AIR-1 Notes

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Handwritten notes by

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AIR-1 ESE 2021

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Standards & Quality Practices

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1. Basic concepts and Quality → QA and QC
2. Quality Thinkers / approaches → TQM
3. Control charts.
4. Six Sigma → Process capability
5. Acceptance Sampling → AOQ, → benefits of sampling
6. Inventory Management → EOQ
7. Manufacturing
8. Maintenance
9. Construction and services.

Key concepts related to Quality

1) Degree of fitness for the use of customers. (whether it solves the intended purpose or not)

2) The product or service should meet the customers' expectation.

Expectations → Stated
→ Implied → not clearly specified.

→ Both stated and implied expectation of the customers should be fulfilled.

3) The product / service should be cost-effective. → affordable to the target customers.

→ Using Lean manufacturing and Value engineering cost of manufactu can be reduced.

→ Wastages ↓ ⇒ Processes standardise ⇒ COM ↓ ⇒ Hence produd becomes more competitive

4) Product should conform to specifications (relevant to products only)

eg → 150 ± 0.2 cm → Specification Range.

USL = 150.2 cm → LSL = 149.8 cm

→ If the value of the products quality characteristics falls within USL and LSL then it is of acceptable quality otherwise we say that a defect has taken place.

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5) The product should be reliable → time oriented characteristic.

Reliability
- 1) should not fail
- 2) over a period of time
- 3) perform as per specified standards
- 4) under given operating time

6) The product should be durable → i.e. it should have a high effective life.

→ The product will become scrap after the durable period and it cannot be restored to its normal working condition even after performing the maintenance.

7) Aesthetics → appearance of product.
Tangibles → indicator of quality for services.
↳ environment or ambience in which service is provided.

8) The product should be serviceable - means that its after sale service should be easily available at a low cost.

9) The product / service should have a good perceived quality.
↳ brand image, advertisement → preconceived notion.

10) Quality is a relative term and it is not absolute, it varies with time location and from person to person. [Subjectivity]

11) Due to globalisation, the competition has increased and now the consumers have more choices, hence if a company has to survive in the market, then it will have to continuously improve the quality of it's products and services, in order to meet the changing requirements of the customers.

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(12) Productivity = Output / Input

⇒ If Quality ↑ ⇒ Productivity ↑

⇒ Types of Quality (Stages)

(1) Quality of Design → Most important.
(2) Quality of Conformance (Implementation)
(3) Quality of Performance

(1) Quality of Design (QOD)

→ Most critical of the three
→ Multi-functional. [Interdepartmental → involving various experts]
→ It is easier and less costly to incorporate quality into the product at an early stage of product development.
→ Robust Design → It is a good quality of design such that the product is able to perform satisfactorily under a wide range of operating conditions.

Quality of Design →
1) Market Survey
2) Concept Development
3) Detailed specification. (Output)

(2) Quality of Conformance (QoC)

→ It deals with whether the product conforms to the specifications finalized at the design stage.
→ Poor QoC ⇒ defects ↑ ⇒ Wastages and Cost of Manufacturing ↑

⇒ Inputs required

(a) Resources
(b) Skilled Manpower
(c) Technology and machines
(d) funds [should be less costly and easily available]
(e) Support of leadership / top management
(f) Participation of grassroot level workers.

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(9) → Heavy dependence on the supplier to provide the right quantity and quality of input materials.

③ Quality of Performance (QoP)

→ regular and adequate maintenance.
→ good after sales services
→ reliable products.

⇒ Cost of Quality
- → 1) Prevention Cost
- → 2) Appraisal Cost

} Cost of conformance or Cost of Good Quality

- → 3) Internal failure cost
- → 4) External failure cost

} Cost of Non-conformance or failure or Cost of Poor quality

→ COQ = CoC + CoNC
→ CoC = CoP + Co A
→ CoNC = CoIF + CoEF

→ Cost of quality includes the cost incurred to prevent poor quality, check the quality of products and the losses resulting from Internal and External failures

① Prevention Cost

→ It involves the money spent in preventing the defects.
→ It includes the costs associated with planning, design review, training, quality assurance, supplier evaluation and effective implementation of the quality Management System.
→ As prevention cost increases, failure cost decreases
→ As the company invests more in prevention, it results in long term sustainable profits to the company because of improved brand image and increased sales.

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(2) Appraisal cost

→ As the cost of prevention increases, the cost of appraisal reduces.

→ The appraisal cost includes the cost associated with inspection of the product, testing equipment and salary of the related staff.

(3) Internal Failure Cost

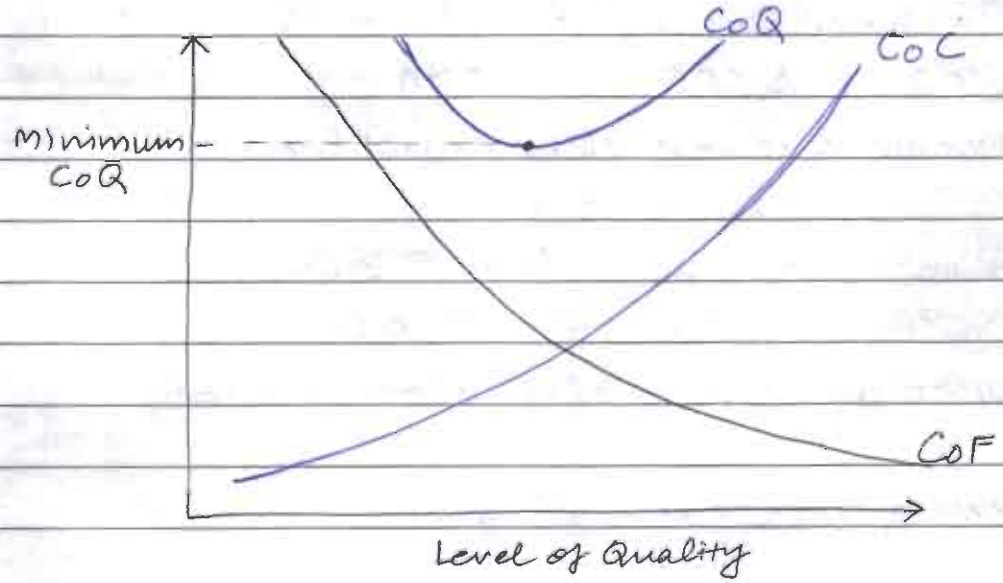
→ It is the loss to the company if a part fails within the company itself

→ It includes the cost associated with scrap, reworking, failure analysis.

(4) External Failure cost

→ It is the loss to the company if a product becomes defective after reaching the customer.

→ It includes the cost associated with processing of customer complaints, delayed payments, returned products, product recall, and loss of future customers. because of damage to the product's image.



Q $CoF = 1500 + 120X$ where X = Percentage defects.

$CoC = \frac{3000}{X}$ Find $(COQ)_{min}$ and corresponding X.

$$COQ = 1500 + 120X + \frac{3000}{X} \rightarrow \frac{d(COQ)}{dx} = 120 - \frac{3000}{x^2} = 0$$

$$\Rightarrow x^2 = \frac{3000}{120}$$

$$\Rightarrow \boxed{x = 5\%}$$

$$\boxed{COQ_{min} = 2700}$$

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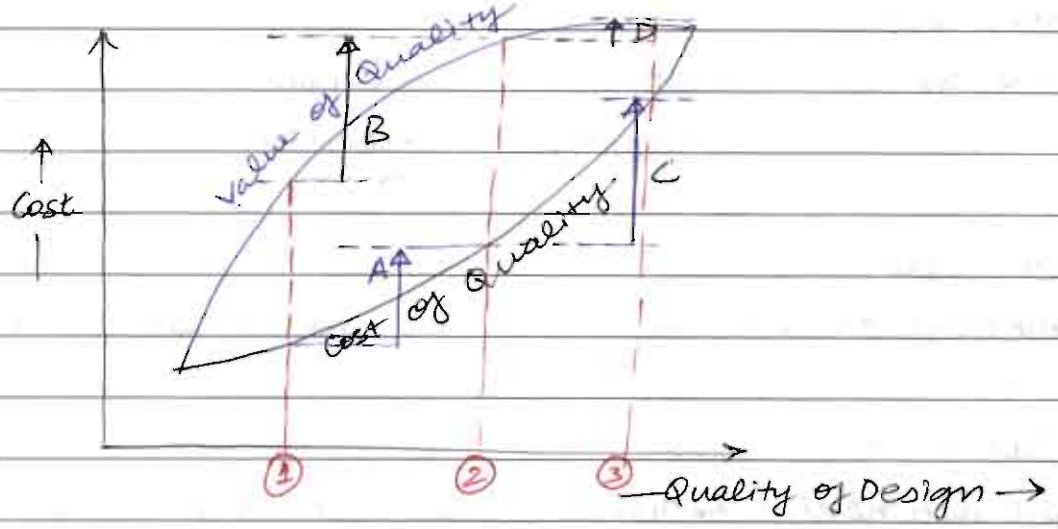
⇒ Balance between Value of quality and cost of quality

→ Value of quality is the returns gained by the company due to various quality related activities. The returns may be due to reduction in defects and due to increased sales and hence profit to the company.



→ If by improving quality from ① to ②
$\Delta VOQ > \Delta COQ$ i.e. $B > A$
then improvement in quality is justified

→ If by improving quality from ② to ③
$\Delta VOQ < \Delta COQ$ i.e. $D < C$
then improvement in quality is not justified.

⇒ Evolution of concept of Quality

Phase I Before industrial Revolution

→ Less use of machines and technology
→ Low volume of production and less capital involved.
→ No institutionalized framework for maintaining quality
→ Quality dependent mainly on the skills of the individual involved.

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Phase 2 : After Industrial Revolution

→ Use of machines and technology and so rapid increase in the volume of production and the capital involved.
→ A separate dept of quality control was established to ensure the quality of final output.
→ The approach was inspection based quality control
→ There was no emphasis on satisfaction and motivation of the workers
→ It focuses on only product (and not the process) and is a reactive approach (post mortem)
→ Treated Quality as an isolated entity and not as a holistic value. Industrial Revolution was also the main cause of colonization

Phase 3 : After World War II

→ There was a radical shift in the approach towards quality from technical to human aspects and employee satisfaction and participation were considered essential for achieving the overall quality goals of the organization.
→ Focus on process and is a preventive approach.
→ TQM, Six Sigma, TPM, Kaizen, JIT were developed in Japan

⇒ Terms associated with Quality

① Quality Policy and objective

→ It is the overall intention and direction of a company towards quality
→ It should be clearly expressed and communicated by the top management of the company
→ It is a general statement made by the company and it forms the basis for framing the quality objectives of the organization
→ The quality objectives are derived from the quality policy and these should be specific, time oriented, measurable and realistic

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(2) Quality Assurance (QA) and Quality Control (QC)

	QA	QC
	Process focussed	product focussed
	Preventive	finds defects
	Proactive	Reactive
Tools ⇒	Quality Audit	Quality Inspection

→ QA provides confidence to the management, customers and the regulating bodies that correct procedures are being followed.

(3) Quality Audit (compliance with SOPs)

→ It is a systematic and independent examination to determine that whether the quality activities are in compliance with the planned arrangements and whether these arrangements are effective or not (SOPs)

Quality Audit →
- 1st Party (Internal Audits)
- 2nd Party
- 3rd Party

[External Audits]

(a) 1st Party Audit

→ It is an internal audit conducted by the employees of the organization itself.

→ It checks that whether the quality management system is working effectively or not and report the conformities and non-conformities to the top management

→ eg - Management Department may audit operations department of an organization.

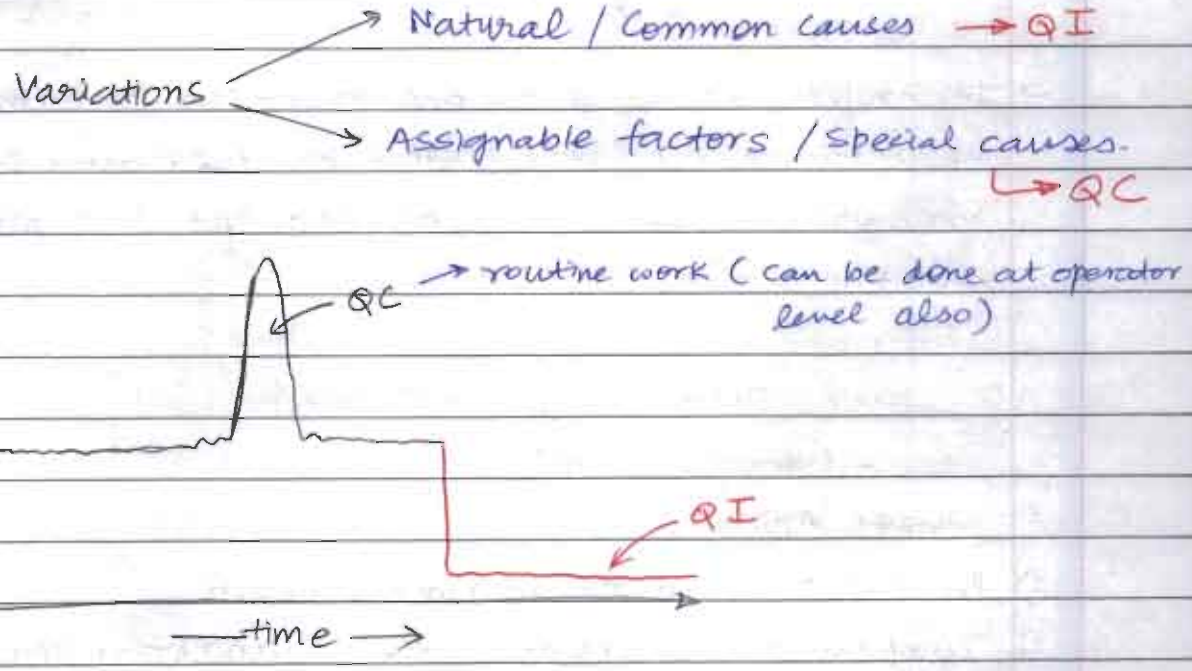
(b) 2nd Party Audit

→ It is an external audit, conducted by the customer organization on a supplier organization. It provides confidence to the customer organization in the supplier's ability to provide materials of right Quality

(c) 3rd Party Audit

→ It is an external audit carried ~~out~~ out by an organization independent of the customer supplier relations. It may result in certifications or awards.

⇒ Quality Improvement



→ Quality Improvement involves using better systems, working methods, machines, materials and workers. This requires the support of top management.

→ The methods of quality improvement are:

① PDCA cycle

② Benchmarking

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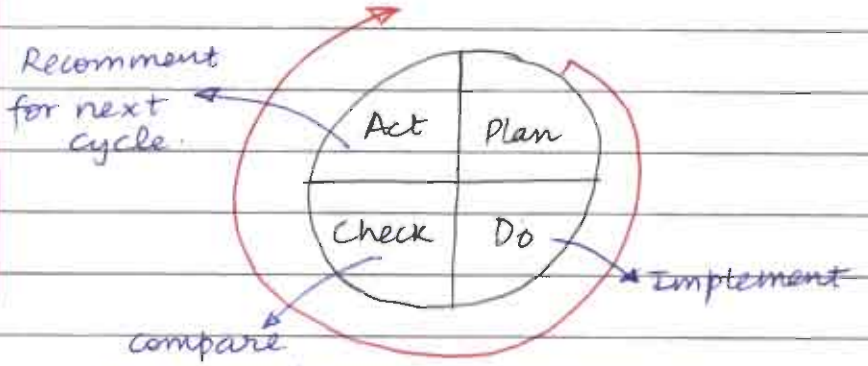
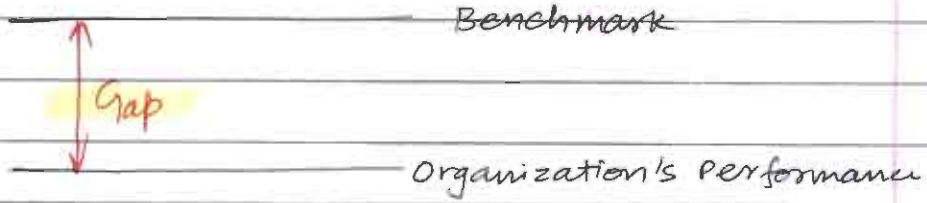
① → In PDCA cycle, involves 4 components



② → Benchmarking → requires quantification of performances.



→ It involves comparing the organizations' performance with the benchmark i.e. best existing practice. Subsequently, the organization can identify the gap b/w both performances and try to overcome that gap.

Chapter-2 Quality Thinkers

(good change)

⇒ Kaizen Approach

1) Process based continuous improvement.
2) Involvement of everyone in the organization and all departments
3) Emphasis on human aspects.
4) Important role of leadership.
5) It involves only small changes by everyone in the organization in their daily operations. Hence it is different from innovation.
6) It is a disciplined approach which reduces wastages and improves productivity
7) It is not limited to any particular department

8) It is a continuous activity.

⇒ Quality Thinkers

① Ishikawa → Quality circle
→ 7 Quality control tools. → help to recognise and analyse the pattern of defect occurence.

➢ Quality Circle

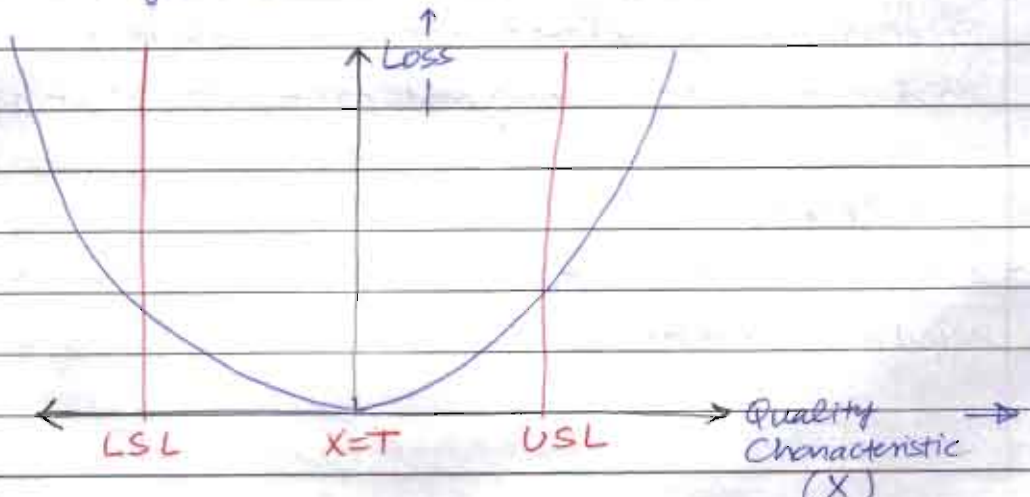
→ It is a voluntary group of workers who regularly meet to identify, analyse and solve quality related problems.
→ These workers perform similar types of works.
→ It increases awareness about quality among the workers
→ Workers are trained by professionals in industry and motivated to ensure their participation and their contribution is recognized.
→ Workers get the opportunity to realise their hidden potential
→ It improves the communication and increases the morale of workers

② Taguchi → Loss function
→ Robust Design.

⇒ Loss Function

$$\text{Loss, } L = C(X-T)^2$$

where C ≡ constant
X ≡ value of Quality characteristic
T ≡ Target value.



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→ Each product has a target value and the manufacturer should try to meet the target value rather than being within USL and LSL.

→ The traditional concept in Quality is that if the product's Quality characteristic value falls anywhere within the USL and LSL, then it is equally acceptable. This approach is called Goal Post Mentality.

→ Taguchi's theory is opposite to this.

→ According to Taguchi, the customer dissatisfaction keeps on increasing as the product deviates from the target value and it is not sudden as was in the traditional methods.

Q. $L = 8500(x-T)^2$

Specification (in cm) = 6 ± 0.25 cm

Quality characteristic value = 6.3 cm.

Loss = $8500(0.3)^2 = 8500 \times 0.09 = 765$

(3) Crosby → Quality is free
→ Zero Defect

⇒ Quality is free

→ Quality is free because the initial expenditure in the various quality related activities can be recovered later on due to increased sales and profits to the company.

⇒ Zero Defect

→ Zero Defect is a management strategy aimed at prevention of defects by motivating the workers

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④ Deming → Principles for transformation of management
→ PDCA cycle.

⇒ Principles for transformation of management

→ According to Deming, most of the quality related problems take place due to flaws in the system and the responsibility for changing the system lies with the management. Hence the management should be transformed.

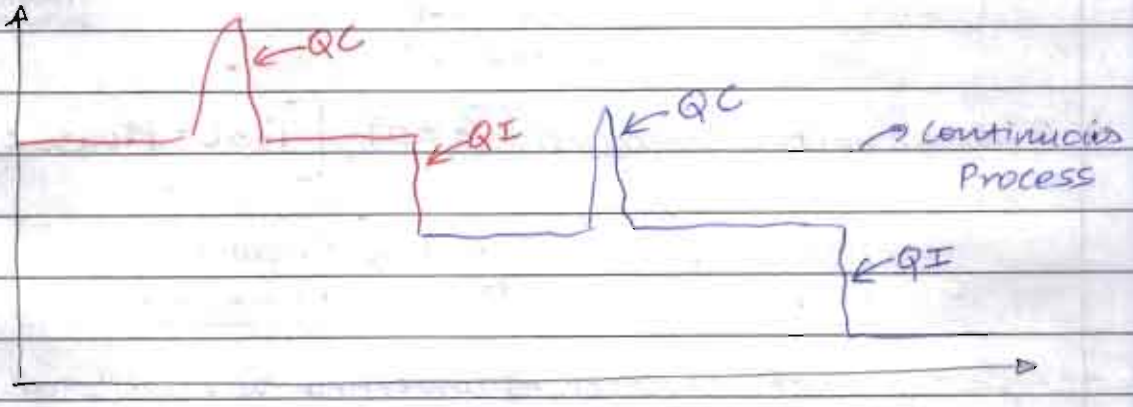
→ For a continuously improving the quality outcomes of the organization, Deming has given a theory of profound knowledge.

→ It consists of the following: → system works as a unit.

