltage is called PSRR.

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2. Specifications of OPAMP?

A.

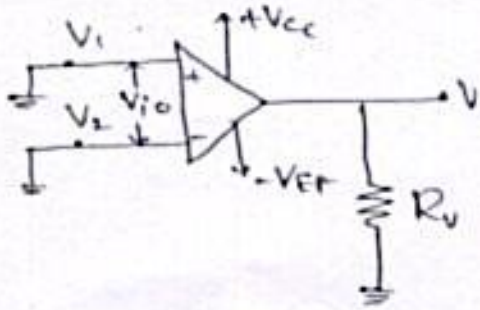
ideal OPAMP	Practical OPAMP
1. Voltage gain $A_V = \infty$	1. $A_V = 10^5$ to 10^8
2. I/p resistance $R_i = \infty$	2. $R_i = 10^6$ to 10^{12}
3. O/p resistance $R_o = 0$	3. $R_o = 80\Omega$
4. zero offset $V_o = 0$, $V_1 - V_2 = 0$	4. $V_o \neq 0$ (due to mismatch of transistors)
5. Bias current $I_B = 0$	5. I_B: 50 – 800 nA
6. CMRR = ∞	6. CMRR = 10 MV/V
7. Slew Rate = ∞	7. SR = 0.5 V/μs to 90 V/μs
8. Band width BW = ∞	8. BW = 1 – 20 MHz
9. I/p offset voltage $V_{io} = 0$	9. V_{IO} = 1 – 6 mV
10. I/p offset current $I_{io} = 0$	10. I_{io} = 2 – 8 nA
11. PSRR = 0	11. PSRR = 150 μV/V

3. Derive expression for Vio with compensation circuit

Voltage

A. Input voltage

Input offset voltage compensating circuit:-



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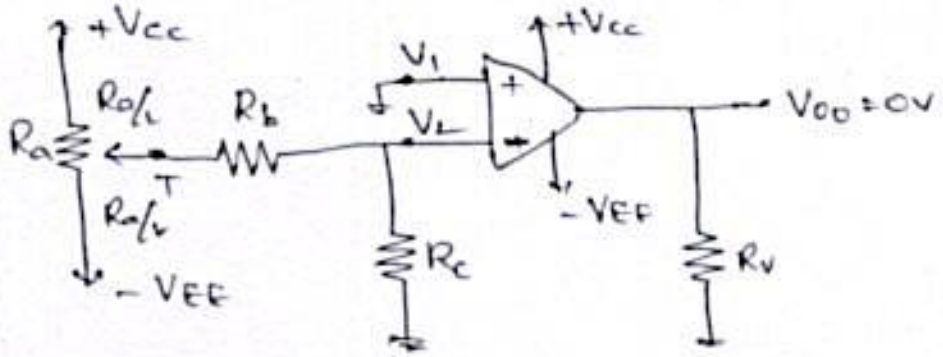
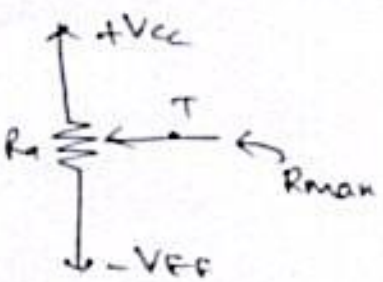
V_{io} = I/p offset voltage

V_{oo} = O/p offset Voltage

Conditions :- $V_1 > V_2$

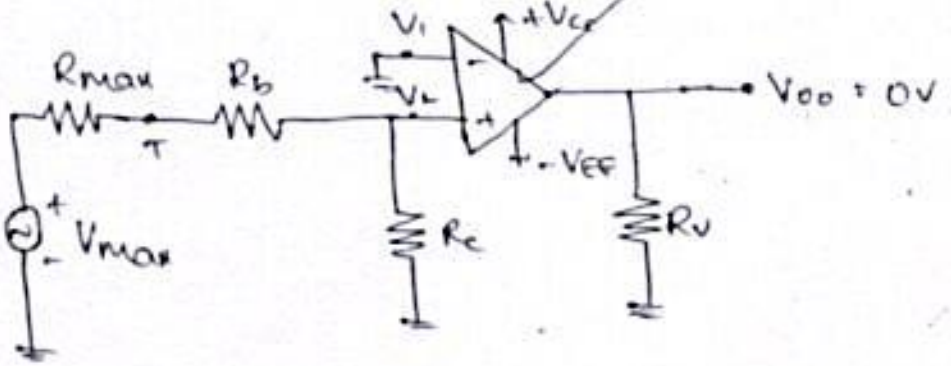
$V_1 < V_2$





$V_{max} = +V_{cc}$

$V_{max} = -V_{EE}$



equivalent resistance at node T

$$R_{max} = \frac{R_a}{2} \| \frac{R_a}{2}$$

$$= \frac{\frac{R_a}{2} \times \frac{R_a}{2}}{\frac{R_a}{2} + \frac{R_a}{2}}$$

$$= \frac{\frac{R_a^2}{4}}{2R_a} = \frac{R_a}{4}$$

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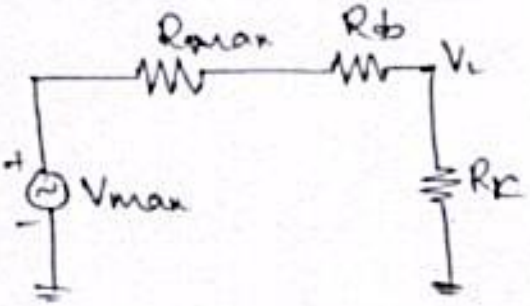
$$R_{max} = \frac{R_a}{3}$$

equivalent voltage at Node 1

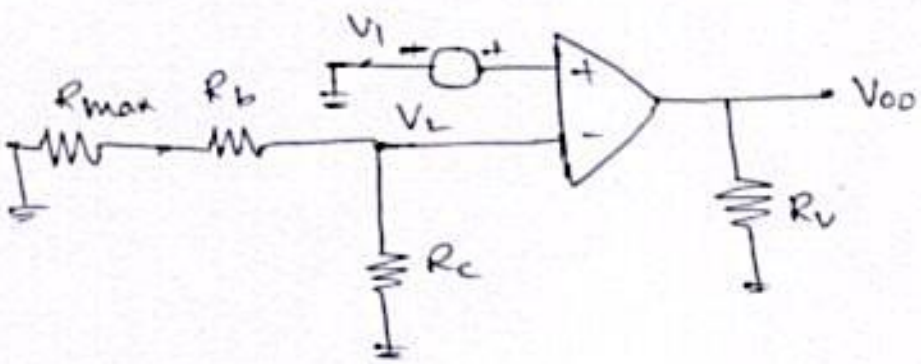


$$V_2 = \frac{R_c V_{max}}{R_{max} + R_b + R_c}$$

$$R_b > R_{max} > R_c$$

$$V_2 = \frac{R_c V_{max}}{R_b}$$

$$V_{MAX} = \frac{V_2 R_b}{R_c}$$



$$V_o = \left(1 + \frac{R_F}{R_1}\right) V_{iO}$$

$$V_o = \left(\frac{R_F}{R_1}\right) V_{iO}$$

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Probability & Statistics

Assignment I

Name : Tanveer

Roll.no : 21X41A05C5

CSE-(B)

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16/03/2023

Tanveer
21X41A05C5

1) Find mean and S.D for given data:

x	33-36	37-40	41-44	45-48	49-52
f	15	17	21	22	25

Sol:
given data is Inclusive & countinous.

⇒ Formula of Arithmatic mean $\bar{x} = A + \frac{\Sigma fd'}{N} \times c$

⇒ Standard deviation (S.D) $= \sigma = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{N}}$

⇒ Initially, converting Inclusive to Exclusive.

