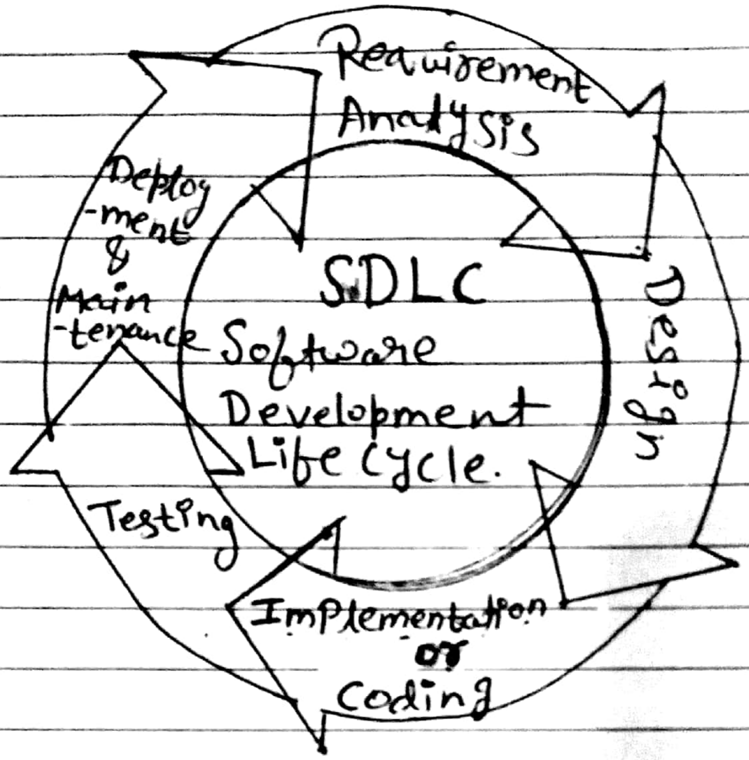
→ **Software Development :-**

Definition :- "S/w development is the computer programming, documenting testing & Bug fixing involved in creating & maintaining applications & frameworks involved in a S/w release life cycle & resulting in a s/w product".

1 **Software Development Life Cycle :- (SWDLC)**

Software development life cycle models describe phases of the s/w development & the order in which those phases are executed. Each phase produces deliverables or o/p required by the next phase in the life cycle. Requirements are translated into design. Code is produced according to the design which is called implementation or development phase. After coding the testing verifies the deliverables of the implementation phase against requirements.



SDLC - Model/Architecture

There are following six phases in every Software Development life cycle model:-

1) Requirement Gathering & Analysis

2) Design

3) Implementation or coding.

4) Testing

5) Deployment & Maintenance.

Name of Lecturer ....

1) **Requirement Gathering & Analysis :-**

Business & s/w requirements are gathered in this phase. This phase is the main focus of the project managers & stake holders. Meetings with managers, stakeholders & users or client are held in order to determine the requirement like; who is going to user the system? How will they use the system? What data should be i/p into the system? What should be o/p by the system? These are general questions that get answered during a requirements gathering Phase. After requirement gathering these requirements are analyzed for their validity & the possibility of incorporating the requirements in the system to be development is also studied.

Finally, a requirement specification document is created which serves the purpose of guidelines for the next Phase of the model.

2) **Design :-** In this phase the system & s/w design is prepared from the requirement specifications which were studied in the first Phase. System Design

Name of Lecturer : Abhishek Jain

helps in specifying H/w & System requirements & also helps in defining overall system architecture. The system design specifications serve as I/P for the next phase of the model.

3) **Implementation or Coding :-**

By receiving system design documents, the work is divided in modules/units & actual coding is started. Since, in this phase the code is produced so it is the main focus for the developer. This is the longest phase of the s/w development life cycle.

4) **Testing :-** After the code is developed it is tested against the requirements to make sure that the product is actually solving the needs addressed & gathered during the requirement phase. During this phase unit testing, integration testing, system testing, acceptance testing are done.

5) Deployment & Maintenance :-

After successful testing the product is delivered/deployed to the customer for their use.

Once when the customers starts using the developed system then the actual problem's comes up & needs to be solved from time to time. This process where the care is taken for the developed product is known as maintenance.

Ref. :- R3, R4, R5

1. 2 Software Development Process Models :-

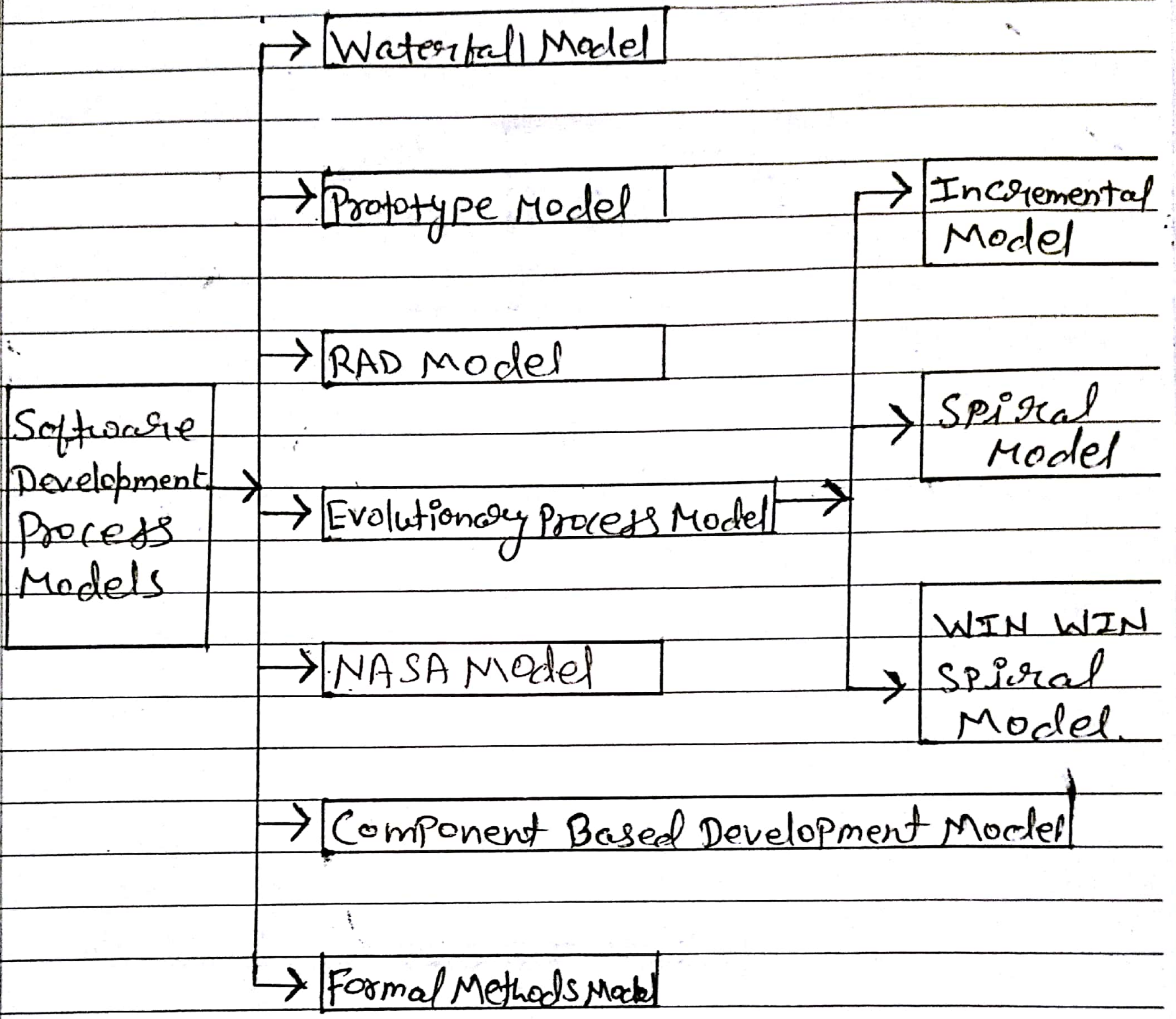
Definition :- "A s/w development process model is an abstract representation of a s/w process."