① Appreciation for the system and the theory of optimization
② Knowledge about variation → various quality defects that can occur
③ Theory of knowledge
④ Knowledge of Psychology → to understand psyche of workers

⑤ Feigenbaum → TQM or TQC

⑥ Juran → Quality Trilogy → Quality Planning
→ Quality Control
→ Quality Improvement



⇒ Total Quality Management (TQM)

→ It is a culture based on continuous improvement of process. It is total because it includes all departments and all the employees of the organization.

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→ There should be long term relationship b/w the customer and supplier organizations based on mutual trust. There is emphasis on systems approach and organization is considered as a system.

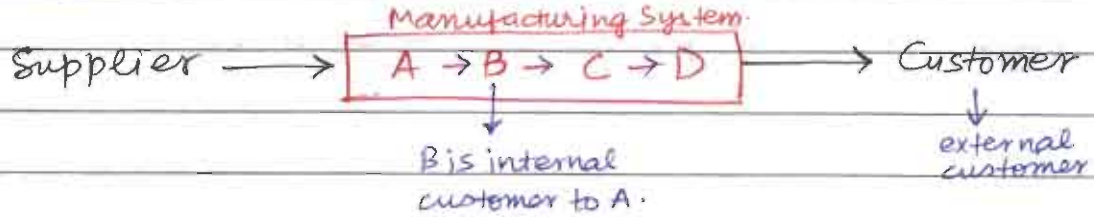
→ There should be fact based decision making and any arbitrary ness should be avoided.

→ There should be focus on customers as the customers expectations are rapidly changing i.e. dynamic and the competition is continuously increasing.

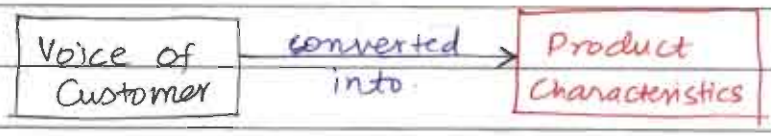
→ There is a significant role of leadership as it provides the required resources, frames policies and empowers people.

→ Employee satisfaction, participation, motivation, sense of belongingness, training, teamwork, communication and recognition of their work are essential to achieve TQM.

→ The expectations of both internal and external customers should be met.



→ Quality Function Deployment (QFD) [Tool - House of Quality]



→ It is a systematic approach of converting the qualitative customer's expectations into quantitative engineering characteristics of the product.

→ It is a multi-functional approach as it involves experts from different departments at the stage of planning and design.

→ It is proactive in nature as it looks at the complete cycle of product development at an early stage and hence

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Engg. Drawing

Syllabus

*** 1) Engg. Curves] Mathematical.
2) Theory of projection
3) Projection of point
4) Projection of line
5) Projection of surface
6) Projection of Solid
** 7) Development of surfaces.] Aptitude.

(2) to (6): common sense and aptitude

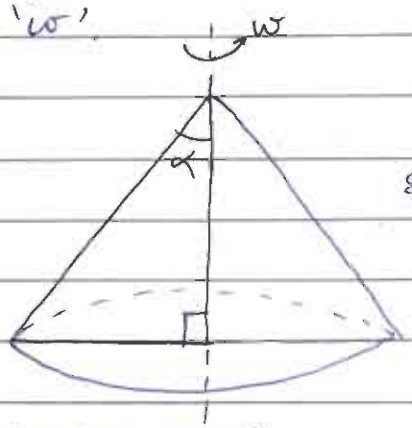
Ch-1 Engineering Curves

1) Conic Sections
2) Special Curves.

1) Conic Sections

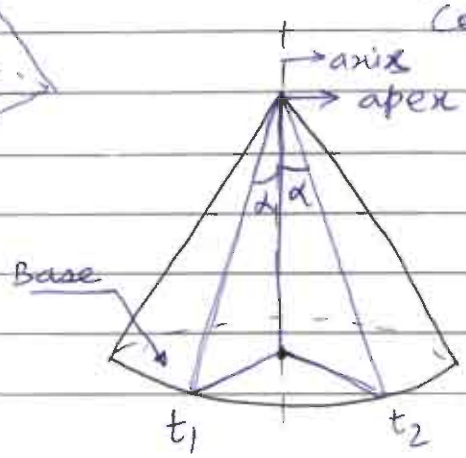
(a) Conic section defined as section of cone

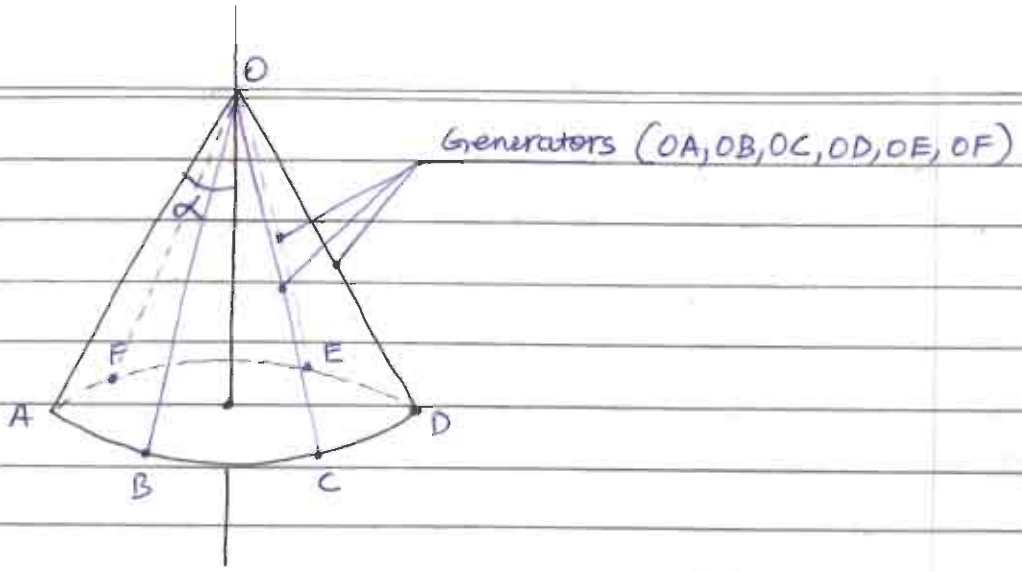
⇒ Consider a right angled Δ rotated about its altitude at a certain angular velocity 'ω'.



α → semi-apex angle.

Solid of Revolution → Right Circular Cone

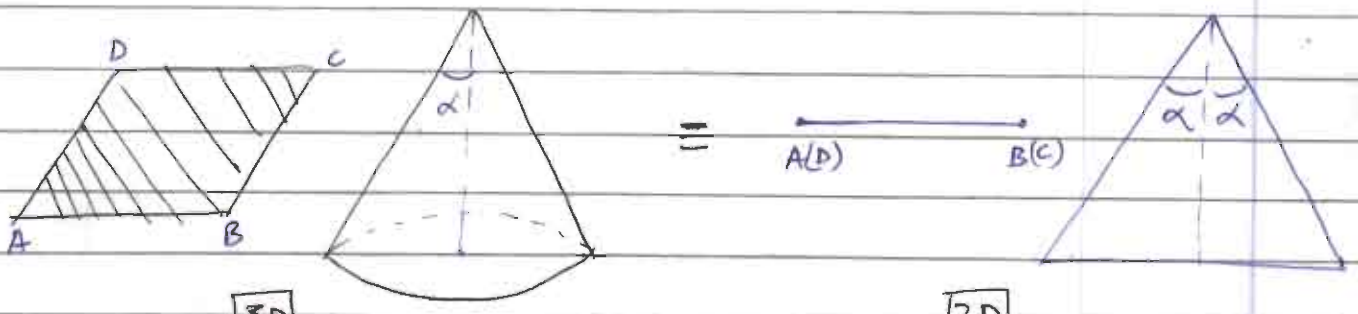




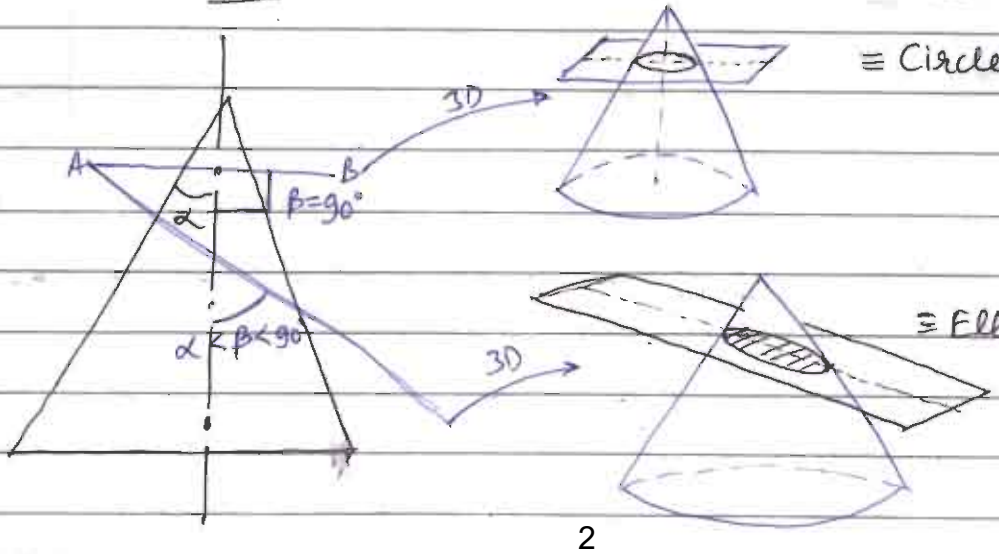
⇒ Any imaginary line joining the apex to the circumference of base of the circle is known a generator.

⇒ Cone is a solid of revolution i.e. it appears as a solid cone only when a triangular plane is rotated about it's altitude.
eg- Cylinder and sphere. → Single Curved surface.

⇒ A conic section is the section of a right circular cone obtained by cutting the cone in different ways by a straight plane known as cutting plane.

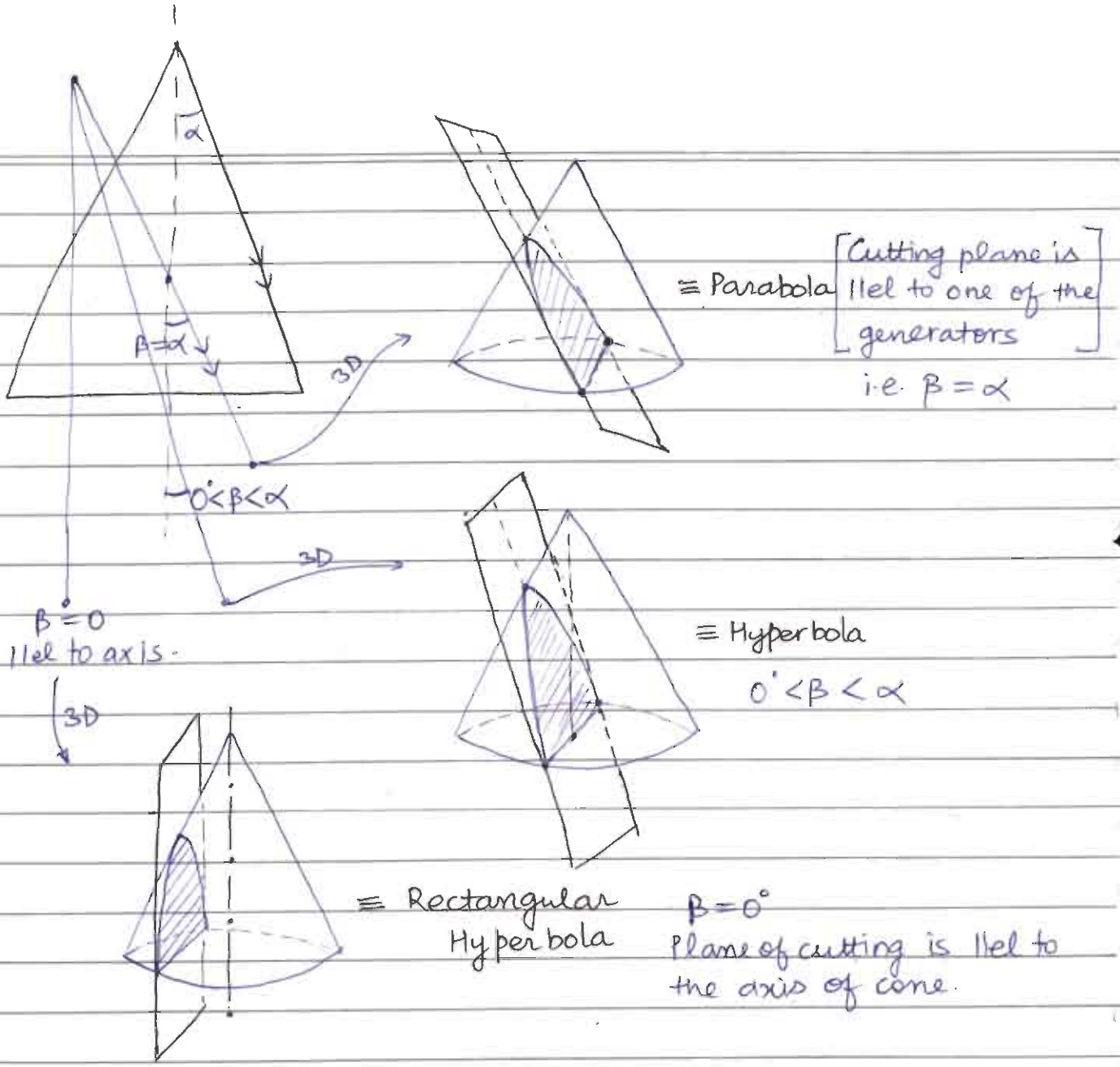


3D 2D



≡ Circle [Plane is ⊥el to the base or β=90°]

≡ Ellipse → α < β < 90°



≡ Parabola [Cutting plane is llel to one of the generators]

i.e. $\beta = \alpha$

≡ Hyperbola

$0° < \beta < \alpha$

≡ Rectangular Hyperbola

$\beta = 0°$

Plane of cutting is llel to the axis of cone.

NOTE: → $\beta = 90°$ → Circle

→ $\alpha < \beta < 90°$ → ellipse

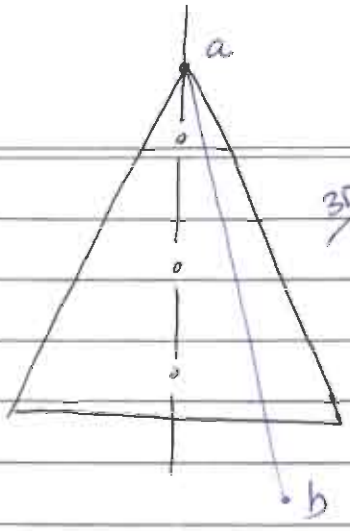
→ $\beta = \alpha$ → Parabola

→ $0° < \beta < \alpha$ → Hyperbola

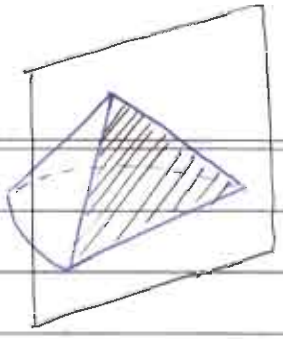
→ $\beta = 0°$ → Rectangular Hyperbola.

→ Circle and ellipse cuts all the generators of a cone whereas parabola, hyperbola and rectangular hyperbola does not cut all the generators.

→ If the cutting plane cuts the right circular cone in such a way such that one end of the cutting plane passes through apex, then an isosceles Δ is formed.

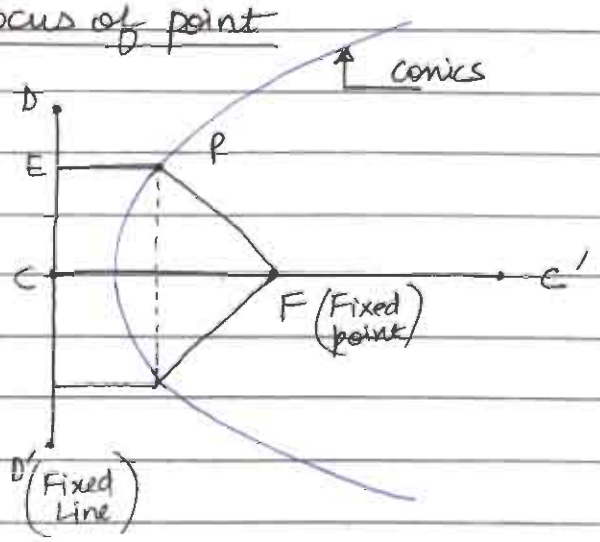


3D →



≡ isosceles Δ.

⇒ Conic sections as locus of point



CC' → axis of cone

DD' → Directrix

F → Focus.

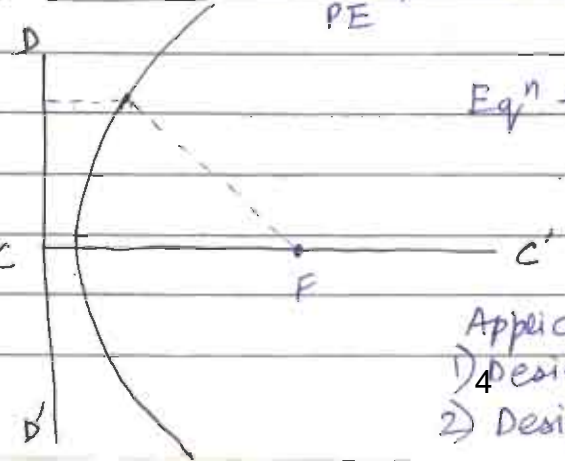
$e = \frac{PF}{PE} = \text{constt.}$

↳ eccentricity.

→ A conic is defined as the locus of a point moving in a plane such that the ratio of it's distance from fixed pt called focus to a fixed line called directrix is always a constant known as eccentricity.

Eccentricity, e = Distance of point from focus / Distance of point from directrix.

(Case 1) $PF > PE \rightarrow \frac{PF}{PE} > 1 \rightarrow e > 1 \rightarrow$ Hyperbola



Eqⁿ → $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

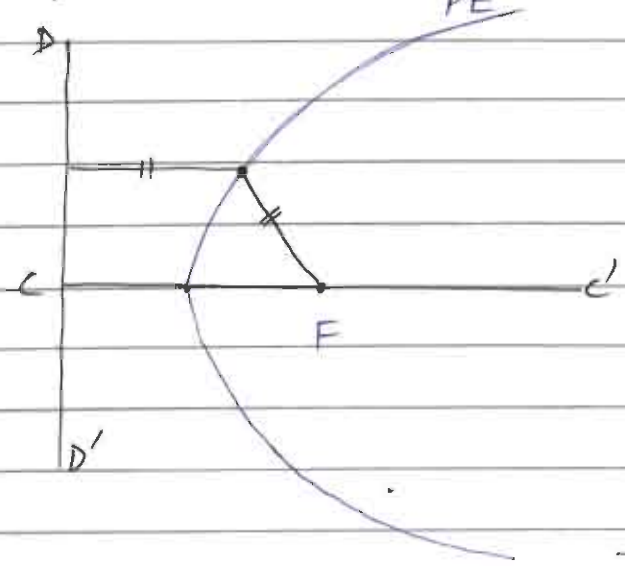
$b^2 = (e^2 - 1)a^2$

Application:

1) Designing of cooling towers

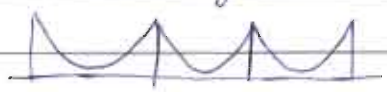
2) Designing of flower vases.

Case 2) $PF = PE \rightarrow \frac{PF}{PE} = 1 \rightarrow e = 1 \rightarrow$ Parabola

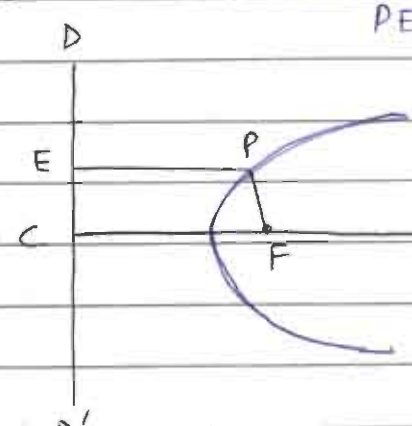


Eqn $\rightarrow y^2 = 4ax$

→ Application:
- ↳ Path of trajectory
- ↳ Solar concentrator
- ↳ Parabolic reflectors.
- ↳ Headlights.



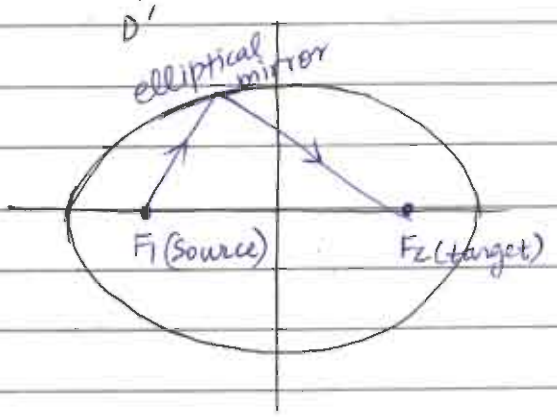
Case 3) $PF < PE \rightarrow \frac{PF}{PE} < 1 \rightarrow e < 1 \rightarrow$ ellipse



Eqn $\rightarrow \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$b^2 = (1 - e^2)a^2$

→ Application:
- ↳ Designing of bridges, arches
- ↳ Use of lithotripsy



Laproscopic Surgery to treat kidney stones.