⇒ $d = 37-36 = 1$ ⇒ [lowerbond $- \frac{d}{2}$, upperb $+ \frac{d}{2}$]

x.	f	x.	$x-A$	$d' = \frac{x-A}{c}$	fd'	$(x-\bar{x})$	$(x-\bar{x})^2$	$f(x-\bar{x})^2$
32.5 – 36.5	15	34.5	-8	-2	-30	-9	81	1215
36.5 – 40.5	17	38.5	-4	-1	-17	-5	25	425
40.5 – 44.5	21	42.5 (A)	0	0	0	-1	1	21
44.5 – 48.5	22	46.5	4	1	22	3	9	198
48.5 – 52.5	25	50.5	8	2	50	7	49	1225
	100				25			3084

$\bar{x} = 42.5 + \frac{25}{100} \times 4 = 43.5$

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$$\sigma = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{N}}$$ whereas, $\Sigma f(x-\bar{x})^2 = 3084$

$N = 100$

$$\sigma = \sqrt{\frac{3084}{100}} = \sqrt{30.84}$$

$$\boxed{\sigma = 5.553}$$

(2) Find mode for given data.

x	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
f	5	8	7	12	28	20	10	10

given data is Exclusive and countinous data.

$$\text{Mode} = l + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times C$$

$\Delta_1 = f_1 - f_0$

$\Delta_2 = f_1 + f_2$

x	f	
0-10	5	
10-20	8	
20-30	7	
30-40	(12)	f_0
(40)-50	(28)	f_1
50-60	(20)	f_2
60-70	10	
70-80	10	

l

$\Delta_1 = 28 - 12 = 16$

$\Delta_2 = 28 - 20 = 8$

$$\text{mode} = 40 + \frac{16}{24} \times 10$$

$$= 40 + 6.666$$

$$\boxed{\text{mode} = 46.66}$$

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3) Find median for given data:

class int	10-14	20-24	30-34	40-44	50-54
f	6	12	20	8	3

Sol: given data is Inclusive countinous data.

$$\text{Median} = l + \frac{\left[\frac{N}{2} - m\right]}{f} \times c$$

Initially converting Inclusive to Exclusive -

$20-14 = 6 = d \Rightarrow \frac{d}{2} = 3 \quad \left[\text{low-b} - \frac{d}{2}, \text{upp-b} + \frac{d}{2}\right]$

class int	f	l.c.f
7-17	6	6
17-27	12	(18) m.c
(27)-37	(20) f	38 l.c.f
37-47	8	46
47-57	3	49
	49	

$\frac{N}{2} = \frac{49}{2} = 24.5$

Here, $l = 27$; $f = 20$

$m = 18$; $N = 49$

$$M = 27 + \frac{[24.5 - 18]}{20} \times 10$$

$= 27 + 3.25$

$= 30.25$

$\therefore$ Median $= 30.25$.

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(4) Obtain karlpearson measure of skewness for the data.

v	5-10	10-15	15-20	20-25	25-30	30-35	35-40
f	6	8	17	21	15	11	2

$$\text{Skewness} = \frac{(\text{Mean} - \text{Mode})}{\text{standard dev}}$$

Given data is Continous data,

$$\text{mean} = A + \frac{\Sigma f d'}{N} \times C \; ; \; \text{Median} \quad \text{Mode} = l + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times C$$

$$SD(\sigma) = \sqrt{\frac{\Sigma f (x - \bar{x})^2}{N}}$$

v	f	x	d'	fd'	$x-\bar{x}$	$x-\bar{x}^2$	$f(x-\bar{x}^2)$
5-10	6	7.5	-3	-18	-14.5	210.25	1261.5
10-15	8	12.5	-2	-16	-9.5	90.25	722
15-20	17	17.5	-1	-17	-4.5	20.25	344.25
20-25	21	(22.5)A	0	0	0.5	0.25	5.25
25-30	15	27.5	1	15	5.5	30.25	453.75
30-35	11	32.5	2	22	10.5	110.25	1212.75
35-40	2	35.5	3	6	13.5	182.25	364.5
	80			-8			4364

$$\bar{x} = 22.5 - \frac{8}{80} \times 5 = 22.5 - \frac{1}{10}$$

$\therefore$ Skewness = 0

i.e; Symmetric skewness

i.e; mean = mode = mean.

7) Calculate Quartile co-efficient of skewness for data

x	f	L.C.F
70-80	12	12
80-90	18	30
90-100	35	65
100-110	42	107
110-120	50	157
120-130	45	202
130-140	20	222
140-150	8	230
	230	

$N = 230$

$\frac{N}{4} = \frac{230}{4} = 57.5$

$\frac{3N}{4} = \frac{3(230)}{4} = 172.5$

$\frac{N}{2} = \frac{N30}{2} = 115$

for $Q_1 \rightarrow L = 90, \frac{N}{4} = 57.4, M = 30, f = 35$

$Q_3 \rightarrow L = 120, \frac{3N}{4} = 172.5, M = 157, f = 45$

$Q_2 \rightarrow L = 110, \frac{N}{2} = 115, M = 107, f = 50$

$Q_1 = L + \frac{\frac{N}{4} - M}{f} \times c$

$= 90 + \frac{57.5 - 30}{35} \times 10$

$= 97.85$

$Q_2 = 100 + \frac{115 - 107}{50} \times 10$

$= 110 + \frac{80}{50}$

$= 111.6$

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$\bar{x} = 22$

$\therefore \Sigma f(x-\bar{x})^2 = 4364$

SD for continuous data is,

$$\sigma = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{N}} = \sqrt{\frac{4364}{80}}$$

$$= \sqrt{54.55}$$

$$\sigma = 7.385$$

Mode for given data:

x	f	
5-10	6	
10-15	8	
15-20	(17)	f_0
(20)25	(21)	f_1
25-30	(15)	f_2
30-35	11	
35-40	2	

$\Delta_1 = f_1 - f_0 = 21 - 17 = 4$

$\Delta_2 = f_1 - f_2 = 21 - 15 = 6$

$$\text{mode} = l + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times c$$

$$= 20 + \frac{4}{4+6} \times 5$$

$$= 20 + 0.4 \times 5$$

$$= 20 + 2$$

$$= 22$$

$\therefore$ Mode $= 22$

$\sigma = 7.365$, $\bar{x} = 22$, mode $= 22$

$$\text{Skewness} = \frac{\text{mean} - \text{mode}}{\sigma} = \frac{22-22}{7.385}$$

$$= \frac{0}{7.385} = 0.$$

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$$Q_3 = L + \frac{\frac{3N}{4} - M}{f} \times c$$

$$= 120 + \frac{172.5 - 157}{45} \times 10 = 120 + \frac{155}{45}$$

$$Q_3 = 123.44$$

$$SK = \frac{Q_3 + Q_1 - 2Q_2}{Q_3 - Q_1} = \frac{123.44 + 97.85 - 2(111.6)}{123.44 - 97.85}$$

$$= \frac{-1.91}{25.59} = 0.074$$

∴ Negatively skewed distribution.

7) Calculate M.D about mean for data.

Marks	No. of Students (f)	x	d'	fd'	$(x - \bar{x})$	$f_i(x - \bar{x})$
0-10	6	5	-3	-18	28.4	170.4
10-20	5	15	-2	-10	18.4	92
20-30	8	25	-1	-8	8.4	67.2
30-40	15	(35) A	0	0	1.6	24
40-50	7	45	1	7	11.6	81.2
50-60	6	55	2	12	21.6	129.6
60-70	3	65	5	9	31.6	94.8
				= 8		659.2

$$\text{Mean}(\bar{x}) = A + \frac{fd'}{N} \times c$$

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$$= 35 + \frac{-8}{50} \times 10$$

$$= 35 - \frac{8}{5}$$

$$= 33.4$$

$$\text{M.D}_{\text{mean}} = \frac{\Sigma f_i (x_i - \bar{x})}{N}$$

$$= \frac{659.2}{50}$$

$$= 131.184$$

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Assignment - (1)

Name :- A. phani

Roll No : 22x45A0501

Class : CSE - A Section

Submitted to

Koteswaramma Madam

CSE Department.