→ So, a s/w process model is a brief overview of the s/w process.

→ Each process model provides an abstract representation of its respective fields. They don't provide any definition rather they include the abstract of its

Ref. :- R1, P.No → [illegible]

2.3 Models Categorization:



Ref:- R3

2.4 Waterfall Model :-

→ The waterfall model was first process Model to be introduced.

→ It is also referred to as a linear sequential life cycle model.

→ It is very simple to understand & use.

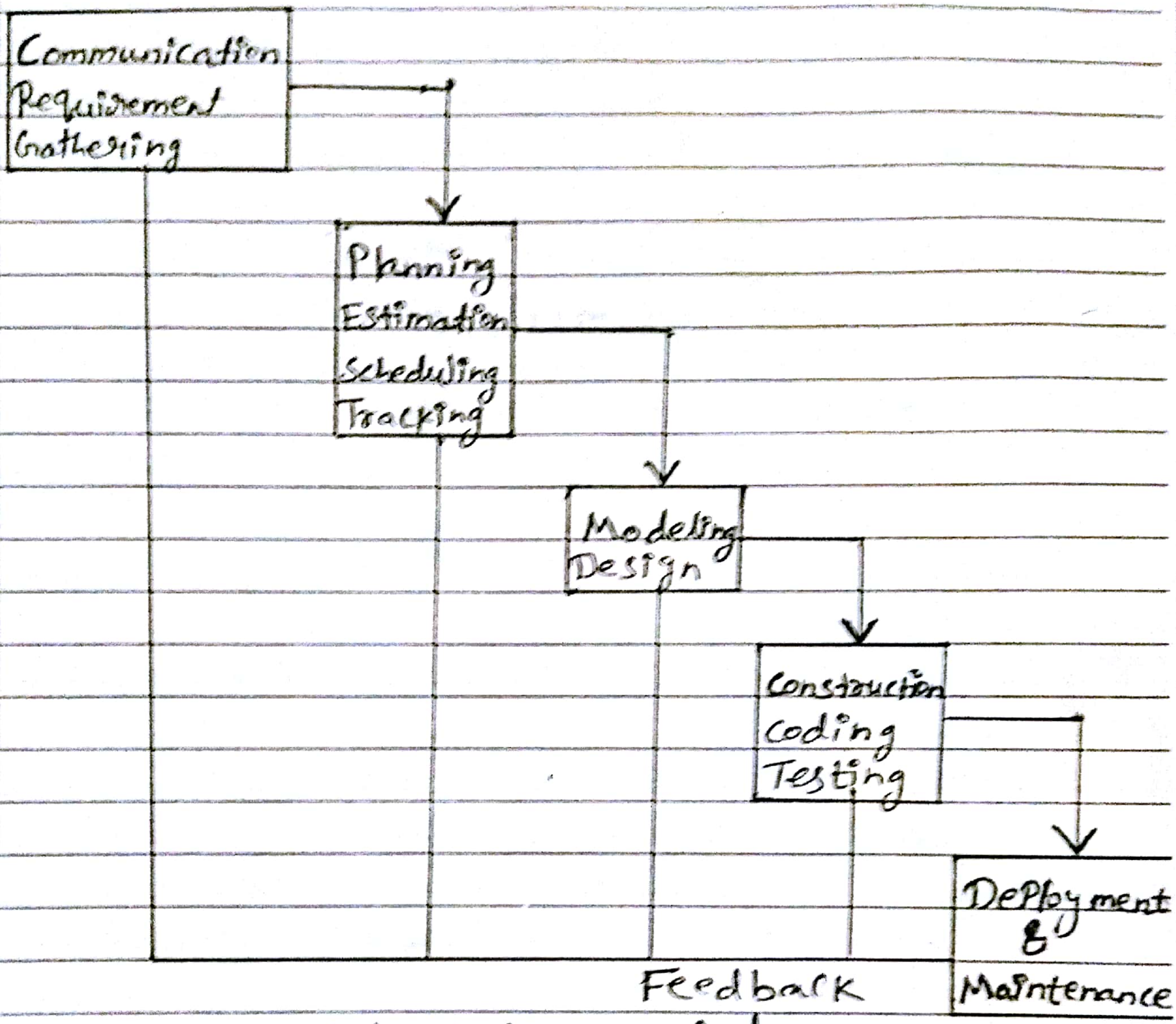
→ In a waterfall model, each Phase must be completed before the next phase. can begin.

→ In waterfall model phases do not overlap.

→ In waterfall model, typically, the outcome of one phase acts as the i/p for the next Phase sequentially.

→ Proposed by Winston Royce in 1970

→ Watefall development has distinct goals foor each Phase of development. Imagine a waterfall on the cliff of a steep Mountain. Once the water has flowed over the edge of the cliff & has begun its Journey down the side of the mountain, it cannot turn back



Waterfall Model

Phases of water fall Model

1) Communication
   a) Project Initiation.
   b) Requirement Gathering & Analysis.

Name of Lecturer: Abhishek Jain

It is the same with ~~the~~ waterfall development once a Phase of development is completed, the development Proceeds to the next Phase & there is no turning back.

2) Planning
  a) Estimation.
  b) Scheduling.
  c) Tracking.

3) Modeling
  a) Design.

4) Construction
  a) Coding.
  b) Testing.

5) Deployment & Maintenance.

1) Communication :- Communication can takes place b/w user or client & company people's.

a) Project Initiation :- In this phase the feasibility study is done, means on the basis of different constraints the possibility of creating a s/w is checked. (constraints like cost, people's, technology); It also proposes one or more conceptual solutions to the problem set.

b) **Requirement Gathering & Analysis :-**

All possible requirements of the System to be developed are captured in this phase & documented in a requirement specification document.

2) **Planning :-** In this phase planning of project is done. Following activities are performed in this phase.

a) **Estimation :-** In this cost of the project is estimated. or planned.

b) **Scheduling :-** In this scheduling for each phases & processes are planned.

c) **Tracking :-** In this each Phase & Process tracking plan is created for checking out whether the activities are performing according to Constraints or not. (correctly or not).

3) **Modeling :-** Modeling is done on the basis of requirement specification.

a) **Design :-** The req. specification from first phase are studied in this phase & system design is prepared. System design helps in specifying H/w & system requirements & also helps in defining overall system architecture.

4) **Constauction :-** In this phase s/w implementation is carried out with following activities.

a) **Coding :-** With i/p from design phase, now in this phase the s/w design is realized as a set of programs or program units.

b) **Testing :-** The s/w created during coding now get tested by following testing techniques.

Name of Lecturer : ....

i) **Unit Testing :-** Each unit is developed & tested for its functionality Which is referred to as unit testing.

ii) **Integration Testing :-** The individual program units or program are integrated & tested as a complete system to ensure that the s/w requirements have been mate.

5) **Deployment & Maintenance :-**

once the testing part is over, the s/w system is delivered or deployed On customer site. The system is installed & put into Practical use.

Maintenance involves correcting errors which were not discovered in earlier stages of the life cycle, improving the implements of system units (modules) & enhancing system's services as new requirements are discovered.

Feedback is given at last of the s/w development.

2.5. **Advantages of Waterfall Model**

→ Simple & easy to understand & use.

→ The model has well-defined phases with o/p's.