NOTE: As $e < 1$,

as $e \to 0$

Eq^n for $e < 1 \Rightarrow \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ where $b^2 = (1-e^2)a^2$

$\downarrow b$

$\boxed{x^2 + y^2 = a^2} \longleftarrow b^2 = a^2$

↳ circle → $\boxed{e = 0}$

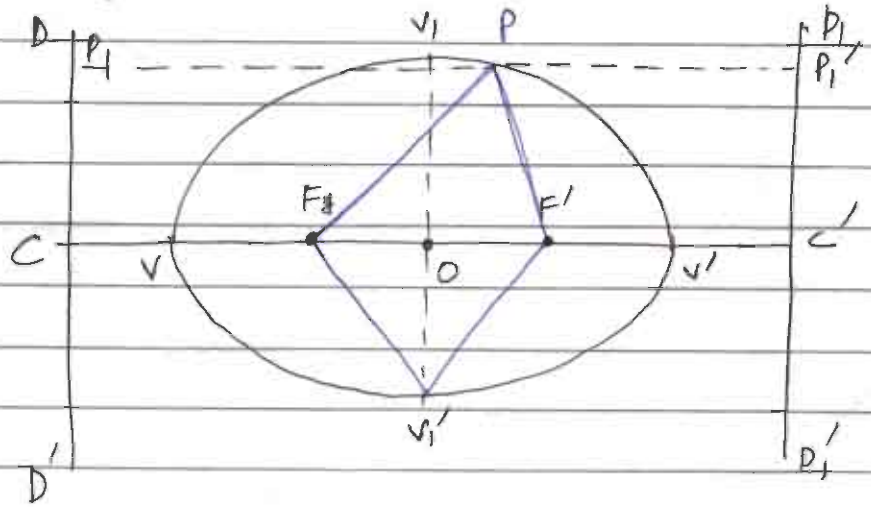
⇒ 3 conic sections:

1) Hyperbola
2) Parabola
3) Ellipse.

→ Circle is the 4th type of conic section and it is a special case of ellipse having eccentricity = 0.

→ Isosceles Δ is not a conic section as it does not form second order equation.

⇒ Properties of conics



DD', D₁D₁' → Directrix

VV' → major axis

V₁V₁' → minor axis

O → Centre of ellipse.

~~⇒ $PF + PF' = e PP_1 + e PP_1' = e(CC')$~~

⇒ $PF + PF' = FV' + F'V = FV' + VF = VV' =$ major axis

⇒ $FV_1' + F'V_1' = VV' \Rightarrow FV_1' = F'V_1' = FV_1 = F'V_1 = \frac{VV'}{2}$

(equal)

→ Ellipse is also defined as the locus of point which moves in a plane such that the sum of its distance from 2 fixed points is always constant and it is equal to major axis

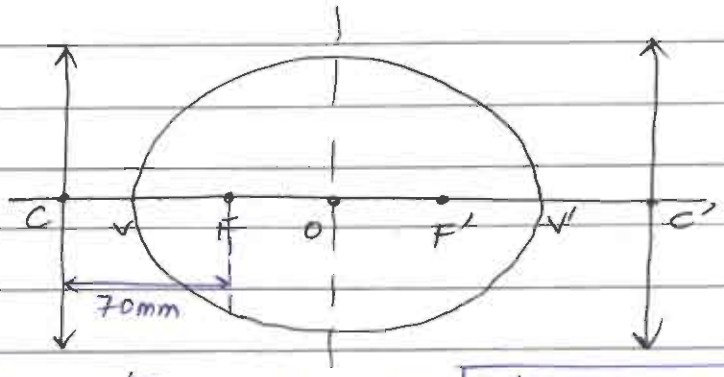
→ The distance of any end of the minor axis from focus is half of major axis.

Q- In the figure shown if distance of focus (F) from the directrix is 70mm. , $e = 3/4$

(a) Find $V'F$

(b) Find FF', VV', CC'

(c) Find Relation b/w (i)



(a) $e = \frac{V'F}{V'C} = \frac{3}{4} \Rightarrow \frac{V'F}{V'F+70} = \frac{3}{4} \Rightarrow \boxed{V'F = 210\,mm}$

(b) $e = \frac{VF}{VC} = \frac{3}{4} \Rightarrow VF = 30\,mm$

$VC = 40\,mm$

$FF' = VV' - 2(VF) \Rightarrow FF' = V'F + VF - 2VF = V'F - VF$

$\Rightarrow FF' = 210 - 30 = 180\,mm$

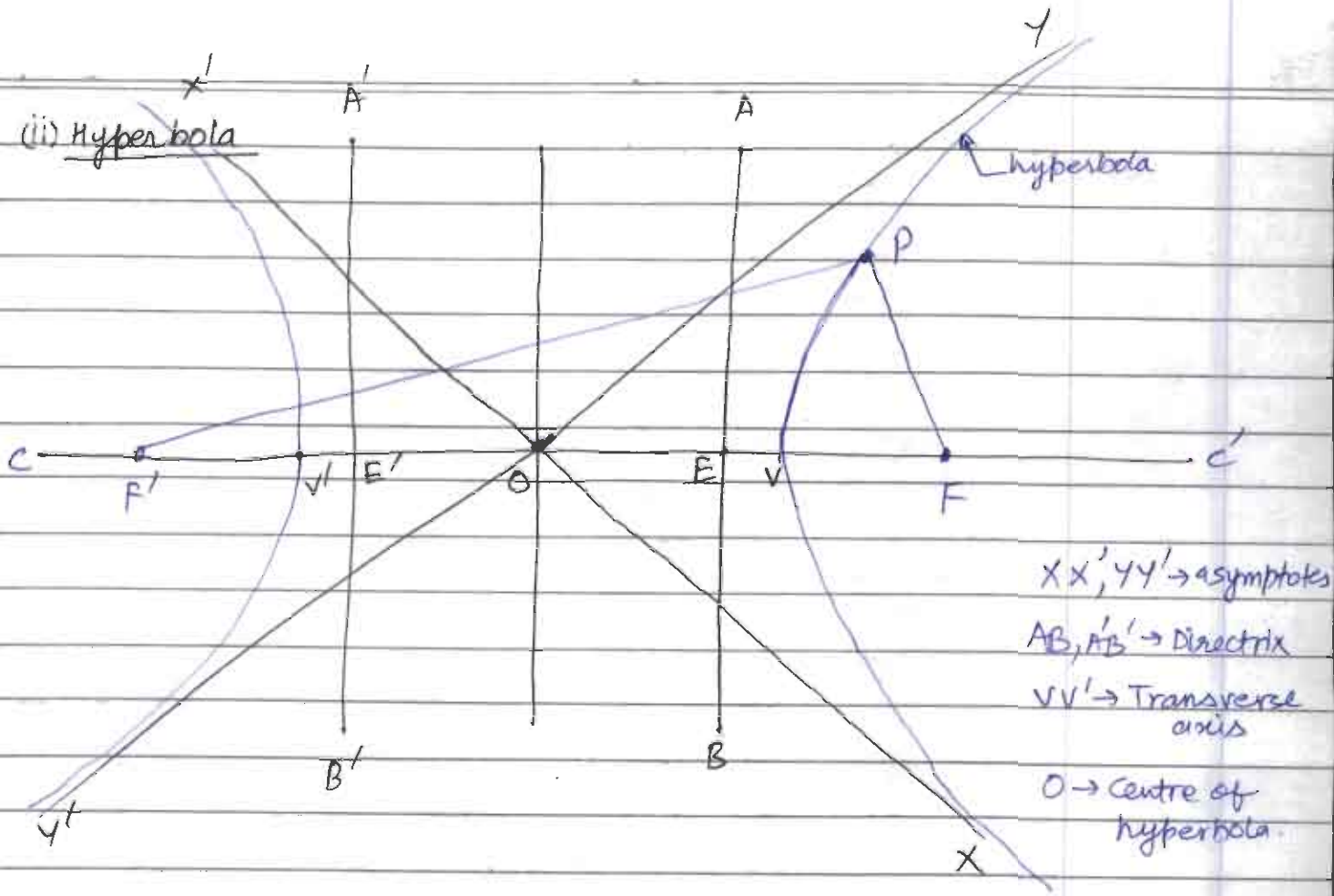
$VV' = V'F + VF = 210 + 30 = 240\,mm$

$CC' = VV' + 2VC = 240 + 2 \times 40 = 320\,mm.$

$$\frac{FF'}{VV'} = \frac{VV'}{CC'}$$

$VV' = \sqrt{FF' \times CC'}$ → geometric mean

(ii) Hyperbola



→ A hyperbola is locus of point which moves in a plane so that the difference between the point and the 2 focus is always constant and it is equal to transverse axis.

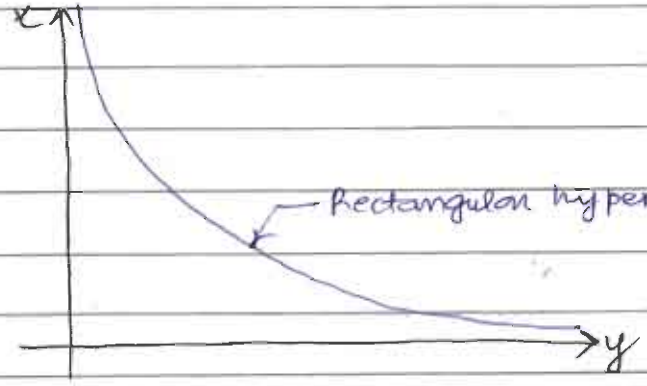
$$PF' - PF = VF' - VF$$
$$= VV' + V'F' - VF = VV'$$

NOTE:

① $\Rightarrow \dfrac{FF'}{VV'} = \dfrac{VV'}{EE'} = e \Rightarrow \boxed{VV' = \sqrt{FF' \times EE'}}$

2) If angle between asymptotes is 90° then hyperbola is known as rectangular hyperbola or equilateral hyperbola, having eccentricity $= \sqrt{2}$

Ex: $xy = \text{Constant} \Rightarrow y = \frac{k}{x} \Rightarrow y \propto \frac{1}{x}$



→ Boyle's Law ⇒ $PV = \text{constant}$.

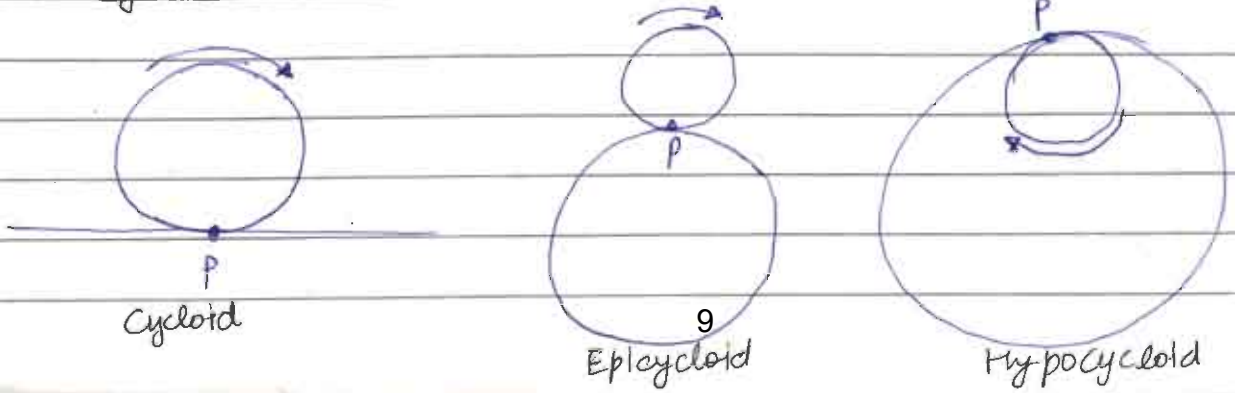
II) Special Curves

- (I) Plane curves
  - (A) Cycloidal curves
    - → cycloid and trochoid
    - → Epicycloid and Epitrochoid
    - → Hypocycloid and Hypotrochoid
  - Involutes
  - Spirals
    - → Archimedian Spiral
    - → Golden spiral
    - → Logarithmic Spiral
- II) Space Curves
  - Helices
    - → cylindrical Helix
    - → Conical Helix.

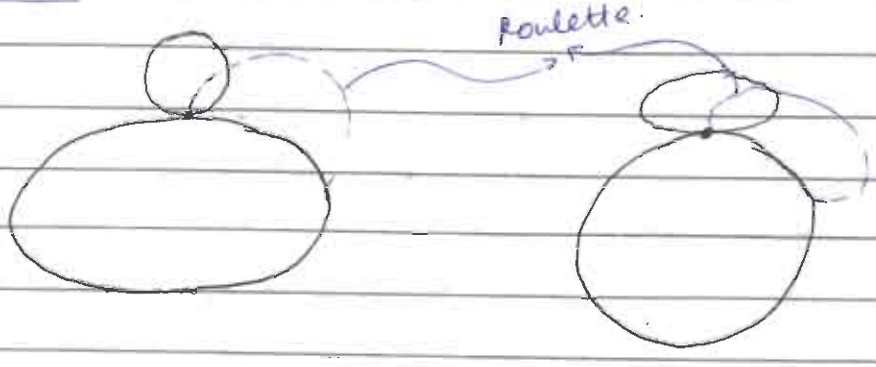
⇒ **Plane curves:**

→ Curve that is drawn on a 2D plane.

(A) Cycloidal curve

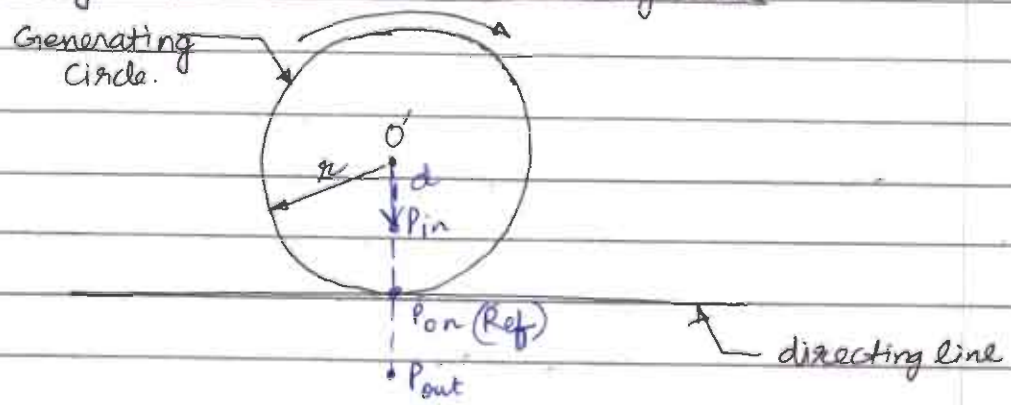


→ When one curve rolls over another curve without slipping or sliding, the path of any point of the rolling curve is called as roulette



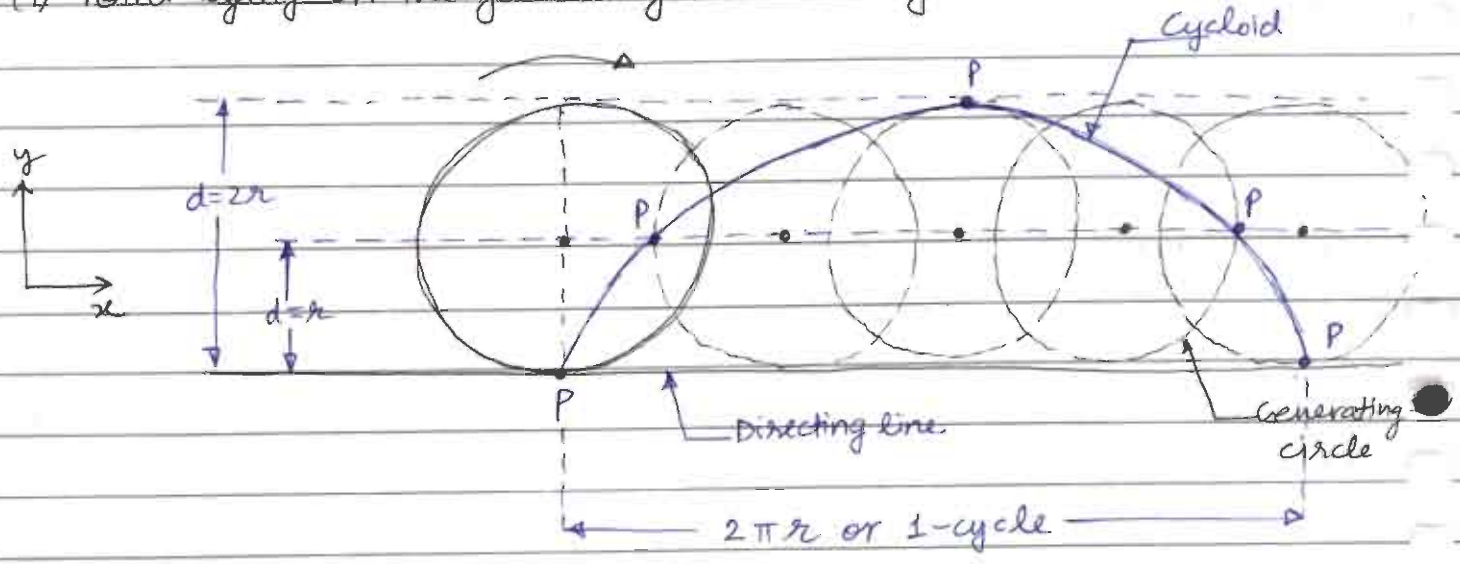
→ When a rolling curve is a circle known as generating circle and the curve on which it rolls is either a straight line known as directing line or rolls on a circle known as directing circle, the locus is known as cycloidal curve.

⇒ Generating circle rolls on a directing line

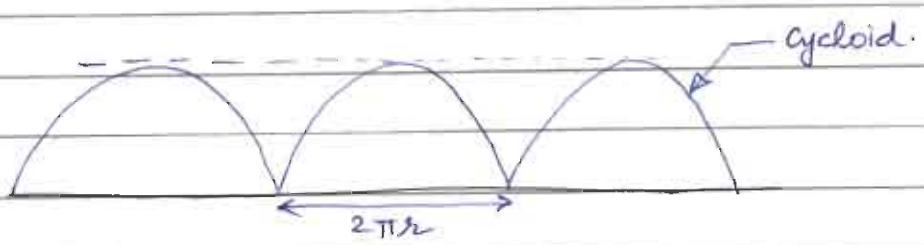


if $d = r$ → cycloid
$d > r$ → Superior trochoid
$d < r$ → Inferior trochoid.

(i) Point lying on the generating circle → Cycloid.



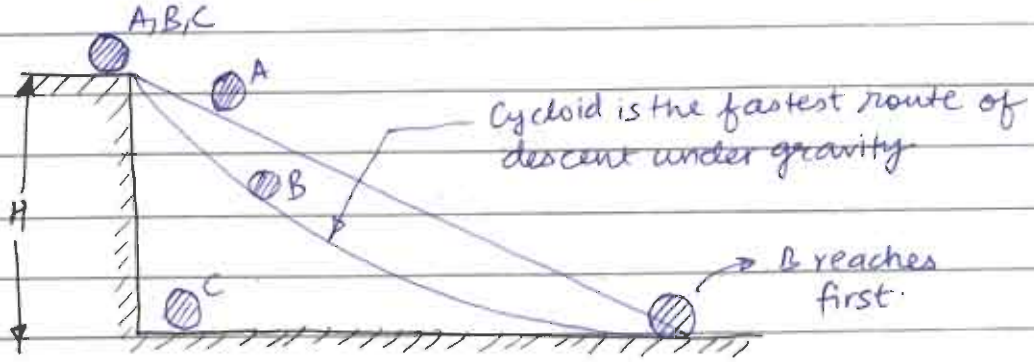
Locus of P



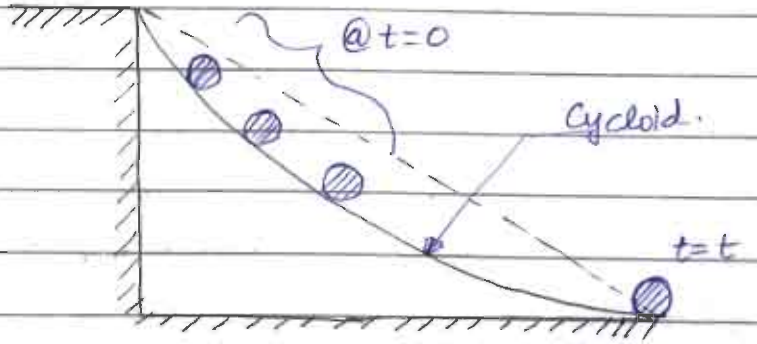
→ In one complete cycle of rotation only 1 cycloid is formed.

→ Application

1) Cycloid is the solution to Brachistochrone problem.

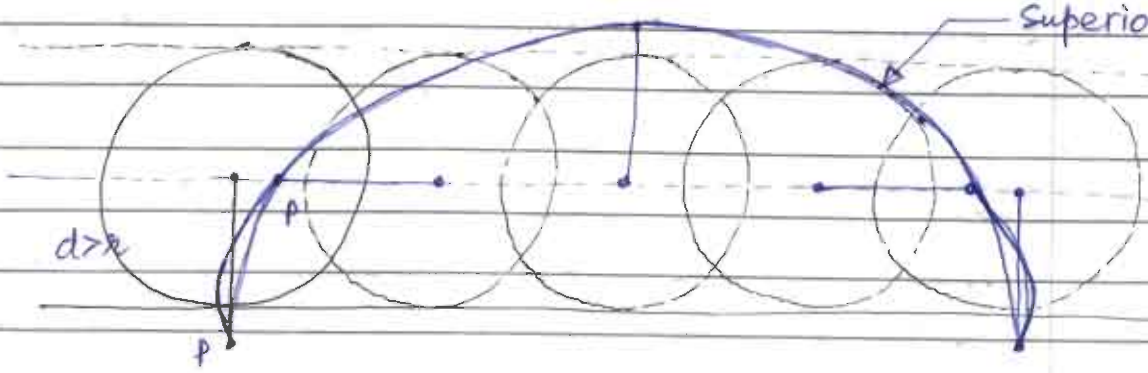


2) Cycloid is the solution to tautochrone problem.