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1. calculate coefficent of correlation from the following data.

x	12	9	8	10	11	13	7
y	14	8	6	9	11	12	3

Sol] -

$$r = \frac{\frac{1}{n}\Sigma xy - \bar{x}\cdot\bar{y}}{\sqrt{\left[\frac{1}{n}\Sigma x^2 - (\bar{x})^2\right]\left[\frac{1}{n}\Sigma y^2 - (\bar{y})^2\right]}}$$

$$\bar{x} = \frac{12+9+8+10+11+13+7}{7} = 10$$

$$\bar{y} = \frac{14+8+6+9+11+12+3}{7} = 9$$

x	y	x^2	y^2	xy
12	14	144	196	168
9	8	81	64	72
8	6	64	36	48
10	9	100	81	90
11	11	121	121	121
13	12	169	144	156
7	3	49	9	21

$$r = \frac{\frac{1}{10}(6+6) - (10)(9)}{\sqrt{\left[\frac{1}{10}(728) - (10)^2\right]\left[\frac{1}{10}(651) - (9)^2\right]}} = 0.948$$

2. From the following data calculate the rank correlation coefficient

x	48	33	40	9	16	16	65	24	16	57
y	13	13	24	6	15	4	20	9	6	19

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x	y	Rx	Ry	$d_i = R_x - R_y$	d_i^2
48	13	3	5.5	-2.5	6.25
33	13	5	5.5	-0.5	0.25
40	24	4	1	3	9
9	6	10	8.5	1.5	2.25
16	15	8	4.	4	16
16	4	8	10	-2	4
65	20	1	2	-1	1
24	9	6	7	-1	1
16	6	8	8.5	-0.5	0.25
57	19	2	3	-1	1

16 repeated 3 times $\frac{7th + 8th + 9th}{3} = 8$

13 repeated 2 times $\frac{5th+6th}{2} = 5.5$

6 repeated 2 times $\frac{8th+9th}{2} = 8.5$

x-series

16 repeated 3 times $\rightarrow$ $m=3$, $H_1 = \frac{m(m^2-1)}{12} = \frac{3(9-1)}{12} = 2$

y-series

13 repeated 2 times $\rightarrow$ $m=2$, $m_2 = \frac{m(m^2-1)}{12} = \frac{2(4-1)}{12} = 0.5$

6 repeated 2 times $\rightarrow$ $m=2$, $m_3 = \frac{m(m^2-1)}{12} = \frac{2(4-1)}{12} = 0.5$

$$S = \frac{1 - 6[\Sigma d_i^2 + m_1 + m_2 + m_3]}{N(N^2-1)} = \frac{1-6(65)}{10(99)} = 0.618$$

3. find two expressions lines for the given data Estimate at 4. at $x = 6$

x	1	2	3	4	5
y	15	25	35	45	55

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Sol:-

x	y	x^2	y^2	xy
1	15	1	225	15
2	25	4	625	50
3	35	9	1225	105
4	45	16	2025	180
5	55	25	3025	275

Correlation coefficient $r = \sqrt{byx \cdot bxy}$

$byx = \frac{\Sigma xy}{\Sigma x^2} = \frac{625}{55} = 11.363$

$bxy = \frac{\Sigma xy}{\Sigma y^2} = \frac{625}{7125} = 0.087$

$r = \sqrt{11.363 \times 0.087} = 0.994$

To find regression lines

x on y

$(x - \bar{x}) = r \cdot \frac{\sigma x}{\sigma y} (y - \bar{y})$

$\bar{x} = \frac{\Sigma x}{n} = \frac{15}{5} = 3, \quad \bar{y} = \frac{\Sigma y}{n} = \frac{175}{5} = 35$

$(x - 3) = \frac{\Sigma xy}{\Sigma y^2} (y - 35)$

$(x - 3) = 0.087 (y - 35)$

$x = 0.87y + 3 - 0.087 \times 35$

$x = 0.087y - 0.045$

y on x

$(y - \bar{y}) = r \cdot \frac{\sigma y}{\sigma x} (x - \bar{x})$

$y - 35 = \frac{\Sigma xy}{\Sigma x^2} (x - 3)$

$y - 35 = 11.363 (x - 3)$

$y = 11.363x + 35 - 11.363 \times 3$

$y = 11.363x - 0.911$

y at $x = 6$

$y = 11.363 (6) - 0.911$

$y = 67.267$ //

4. Fit the parabola to the following data [$y = a + bx + cx^2$]

x	1	1	20	2	3	3	4	5	6	7
y	2	7	7	10	8	12	10	14	11	14

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sol:- the normal eqns for the parabola $y = a + bx + cx^2$ are

$$\Sigma y = na + b\Sigma x + c\Sigma x^2 \rightarrow (1)$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2 + c\Sigma x^3 \rightarrow (2)$$

$$\Sigma x^2 y = a\Sigma x^2 + b\Sigma x^3 + c\Sigma x^4 \rightarrow (3)$$

x	y	xy	x^2	x^2y	x^3	x^4
1	2	2	1	2	1	1
1	7	7	1	7	1	1
2	14	14	4	28	8	16
2	10	20	4	40	8	16
3	8	24	9	72	27	81
3	12	36	9	108	27	81
4	10	40	16	160	64	256
5	14	70	25	350	125	625
6	11	66	26	396	216	1296
7	14	98	49	686	343	2401
34	95	377	154	1849	820	4774

$$95 = 10a + 34b + 154c \rightarrow (1)$$

$$377 = 34a + 154b + 820c \rightarrow (2)$$

$$1849 = 154a + 820b + 4774c \rightarrow (3)$$

solving (1) & (2) & (3)

we get

$$a = 1.802, \quad b = 3.482, \quad c = -0.268.$$

$$y = 1.802 + 3.482x + (-0.268)x^2$$

3) two random variable have regression lines with Equation $3x + 2y = 26$ & $6x + y = 31$

∴ find means and correlation coefficient b/w x and y.

sol: Given two lines $3x + 2y = 26 \rightarrow (1)$

$6x + y = 31 \rightarrow (2)$

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Solving ① & ② we get $\bar{x}$ & $\bar{y}$

$\bar{x} = 4 \quad \bar{y} = 7$

Let the given two lines are x on y and y on x

$3x+2y=26$ is x on y

$3x = -2y + 26$

$x = \left(-\frac{2}{3}\right)y + \frac{26}{3}$

$b_{xy} = \frac{-2}{3}$

$6x+y=31$ is y on x

$y = 31-6x$

$b_{yx} = -6$

$r = \sqrt{b_{xy} \cdot b_{yx}} = \sqrt{\left(\frac{-2}{3}\right)(-6)} = \sqrt{4} = 2$

$\therefore r = 2$ is always lies b/w $-1 \leq r \leq 1$

so, our assumption is wrong.

$3x+2y=26$ is y on x

$2y = 26-3x$

$y = \frac{-3x}{2} + 13$

$b_{yx} = \frac{-3}{2}$

$6x+y=31$ is x on y

$6x = 31-y$

$x = \left(\frac{-1}{6}\right)y + \frac{31}{6}$

$b_{xy} = -1/6$

$r = \sqrt{b_{xy} \cdot b_{yx}} = \sqrt{\frac{-3}{2} \cdot \frac{-1}{6}} = \sqrt{\frac{1}{4}} = \frac{1}{2} = 0.5$

$\therefore r$ lies b/w $-1 \leq r \leq 1$

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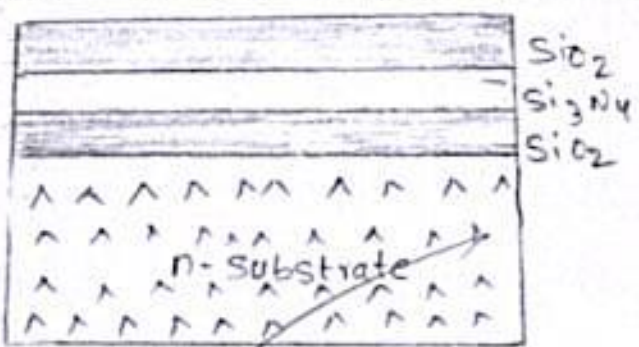
ASSIGNMENT-1 (5) VLSI

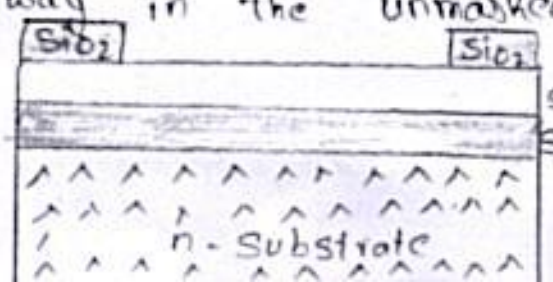
(1) With neat sketches Explain the fabrication process of p-MOS transistor Fabrication?