Name of Lecturer : Abhishek Jain

→ Phases are processed & completed one at a time.

→ Works well for smaller projects.

→ Clearly defined stages which result in a s/w product

2.6 Disadvantages of waterfall Model:-

→ User's don't use this model because it takes time.

→ Quite difficult to mention all requirements at begining stages.

→ Developers have very little interaction with users.

→ Not worthy for complex & big projects.

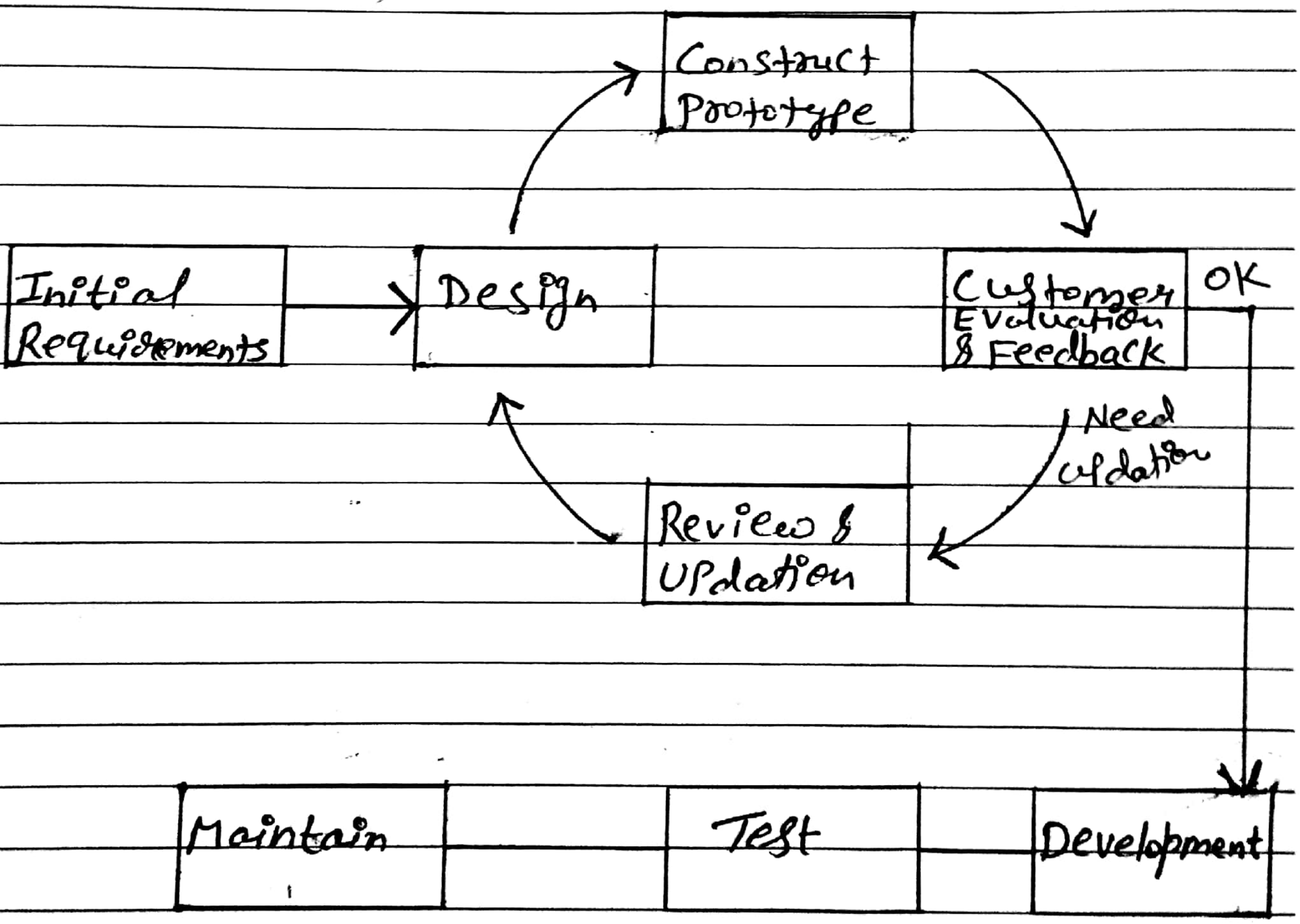
→ It is not flexible, Cannot accomodate Changing requirements.

Ref.:- R1, P.No: 79, 80
Ref:- R2, P.No: 30, 31

3.7 Prototype Model:-

To overcome from the drawbacks of waterfall Model, a new s/w dev. model was introduceed i.e. called as Prototype Model.

"A Prototype is a dummy implementation of s/w system".



Prototype Model

Name of Lecturer : Abhishek Jain

The basic principle of this model is that, instead of freezing the requirements before a design or coding can proceed, a throwaway prototype is built to understand the requirements.

The prototype is developed based on the currently known requirements.

By using this prototype, the client can get an "actual feel" of the system.

Model Description:-

→ An initial system requirements are gethered in as much detail as possible from the customer (by interviewing & meeting).

→ These requirements from the customer doesn't produce any end product.

→ A preliminary design is created for the new system.

→ A first prototype of the new system is constructed from the preliminary design. This represents an approximation of the characteristics

Abhishek Jain

of the final product.

→ The users or customer thoroughly evalute the first prototype & gives his feedback & suggestions, what needs to be added, & what should be removed.

→ The developers collects, analyzes & review the remarks from the users.

→ Developers update the system on the basis of feedback & create a new prototype or second prototype.

→ The second prototype is evaluated in the same manner as was the first prototype

→ The preceding steps are iterated (repeated) as many times as necessary, until the users are satisfied that the prototype represents the final product desired.

→ The final system is developed, based on the final prototype.

→ The final system is thoroughly evaluated & tested. Rouitine maintenance is carried out on a continuing basis to prevent large scale failures.

2.8 Advantages Of Prototype Model:-

→ User are actively involved in the development even before implementation

→ Since a working model of the System is displayed, the users get a better understanding of the system being developed.

→ Errors can be detected much earlier. Reduces time (some times) & cost also.

→ Quicker user feedback is available leading to better solutions.

→ Missing functionality can be identified easily.

→ Confusing & difficult functions can be identified.

2.9 Disadvantages of Prototype Model:-

→ Risk of insufficient requirement analysis owing to too much dependency

Name of Lecturer Abhishek Jain

on prototype.

→ Users may confused in the prototypes & actual systems.

→ Due to the iterative process the scope of the system may expand beyond original plans.

→ Developers may try to reuse the existing prototypes to build the actual system, even when it is technically not correct.