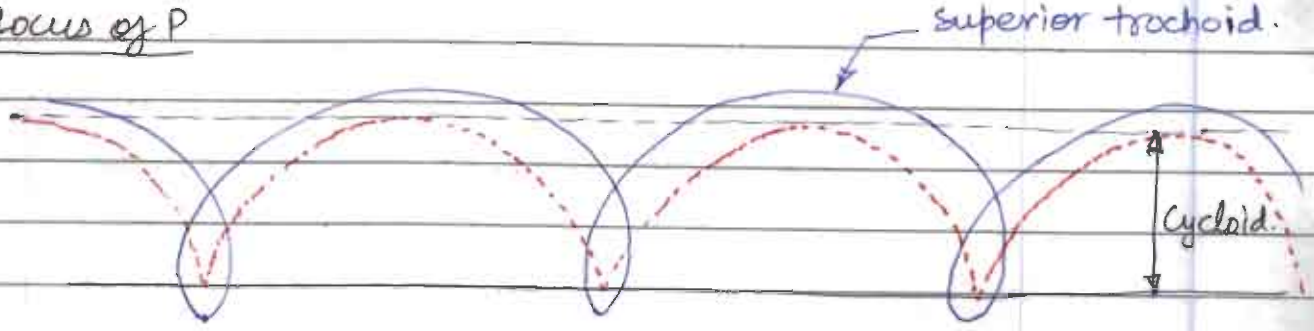


→ The time period of an object in descent without friction inside the curve does not depend on the objects starting position.

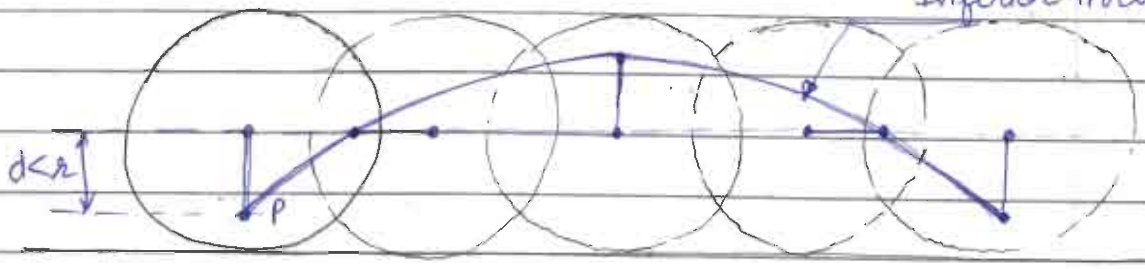
(ii) Superior Trochoid → Point lying outside the generating circle ($d > r$)



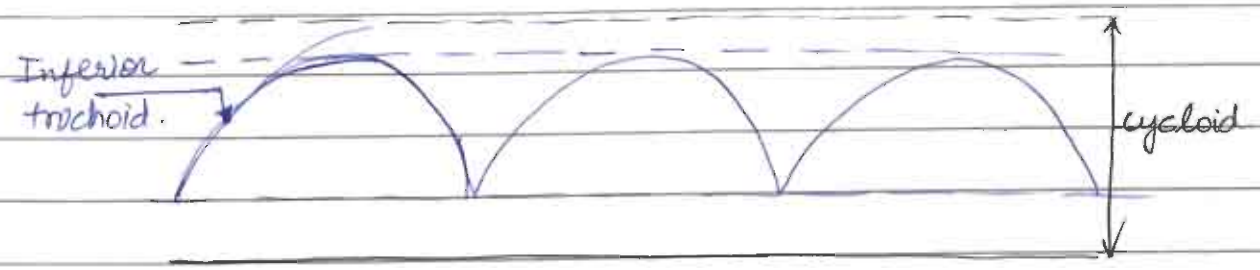
Locus of P



(iii) Inferior trochoid → Point lying inside the generating circle ($d < r$)



Locus of P

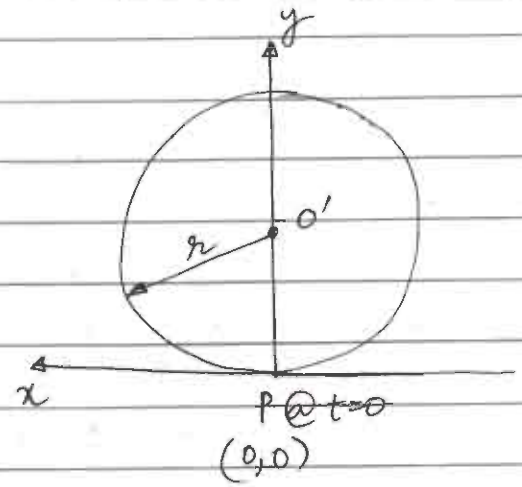


NOTE: Application of both inferior and superior

⇒ Naval Architecture

→ It approximates wave profile used in naval architecture

⇒ Parametric equations of cycloid



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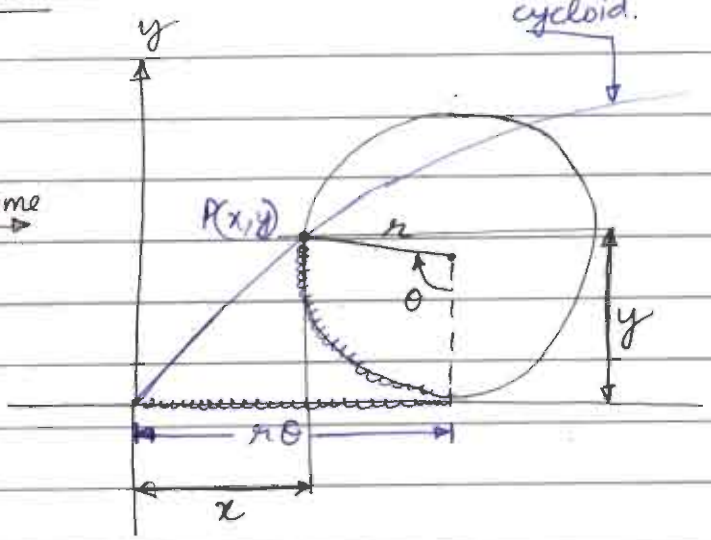
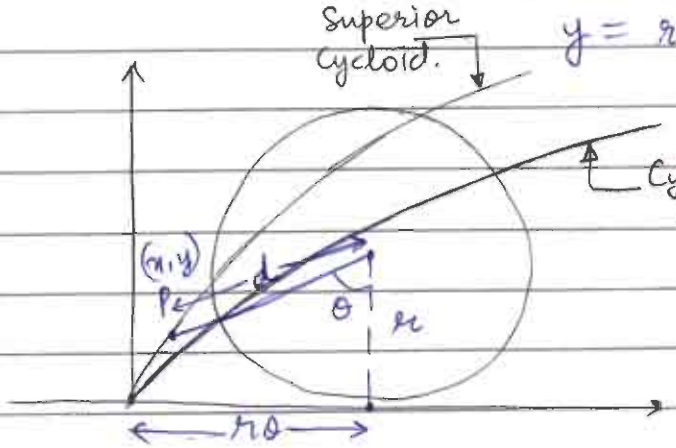


$$x = r\theta - r\sin\theta$$

$$y = r - r\cos\theta$$



In general,

$$x = r\theta - d\sin\theta$$

$$y = r - d\cos\theta$$

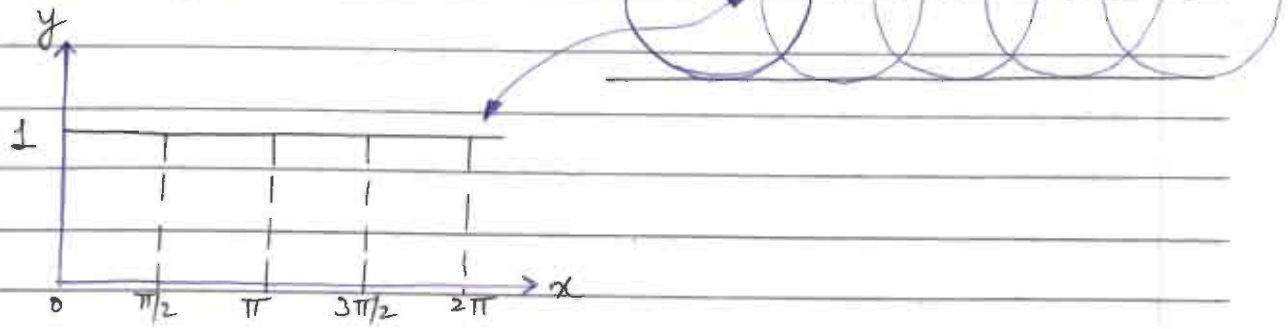
Valid for $d = r$, $< r$, $> r$

NOTE: (i) if $d > r$ → superior trochoid
(ii) if $d = r$ → cycloid.
(iii) if $d < r$ → inferior trochoid.
(iv) if $d = 0$ → Straight line.

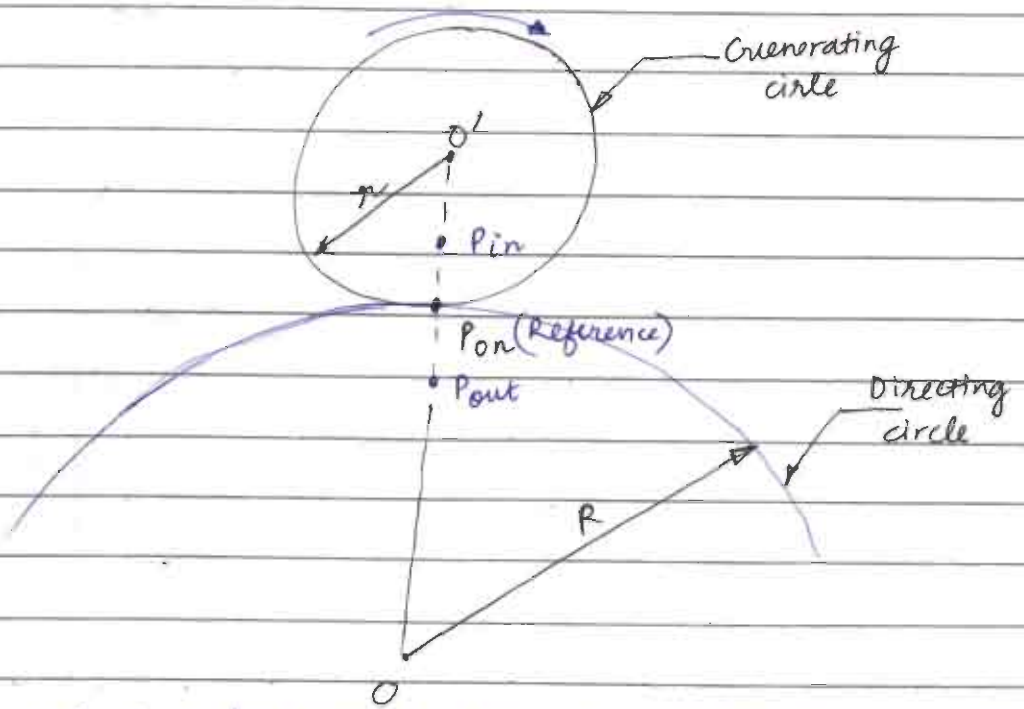
$x = r\theta$

$y = r$

For $r = 1$



B) ⇒ Cgenerating circle rolls out side the directing circle



Let d is distance of point from centre of generating circle:
(i) if $d = r$ → epicycloid
(ii) if $d > r$ → superior epitrochoid
(iii) if $d < r$ → inferior epitrochoid.

AIR-1 Notes

Pages: 82

Handwritten notes by

Kartikay Kaushik

AIR-1 ESE 2021

IES Master classroom Student

General Studies

Environment & Ecology

⇒ Basic terms related to Ecology, Environment and Energy

1) Species

2) Population

3) Factor

4) Environment and Atmosphere

5) Latitudinal division of earth

6) Community / Biocenosis

7) Ecosystem / Geobiocenosis

8) Ecology / oekologie

9) Autecology v/s synecology

10) Ecotone / principle of edges

11) Technoecosystem

12) Biosphere and Biosphere-2

13) Natural Capital / Ecosystem Services

14) Ecological Foot Print / E.F.P and Earth Overshoot Day

15) Biocapacity

16) C.C.S. / Carbon Capture and Storage
Carbon Sequestration

17) Concept of Carbons

18) Carbon Footprint

19) Carbon Hand print

20) Ecological Equivalent

21) Ecological Guild

22) Ecological Succession

Miscellaneous.

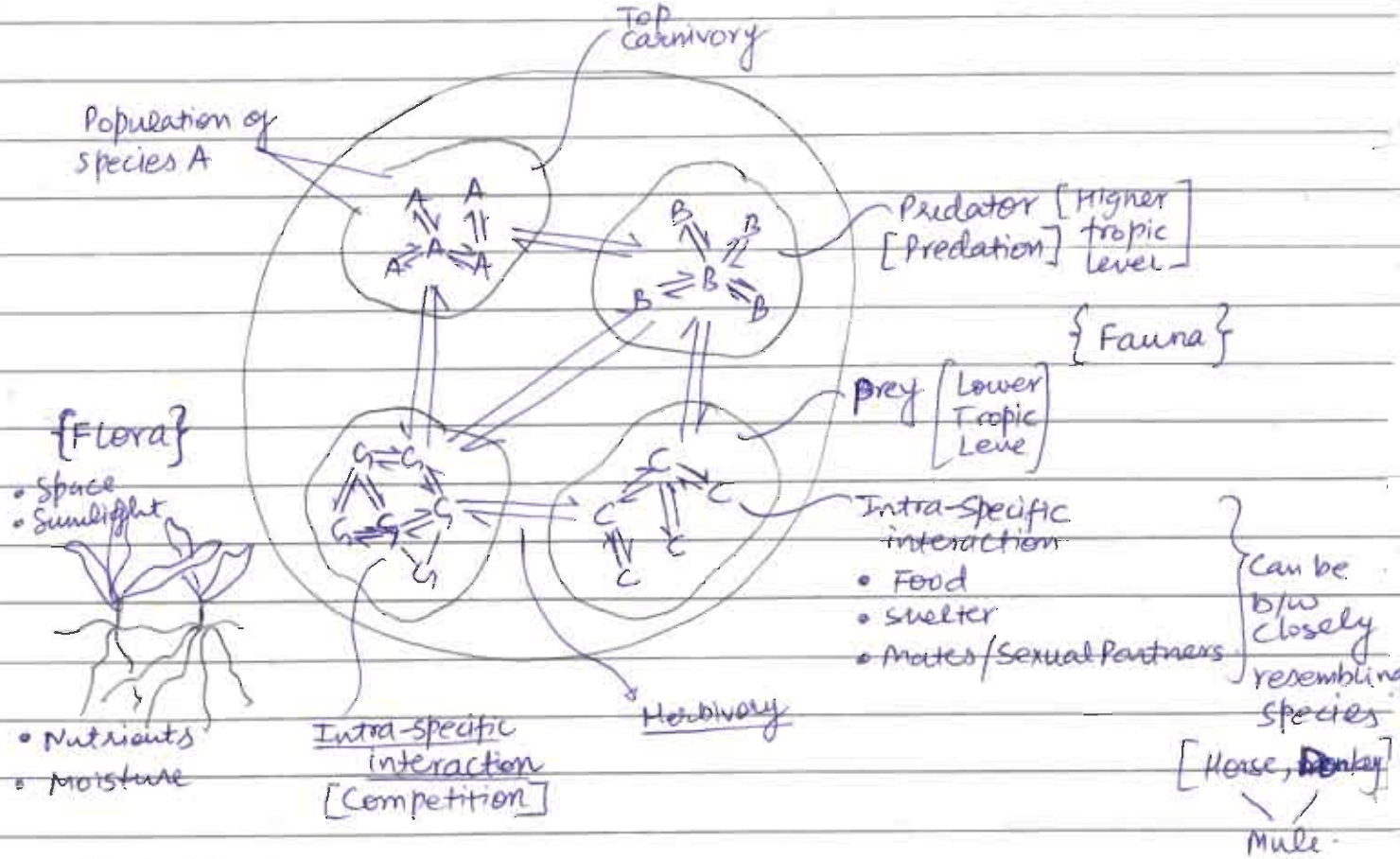
⇒ Species concept

1) There are different concept of species like morphological, genetic and biological.
2) Species is basic unit of Taxonomy that deals with nomenclature and classification.
3) In ecology and environment, biological species concept given by Mayr is widely used.
4) According to Mayr, when individuals can interbreed or reproduce and can form fertile offspring, then they belong to same species.
(ant. sterile)

M ♂ F ♀ Bi ⚥

NOTE: Linnaeus → Father of Taxonomy gave morphological species concept which is on the basis of ?age similarity in external morphology (appearance) (Concept was rejected)

Lotsy → gave genetic species concept. According to which members of same species are genetically identical In humans, only identical twins are genetically identical



⇒ Population

It is sum of all individuals that belongs to a given species present in a given area.

⇒ Community / Biocenosis

→ It is sum of all different populations present in a given area.

→ It includes population of all plants [Flora], animals [Fauna] and micro-organisms. ex- bacteria and fungi.

→ Community forms biotic component of the locality.

⇒ Factor

→ Factor is any force or substance or condition that affects individuals in any way

→ For ex- light, temperature, rainfall, chemical fertilizer, wind, competition, herbivory, carnivory.

NOTE: When interaction occurs among members of same species it is called as intra-specific interaction. ex- competition among members of same species.

→ When interaction occurs among members of different species it is called as inter-specific interaction ex- herbivory, carnivory and competition.

→ Bamboo is the longest grass and it is monocarpic as flowering occurs only once

→ when flowering occurs multiple times, it is called as polycarpic ex- mango tree.

⇒ Environment

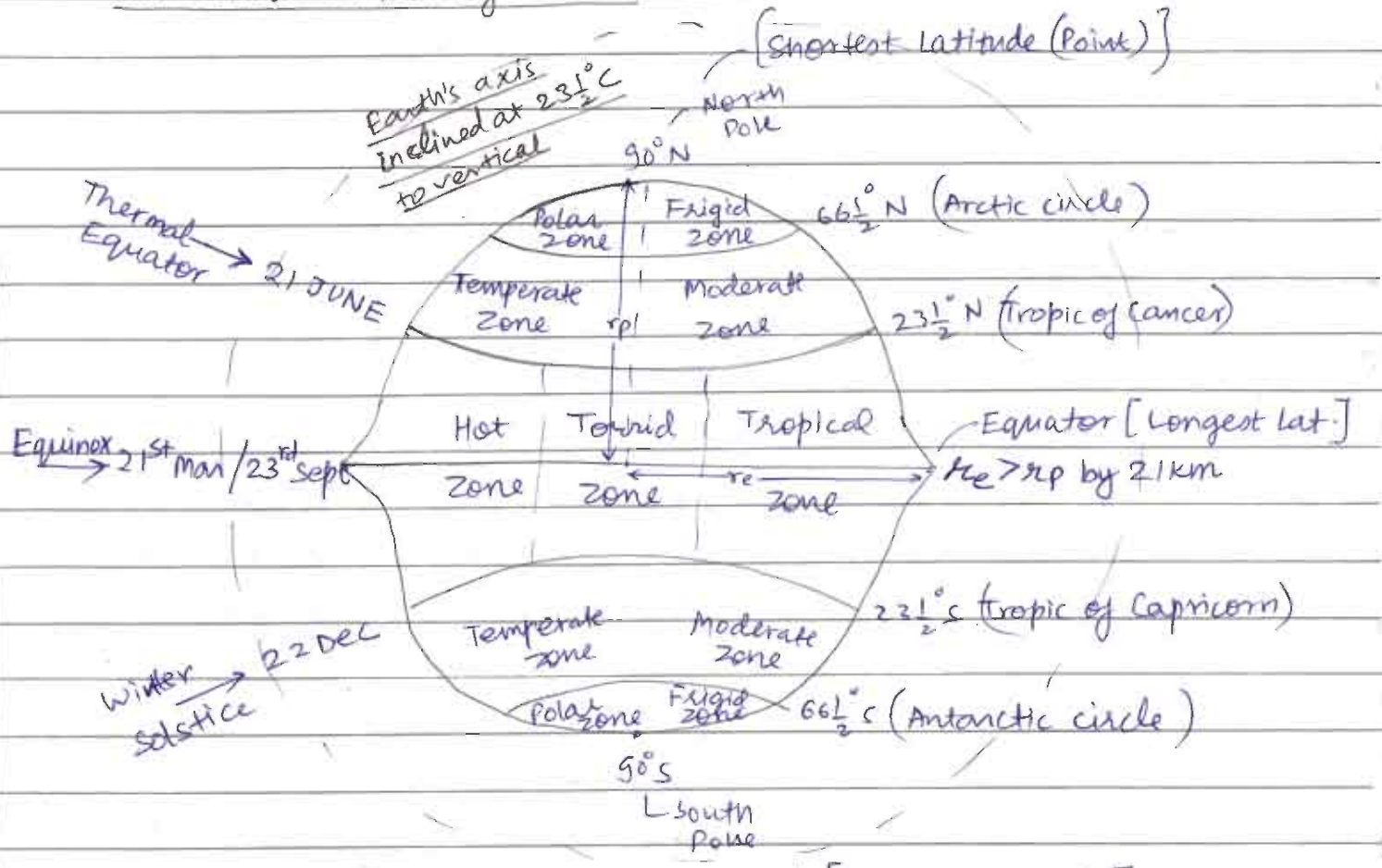
It is sum of all biotic and abiotic factors.

NOTE: 5th June is declared as World Environment Day due to Stockholm Conference or Stockholm Declaration (5th June 1972).