Ans:- The steps involved in the p-MOS fabrication process are illustrated as

Step 1:- Initially, a lightly doped n-type substance on which a 500 A° thermally grown SiO_2 layer, a 500 A° layer of Si_3N_4 and a 1000 A° layer of SiO_2 is considered as shown. The last two layers are deposited form a condensing gas phase is called chemical vapour deposition (CVD).



Step 2:- The first mask step is used to define those area that will contain transistors. The top layer of SiO_2 is etched a way in the unmasked area as shown.



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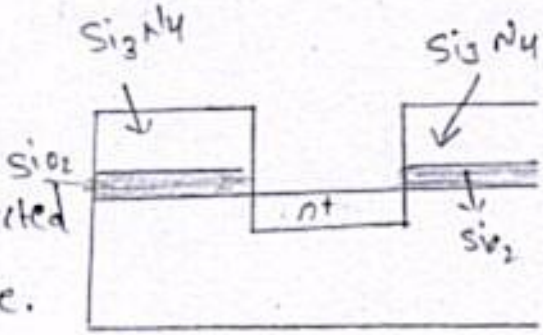
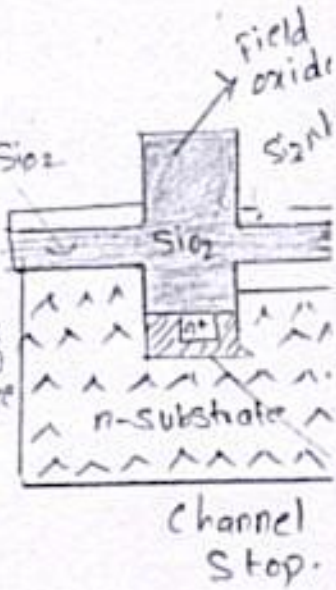
Step3 :- Now, the wafer is subjected to n-type (boron) ion-implantation that forms a self-aligned n^+ region called a channel stop as shown in figure. The self-alignment process is a consequence of acting Si_3N_4 as a mask.

Step4:- Next, the SiO_2 layer under Si_3N_4 is protected and the unprotected SiO_2 is etched as shown in figure.

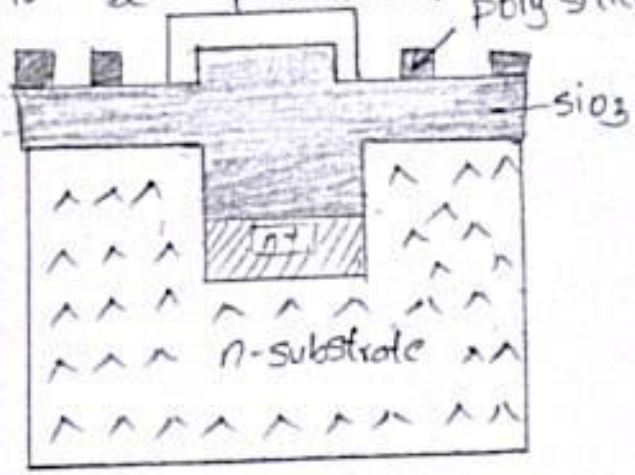


Step5:- In this step an additional SiO_2 layer of thickness 1.54μm is grown thermally. As the upper surface of silicon is oxidized, that SiO_2 layer is spreading below the surface about half of its thickness as shown in figure. The thickness as shown oxide layer is called field oxide & thin oxide layer is called gate oxide.



Step6:- Now, Si_3N_4 is removed and poly crystalline silicon is deposited over the entire wafer as shown in figure.

Step7:- Further, photoresist coating and masking allows the polysilicon to be patterned.



Step8:- Then, the thin oxide is removed to expose area in to which p-type impurities area to be diffused to form the surface and source & drain. Again the thick oxide (SiO_2) layer is developed & masked with photoresist. The drain & the source areas where contacts are to be made.

Step9:- Finally, a metal layer is deposited over the entire surface of the chip. Then this is masked & etched to build the necessary inter connection pattern.

(2) Derive the pull up to pull down ratio of inverter driven one or more pass transistors?

Ans:- Consider inverter with i/p = V_{DD}. If the i/p is at V_{DD} then the n-d transistor T_2 conduction but with a low voltage across it. Therefore, it is in its resistive region represented by R, in figure. In this period, the n-d transistor T_1 is in saturation and is represented as a current surface.

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Inverter 1

for the pull-down transistor

$$I_{ds_1} = \frac{K W_{pd\cdot1}}{L_{pd\cdot1}}\left[(V_{DD}-V_t)V_{ds_1} - \frac{V_{ds_1}^2}{2}\right] \quad -(1)$$

Therefore

$$R_1 = \frac{V_{ds_1}}{I_{ds_1}} = \frac{1}{K}\frac{L_{pd_1}}{W_{pd_1}}\left[\frac{1}{V_{DD}-V_1 - \frac{V_{ds_1}}{2}}\right]$$

since V_{ds_1} is small neglecting $\frac{V_{ds_1}}{2}$

$$R_1 = \frac{1}{K} Z_{p.d_1}\left[\frac{1}{V_{DD}-V_1}\right] \quad -(2)$$

Now, for depletion mode pull-up transistor is in Saturation with $V_{gs}=0$.

$$I_1 = I_{ds} = K\,\frac{W_{p.u.1}}{L_{pu}}\left[\frac{(V_{DD}-V_{td})^2}{2}\right]$$

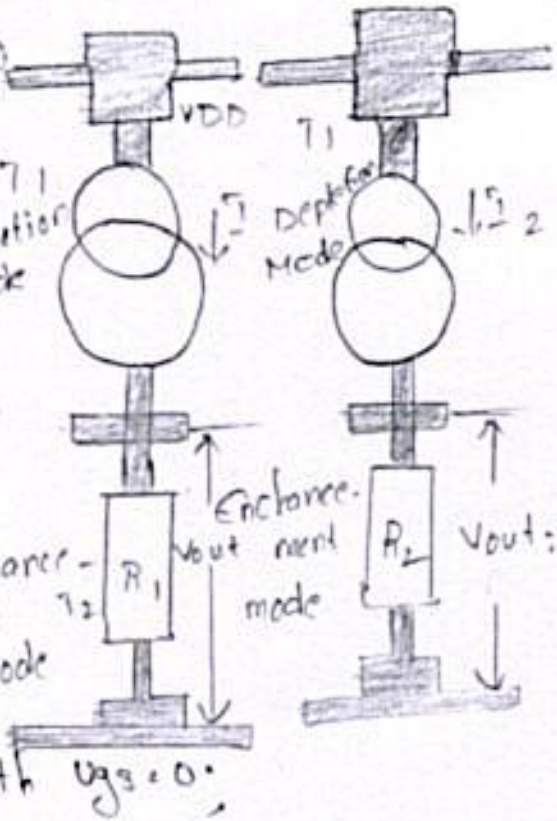
$$I_1 = \frac{K}{Z_{p.u.1}}\,\frac{(V_{td})^2}{2} \quad -(3)$$

The o/p voltage $V_{out\,1} = I_1 R_1$ —(4)

Sub (2) & (3) in eq (4)

$$V_{out\,1} = \frac{K}{Z_{pu_1}}\left(\frac{V_{td}^2}{2}\right)\left(\frac{1}{K}\frac{Z_{pd\cdot1}}{(V_{DD}-V_1)}\right)$$

$$= I_1 R_1 = \frac{Z_{p\cdot d_1}}{Z_{pu}}\left(\frac{1}{V_{DD}-V_1}\right)\left(\frac{V_{td}}{2}\right)^2 \quad -(5)$$



Inverter 2:-

when $V_p = V_{DD} - V_{tp}$

$$I_{ds_2} = \frac{K W_{p\cdot d_2}}{L_{p\cdot d_2}}\left[\left[(V_{DD}-V_{tp}) - V_t\right]V_{ds}\right.$$