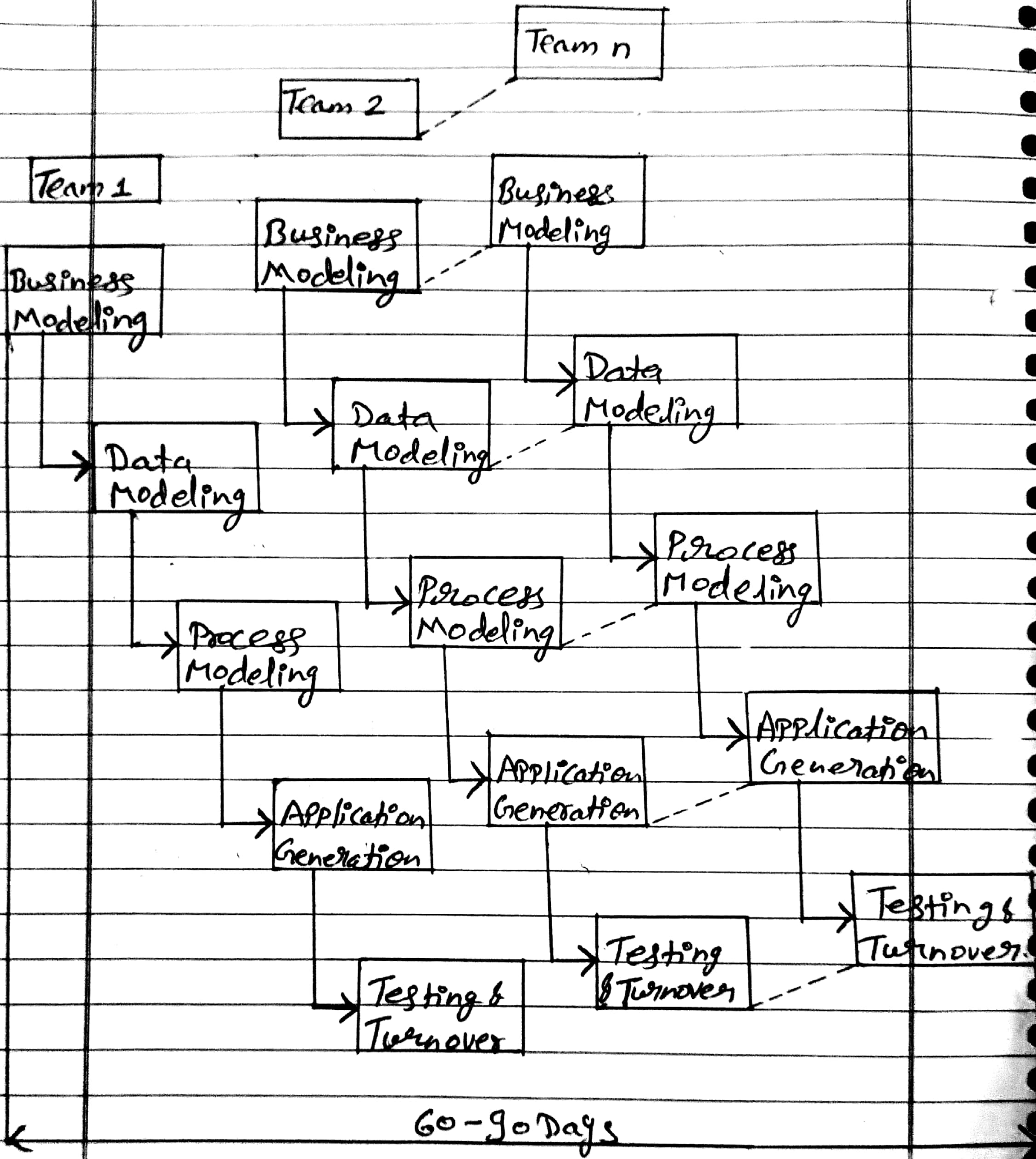
→ The effort invested in building prototype may be too much if not monitored properly.

Ref. :- R6, R7, R8

Q. 10 RAD (Rapid Application Development) Model :-

RAD is an alternative to conventional waterfall model of s/w development. RAD s/w development put less emphasis on planning tasks & more emphasis on development. In contrast to the Waterfall Model which emphasizes on Specification & Planning.

* It is a type of incremental model.



Rapid Application Development Model

Name of Lecturer : Abhishek Jain

→ RAD Model is based on prototyping & iterative development.

→ It uses the Concepts of reuse of the existing prototypes (components).

→ Requirements are gathered through workshops or focus groups.

→ Components or functions are developed in parallel as if they were mini projects.

→ The developments are timely delivered & then assembled in to a working prototype.

→ By using this prototype user can give his feedback regarding the delivery & their requirements.

Phases of RAD Model;

1) <u>Business Modeling :-</u> The information flow is identified b/w various business functions.

2) <u>Data Modeling :-</u> Information gathered from business modeling is used to define data objects that are needed for the business.

Name of Lecturer : Abhishek Jain

3) Process Modeling :-

Data objects defined in a data modeling are converted to establish the business information flow to to achieve some specific business objective. The process model for any changes or enhancements to the data object sets is define in this phase. Process description for adding, deleting, retriving or modifying a data object are given.

4) Application Generation :-

The actual system is built & coding is done by using automation tools to convert process & data models into actual prototypes.

5) Testing & Turnover :-

The overall testing time is reduced in RAD Model as the Prototypes are independently tested during every iteration. since most of the programming components have already been tested, it reduces the risk of any major issues.

2.11 Advantages of RAD Model:-

1) Reduced development time.

2) Increases reusability of Components.

3) Quick initial review occurs.

4) Encourages Customer feedback.

5) Integration from very beginning solves a lot of integration issues.

6) Iteration time can be short with use of Powerful RAD tools.

7) Changing requirements can be accomodated.

2.12 Disadvantages of RAD Model:-

1) Dependancy on technically strong team members for identifying business requirements.

2) only system that can be modularized can be built using RAD.

3) Requires high skilled developers/designers

4) Incapable for cheaper projects as cost of modeling & automed code generation is very high.

5) Management complexity is more.

6) Suitable for scalable systems (adapt changes).

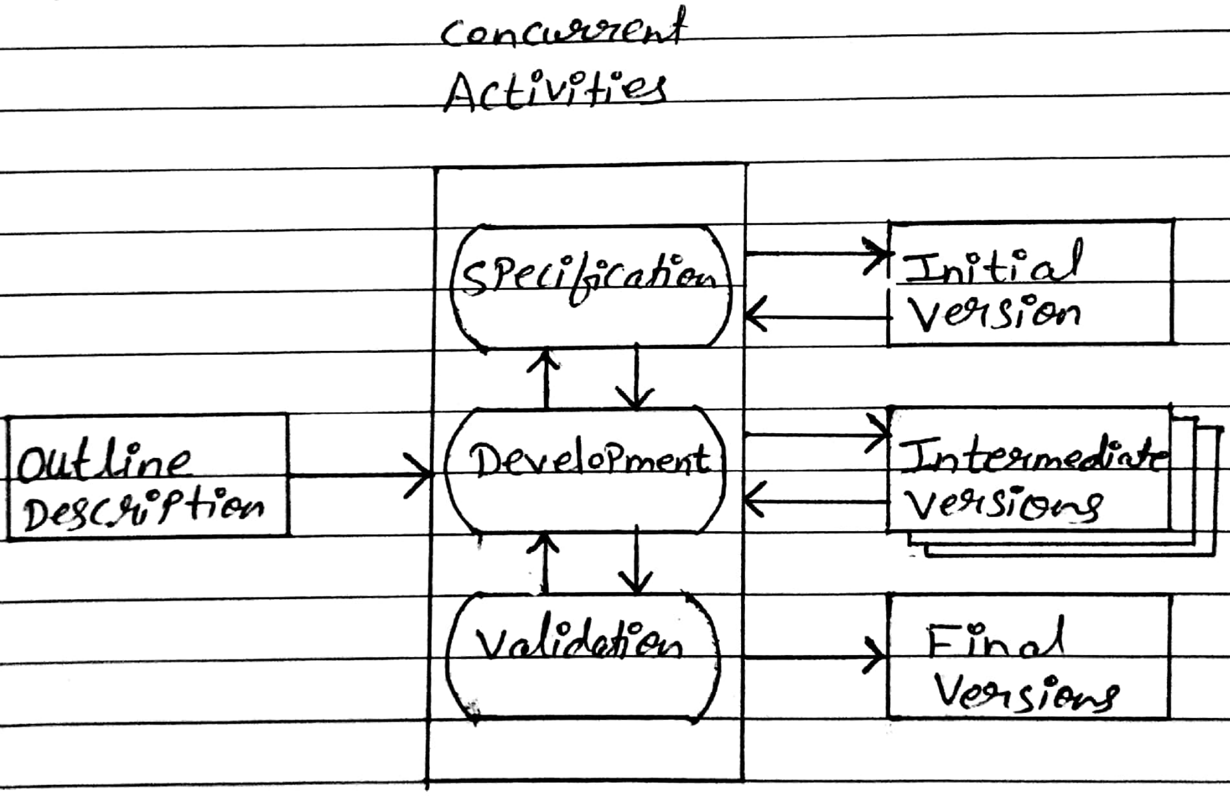
7) Requires user involvement throughout the lifecycle.