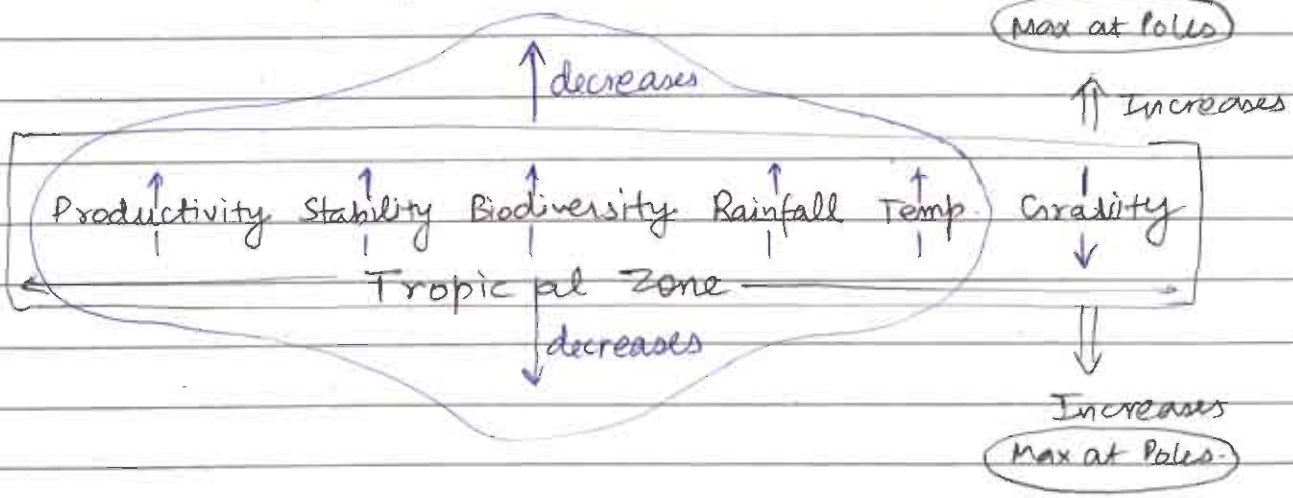
→ For 5th June, 2018, India was host country and theme was beat plastic pollution.

→ For 5th June, 2019 china was the host country and theme was air pollution.

⇒ Latitudinal Division of Earth



Shape of earth ⇒ Geoid [Oblate spheroid]



⇒ Atmosphere

→ It is gaseous envelope surrounding earth surface which is endogenous in origin i.e. gases are released from interior of earth.

→ Atmosphere is responsible for maintenance of low diurnal range of temperature i.e. habitable temperature

→ Atmosphere is held by means of force of gravity which is maximum at the surface of earth.

NOTE: The difference in temperature between day and night is called as diurnal range of temperature.
→ moon is devoid of atmosphere like that of mercury (1/6th gravity) (Solar impact)

⇒ Ecosystem

→ British plant ecologist A.G. Tansley gave the term ecosystem.
→ According to Tansley, it is a system formed by Interaction b/w interacting biotic component with that of interacting abiotic component
→ Spatial dimension of ecosystem is highly variable. For ex - small drop of water having few bacteria upto the whole earth. When whole earth is taken as ecological model, it is the largest ecosystem called as ecosphere.
→ For natural ecosystems, sun is the main source of energy

⇒ Ecology

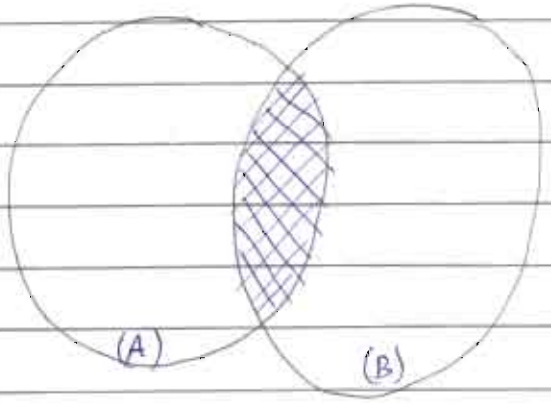
→ German scientist, Haeckal gave the term ecology. ~~it is the study of~~
→ Ecology is the study of structure and function of ecosystem.
→ While performing ecological studies, when focus is on single individual species, it is called as Autecology.
→ In Autecology focus is on single species about it's geographical location, taxonomic position (species) and functional role in ecosystem (producer, consumer)
it is called as Autecology.
→ While performing ecological studies, when the focus is on entire community or biotic component it is called as Synecology.

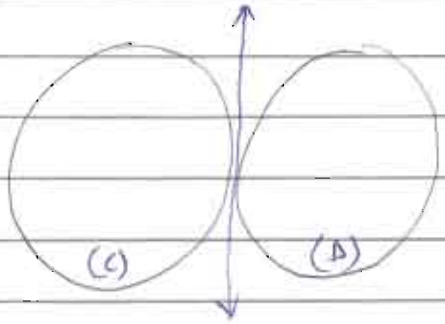
Homo sapiens.
Genus Species.

→ Synecology gives true picture of ecosystem

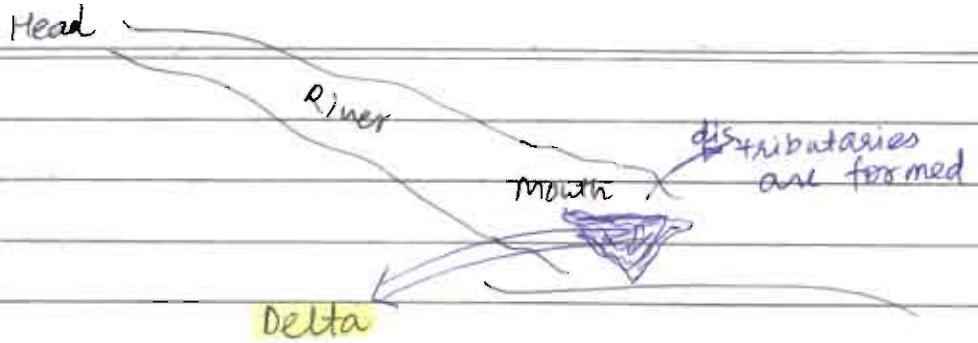
⇒ Ecotone / Principle of edges / Edge effect

Q- Which of the following is not example of ecotone.
(A) swamps ✓
(B) Marshes ✓
(C) Bogs ✓
(D) Wetlands ✓
(E) Estuary ✓
(F) Savanna ✓
(G) None.

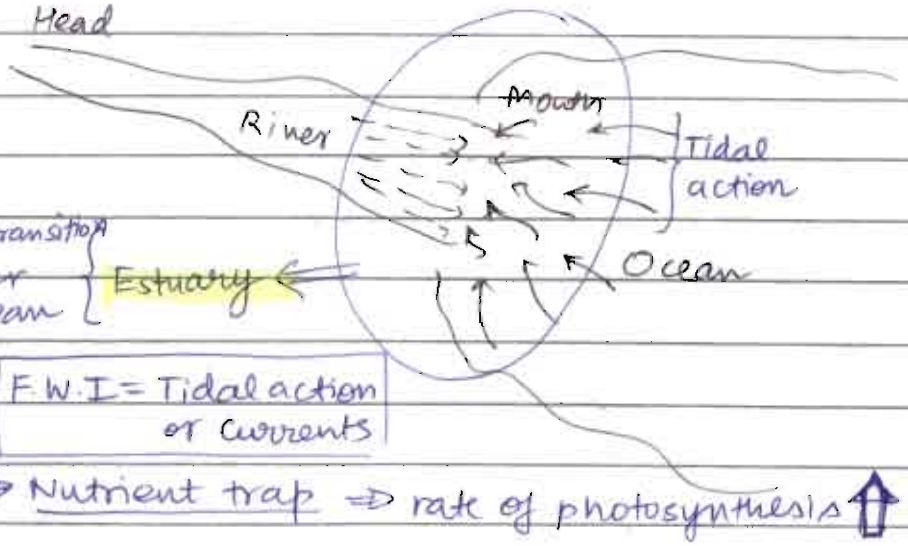




→ Ecotone is zone of transition b/w 2 adjacent ecosystems.
→ As it is zone of transition, it has high value of species richness or variety commponent which is responsible for high value of biodiversity.
→ As the value of biodiversity is maximum at the edge or margin of adjacent ecosystem, it is called as edge effect or principle of edges.



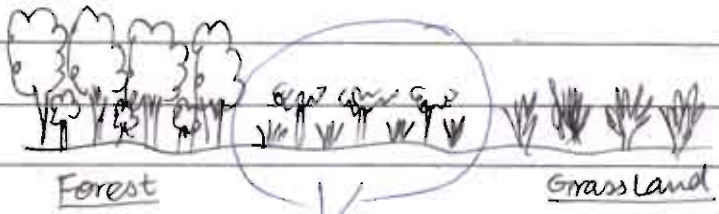
Ocean



Zone of transition b/w river and ocean → Estuary

When F.W.I = Tidal action or currents

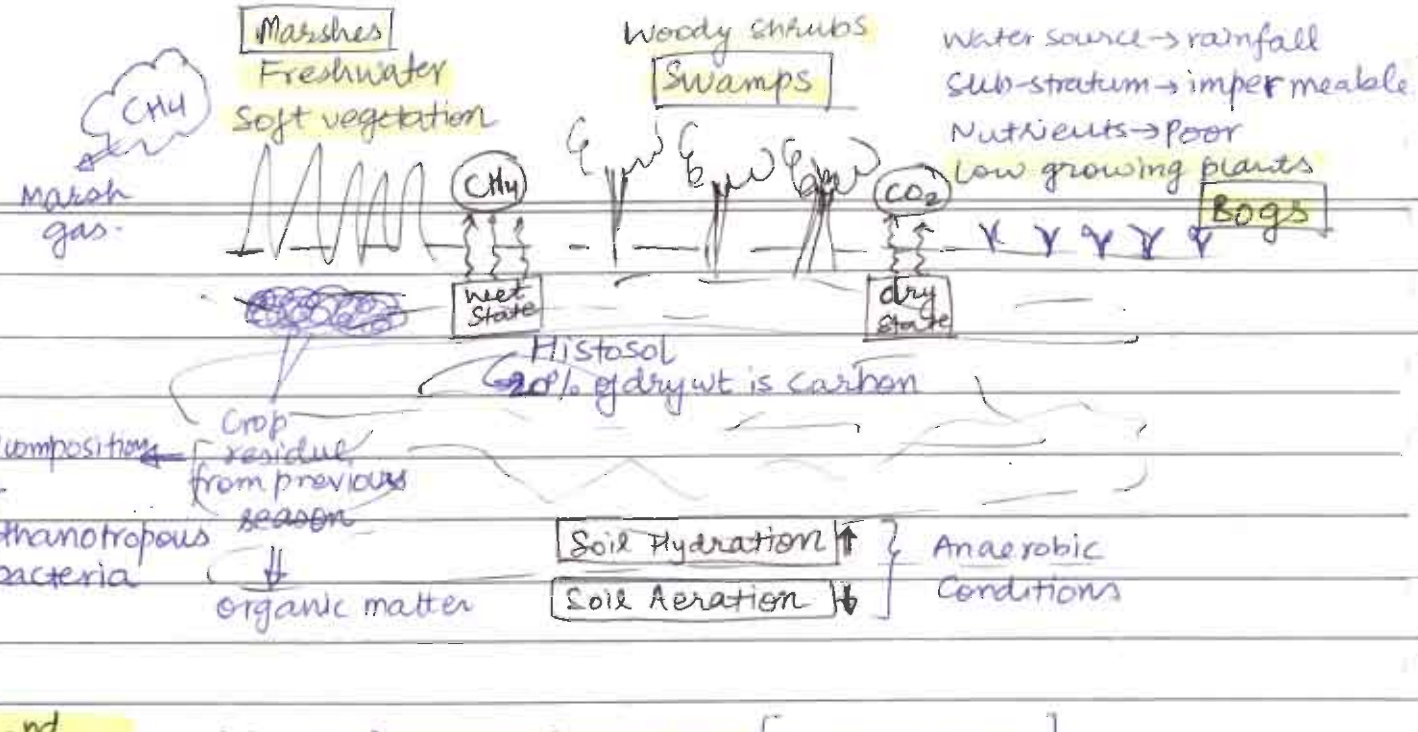
→ Nutrient trap ⇒ rate of photosynthesis ↑



Grass ↑ → Herb Savanna

Shrubs ↑ → Shrub Savanna

Trees ↑ → Tree Savanna



2nd Feb, 1971 ⇒ Ramsar Convention [Ramsar, Iran]

⇓ World Wetland Day

42 ⇑ Ramsar sites in India

Montreaux Record ⇒ ecological threat → Chilika Lake (has been removed now as restored.)

→ Loktak → Keibul Lamjao NP (Only Floating park)

→ Keoladeo NP (Rajasthan)

NOTE:

1) Wetlands are zone of transition b/w land and marine ecosystem.
2) When wetlands are dominated by soft vegetation ⇒ Marshes
   eg - Paddy crop
3) When wetlands are dominated by woody shrubs ⇒ Swamps
   eg - Mangroves
4) When substratum is hard / rocky / impervious, rain fall is main water source, nutrients are poor and low growing plants are found ⇒ Bogs eg - Spaghnum

Q- List out whether the given statement is True / False

1) Montreax Record is register of wetlands which are under ecological Threat i.e. either ecological character has changed or changes are likely to occur (True)
2) Forest, grassland, savanna are example of carbon sink. (True)
3) In India, maximum wetland is under paddy cultivation around 70% (True)
4) Ramsar Convention is regarding wetlands and it was signed on 2nd Feb, 1971 at Ramsar, Iran (True)

5) India is signatory to Ramsar Convention. (True)

6) wetlands are kidney of nature involve in water purification ground water recharging, flood mitigation and nutrient recycling. (True)

7) In India, total 27 Ramsar sites are present in which recently identified is Sunderban. (True)

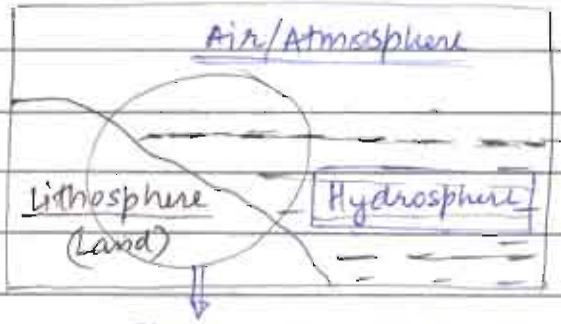
8) In India, 3 wetlands are mentioned under Montreax record (False)

9) Ramsar Convention is legally binding treaty and is part of UN Conventions like UN convention on Biodiversity. (False)

Biosphere and Biosphere-2

→ Biosphere is zone of transition b/w Lithosphere, hydrosphere, atmosphere having biotic component

→ when in Biosphere, human is dominating biotic component it is called as Biosphere 2.



⇒ Ecological Equivalent

→ Individuals that occupy different geographical location, diff. taxonomic position, but they have same tropic level or ecological role or food habit or ecological function they are said to be ecological equivalent to each other.

→ eg - Buffalo of Haryana and Mithun of Arunachal Pradesh

eg - Cow of India and Kangaroo of Australia

eg - Doob grass of Delhi and Elephant grass of African Savanna

⇒ Ecological Guild

Ecological Guild is formed by group of individuals that belongs to different species but exploits same class of resources almost in similar manner. Thus membership in guild is on the basis of competition for same class of resources almost in similar manner.

Q- Which of the following forms ecological guild

(A) All nectar feeding insects of sunderbans

(B) All flowers in which anemophily occurs.

(C) Group of insects performing entomophily.

(D) Detrivores present at the floor of forest ecosystem.

Select the correct code:

1) A and B 2) B and C 3) A, B, C 4) A, B, C and D.

Agent	→	Classification of Pollination
Wind		Anemophily
Water		Hydrophily
Insect		Entomophily
Ant		Myrmecology
Human/Elephant		Zoophily
Snails		Malacophily

⇒ Natural Capital / Ecosystem Services

→ All those services and benefits provided by natural or natural ecosystem or unmanaged ecosystem, free of cost is called as ecosystem services or natural capital.

→ As energy is currency of ecology, it is expressed in unit of energy.

Q- which of the following is not an example of natural capital or ecosystem services

1) Pollination of crops by wind, water and insects.
2) Purification of air through rainfall
3) Olericulture, cultivation of vegetables
4) Artificial rainfall / Project / Cloud seeding.

Select the correct code:

(A) 1 and 2 (B) 2 and 3 (C) 3 and 4 (D) 1, 2, 3 and 4

Technoecosystem → Naveh gave the concept of technoecosystem
→ which is technologically advanced ecosystem that behaves as energetic island as consumption of fossil fuels like coal and petroleum is very high that causes high level of environmental degradation
→ As in this system, there is high level of green house gas emmission emission of ODS (Ozone Destroying substances) and various other pollutants, it behaves like parasite on natural surrounding.

Ecological Foot Print (E.F.P.)
→ Concept was given by Rees and Wackernagel
→ The used the phrase "small is beautiful"
→ EFP is defined as area present outside any given technoecosystem i.e. required to support life activities by fulfilling the demand i.e. demand of fresh water, food, air and also to absorb, recycle and regenrate resources.
→ The value of EFP depends upon:
(a) Demand of Technoecosystem (EFP $\propto$ Demand)
(b) Biocapacity of surrounding area (EFP $\propto \frac{1}{\text{Biocapacity}}$)

NOTE:

1) Resource regenerating capacity of a given area or ecosystem is called as it's Biocapacity.
2) Biocapacity also takes into account capacity of ecosystem to absorb waste, regenerate resources and thus different assets of ecosystem that maintains it's biocapacity are forests, lakes rivers and wetlands

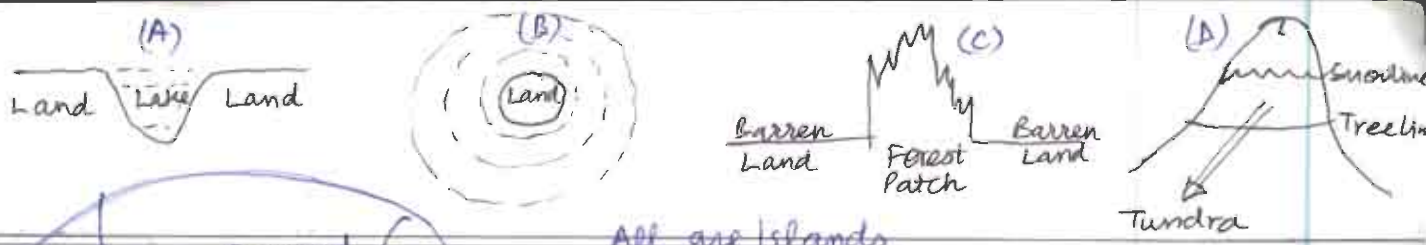
Q Fill in the blanks, with the help of given table:

Techno ecosystem	Ecological Foot Print per capita
A	0.75 ha/ per person
B	1-50 "
C	2.99 "
D	4.75 "
E	5.50 "

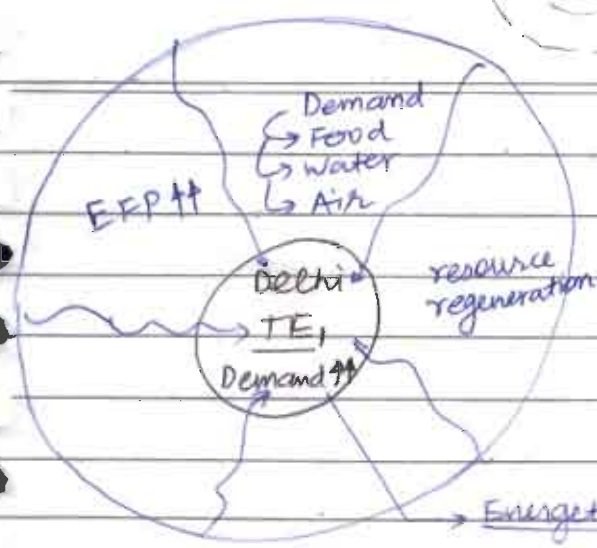
1) A is most stable. A
2) In E environmental degradation is very high. E
3) A is least parasitic on natural surrounding. A
4) E is least sustainable. E
5) E is stronger or intense energetic island. E
6) Impact of pollution is maximum in E E
7) A has maximum biocapacity. A

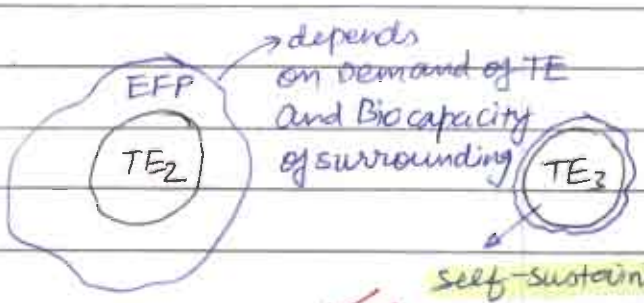
NOTE:

1st August 2019 is observed as Earth overshoot day as resources allocated for their 2019 got consumed by 1st Aug. Thus remaining months are parasitic on ecosphere and conditions are ecologically not stable.



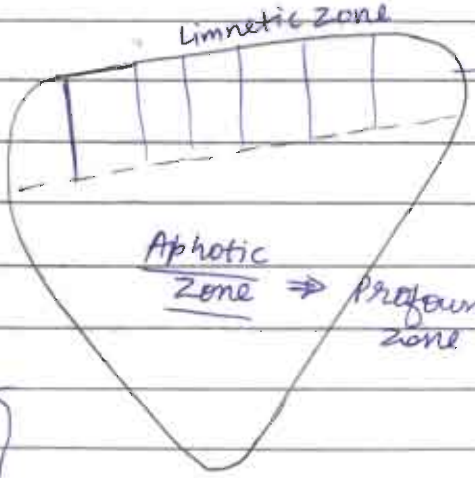
All are Islands





self-sustaining Technoecosystem.