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Therefore

$$R_2 = \frac{V_{ds}}{I_{ds_2}} = \frac{V_{ds_2}}{K \frac{W_{op} d_2}{L_p \cdot d_2} \left[V_{DD} - V_{tp} - V_t - \frac{V_{ds}^2}{2} \right]}$$

Since V_{ds_2} is small, neglecting $\frac{V_{ds_2}}{2}$

$$R_2 = \frac{1}{K} Z_p \cdot d_2 \left[\frac{1}{V_{DD} - V_{tp} - V_t} \right] \quad \text{---} \quad (6)$$

for depletion mode pull-up transistor in saturation with

$V_{gs} = 0$ $\quad I_2 = K \frac{1}{Z_p d_2} \frac{(V_{td})^2}{2}$

Thus $V_{out_2} = I_2 R_2 \frac{Z_p d_2}{Z_p u_2} \left[\frac{1}{V_{DD} - V_{tp} - V_t} \right] \frac{(V_{td})^2}{2}$ --- (7)

If under these conditions o/p of inverter 2 is same o/p of inverter 1, i.e

$$V_{out_1} = V_{out_2}$$

(or)

$$I_1 R_1 = I_2 R_2$$

$$\Rightarrow \frac{Z_p \cdot u_2}{Z_p \cdot d_2} = \frac{Z_{pu1}}{Z_{pd_1}} \frac{(V_{DD} - V_t)}{(V_{DD} - V_{tp} - V_t)}$$

Sub typical values of V_t & V_{tp}, ie $V_t = 0.2\ V_{DD}$ & $V_{tp} = 0.3 V_{DD}$.

$$\Rightarrow \therefore \frac{Z_p \cdot u_2}{Z_p \cdot d_2} = \frac{2 Z_p \cdot u_2}{Z_p \cdot d_2} = 8/1 \left[\because \text{for an nmos inverter } \frac{Z_{pu_1}}{Z_p d_1} = 4/1 \right]$$

Therefore, pull-up to pull-down ratio of an nmos inverter driven through one or more pass transistor is $\frac{Z_p \cdot u_2}{Z_p d_2} = 8/1$

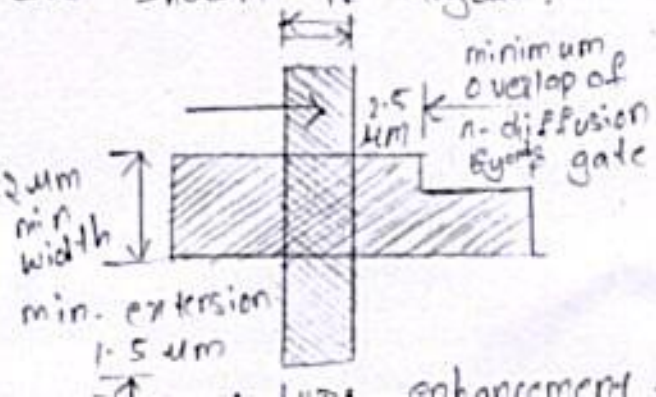
(3) Given the detailed comparision b/w CMOS & BiCMOS technology?.

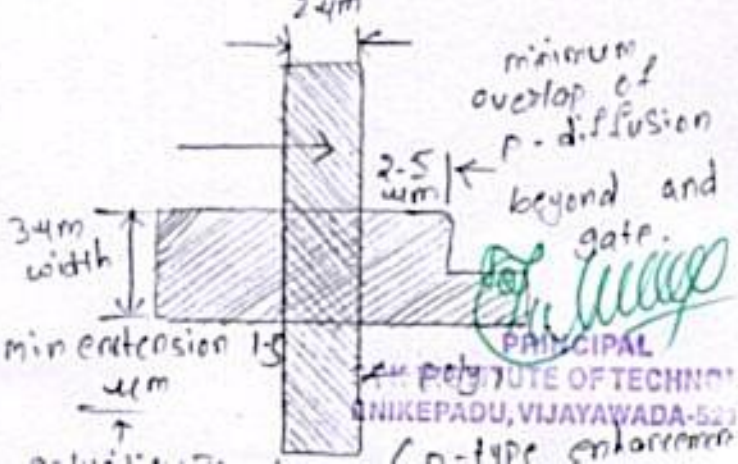
Ans:-

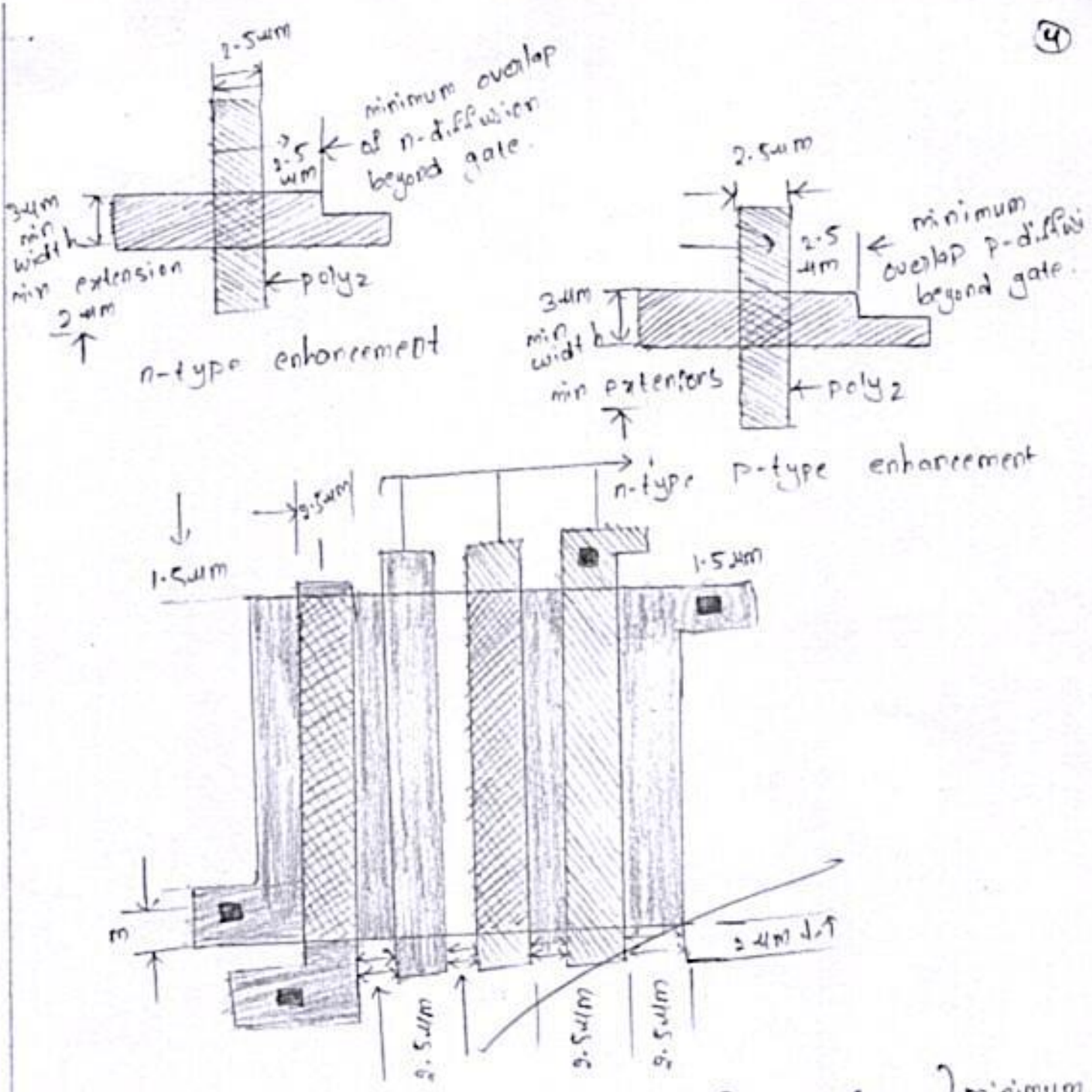
CMOS	BiCMOS
1) This technology employes Both PMOS & NMOS devices as its active elements.	1) This technology employes BJT, PMOS & NMOS devices as its active elements.
2) It consumes more power	2) It consumes less power compared to CMOS technology
3) low static power disapation	3) low power dissipation.
4) High packing density	4) High packing density.
5) It i has low o/p drive current	5) It has high o/p drive current
6) High speed	6) low speed.
7) It has high i/p impedence	7) It has low i/p impedence
8) It is used only in logic circuits	8) It is used for I/O & drive circuits.