- Ref. :- R9, R10, R11

Name of Lecturer : ....

2.13 Evolutionary Process Model:-

→ Evolutionary Process Models are iterative.
→ It combines elements of Waterfall & Prototype model.
→ This approach is based on the idea of rapidly developing an initial s/w implementation based on abstract specifications & modifying this according to your appraisal.



Evolutionary Process Model

2.14 Phases of Evolutionary Process Model:-

→ Each program version inherits the best features from earlier versions.

Name of Lecturer : Abhishek Jain

→ In the first step an initial requirements & Specifications for s/w are Created.

→ In the next step specification, development & validation activities are concurretly performed with Strong feedback b/w each other.

→ After these concurrent activities an intial version of s/w developed.

→ Now the feedback from the user is taken.

→ On the basis of feedback from the user an intermedlitate version are created.

→ Feedback from the user is used throughout the entire process.

→ The s/w product is refined through many versions.

→ After so many iterations the final product is delivered to the user.

Name of Lecturer : ....

Types of Evolutionary Development:

1) Exploratory Development :-

The objective of the process is to work with user to explore their requirements & deliver a final system. The s/w evolves by adding new features as they are proposed.

2) Throwaway Prototyping :-

The prototype concentrates on experimenting with those components of the requirements which are poorly understood.

When to use EPM :-

→ When requirements are not well understood.

→ When the client & the developer agree on a "rapid prototype" that will be thrown away.

→ Good for small & medium-sized s/w systems.

Advantages of EPM :-

→ Deals constanty with changes.

→ Provides quickly an initial version of the system.

→ Involves all development teams.

→ user's are involved through out the development

Disadvantages of EPM :-

→ Quick fixes may be involved.

→ The system's structure can be corrupted by continuous changes.

→ Special tools & techniques may be necessary.

→ It is difficult to document the progress of each & every version of system.

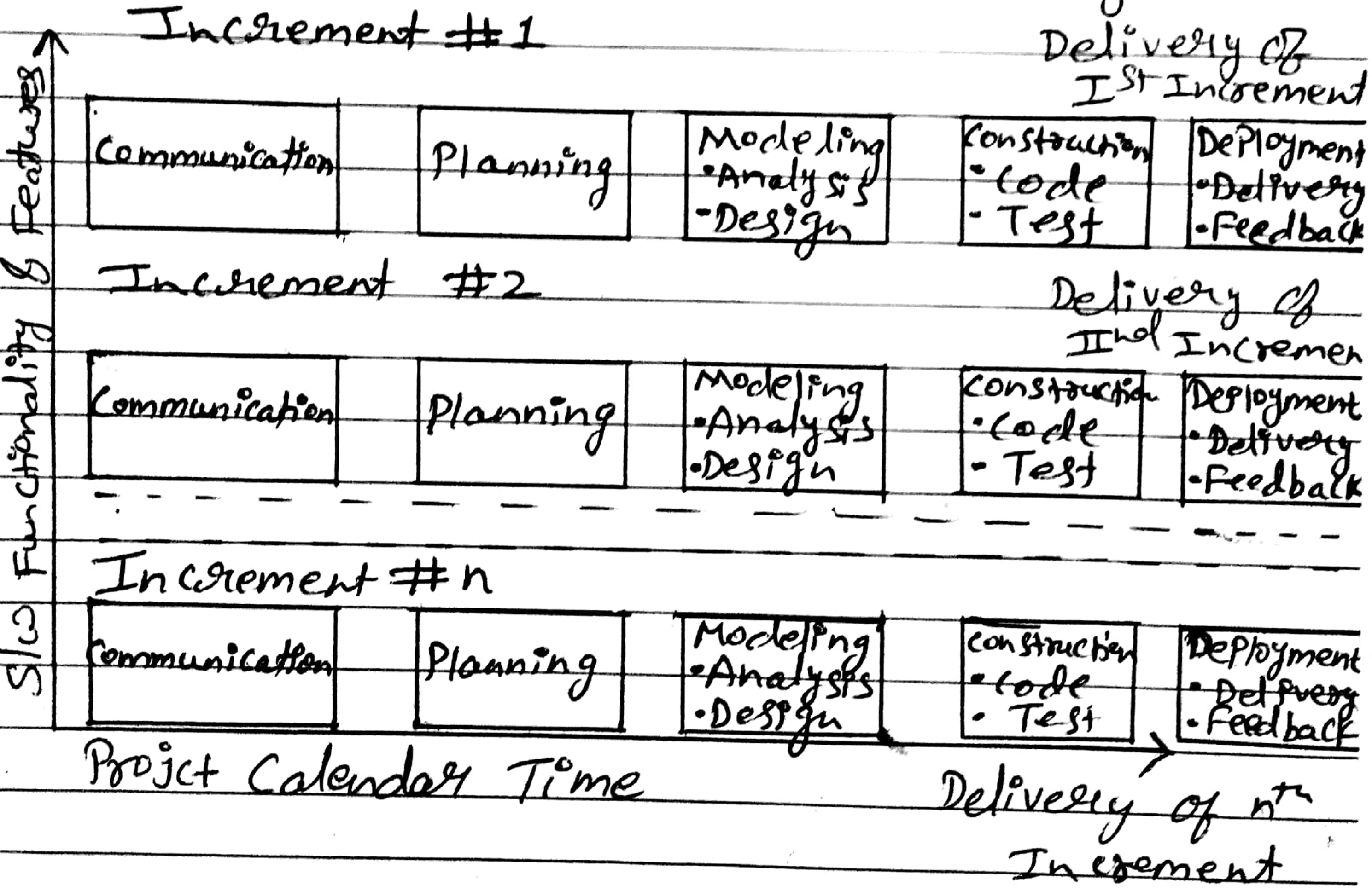
→ Too much user interaction

Ref. :- R12, R13

Incremental Model:-

→ The incremental model combines elements of the waterfall model applied in an iterativ fashion (EPM).

→ Incremental model produces deliverable "increments" as calender time progresses.



Incremental Model.

• The first increment is often a core product.

→ The basic requirements are adderessed, but many

Supplementary features are remain undelivered.

→ The core product is evaluated by user & feedback is collected from user.

→ On the basis of feedback the plan for next increment is developed.

→ The next increment include modifications, additional features & functinality.

→ This process is repeated following the delivery of each increment, until the complete product is produced.

→ The s/w product is refined through many versions

2.16 Advantages Of Incremental Model:-

→ Less human resoures. If core product is well defined & understood more employees can be added if needed in the future increments.

→ Customer is involved throughout n^{th} increment.

→ Less project failure risk.

→ Deals constantly with changes.

→ Provides quickly an initial version of the system.

-.17 Disadvantages of Incremental Model:-

→ Incorrect categarization may lead to technical problems.

→ Resulting cost may exceed the original cost

→ Documentation may be complex.

→ Highly skilled resources are required for risk analysis.

Ref. :- R1; P. NO'- 80-81

2.18 Spiral Model :-

Spiral Model was proposed by Boehm in 1988. It is an evolutionary process Model. It couples the iterative nature of Prototyping with liner sequential & stepwise procedure. It Provides the Potential for rapid development of increasingly more complete versions of S/W!