⇒ Ecological Niche → Grinnel



1) Habitat / Spatial Niche [Microhabitat]

2) Trophic niche / Functional Zone
Autotrophs v/s consumers (Producers)

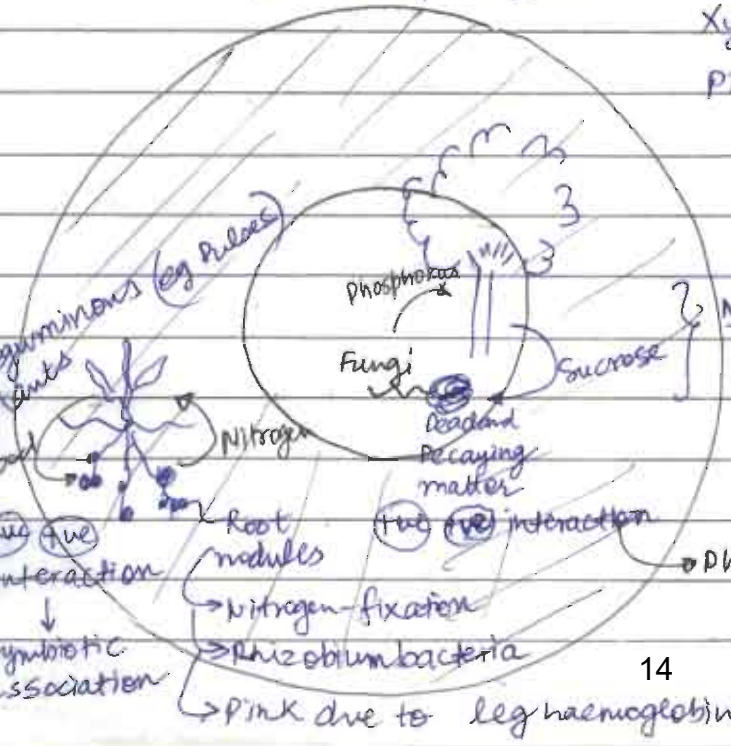
3) Multifactor Niche [Fundamental Niche] → Hutchinson

Pond → Profoundal Niche Zone → Poorly Developed

Realised Niche > Fundamental Niche

Xylem = Water + Nutrients → Ascent of Sap

Phloem = Translocation ≡ Sucrose of food



Mycorrhiza → Symbiotic association

→ Phosphate

In humans DNA, RNA, ATP → all contain phosphate.

AIR-1 Notes

Pages: 35

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Project Management

1. Basics of Project Management
2. Project Initiation
3. Risk Management
4. Project Execution, Monitoring and Closing
5. Project Financing

→ Project is a temporary endeavour undertaken to create a unique product, service or result

→ Each project is temporary because it has a definite beginning and a definite end.

→ A project is not a continuous ongoing activity.

→ A project is unique because some aspects related to the project will be specific to that project only.

⇒ Project Management - It is the application knowledge, skills, tools and techniques to the project activities to meet project requirements.

→ It has increasingly become significant because:

1) Many projects are large and complex which require a lot of coordination and communication with the suppliers, sponsors, government agencies etc.
2) Large amount of money may be involved in the project.
3) There is risk and uncertainty involved.
4) The market situation is dynamic and the prices of various inputs continuously fluctuate.
5) Management of stakeholders is required.
6) There is increased competition and increased focus on meeting the client's requirements.

⇒ Features/Characteristics of a project

1) Change
→ Projects can be considered as agents of social change
2) Temporary
3) Unique
4) Risk → Because each project is unique
5) Requirement of effective communication & coordination with various stakeholders.
6) Multifunctional → as it requires involvement of people from different departments.
7) There should be a defined objective so as to avoid any confusion and conflict at a latter stage.
8) Sub-contracting - A specialized knowledge or work force may be required for a very small duration. Hence they may be outsourced to another agency.
9) Made to order -
10) Life Cycle - Each project has a life cycle irrespective of its scope and cost → Initiation, planning, execution, closing.

⇒ Comparison of operations and projects

1) Both require planning, execution and control and both are subjected to constraints of time cost and quality.
2) Projects are temporary while operations are continuous activities.
3) While projects have unique outputs, operations result in similar products
4) Projects involve more risk whereas operations involve less risk.
5) Management of projects is more difficult in comparison to operations.
6) Projects involve wide variety of skills whereas operations require limited skills.
7) Projects involve many outside agencies whereas operations require relatively few outside agencies.

⇒ Project Stakeholder - It refers to an individual, group or organizati who may affect, be affected by, or perceive itself to be affected by a decision, activity or outcome of a project.

→ Stakeholders can be of 2 types:

1) Internal Stakeholders → Project Manager, team manager, Sponsors etc
2) External Stakeholders → Govt regulating bodies, local people, suppliers, external funding agencies.

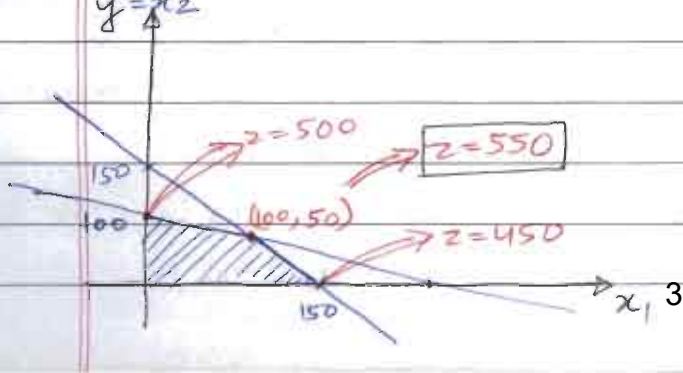
OR

1) Positive Stakeholders - They have a positive view about the project and are likely to be benefitted by the project's outcome.
→ They help in successful completion of the project.
2) Negative Stakeholders - They have a negative opinion about the project and are likely to be negatively impacted. They may present hurdles in successful completion of the project. Hence, they need to be managed and taken into confidence by effective communication and coordination.

⇒ Project constraints

→ Time, Cost & Scope → universal constraints.
→ Resources, Quality → other constraints.
→ These are the limiting factors or the boundaries within which the project should be completed.

Q- The objective function $Z = 3x_1 + 5x_2$ is to be maximized subject to constraints $x_1 + 2x_2 \leq 200$, $x_1 + x_2 \leq 150$ and $x_1, x_2 \geq 0$



⇒ Types of organizations:

① Functional Organization

→ The organization is divided into specialized departments with each department performing one type of function.

→ The functional manager will have full authority regarding decision making, allocation of funds, resources etc. in that particular functional domain.

→ The position of Project Manager either does not exist or if it exists, he will have limited powers and will act more as a coordinator.

→ The decision making is slow and there is poor inter-departmental communication and coordination.

→ At any point of time, a department may have one or more no. of projects, hence the project oriented focus is missing. There is no one person responsible for the project as a whole.

→ The functional manager may adopt analytical approach rather than systems approach.

② Projectised Organization

→ Here the PM has full authority to take decisions and allocate resources.

→ Either there will be no functional manager or if he/she exists, he/she will have very limited powers.

→ It leads to fast decision making and fast completion of projects

→ The PM uses systems approach

→ The PM can directly communicate with the top management and hence there are shorter communication channels.

→ Employees may become less loyal to the organization because once the project is complete they may lose their jobs.

→ Project team forms a separate identity which results in high level of motivation for the employees [non-monotonous work]

→ It creates an internal rft in the organization because the project team members feel that they are more important to the organization in comparison to other employees of parent org. [Projectities]

③ Matrix Organization

→ It is a mixture of the projectised type of org structure and functional type of org structure.

→ There are 2 chains of command, one on the functional lines and other on the project lines.

→ Hence, there might be some practical difficulties in reporting to 2 bosses. Thus, there must be clear communication and division of power to avoid any confusion and conflict.

Matrix Organization
- Strong matrix → PM has more power; similar to projectised org.
- Balanced matrix
- Weak matrix → Functional manager has more power; similar to functional org.

⇒ Project Manager

→ A PM is an individual with the authority, responsibility and accountability for managing a project to achieve the desired objectives.

→ PM should have skills related to leadership, communication, motivation, decision making, team making, conflict resolution, negotiation, Human Resource Management, time management, budgeting, political and social awareness

⇒ Powers of a PM

① Positional Power
- Legitimate / Formal
- Reward
- Coercive / Punishing

} Relevant for Projectised and Strong matrix organisations.

(a) Legitimate / Formal Power – The team members will obey the instructions of the PM because they know that he has the authority to issue such orders.

(b) Reward Power – The project Manager can reward the team members / sub-ordinates monetarily / non-monetarily if they perform well.

(c) Coercive / Punishing Power – The team members will obey the PM because they may be punished if they do not perform well.

→ The positional powers need a pre-justification before their use. But in case of emergency, they can be used without approval and subsequently the post justification may be given.

② Personal Power → Referent
→ Expert

(a) Referent Power – It is due to the respect and admiration of the subordinates.

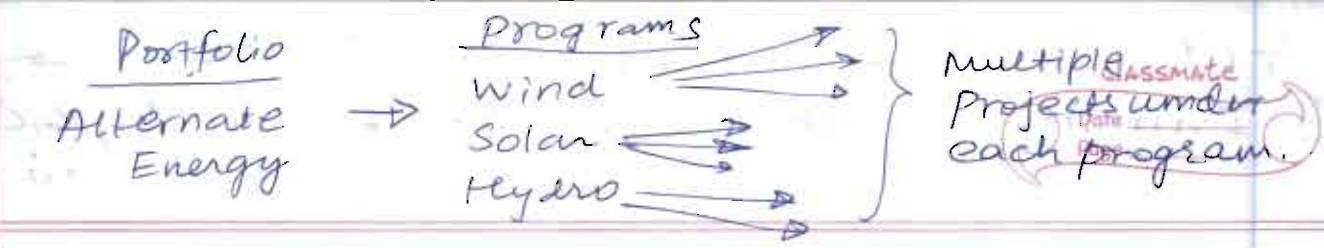
(b) Expert Power – It is based on the skill, knowledge, experience & expertise of the PM.

⇒ Project Management Office (PMO)

→ This a group of individuals who are responsible for centralised and coordinated management of the projects.

PMO → Supportive → Low degree of control over projects → Weak matrix / functional
→ Controlling → Moderate degree of control → Balanced matrix
→ Directing → High degree of control → Projectised, Strong matrix.

→ Project, Program, Portfolio management



⇒ Program - It is a group of related projects managed in a coordinated way to obtain the benefits and control which is not available from managing them individually.

→ Programme management leads to better utilisation of resources, minimised resource constraints, reduced conflicts b/w projects, good communication and coordination b/w projects and overall improvement in the organization's performance.

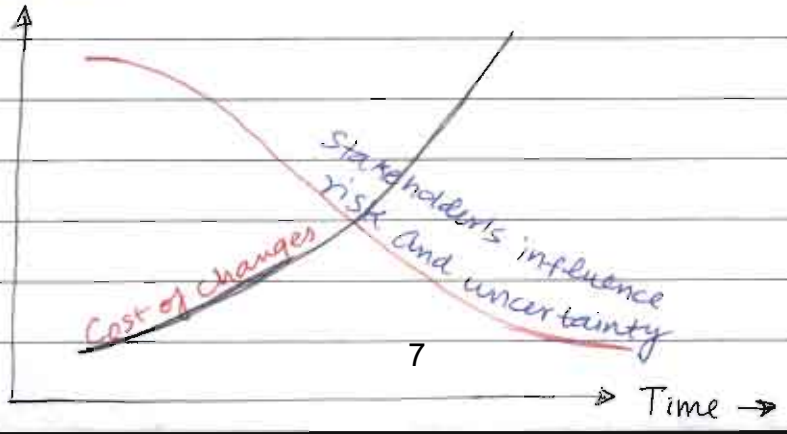
⇒ Portfolio management - A portfolio is a group of related or non-related programs or projects. Portfolio management will have a larger scope than the programme management.

→ The portfolio management helps in achieving the strategic objectives of the organization, prioritization of the works and optimization of organization's performance.

⇒ Project Lifecycle

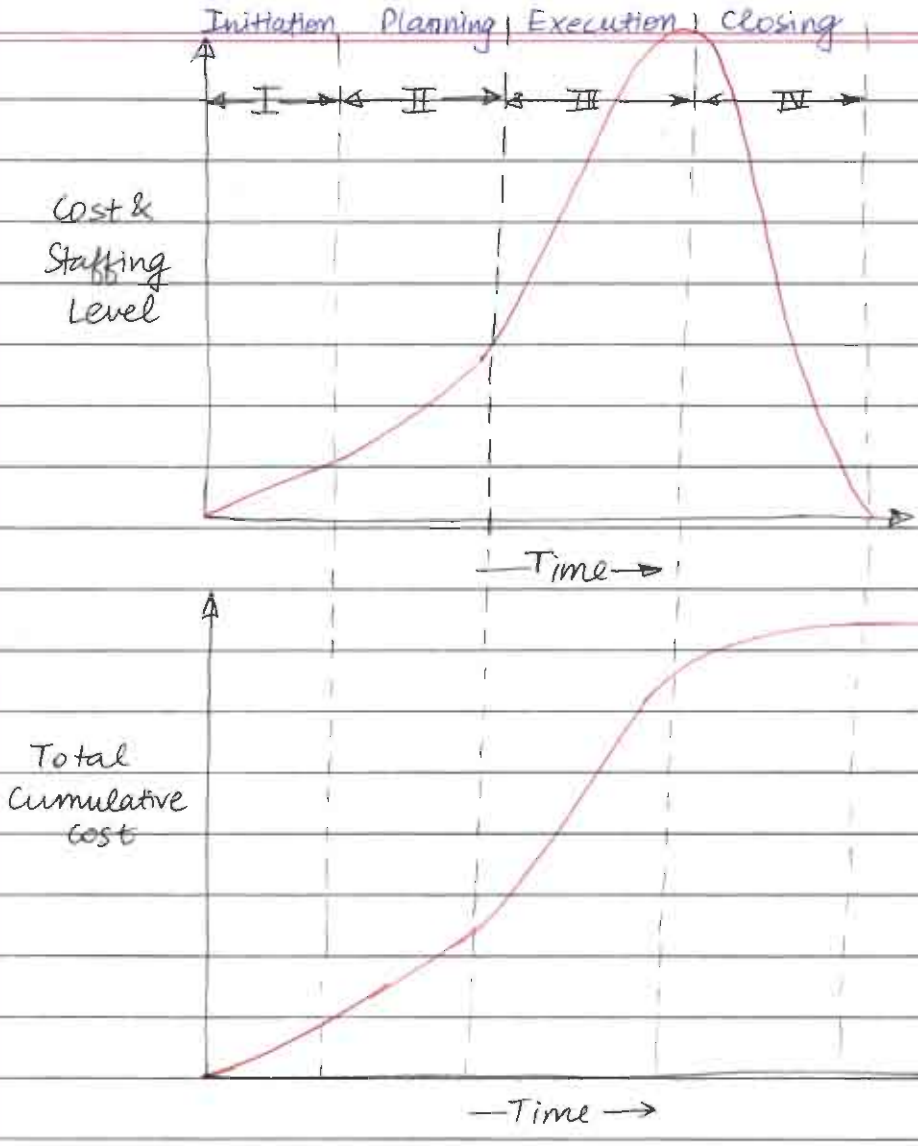
① Initiation ⟶ o/p Project Charter
② Planning ⟶ o/p Project Management Plan
③ Execution ⟶ o/p Accepted deliverables to client
④ Closing ⟶ o/p archived documents → Both Physical and financial closure.

→ Irrespective of the scope, cost and complexity, any project goes through a series of stages during its life which are collectively called the project lifecycle. It helps in better management and control over the projects



47 Project processes → divided into 5 process groups

① Initiating, ② Planning ③ Executing ④ Monitoring & Control ⑤ Closing.



Chapter 2 - Project Initiation

→ Project Identification → Pre-feasibility study → feasibility study → DPR → Appraisal → Project Charter

⇒ **Project Identification**

→ The process of project management starts with the project identification

→ At this stage, the project authority generates various ideas about the possible projects that can be undertaken.

Project Identification → SWOT Analysis → Strength, weakness (Internal factors), opportunity & threats (External factors).

Project Identification → Brainstorming

classmate
Date
Page
first look

⇒ Pre-feasibility analysis or Preliminary filtration or Prima-facie analysis

→ Most of the identified projects are screened out and eliminated at this stage. The decisions are made on the basis of the following factors:

1) Whether sufficient funds are available
2) Whether the demand is high and stable
3) Whether the project is adequate from the locational aspects
4) Whether there are any major problems related to environment or land acquisition.
5) Whether there is too much competition
6) Whether the performance of existing industries is encouraging.
7) Whether the govt policies are favourable.

⇒ Feasibility study
- Market Feasibility
- Financial Feasibility
- Technical Feasibility
- Socio-economic feasibility
- Environment Feasibility

→ If the project is selected on the basis of pre-feasibility report then the practicality of the proposed project is further examined in greater detail in the feasibility study.

① Market Feasibility

→ It includes the current market analysis, existing competition, anticipated future market growth and the potential size of the market that can be captured.

→ The analysis is carried out through fore casting of the future demand.

Market Forecasting
- Subjective → Qualitative Forecasting
  - Delphi method
  - Sales force composite
  - Consumer panel survey
- Objective → Quantitative Fore casting
  - Moving avg method
  - Weighted moving avg
  - Exponential smoothing
  - Regression Analysis

Qualitative Forecasting

→ Qualitative methods will be used when the past data is not available, a brand new product is to be launched, or when the forecasting has to be done for long time period.

→ The Qualitative forecasting is based on personal judgement, intuitions and experience. Hence, it is subjective in nature.

(a) Delphi Technique

→ It is an iterative process which employs a group of experts to obtain forecasts.

→ The interaction b/w the experts takes place through a coordinator.

→ The coordinator obtains the forecasts from all the experts and each of the experts whose estimate is at either extremes, are asked to give a justification for their forecast which is then circulated to all the experts.

→ Based on this additional information, experts may revise their original forecast.

→ This process is repeated many times so that a consensus forecast is reached.

(b) Sales force method

→ All the members of the sales team of the company are asked to estimate the likely sales in their respective areas.

→ These estimates are combined at the regional and national level to obtain the overall forecast.

(c) Consumer Panel Survey

→ The company uses the consumers on the consumer panel for obtaining the forecasted demand. These consumers are assumed to be representative of the actual consumers in the market.

Quantitative Forecasting

(a) Moving Average method

Year	Sales (Cr)
1	50
2	60
3	70
4	50
5	70

3 year moving average

$\Rightarrow F_6 = \frac{D_3+D_4+D_5}{3} = \frac{190}{3} = 63.33$

→ 4 year moving average

$F_6 = \frac{D_2+D_3+D_4+D_5}{4} = \frac{250}{4} = 62.5$

→ This method averages the data of few recent periods while ignoring the older observations.

→ Equal weightage is assigned to all the periods selected for averaging.

(b) Weighted moving average method

→ The highest weight is assigned to the most recent value and progressively smaller weights are assigned to the preceding values.

→ 3 year weighted moving avg

$F_6 = \frac{3\times70 + 2\times50 + 1\times70}{6}$

→ 4 year weighted moving avg

$F_6 = \frac{4\times70 + 3\times50 + 2\times70 + 1\times60}{10}$

(c) Exponential Smoothing

$$F_t = F_{t-1} + \alpha (D_{t-1} - F_{t-1})$$

α = Smoothing constant

Q $\alpha = 0.4$

Year	Demand (D_t)	(F_t)
1	70	70
2	60	70
3	80	66
4	90	71.6
5	?	

Forecasting → Assume $F_1 = D_1 = 70$

$F_2 = F_1 + \alpha(D_1 - F_1) = 70$

$F_3 = F_2 + \alpha(D_2 - F_2) = 66$

$F_4 = F_3 + \alpha(D_3 - F_3) = 71.6$

$F_5 = F_4 + \alpha(D_4 - F_4) = 78.96$

(#) Regression Analysis → most commonly used in the project initiation stage.

$y = a + bx$

$\rightarrow \Sigma y = an + b\Sigma x$ × Σx

$xy = ax + bx^2$

$\rightarrow \Sigma xy = a\Sigma x + b\Sigma x^2$ × n

$n\Sigma y = an\Sigma x + bn\Sigma x^2$

$\Sigma y \cdot \Sigma x = an\Sigma x + b(\Sigma x)^2$

$$b = \frac{n\Sigma xy - \Sigma x \cdot \Sigma y}{n\Sigma x^2 - (\Sigma x)^2}$$

$$a = \frac{\Sigma y - b\Sigma x}{n}$$

Take $\Sigma x = 0$

Then → $b = \frac{\Sigma xy}{\Sigma x^2}$ & $a = \frac{\Sigma y}{n}$

Q-

(in crores)

Year	Sales	Deviation from 2016
2014	50	-2
2015	60	-1
2016	70	0
2017	50	1
2018	70	2
	(y)	(x)

$b = \frac{\Sigma x \cdot y}{\Sigma x^2} = \frac{30}{10} = 3$, $a = \frac{300}{5} = 60$

So, $y = 60 + 3x$

$y|_{@x=3} = 60 + 9 = 69$

(2) Financial Feasibility

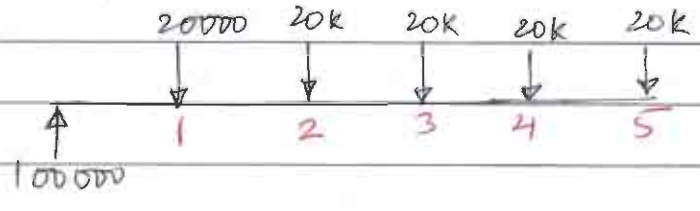
→ It assesses the feasibility of a proposed project by evaluating the various costs and thus making fore casts of the future profitability of the investment.

- Non-Discounting Techniques
  - → Payback Period
  - → Accounting Rate of Return
- Discounting techniques
  - → NPV
  - → Profitability Index (Benefit / Cost)
  - → Internal Rate of Interest
- Break-even analysis.

→ The non-discounting techniques do not consider the time value of money whereas the discounting techniques take into consideration, the time value of money.

(a) Payback Period

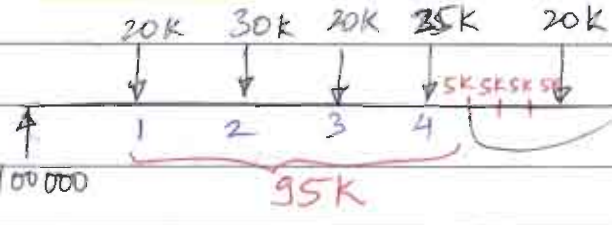
→ It is the time taken by a company to recover the initial cost of the project. (without considering the time value of money)



Payback Period = 5 years.

↳ without considering the time value of money.

→ Payback period is the ratio of initial investment and the annual cash flow.



Payback Period = 4.25 years.

→ The projects having lower pay back period may be preferred over the projects having higher payback period.

→ If the payback period of the project is lower than the expected Payback period, then the project may be selected.