(4) Give the 2 micrometer double poly, double metal & based design rules.

Ans:- The orbit 2 μm CMOS transistor based design rules are shown in figure.







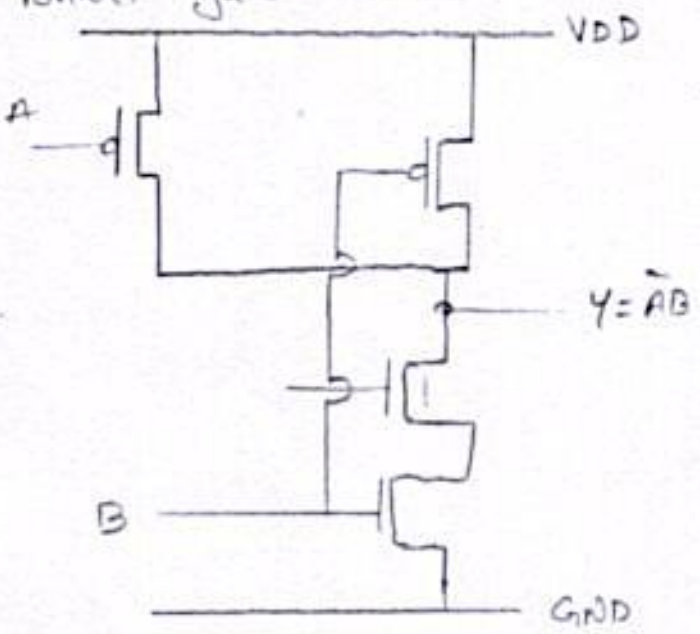
(5) Transistor Related design Rules (orbit 2) um (CMOS) minimum Sizes & overlaps.

In the design of n-type enhancement polysilicon transistor the minimum overlap of n-diffusion (n^+ active) beyond gate must be 2.5um & the minimum extension of polysilicon will be 1.4 um. Similarly in the design of p-type enhancement polysilicon transistor the minimum overlap of p+ diffusion (p^+ active) beyond gate must be 2.5 um & minimum extensi

(5) Draw the layout diagram for 2-i/p CMOS NAND gate?

Ans: Stick Diagram:-

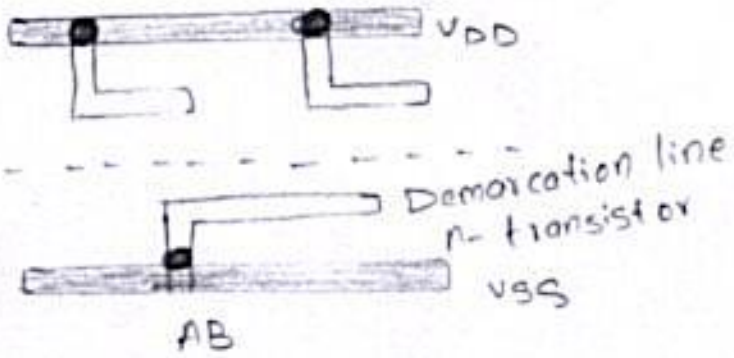
The steps involved in obtaining stic Diagram 2-i/p CMOS NAND gate are:-



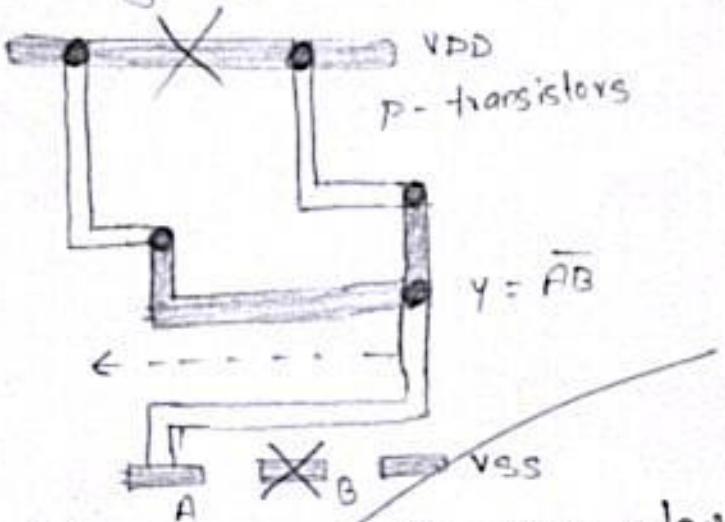
Step 1:- The design begins with the drawing of VDD & Vss rails in parallel & in metal & the creation of an imaginary demarcation line in blw as in figure(a) Two types of transistors n & p are seperated in the stick layout by demarcation line.

Rails VDD & Vss in parallel with Demarcation.

Step 2:- The n-transistors are placed below the demarcation line. close to Vss. while p-transistors are placed above the demarcation line & below VDD. Diffusion path are placed parallel to the rails as shown in figure. polysilicon gates & diffusion paths wherever transistors are required.

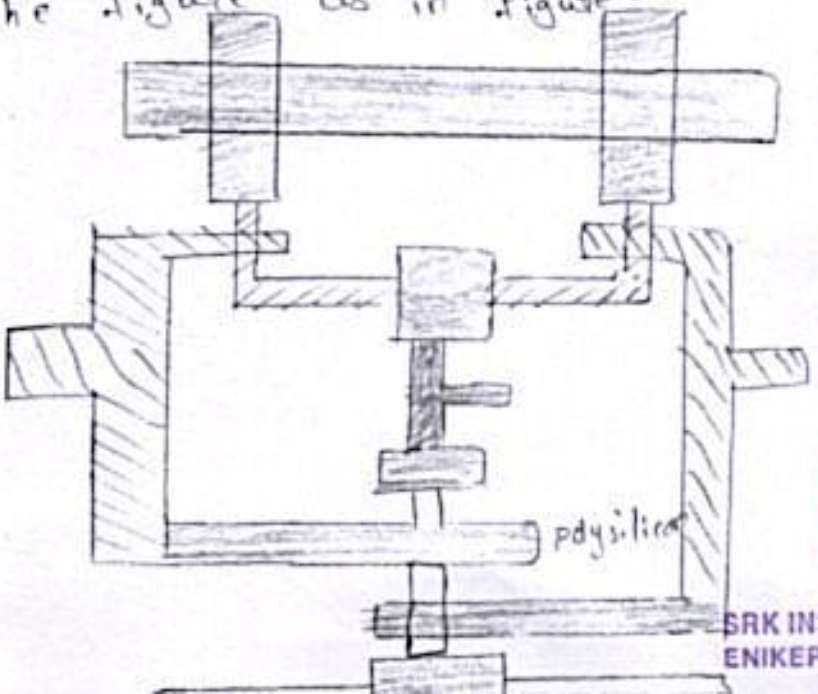


Step 3 & step 4 :- only metal and polysilicon can cross the demarcation line. The nand 4 transistors are inter connected using metals and connected to the rails as shown in figure (4). The data i/p's & o/p's are added shown in figure.



Stick Diagram of CMOS NAND gate.

The layout diagram for 2- i/p CMOS NAND gate is obtained from the figure as in figure.



layout diagram for 2 i/p CMOS NAND gate.