There are total 4 loops or Spirals,

1) Product concept does the feasibility study & Produces the product specification.

2) Product development develops S/w acc. to the mentioned specification.

3) Product testing include testing of product

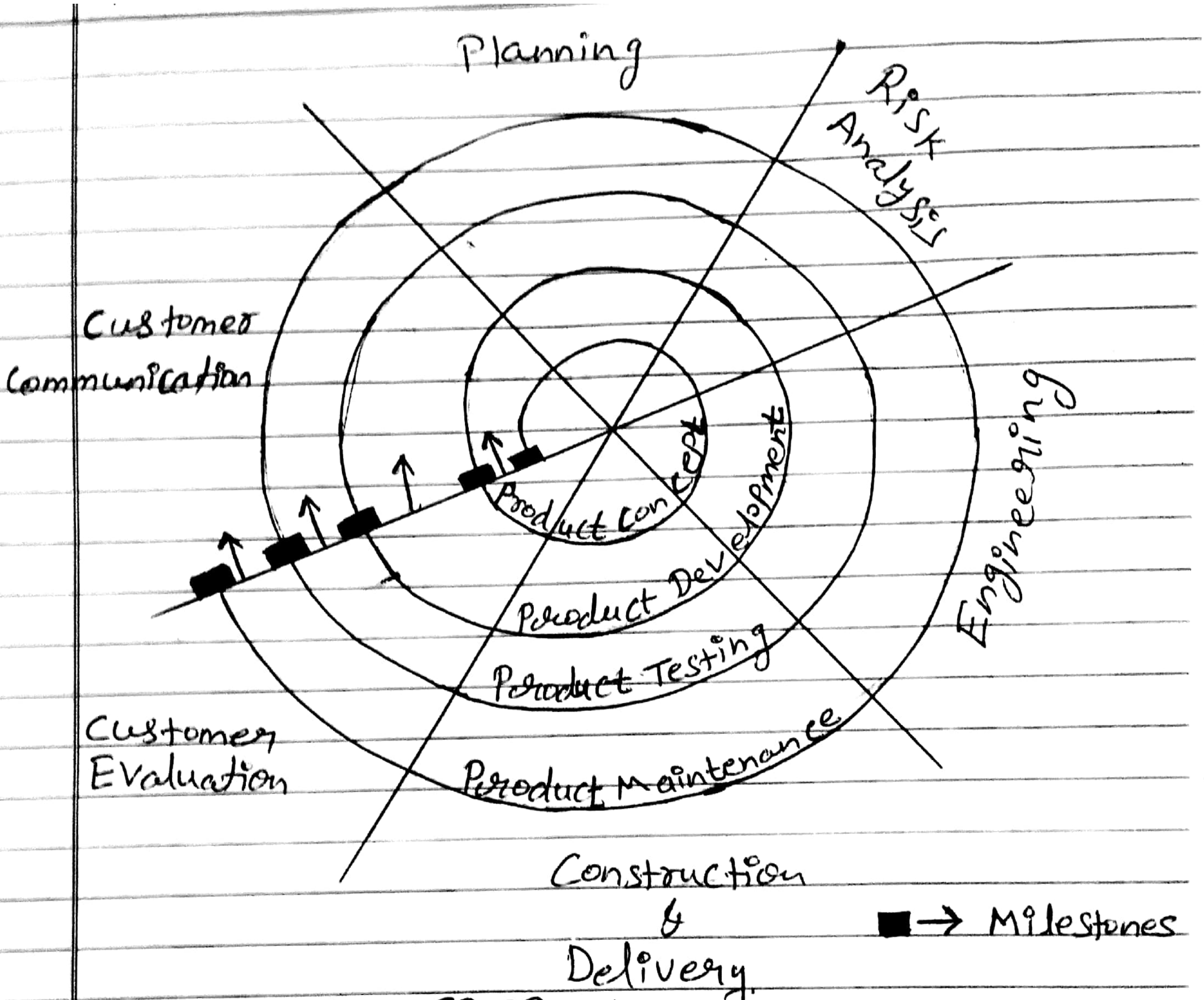
4) Product maintenance maintains the product where the changes can be done in controlled manner.

→ The spiral Model combines the idea of iterative development with the systematic, controlled aspects of the waterfall Model.

→ Spiral Model is a combinition of iterative development process model & sequential linear development Model i.e. waterfall Model with very high emphasis on risk analysis.

→ It allows for incremental releases of the Product, or incremental refinement through each iteration around the spiral.

Name of Lecturer : ....



SPIRA MODEL

→ Each box represents the milestone & Starting Point of another spiral.

→ The loop goes itratively until it is Completed.

→ When this phase Produces an end Product, then next Spiral is Started.

Name of Lecturer : Abhishek Jain

→ Spiral model is partioned into 6 task regions;

1) <u>Customer Communication :-</u>

To gather the requirement from the user, a meeting is conducted b/w customer & developer

2) <u>Planning :-</u>

Planning is done by developer's side which include scheduling, estimating cost, resource availability & risk analysis to follow the aim & requirements mentioned by the customer.

3) <u>Risk Analysis :-</u> A risk analysis is taking care of all the risk raise at any time

4) <u>Engineering :-</u> It is used when one or more representations are built of that s/w & the best one is to be chosen.

5) <u>Construction & Release :</u>

In this phase coding, testing &

deployment is done with providing user Support.

6) Customer Evaluation:-

The customer will evaluate the product, Check its functionality & then gives its feedback to the developer.

2.19 Advantages of Spiral Model:-

→ s/w remain active till it is retired.

→ It is a practical approach.

→ Changing requirements can be accommodated.

→ High amount of risk analysis hence, avoidence of Risk is enhanced.

→ Good for large projects.

→ Strong approval (from users) & documentation control.

Name of Lecturer Abhishek Jain.

2.20 Disadvantages of Spiral Model:-

→ Can be costly model to use.

→ Risk analysis requires highly specific expertise.

→ Projects success is highly dependent on the risk analysis phase.

→ Dosen't workwell for Smaller projects.

→ very difficult to implement.

→ Slow Speed.

Ref:- R1; P.No.:-86,87,88

2.21 Win-Win Spiral Mode :-

→ The win-win Spiral approach is an extension of the Spiral Model. The Phases in this approach or model is Same as the Phase in the Spiral Model.

→ The only difference is that at the

time of the identifying the requirements, the development team & Customer hold discussion & negotiate on the requirements that need to be included in the current iteration of the s/w.

→ The approach is called win-win because Customer wins by getting the S/w which satisfies all its requirements, While the development team wins by delivery S/w which is developed with all the requirements established after negotiations with the customer.

→ Development team will deliver the Product acc. to schedule constraints. & get the Proper cost of the product through dealing.

→ The win-win approach is generally used When you have time-bound releases.

2.22 Advantages of Win-Win Spiral Model:-

→ Emphasizes Final Product.

→ Faster s/w production facilitated through Collaborative involvement of the relevant Stake holders.

→ Suits for small-medium size projects.

→ Cheaper s/w via rework & maintenance reductions.

2.23 Disadvantage of Win-Win Spiral Model:-

→ Programming pair is costly.

→ Needs experience & skill if not to degenerate into code-and-fix.

→ Difficult to scale up large projects where documentation is essential.