(b) Accounting Rate of Return = $\frac{\text{Average income}}{\text{Avg. investment}}$ OR $\frac{\text{Average income}}{\text{Initial investment}}$

Average Investment = $\frac{\text{Initial investment} + \text{Salvage value}}{2}$

$= \frac{I+S}{2}$

Q: If the initial investment is Rs 3 lacs and the life of investment is 5 years with the following cash flows
Rs 90K, Rs 90K, Rs 120K, Rs 90K, Rs 150K
Then what will be the ARR based on initial investment and average investment. Assume that the asset has no salvage value after 5 years.

	1st	2nd	3rd	4th	5th
Cash Flow	90K	90K	120K	90K	150K
Depreciation	60K	60K	60K	60K	60K
Income	30K	30K	60K	30K	90K

Average income = 48K $\Rightarrow$ ARR = $\frac{48}{300}$ = 16%

$\Rightarrow$ ARR$\Big|_{\text{based on avg investment}}$ = $\frac{48}{300/2}$ = 32%

Q: A machine is expected to generate cash saving of Rs 50000/year for 5 years. Salvage value is 40% of the original cost. If ARR based on initial investment is 20%, then what will be the cost of 2 such machines.

$0.2 = \frac{50000 - 0.12x}{x}$ $\Rightarrow x = \frac{50000}{0.32}$

$\Rightarrow 2x = 312500$

AIR-1 Notes

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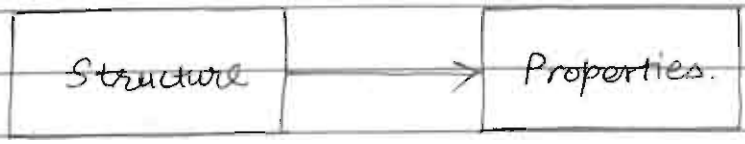
Material Science

→ It is a branch of science which deals with the investigation of relationship that exist between structure and property.



→ Property - It is a characteristic of a material which can be measured.
→ Property can be observed by applying external stimulus and hence a response can be measured.
→ Stimulus can be electrical, magnetic, optical, mechanical force etc.

→ Following are the different types of structure:

1) Macrostructure - External shape and forms such as shape and size by naked eye.

Mechanical POV:

2) Microstructure - In it we study shape and size of grains by optical microscope

3) Sub-structure - In it we study defects in the grains by ~~magnifi~~ scanning electron microscope.

4) Crystal structure - In it we study arrangement of atoms by X-Ray Diffraction technique.

Electronics and Electrical POV:

5) Electronic structure - In it we study electrons distribution around an atom by Electron spectroscopy.

6) Nuclear structure - In it we study about the nucleus by nuclear magnetic Resonance or Moss-Bauer Spectroscopy

→ Following are the important engineering materials:

1) Metals and Alloys - Aluminium, Iron, Copper, Magnesium, Zinc, Titanium, Nickel, Tin and Lead.

2) Polymers
   (a) Thermoplastic polymers
   (b) Thermo-setting plastic polymers

3) Composite

4) Ceramics - Oxides, Carbides, Nitrites, glasses etc.

~~Depending upon the atomic arrange~~

→ Depending upon the atomic arrangement of the above materials are classified into 2 groups.

Crystalline	Non-crystalline / Amorphous
1) Atoms are regularly arranged over large atomic distances.	1) Atoms are irregularly or randomly arranged.
2) Long range order exist.	2) No long range order exist.
3) Since Bond Length is same everywhere, hence sharp melting point exists.	3) No sharp melting point exists.
4) Mechanical property depends on no. of atoms on a given line hence crystalline materials are anisotropic in nature	4) Since no. of atoms on each and every line is same, hence property is isotropic in nature.
5) It is true solid having fixed external shape and size.	5) It is called super cooled liquids which doesn't have fixed shape and size.
eg- All metals, many ceramics and some polymers. (Crystalline materials are hard and brittle)	eg- charcoal, glass, many polymers and some ceramics

⇒ Crystal Structure

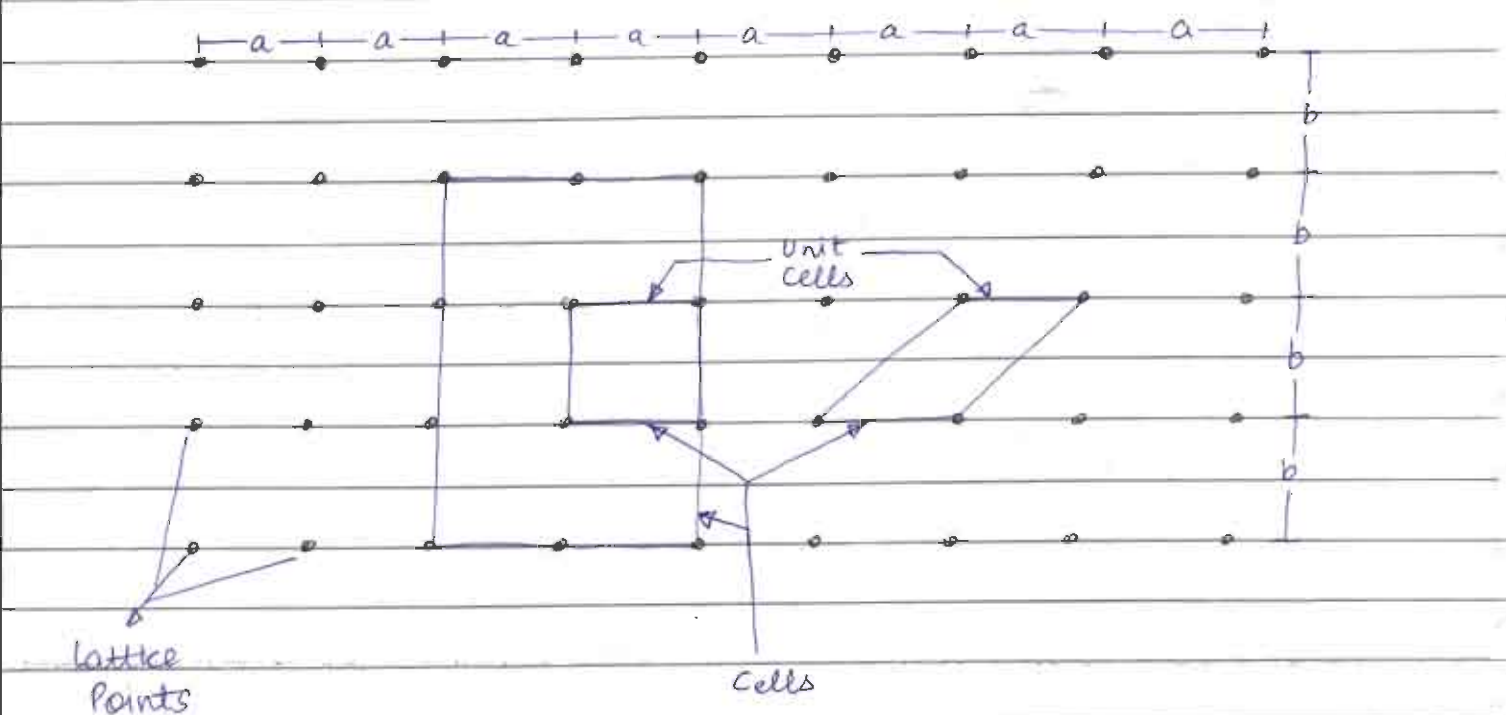
In it we study arrangement of atoms and the science involved is called crystallography.

→ In this we assume atoms to be having some well defined diameter i.e. It is assumed to be sphere. This model is called Hard Sphere Model.

→ Assumptions of Hard Sphere Model

1) Cation is always smaller than its respective anion.
2) Cations and Anions always are in contact with each other.
3) Since cation has higher charge Density (charge per unit Surface area) hence it is always surrounded by maximum no. of anions as permitted by geometry.

→ Space Lattice - It is an infinite array of points arranged in 3-dimensional space which is periodically repeated and has identical surroundings.

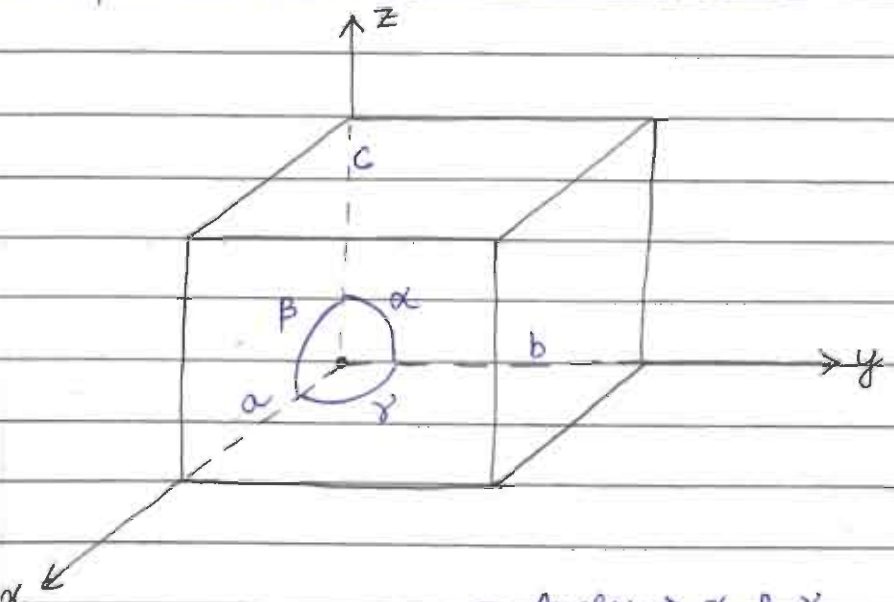


→ These space lattice are periodically repeating in three directions (x, y, z) and the periodic distance along those directions are called Lattice Parameter (a, b, c).

→ With the help of these 3 Lattice parameter, we can create a volume which is called cell.

→ A cell can be said to be unit cell if it has smallest size, maximum symmetry and if it is repeated in space lattice then it can cover entire space lattice.

→ There can be ∞ number of unit cell possible and out of them some important unit cells will be studied.



6 Lattice Parameters
- Angles → α, β, γ
- length → a, b, c

→ With the help of 6 Lattice Parameters there are large no. of unit cell possible but we have to study only those unit cells which have smallest size and maximum possible symmetry and Bravais found out that there are only such 14 unit cell available which is called crystal class and they can be grouped into 7 crystal systems.

⇒ Following are the 7 crystal systems:

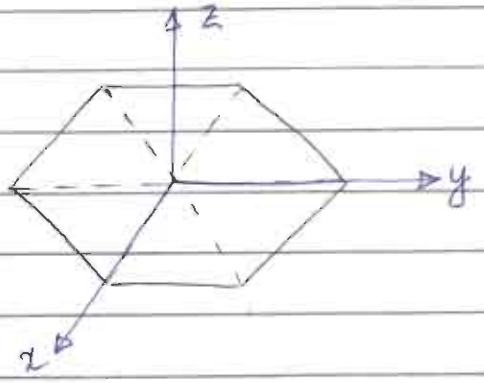
1) Cubic Crystal → $a = b = c$, $\alpha = \beta = \gamma = 90^\circ$

2) Rhombohedral → $a = b = c$, $\alpha = \beta = \gamma \neq 90^\circ$
(Cube + Shear on all faces)

3) Tetragonal → $a = b \neq c$, $\alpha = \beta = \gamma = 90^\circ$
(Duster)

4) Orthorhombic → $a \neq b \neq c$, $\alpha = \beta = \gamma = 90^\circ$
(CPU)

5) Hexagonal → $a = b \neq c$, $\alpha = \beta = 90^\circ$ and $\gamma = 120^\circ$

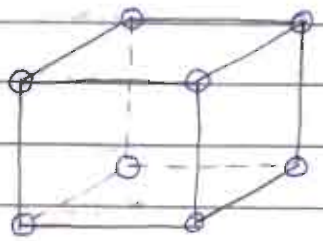


6) Triclinic → $a \neq b \neq c$, $\alpha \neq \beta \neq \gamma$
(Highly unsymmetrical)

7) Monoclinic → $a \neq b \neq c$, $\alpha = \gamma = 90^\circ \neq \beta$.

⇒ Cubic crystal system

1) Simple Cubic Crystal



→ No. of Lattice Points = 8

→ Contribution of each corner atom = $\frac{1}{8}$

→ Atoms per unit cell = $8 \times \frac{1}{8} = 1$

→ Geometrical relationship $\boxed{a = 2r}$

Lattice Parameter — Radius of atom.

→ Coordination Number → No. of nearest neighbour atoms.

$\boxed{CN = 6}$ (2×3)

↳ No. of axes.

→ Atomic packing factor / efficiency → It represents the fraction of volume of unit cell that is filled by atoms and is given by a ratio as:

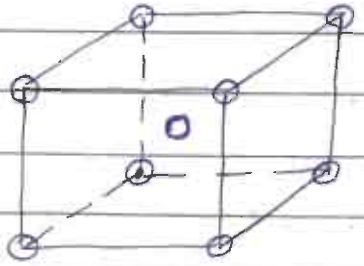
$$APF = \frac{n \times \text{Volume of atom}}{\text{Volume of unit cell}} = \frac{1 \times \frac{4}{3}\pi\left(\frac{a}{2}\right)^3}{a^3}$$

$n \rightarrow$ no. of atoms per unit cell.

$\boxed{= 0.52}$

eg - Manganese (Mn)

2) Body Centered cubic



No. of Lattice points = 8 + 1

Corner — Body centre.

→ Contribution of each corner atom = $\frac{1}{8}$

→ Contribution of body centered atom = 1

→ No. of atoms per unit cell = $\frac{1}{8} \times 8 + 1 \times 1 = 2$

→ CN = 8

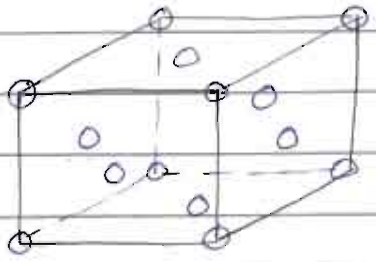
→ Geometrical Relationship → $\sqrt{3}a = 4r$

→ $\boxed{a = \frac{4r}{\sqrt{3}}}$

→ APF = $\frac{2 \times \frac{4}{3}\pi \times \frac{3}{16} a^3 \frac{\sqrt{3}}{4}}{a^3} = \frac{\sqrt{3}\pi}{8} \boxed{= 0.68}$

→ eg- Iron (α), Chromium, Tungsten, Molybdenum

3) Face Centered Cubic (FCC)



→ No. of Lattice points = 8 + 6 = 14
(8 ↙ Corner, 6 ↘ Face centered)

→ Contribution of each corner atom = 1/8

→ Contribution of each face centered atom = 1/2

→ No. of atoms per unit cell = 1/8 × 8 + 1/2 × 6 = 4

→ CN = 12 = 4 × (3) (→ No. of planes.)

→ Geometrical Relationship ⇒ $\sqrt{2}a = 4r$

→ APF = $\frac{4 \times \frac{4}{3}\pi \left(\frac{\sqrt{2}a}{4}\right)^3}{a^3} = \boxed{0.74}$

→ eg- Iron, copper, Aluminium, Silver, nickel, gold, platinum.

Allotrops – When 2 elements exist in more than 1 form at different temperature and pressure then they are called Allotrops and this phenomena is called Allotropy.

eg – Carbon → Graphite, Diamond.

Iron → α-Iron (BCC), γ-Iron (FCC), δ-Iron (BCC)

Tin → α-Tin and β-Tin

⇒ As atomic packing factor increases, ductility increases.

Simple Cubic < BCC < FCC

Ductility ↑↑ →

4) Hexagonal Closed Packed Structure (HCP)

→ No. of lattice points = $6X2 + 2 + 3$

→ Contribution of corners = 1/6

→ Contribution of face atom = 1/2

→ Contribution of centre atom = 1

→ $N = 12 \times \frac{1}{6} + 2 \times \frac{1}{2} + 3 \times 1 = 2 + 1 + 3 = 6$

→ CN = 12

→ APF = 0.74

→ Eg – Titanium, Zinc#, Cobalt Cadmium, Graphite#

⇒ Difference b/w FCC and HCP

→ Although FCC and HCP have same coordination no. and same APF and both are called closed packed structure (voids are low) but arrangement of atom sequence is different.

→ Stacking sequence of FCC structure is ABC ABC

→ Stacking sequence of HCP is ABABAB

⇒ Closed Packed structure

→ These are those structures which creates minimum empty space and these empty spaces are called voids or interstitial or holes.

Q- What is the diameter of largest sphere in terms of lattice parameter a which will fit the void at the centre of the cube edge of a BCC crystal.

$\sqrt{3}a = 4r$

$d = a - 2r$

$= a - 2 \times \frac{\sqrt{3}a}{4\sqrt{2}} = a - 0.866a$

$\boxed{d = 0.134a}$

Q- Repeat the above question for FCC structure.

$\sqrt{2}a = 4r$

$d = a - 2r$

$= a - \frac{a}{\sqrt{2}} = (1 - 0.707)a = 0.293a$

$\boxed{d = 0.293a}$

Since size of voids in FCC > size of voids in BCC

→ more carbon can be alloyed with FCC Iron to form steel.

⇒ Types of Void

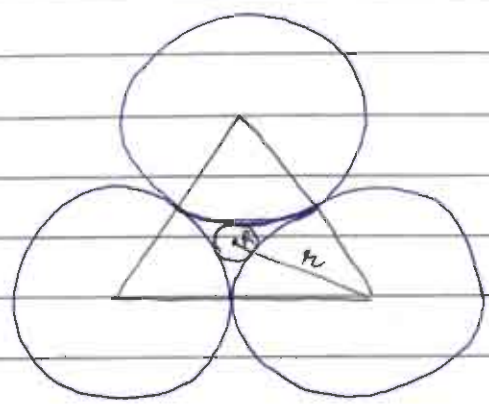
There are 3 types of void:

1) Trigonal void

Formed by 3 spherical atoms.

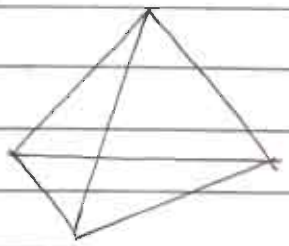
Size of void, $R = 0.155\,r$

R: Radius of void; r: Radius of atom



⇒ Tetragonal / Tetrahedral void

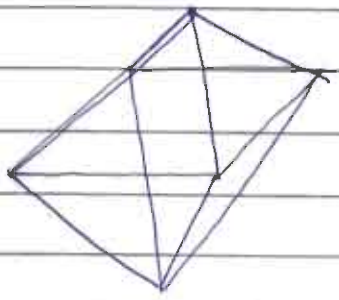
Formed by 3 atoms in one plane and one atom above that plane.



$R = 0.225r$

⇒ Octahedral void

Formed by 4 atoms in one plane, 1 atom above and one atom below that plane.



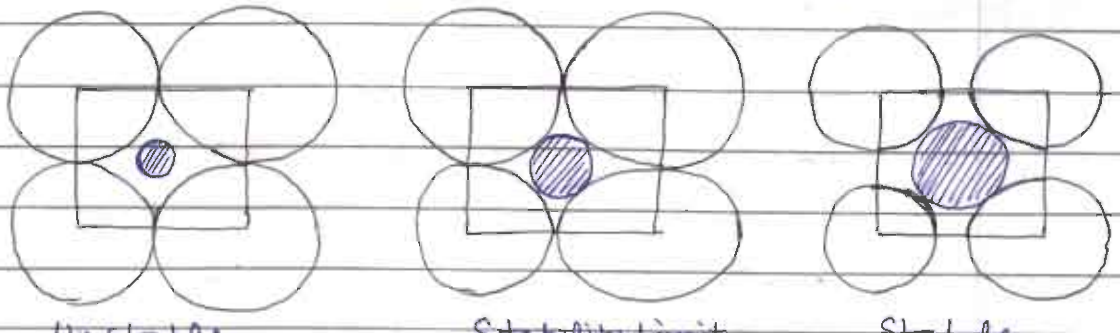
$R = 0.414r$

Examples

1) Tetragonal → Zinc Sulphide (ZnS) → Zinc Blende
2) Trigonal → Boron Oxide.
3) Octahedral → Sodium Chloride (NaCl)

⇒ Rules of stacking cations and anions for stable configuration

① Cation and anion must touch each other.
② Cation is surrounded by maximum number of anions.



For stable configuration | Size of atom which fits in the void > Size of void.

⇒ Density of crystal

Avagadro No: 6.022×10^{23} ← N atoms weigh A gms. (A → Atomic weight.)

n atoms weigh $\frac{A}{N} \times n$ gms.

(n ← no. of atoms per unit cell.)