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II - semester

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SWITCHING THEORY OF LOGIC DESIGN

ASSIGNMENT- 1

NAME : P.GeethaRani

ROLLNUMBER : 21XU1A0404

BRANCH : ECE-'A'

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(AP) (5)

1.(a) Convert Hexadecimal number $(1E.53)_{16}$ to Octal

$(1E.53)_{16} \rightarrow (\ )_8$

$(1E.53)_{16} \rightarrow (\ )_2$

$(0001\,1110.0101\,0011)_2 \rightarrow (\ )_8$

$000|011|110.010|100|110 = (36.246)_8$
$\quad 0 \quad 3 \quad 6 \quad 2 \quad 4 \quad 6$

(b) Convert Decimal number $(417)_{10}$ to Octal

$(417)_{10} \rightarrow (\ )_8$

8	417	-1
8	52	-4
	6	

$\therefore (417)_{10} \rightarrow (641)_8$

(c) Convert Octal Number $(214)_8$ to Decimal Number

$(214)_8 \rightarrow (\ )_{10}$

$2 \quad 1 \quad 4 = 2\times8^2 + 1\times8^1 + 4\times8^0$
$8^2 \quad 8^1 \quad 8^0$

$= 126 + 8 + 4 = 140$

$(214)_8 \rightarrow (140)_{10}$

(d) Convert Binary Number $(01011.1011)_2$ to decimal

$(01011.1011)_2 \rightarrow (\ )_{10}$

01011.1011

$2^4\ 2^3\ 2^2\ 2^1\ 2^0 .\ 2^{-1}\ 2^{-2}\ 2^{-3}\ 2^{-4}$

$1\times2^3 + 1\times2^1 + 1\times2^0 .\ 1\times\frac{1}{2} + 1\times\frac{1}{2^3} + 1\times\frac{1}{2^4}$

$= (11.6875)_{10}$

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2. Excess-3 subtraction of 33 - 22.

33 - 22 = 11

9's compliment for 22

```
 99          33 → 0110   0110
-22          22 → 0101   0101
 77
                  1011   1011
                  0100   0011
                         +1
                  0100   0110  → Excess-3 of 11
```

Excess-3 addition of 22+33

```
 22  → 0101   0101
 33  → 0110   0110
 55
          1011   1011
          0011   0011
          1000   1000
```

3. Perform BCD addition of 206+147

```
206  → 0010   0000
147  → 0001   0100
353
          0011   0100
                 0110
                 0111
                 1101
                 0110
          0011   0101   0011
            3      5      3
```

= 353

Perform BCD subtraction of 135-128

135-128

write 9's compliment for 128

999 ⟹ 135 → 0001 0011 0101

−128 871 → 1000 0111 0001

871 → 1001 1010 0110

0110 0110

0000 0000 0110

+1

0000 0000 0111

0 0 7

4. Subtraction using 9's compliment $(1234-1000)_9$

$(1234-1000)_9$ write 9's compliment of 1000

9999 ⇒ 1234 + 8999

−1000

8999 = [1]0233 ⇒ 0233

+1

0234

Subtraction using 10's compliment for $[215-155]_{10}$

10's compliment means 9's compliment +1

9's compliment of 155

999

155

844

+1

845 ⇒ 215 + 845 = [1]060 = 60

Signed represented of +108 and −108

2|108 −0

2|54 −0

2|27 −1

2|13 −1

2|6 −0

Signed representation +108 = [0] 1101100

−108 = [1] 1101100

5. Define and Prove laws of Boolean Algebra.

Property-1:

Operation with '0'

a. $0+A = A$

b. $0 \cdot A = 0$

Proof: Variable A can take values of 0 & 1.

$0+0 = 0$

$0 \cdot 0 = 0$

$0+1 = 1$

$0 \cdot 1 = 0$

Property-2:

Operation with '1'

a. $1+A = 1$

b. $1 \cdot A = A$

Proof: Variable A can take values 0,1

$1+0 = 1$

$1+1 = 1$

$1 \cdot 0 = 0$

$1 \cdot 1 = 1$

Property-3:

Identify law

1. $A+A = A$

2. $A \cdot A = A$

Proof: Variable A can take values 0, 1

$0+0 = 0$

$1+1 = 1$

$0 \cdot 0 = 0$

$1 \cdot 1 = 1$

Property-4:

Complimentary law

1. $A+A' = 1$

2. $A \cdot A' = 0$

3. $(A')' = A$

Proof: Variable A can take values 0,1

1. $0+1 = 1$

$1+0 = 1$

2. $1 \cdot 0 = 0$

$0 \cdot 1 = 0$

3. $(0')' = 0$

$(1')' = 1$

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Property-5:

Commutative law

1. $A+B = B+A$
2. $A \cdot B = B \cdot A$

Proof:

A	B	A+B	B+A	AB	BA
0	0	0	0	0	0
0	1	1	1	0	0
1	0	1	1	0	0
1	1	1	1	1	1

Property 6: Distributive law

$A(B+C) = A+BC$

$A+(BC) = (A+B)(A+C)$

A	B	C	B+C	AB	AC	A(B+C)	AB+AC	BC	A+B	A+C	A+BC	(A+B)(A+C)
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0	0	0	1	0	0
0	1	0	1	0	0	0	0	0	1	0	0	0
0	1	1	1	0	0	0	0	1	1	1	1	1
1	0	0	0	0	0	0	0	0	1	1	1	1
1	0	1	1	0	1	1	1	0	1	1	1	1
1	1	0	1	1	0	1	1	0	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1

Property-7: Associative law

1. $(A+B)+C = A+(B+C)$
2. $(AB)C = A(BC)$

Proof:

A	B	C	A+B	B+C	(A+B)+C	A+(B+C)	AB	BC	(AB)C	A(BC)
0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	1	1	0	0	0	0
0	1	0	1	1	1	1	0	0	0	0
0	1	1	1	1	1	1	0	1	0	0
1	0	0	1	0	1	1	0	0	0	0
1	0	1	1	1	1	1	0	0	0	0
1	1	0	1	1	1	1	1	0	0	0
1	1	1	1	1	1	1	1	1	1	1

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Property-8: Absorption law

1. $A + AB = A$ proof: $A + AB = A(1+B) = A(1)$
$= A$

2. $A(A+B) = A$ proof: $A(A+B) = AA + AB = A + AB$
$= A(1+B) = A$

3. $A + A'B = A+B$ prof: $A + A'B = A \cdot 1 + A'B = A(1+B) + A'B$
$= A + (AB) + A'B$
$= A + B(A+A') = A+B$

6. Define and prove De-Morgans theorem.

1. $(A+B)' = A' \cdot B'$

2. $(A \cdot B) = A' + B'$

Proof:

A	B	A'	B'	$(A+B)$	$(A+B)'$	AB	$A'B'$	$A \cdot B'$	$A' + B'$
0	0	1	1	0	1	0	1	1	1
0	1	1	0	1	0	0	0	1	1
1	0	0	1	1	0	0	0	1	1
1	1	0	0	1	0	1	0	0	0

7. Encode data bits 0100 into 7bit even parity Hamming code.

$n = 7$

$m = 0100$

$2^p \geq p+m+1$

$2^p \geq p+5$

$p = 3$

$2^3 \geq 8$

$H(7,4)$

2^0	2^1		2^2			
1	2	3	4	5	6	7
P_1	P_2	0	P_3	1	0	0

$P_1(1,3,5,7) = (P_1, 010)$

$P_2(2,3,6,7) = (P_2 000)$

$P_3(4,5,6,7) = (P_3 100)$

$P_1 = 1$

$P_2 = 0$

$P_3 = 1$

$\therefore 1001100$

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8. Explain about Gray codes and with a example for gray to Binary and Binary to Gray Conversion.

Gray code:

gray codes are non-weighted codes

Let $g_n, g_{n-1}, g_{n-2}, \ldots g_0$ denote a code word in the (n+1) bit gray code.

$b_n, \ldots b_2, b_1, b_0$ designate corresponding binary numbers, the subscripts denotes the LSB and MSB.

Consider 4 bit binary code $b_3\ b_2\ b_1\ b_0$ corresponding 4 bit binary code $g_3\ g_2\ g_1\ g_0$ is given by

$b_3\ \ b_2\ \ b_1\ \ b_0$

$g_3\ \ g_2\ \ g_1\ \ g_0$

$g_3 = b_3,\ g_2 = b_3 \oplus b_2,\ g_1 = b_2 \oplus b_1,\ g_0 = b_1 \oplus b_0$

Binary code can be obtained from gray code as follows:

Consider 4-bit gray code $g_3\ g_2\ g_1\ g_0$ to corresponding binary code $b_3\ b_2\ b_1\ b_0$

Gray to Binary

$g_3\ \ g_2\ \ g_1\ \ g_0$

$b_3\ \ b_2\ \ b_1\ \ b_0$

$b_3 = g_3 \quad b_2 = b_3 \oplus g_2 \quad b_1 = b_2 \oplus g_1,\ b_0 = b_1 \oplus g_0$

Ex: Binary to Gray code

Binary code = 10101011

Gray code = 11111110

Gray to Binary Code

Gray code = 1101

Binary code = 1001

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Assignment - 1

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1. Explain different generation in the wireless communications and compare how they are diff from 1 & another.