Ref :- R14, R15

2.24 Component Based Development Model:-

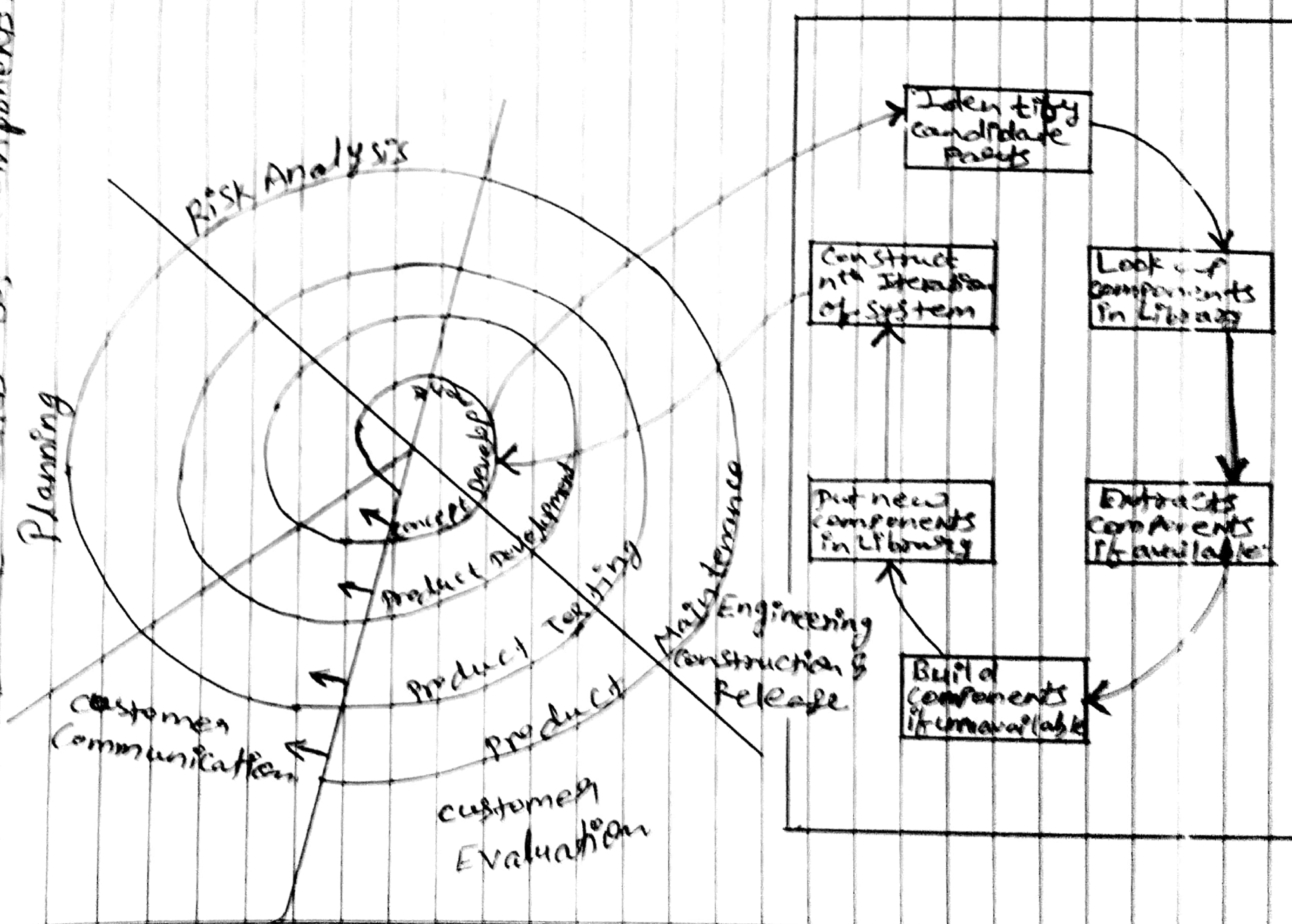
→ The component based development model incorporates many characteristics of the spiral model.

→ It is evolutionary in nature demanding an iterative approach for rapid system development.

→ In this s/w development, the reusability features are used, means already built parts of previous s/w's are used in current development.

Such Parts are called as Components.

Component Based Development Model



Planning
Risk Analysis
Customer Communication
Customer Evaluation
Engineering Construction & Release
Concept Development
Product Development
Product Testing
Product Maintenance
Identify candidate Parts
Look up components in Library
Extracts components if available
Build components if unavailable
Put new components in Library
Construct nth Iteration of System

→ This model uses a component, which is different from Spiral & evolutionary model.

→ It goes through the Spiral model loops whose procedure is jst like Spiral model.

→ In concept development phase, like any new Candidate Component is required & there is some probability to get it from the library.

→ If it is available there, then that Component is extracted for use otherwise that part is to be built.

→ After using it with the s/w, it can be put in the library for further use.

→ This iterative process will continue untill all the candidate components are built.

Name of Lecturer :

Scanned by CamScanner

2.25 Advantages of Component Based Development Model:-

→ Reusability concept.

→ Less cost

→ Reduction in development cycle time (70% reduction)

2.26 Disadvantages of Component Based Development Model:-

→ Compromises in requirements are needed.

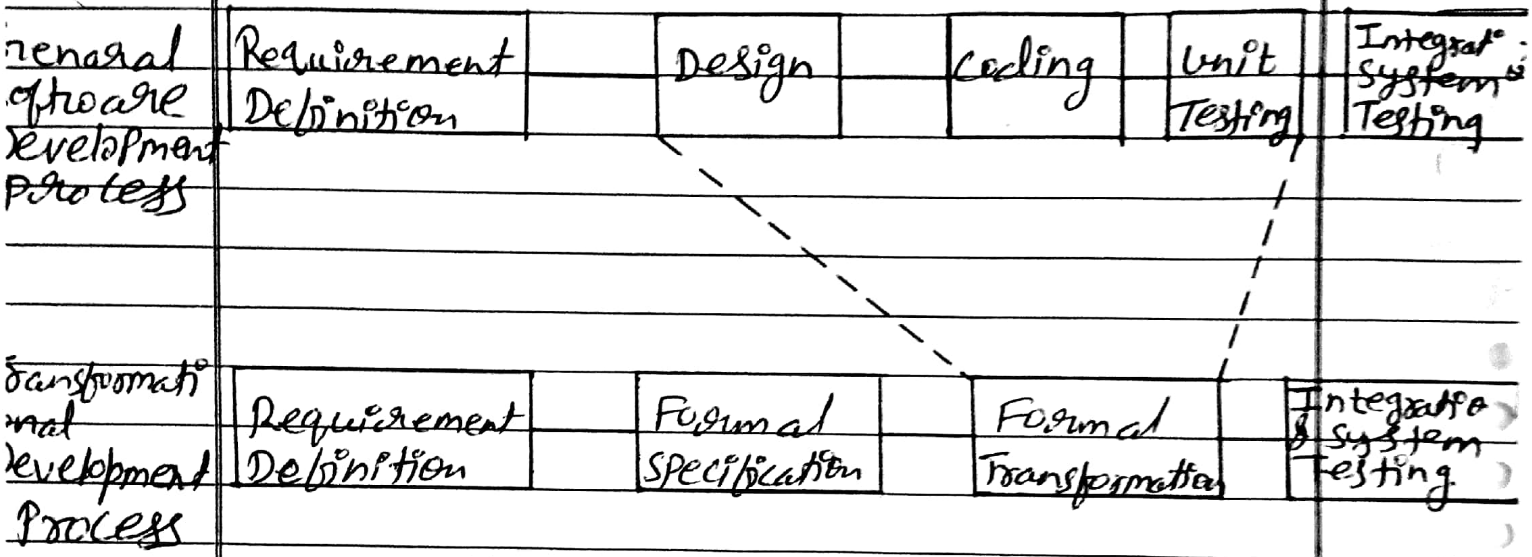
→ Less control over the system's evolution

Ref:- R1; P.No:- 91,92

2.27 Formal Methods Model:-

Formal methods model consists of a set of activities that establishes the formal mathematical specification of computer s/w.