2G wireless standards:- Voice transmission & low data state

Generation	Standards	Datarate
2G	GSM global system mobile phone	10 kbps
2G	IS-95 (CDMA)	10 kbps
2.5G	GPRS	50 kbps
2.5G	EDGE	200 kbps

GSM - Gobal system for mobile

IS - Inter in standard

cDMA - code division multiple acc.

GPRS - General packet radio servic.

EDGE: Enchanced Data for Gsm evolution

W CDMA: Wideband CDMA.

UMTS: universal mobile Telecommunication sy

HSDPA: High speed down link packet acces

HSUPA: High speed uplink packet accss

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4G wireless standards.

Generation	standard	Datarate
4G	LTE	100-200mbps
4G	WiMAX	100mbps
4G	LTE advanced	1 Gbps.
-3 Ge	partnership	Project - 3gpp developed

Difference:-

Generation	Rate	Application
2.0 - 2.75	100-100kbps	voice, low rate data
3.0 - 3.5	300kbps - 3mbps	voice, data, video calling
4G	100 - 1000mbps	online gaming HDTV

2. Derive the expression for modelling of wireless system & how it different from narrow band signals.

To gain a better understanding of nature of wireless environment and quantity analyze the performance of wireless comm sys. $s(t)$ is the transmitted passband signal can be described analytically as

$$s(t) = Re\{s_b(t)\, e^{j2\pi f_c t}\}$$

Recall from your knowledge of linear time invariant (LTI) sys that the impulse response of an LTI sys.

which attenuations a signal by a_i and delays it by τ_i is given as

$$h_i(\tau) = a_i\, \delta(\tau - \tau_i)$$

$$h(\tau) = \sum_{i=0}^{l-1} a_i\, \delta(\tau - \tau_i)$$

each i^{th} path is characterized by two parameters. ① the attenuation factor a_i

② the path delay τ_i

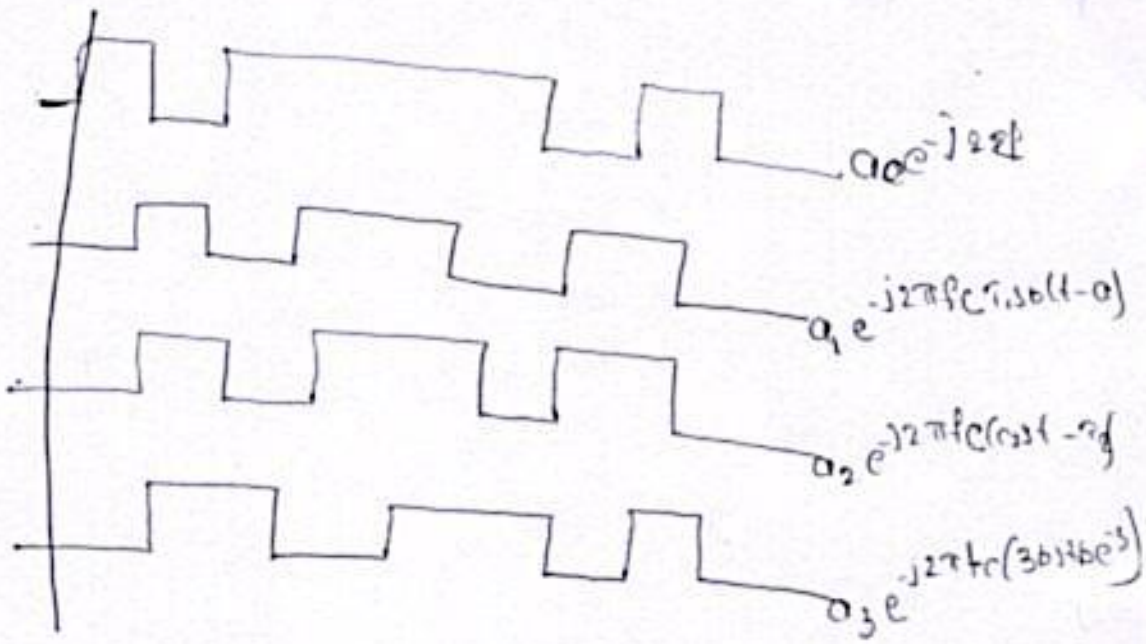
$$y(t) = s(t) * h(t) = \int_{-\infty}^{\infty} h(\tau)\, s(t-\tau)\, d\tau$$

$$= Re\left\{ \left(\sum_{i=0}^{l-1} a_i e^{j2\pi f_c \tau_i} \right) s_b(t)\, e^{j2\pi f_c t} \right\}$$

$$y_b(t) = \sum_{i=0}^{L-1} a_i e^{-j2\pi f_c \tau_i} s_b(t-\tau_i)$$

It consist of ① attenuation factor a_i;
② Path delay τ_i
③ phase factor $e^{-j2\pi f_c \tau_i}$

Here $\tau_{max} << T$. The above signal model will be further simplified in the following section to get its meaningful insight into performance of wireless comm



Multipath signal components of the receiver.

System model for Narrow band signals :-

The exp for received baseband signal can be further simplified as.

$$y_b(t) = \left(\sum_{i=0}^{L-1} a_i e^{-j2\pi f_c \tau_i}\right) s_b(t) = h_{sb}(t)$$

$$e^{-j2\pi f_c \tau_0} = -e^{-j2\pi f_c \tau_1}$$

$h_b(t) = 0 \Rightarrow a_0 = a_1$ Rado.

3. Explain the performance of BER & SNR in wireless sys & derive the expression for BER Rayleigh in terms of SNR?

Let us consider a Transmitter with pass band wireless signal s(t) which is transmitted across the wireless channel. such a passband signals can be describe analytically.

$$s(t) = Re\{s_b(t) e^{j2\pi f_c t}\} \rightarrow (1)$$

where $s_b(t)$ is complex passband of Tx signal.

f_c = carrier freq.

case ii) Analytical model of transmitter

i. Delay in the signal before of scattering effs

ii. Attenuation in signal attenuation. & delay will be represented as i^{th} channel

$$h_i(t) = a_i \delta(t - \tau_i) \rightarrow$$

for 'i' different multipath is represented as sum of diff multipath signals at the receiver.

$$h(t) = \sum_{i=0}^{l-1} a_i (\delta(t - \tau_i)) \rightarrow (2)$$

Receiver:- the received signal $y(t)$ is convolution with $s(t)$ & $h(t)$

$$y(t) = s(t) * h(t) = \int_{-\infty}^{\infty} h(t)\, s(t-\tau)\, d\tau$$

from eq (2)

$$= \sum_{i=0}^{l-1} a_i \left[Re\{ s_b(t) \tau_i e^{j2\pi f_c (t)} \tau_i \} \right]$$

$$= Re\left\{ \sum_{i=0}^{l-1} a_i e^{-j2\pi f_c s_b(t - \tau_i)} e^{j2\pi f_c t} \right\}$$

$s_b(t)$

$$y[k] = \sum_{i=0}^{l-1} a_i e^{-j2\pi f_c \tau_i} s_b(t - \tau_i)$$

Received

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with a neat fig. Explain diversity in wireless communications.

The theory of diversity lies at the heart of all modern wireless comm theory and technology. Diversity is based on simple fact that independent wireless

single inp wireless

wireless sys Diversity.

Schematic of diversity-based wireless sys

transmission of multiple copies of the information signal over independent channels, thereby reducing the chance of information loss due to the wireless channel which causes any one or a subset of these channels to be in a deep fade.

A Typical example of such a diversity-based system is the multiple antenna wireless sys, also termed the signal Input multiple-o/p (SIMO).

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