→ In this model, initially a mathematical specification is constructed, which can be written in VDM (Vienna Development Model, IBM's in 1970's vienna lab). or language Z. (Proposed by Abiral in 1977, zermelo-Fraankel Set theory}



Formal System Development

→ The Specification is then transformed Stage-by-Stage into the working software.

→ That's why it is also called as Transformational model.

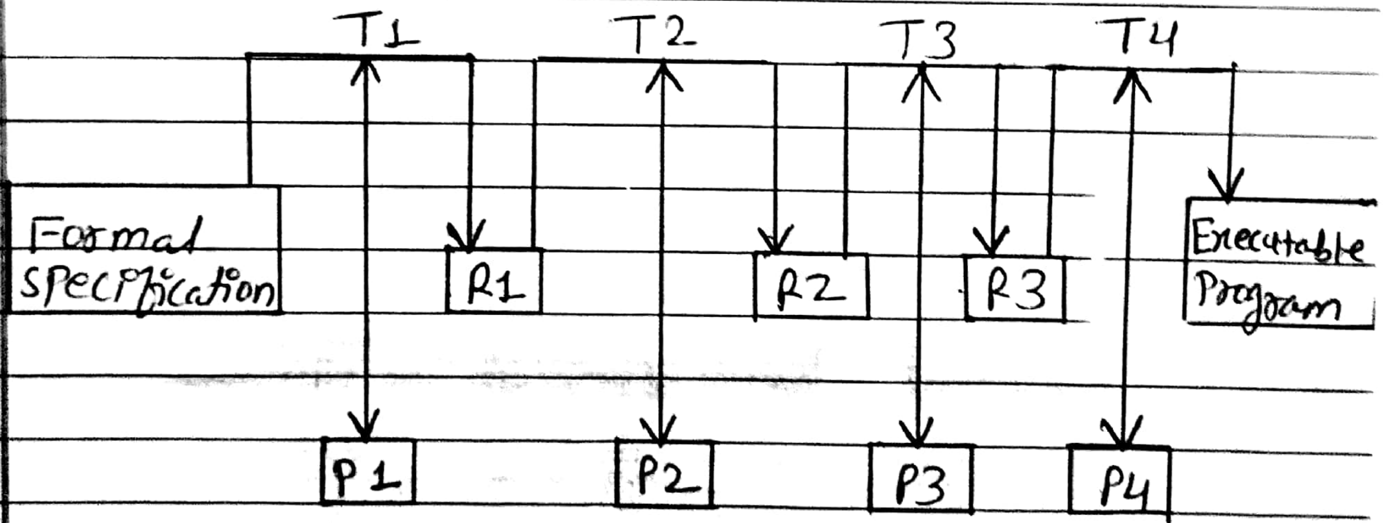
→ So, the main aim in this model is to convert the formal mathematical specification of a system specification to an executable program.

→ This model is concerned to the theoretical work on formal specification.

→ The Partial development Process which includes phases of design, coding & unit testing are replaced by one of the transformational development process Phase i.e formal transformation.

→ And one more phase formal specification is also included.

→ Inthe transformational phase, the formal specification is refined through a series of transformations into a program.



Formal Transformation.

* Here;

→ T1, T2, T3, T4 : Transformation steps.

Name of Lecturer Abhishek Jain

Scanned by CamScanner

→ P1, P2, P3, P4: Process Steps to transform the formal Specification

→ R1, R2, R3: Refinements.

* The transformation process consist of fallowing steps:

1) Informal requirements are analyzed & functions are specified formally.

2) In next Step, the development process takes this formal specification & transforms it into a more detailed, less abstract formal description.

3) This description becomes executable by some abstract process.

4) If executability in the transformation process is achieved soon, then the executable description may be viewed as an evolutionary prototype that is obtained as-a-by-product of the transformation process.

2.28 Advantages of Formal Method Model:-

→ The errors can be discovered & corrected.

→ Mathematical proofs use only numerical concepts.

→ Best for scientific & research projects.

2.29 Disadvantages of Formal Method Model:-

→ Because few s/w developers have the necessary background to apply formal methods, extensive training is required.

→ It is time consuming & expensive.

→ It is difficult to use the models as a communication mechanism for technically unsophisticated customers.

→ Program proofs are very long & impractical for large projects.

Ref. :- R1: P. No. → 92, 93

Name of Lecturer : Abhishek Jain

2.30 Software Engineering APProaches:-

* The basic objective of s/w engg. is to:-

"develop methods & procedures for s/w development that can scale up for large systems & that can be used to consistently produce high s/w at low cost & with a small cycle time".

→ So, the key objectives are consistency, low Cost, high quality, small cycle time & scalability.

→ The basic approach that s/w engg. takes is to seperate the development process from the developed product.

→ The main thing is that the development Process controls all the key objectives mentioned. To satisfy objectives one must focus on the s/w process.

→ The SWDLC is required to have a sequential, well defined, accurate & disciplined process. If it is followed to develop any s/w product, the resultant product

→ Resultant Source code produced is inefficient.

→ Maintainability of large s/w systems is required.

Ref. :- R3

will be the desired S/w product.

→ The various S/w engg. approaches are various SWDLC Models.

→ The basic SWDLC in an ideal SWDLC, which is followed & modified by all various SWDLC Models.

→ Design of proper SWDLC models & their control is the primary goal of S/w engg.

Ref:- R3 9

2.31 Fourth Generation Techniques:-

→ 4GT Consist of many S/w methods & tools that have one thing common that each enables the S/w Engineer to specify some Characteristics of S/w at a high level.

→ The 4GT paradigm refers to the ability to specify S/w using specialized language forms or a graphic notation that describes the problem to be solved in terms that the Customer can understand

⇒ The various steps included in 4GT:-

→ Requirements gathering to collect requirements from customer.

Name of Lecturer Abhishek Jain

→ Requirements gathering to collect requirements from customer.

→ Design Stratergy to design all the modules.

→ Implementation using 4GT is performed to automatic generation of code.

→ Conversion of 4GT implementation into a product

→ The 4GT developed s/w must be built in a manner that enables maintenance to be performed.

2.32 **Advantages:-**

→ 4GT gives a viable approach & credible solutions to many applications

→ Less time is required to produce s/w.

→ Productivity is greatly improved.

2.33 **Disadvantages:-**

→ 4GT tools are not easy to use.

Definition of Testing :- Testing is the Process of evaluating a System or its Components with the intent to find Whether it satisfies the Specified req's. or not.

OR

Testing is executing a system in order to identify any gaPs, errors or missing req's. in contrary to the actual req's.

S/w testing is broadly divided in two categories;

1) Black Box Testing

2) White Box Testing

1) Black-Box Testing :-

Definition :- "The technique of testing without having any knowledge of the interior workings of the application is called black-box testing".

The tester does not access the source code.

The tester will interact with the system's user interface by Providing i/p's & examining o/p's without knowing how & Where the i/p's are worked upon.

2) **White-Box Testing :-**

Definition :- " White box testing is the detailed investigation of internal logic & structure of the code."

White-box testing is also called glass testing or open Box Testing or transpent Box Testing, or Structural testing.

In order to perform white Box testing on an application, a tester needs to know the inter working or logic of the code.

The tester needs to have a look inside the source code & find out which unit/chunk of the code is behaving inappropriately.

Types of White-box testing ;

i) **Unit Testing :-** In this individual units of source code are tested. This type of testing is performed by developers before the setup is handed over to the testing team to formally enecute the test cases.

ii) **Integration Testing :-**

In this testing individual s/w modules are combined & tested as a group.

iii) **System Testing :-** System testing tests the system as a whole (s/w & H/w

Once all the components are integrated, the application as a whole is tested rigorously to see that it meets the specified req's. This type of testing is performed by specialized testing team.

Name of Lecturer : Abhishek Jain