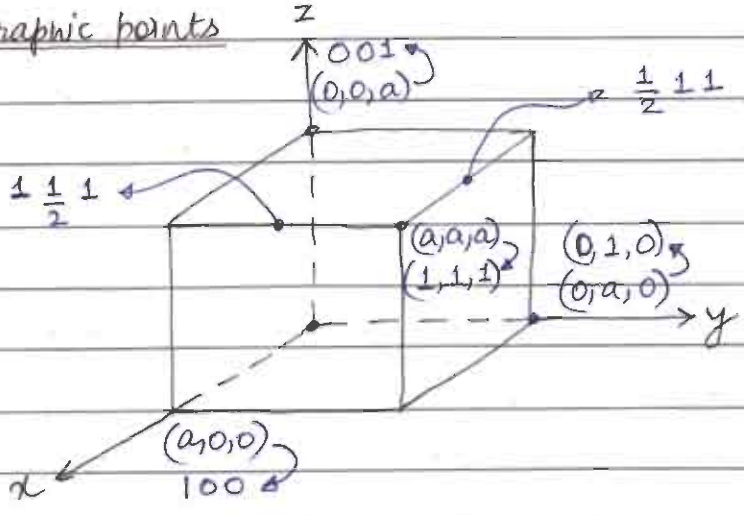
$$\therefore \quad \rho_{Crystal} = \frac{A \times n}{N \times a^3}$$

Q- Find the density of γ-Iron (FCC) if atomic weight is 56 gm/mole and length of unit cell is 10 Å. (in kg/m^3)

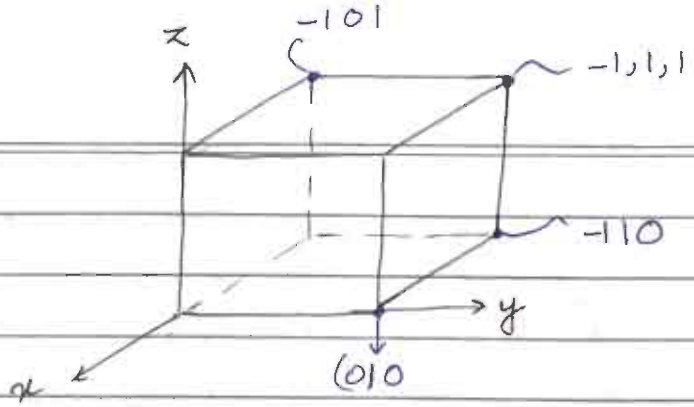
$$\rho_{Crystal} = \frac{\frac{56}{6.022 \times 10^{23}} \times 4 \times 10^{-3}}{(10 \times 10^{-10})^3} = 372 \ kg/m^3.$$

⇒ Crystallographic points, directions and planes

1) Crystallographic points



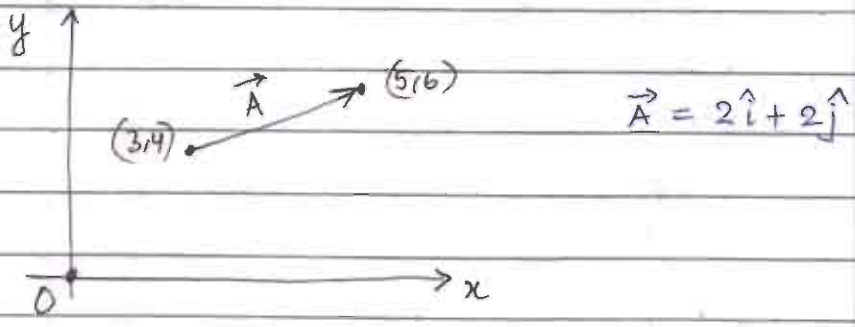
→ Point coordinates are represented as p q r without any comma (,) and bracket [()] as a fraction of a, b, c respectively



⇒ Crystallographic direction

→ Since it is a vector quantity and it can be represented by an arrow. and that arrow has a tail and head.

→ Head represents the direction.



→ In order to find a vector quantity it's tail and head coordinate is desired but if tail of vector passes through origin, then only head coordinate is desired. Therefore, in order to find a direction vector, we shift the origin to the tail.

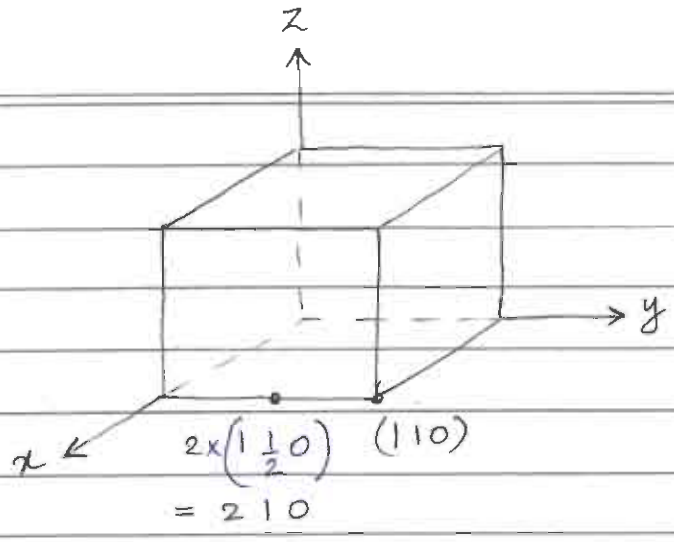
#

→ Rules for finding direction vector

Rule 1 → Check whether the direction vector is passing through origin or not.

→ If the tail of vector is not passing through Origin then shift the origin to it's tail.

Rule 2 → Find the head coordinate as a fraction of a, b, c.



Rule 3 - The indices obtained in step 2 is converted into nearest integer values.

Rule 4 - The obtained indices after reduction is written as

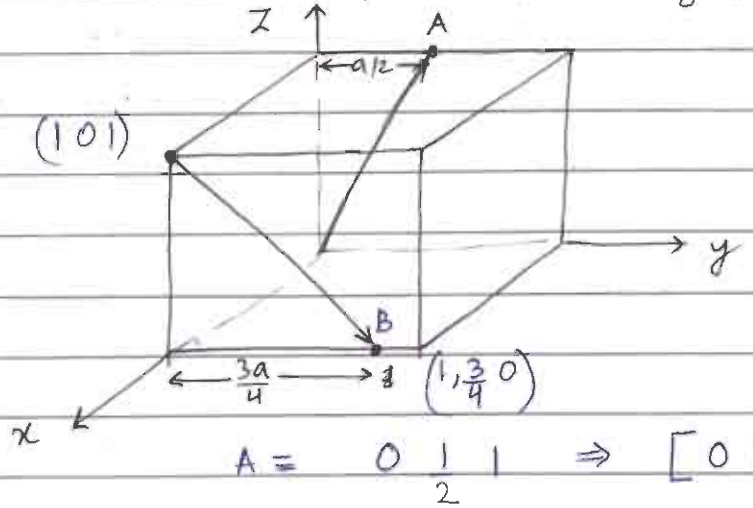
$[u\ v\ w]$

without any comma in square bracket

If any value comes out to be negative, we put a bar over it eg- $[u\ \bar{v}\ w]$ → v is negative.

	x	y	z
Intercept of head	1	1	0
Reduction	1	1	0
Direction.		[1 1 0]	

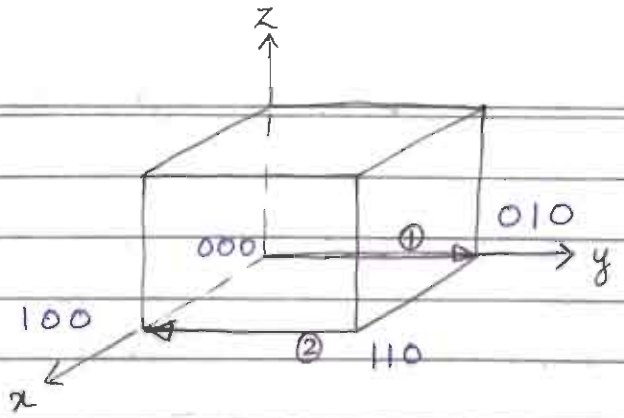
Q- Find the direction vector for the following figure.



$\vec{B} \equiv 0\ \frac{3}{4}\ -1$

$\Rightarrow [0\ 3\ \bar{4}]$

$A \equiv 0\ \frac{1}{2}\ 1 \Rightarrow [0\ 1\ 2]$



① ≡ [0 1 0]

② ≡ 0 → 1 0 ≡ [0 $\bar{1}$ 0]

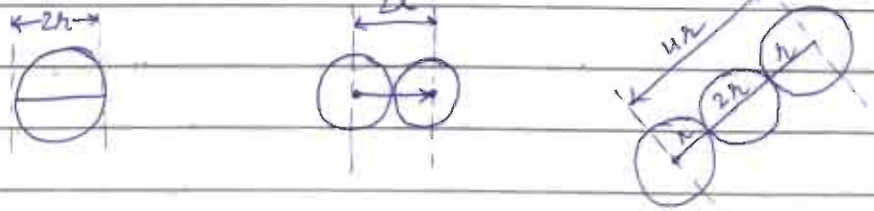
NOTE:

① When a direction vector [u v w] is multiplied by -1 then it will give an antiparallel direction vector

② The indices u, v, w in direction vector [u v w] is proportional to lattice parameters a, b, c respectively.

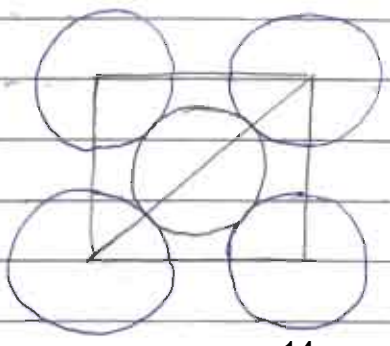
⇒ Linear Density

→ It is defined as the number of atoms centered on a given direction vector per unit length of that direction vector.



2r ≡ 1 atom 2r ≡ 1 atom 4r ≡ 2 atoms.

FCC



LD along [0 1 0]

$LD_{[010]} = \frac{1}{a}$

~~LD along~~ [0 1 1]

$LD_{[011]} = \frac{2}{\sqrt{2}a} = \frac{\sqrt{2}}{a}$

AIR-1 Notes
Pages: 80

Handwritten notes by

Kartikay Kaushik

AIR-1 ESE 2021

IES Master classroom Student

ICT

(Information, Communication & Technology)

→ ICT is the convergence of telecommunication tools on a single link system which is controlled by computer systems. It acts as a unified communication tool which helps to integrate following:

1) Telecommunication tools and telephone lines.
2) Wireless communication tools and mobile phones.
3) Computers and computer networks
4) Enterprise Softwares
5) Middlewares [Help to increase user accessibility]
6) Storage devices.
7) Audio Video signals etc.

⇒ Middleware - They act as a software glue. It helps to provide additional applications to a software and a program according to user accessibility. They can be an extension to Operating System, Applications or softwares.

Types of Middlewares:

① Enterprise Application Integration - It helps to integrate distributed applications of enterprise programs and softwares.
eg- Supply Chain Management Middleware, Human Resource management middleware etc.

② Data Integration Middleware (DIM) - It helps to synchronise distributed data to provide a unified view.
eg- Bio Informatics, Big Data.

③ Message Oriented Middleware - These are used as a software or hardware which helps in sending and receiving messages over a distributed system.

④ Enterprise Service Bus (ESB) – It acts as a communication system b/w mutually interacting softwares.

⇒ Unified Communication

→ It acts as integration of many communication tools which helps to optimize processes and increase communication efficiency.

→ Unified communication helps to unify human and device communication in a common context and experience. It has following tools:

① Instant Messaging
② Mobile Communications
③ Location features and presence information
④ Audio, video and web conferencing
⑤ Desktop and data sharing.
⑥ Unified Call control.

⇒ Advantages of ICT

① It helps in electronic distribution of information
② It helps in electronic data storage.
③ It helps in abolishing language and cultural barriers
④ It reduces response time in communication.
⑤ It increases communication reliability and reduces communication gaps and glitches.
⑥ It helps to increase social participation, reduces barriers between governments and citizens
⑦ It helps to transform society into knowledge society
⑧ It helps in inclusive growth and increases human development
⑨ It helps in resource management, mobilization and sustainability Hence it is one of the powerful tool for sustainable development.

⇒ Disadvantages of ICT

① Unemployment - ICT leads to loss of employment for core, unskilled and unorganised sectors whereas it can also increase skill development which may improve the quality of jobs.

② Overuse of ICT would lead to loss of Emotional Quotient of citizen service delivery where the emotional values of front end human customer service would be lost.

③ ICT may lead to loss of personal privacy, data privacy and social equilibrium.

④ Overuse of social media tools may also lead to social polarization which can disbalance the knowledge society.

⑤ ICT can also lead to loss of social, data and device security.

⇒ Roles of ICT

⇒ Role of ICT in Internal Administration

It helps in following:

① Centralized storage of files and data.
② Reduced delay in file processing
③ Efficient communication and transparent platforms of communication between all the stakeholders.
④ It makes administration paperless.
⑤ It helps in skill improvement of employees.
⑥ It helps in development of electronic administration.

PRAGATI → PRO-Active Governance and Timely Implementation.

Tools used in Internal Administration are:

① Componentware: It helps to unify computers and different physical equipments used in file processing and communication.

② Groupware: It helps to integrate different works of a project together on a single point

③ Wireless devices like phones and wireless networks.

④ Unified messaging: It integrates messaging, mail and fax services together.

⑤ File tracking module: It acts as a software system to provide file tracking tokens and logins

⑥ Intranet - It acts as an internal communication network of any organization. It acts as a wide Area Network which can have search engines, profiles, blogs etc.

⑦ Video conferencing - It is a real-time audio video signal transmission tool which helps in peer to peer communication using a public network, a lease line, a wireless network or a private network.

Ex- PRAGATI - Initiated in 2015 as an internal administration tool. It is headed by the PM and uses ~~Geo~~ video conferences, digital data management and Geospatial technology in management of hurdles related to policy implementation.

→ It connects PM to Union secretaries and chief secretaries of states to discuss problems in governance and implementation.

→ It is an example of cooperative federalism.

→ Every month 4th Wednesday is celebrated as PRAGATI day in internal administration.

→ Issues to be discussed on PRAGATI day are flagged on every 3rd Wednesday and are to be answered in 2 working days after the PRAGATI day.

→ Role of ICT in planning and Management

→ ICT in planning and management can utilize following tools

① Transaction Processing systems - It helps to create indivisable units of work, hence it is used to divide and distribute works to lower level employees, clerks etc. It is a hardware and a software combination. which is used in batch processing or real time.

② Management Information System - It is useful for control analysis and visualisation of information required for coordination, management and planning. It is utilized by middle level officers or managers in an organization. Types of MIS are:
(a) Human Resource MIS - For jobs and employment management
(b) Accounting MIS - For bills and wages
(c) Decision support systems - For planning and making decisions by senior managers.
(d) Executive Information system (EIS) - Helps in decision making of executives and highest officials.

→ Advantages of MIS
① Paperless administration
② Increased productivity and efficiency
③ Integration of distributed systems.
④ Centralization
⑤ Electronic records and feed backs.

→ GIS | Geographic Information System
-> It helps to provide geo spatial information about any area which can be utilized, edited, mobilized and used in planning and management
→ GIS act as a large scale imaging tool which consists of 3 components

① Imaging component which help in local, regional and satellite imaging.
② Software component helps in integration of images collaterally.
③ Observation stations - These are ground based stations which help to validate geospatial information.

Uses of GIS

(a) Provides geospatial data for internal administration and planning.
(b) Used in remote sensing search and rescue.
(c) It is used in agricultural irrigation planning.
(d) It is used in validation of land and revenue records.
(e) It is useful in natural resource management.
(f) Useful in wildlife and forest management.
(g) Quantification of MNREGA works and it's wage distribution.

Q Which of the above are applications of ICT in administration.
① It helps to create inter-departmental coordination, hence reduce delay due to interdepartmental barriers.
② It helps to establish centralized governance.
③ ICT in administration helps to increase public participation which also helps in new public management.
④ ICT in administration helps in improvement of delivery of citizen services and large scale analysis of citizen service requirements.

(a) only ① and ③ (b) ① ③ and ④ (c) ① ② and ④ (d) All of the above.

Q- Which of the following can be applications of ICT:

① In management of wages and payments for Dept of Personnel and Training (Accounting MIS) (GIS)

② Development of watershed management plan by central Water Commission.

③ Management of rural Infrastructural project by State PWD

④ Management of Tiger conservation by NTCA (National Tiger Conservation Authority) (Forest MIS)

(a) Only ① and ② (b) Only ② and ③ (c) ①, ② and ④ (d) All of these ✓

⇒ E-governance

→ It is development of electronic citizen service delivery where government, it's stakeholders, administration and citizens can be synchronised to singular participation ~~over~~ mediated by ICT tools.

APJ Abdul Kalam → E-governance is inter-departmental participation through computer mediated tools, telephone lines, communication medium, which helps to reduce hurdles and increase efficiency of government policy implementation.

→ Stages of e-governance

① Emerging presence - It is meant by computerization and computer data generation.

② Enhanced presence - It is meant by electronic data generation and development of web resources for citizen information and services.

③ Transactional Presence - It is development of ICT network to initiate government citizen transactions.

④ Network Presence - It is development of large scale public policies over ICT tools to generate networked benefits

⑤ Transformational Presence - It is large scale transformation mediated by ICT based service delivery. It can relate to infrastructural development, improvement in service delivery and a large scale social Transformation.

⇒ Models of e-governance

① G2C - Government to Citizen

It refers to benefits provided by governments to citizens through ICT. It involves following:

① e-registration - to register for government policy and benefits.
eg - Online examination forms etc.

② e-citizenship - to get citizenship related documents online.
eg - AADHAR, PAN Card, Voter's ID, Passports etc.

③ e-transport - to achieve transport benefits.
eg - e-tickets, online driver's license, RTO registration.

④ e-education - to provide education tools electronically.
eg - e-Basta

⑤ e-Health - for patient registries, online appointment etc.

⑥ e-Help - to provide search, rescue, preparedness etc during the state of disaster.

⑦ e-Taxation - for online income Tax submission.

② G2G - Government to Government Initiatives

① e-Administration - for improvement of Internal administration.
eg - Bhumi Project for Land Revenue in Rajasthan, e-chaupal initiatives, Lok-Mitra initiatives for grievance redressal etc.

② e-Courts - for web-based judicial documents.

③ e-Police - for online police records., inter-state police coordination, centralized Criminal Tracking and System (CCTNS)

④

③ C2G - Citizen to Government Initiatives

① e-Democracy - to participate in democratic practices

② e-Feed back - To provide public policy feed back

④ G2B - Government to Business Initiatives

① e-Taxation - for corporate tax, GST, Sales Tax

(2) - e-Tenders
(5) e-Licensing

⇒ Advantages of e-governance

(1) It makes the government a SMART government which is Simple, Moral, Accountable, Responsive and Transparent.
(2) It reduces response time and increases efficiency and grievance redressal.
(3) It reduces Red-Tappism of bureaucracy
(4) It increases citizen-centric policy making
(5) It establishes new public management
(6) It utilises participatory governance or P4 governance (People-Public-Private-Partnership).

⇒ Disadvantages of e-governance

(1) Low Emotional Quotient (EQ).
(2) Privacy and security.
(3) Over dependency may lead to chaos during failures due to glitches.

⇒ ICT in Education

It is helpful in qualitative and quantitative improvement of education.
It helps in following:

(1) Management of Education system and Syllabus.
(2) Training and skill improvement of teachers.
(3) Remote access to education.
(4) To reduce effort and cost spent in education.
(5) To reduce language barriers of education.
(6) Helps to increase learner's interaction and motivation.
(7) Helps to link academic institutes together and develop a knowledge network

⑧ It helps to reduce, physical, regional and cultural barriers to attain education.
⑨ It increases flexibility of the learner and the educator.
⑩ It can bring self paced learning tools
⑪ It helps to promote technology based learning and increases involvement of engaging tools in education.

⇒ Tools used in education

① Smart books - They are web-based repositories of books or content sources which can be distributed easily.

② Smart diaries - It is a web based resource which can help to store notes, notices and notifications required for education. It helps to connect educator, learner and parent together in education assessment.

③ Smart Boards - It is a LED or OLED monitor which can be connected to internet and used to display pictures, write, edit and provide print commands.

④ OCR (Optical Character Recognition) - It is a scanner based tool which can convert offline data or content into editable electronic data. It is used to achieve editable soft copies of books and education resources.

⑤ Speech Recognition - It is a real time transliteration and translation tool, which helps in translation of 1 language to another based on an electronic database. It has 3 components:
(a) Input audio device or mike
(b) Output audio device or speakers
(c) Universal software for translation.

Uses of speech Recognition

① Development of Indic language tools for education.
② Used in Kisan Call centres to provide technical help in local languages.
③ Used to reduce cultural and language barriers in international diplomacy
eg- SARTHAK by Ministry of Agriculture.

⑥ 3-D displays - It is a projection tool to provide depth perception in imaging. It places barriers b/w image source and observer such that light reaches to one eye of observer prior to other which formes 2-resolved images with a depth perception.

Uses of 3D displays

① In display of education models and interactive learning.
② Gaming, animation
③ Geomorphological and Geological exploration.
④ Marketing and advertisement.
⑤ Town and country planning etc.

⑦ Virtual Reality - It is an integration tool of display and observer such that light reaches from display to observer in it's complete angle of sight which creates perception of one-ness. hence, observer realises itself to be integral part of virtual surrounding.

Uses of VR

① Display of education models and increased classroom interaction
② Animation, Gaming.
③ Search and Rescue and disaster planning.
④ Urban Planning and management.

(8) Augmented Reality: It integrates VR and physical world objects together such that observer and physical objects have a closed interaction and observer finds the object to be extension of virtual surrounding.

(9) Uses of AR

① Education Models
② Planning
③ Mining
④ Animation.

Eg- SAAKAR - It is an AR tool of ISRO which is used for space ~~educa~~ exploration education to school students of class 9th to 12th.

(9) Merged Reality - It is an integration of Augmented Reality such that the physical objects can control Virtual Reality surrounding.

Uses of MR

① Animation- ~~Project Alloy~~
② Project Alloy Developed by IBM in 2016. It is an headset which can control VR functions.

⇒ ICT and Distance Education - ① Internet Forums

They are web based platforms which help to develop electronic info. to aid education. It can operate as a blog, or microblogging platform to share educational content and to discuss hurdles in education.

② MOOC (Massive Open Online Courses)

They act as an open source platform that can help to host large scale multimedia, audio and video formats related to

educational content delivery - eg - NPTEL (National Programe on Technology Enabled Learning).

I) NPTEL - It is an initiative of MHRD. It was started in 2003 by IISc Bangalore and 7 major IITs. It is divided into 2 phases:

(a) Phase I (2003-2008) where it hosted 235 courses of engineering discipline through audio-video lectures.

(b) Phase II (2008-2014) where it hosted 600 courses of engineering and fundamental science disciplines

II) Swayam - MOOC - It is an initiative of MHRD. It is developed for providing school education to remote inaccessible students and elderlies. Initially it provided education from class 9th to Post graduation through video lectures, self assessment tools and online content

→ It is also supported by AICTE (All India Council for Technical Education)

③ VSAT (very Small Aperture Technology / terminals)

→ It is a peer to peer communication tool which is developed through a small satellite operatable at a narrow radio bandwidth)

→ It helps to communicate b/w classroom relay centres and remote reception centres.

→ It helps in distance education and providing quality teaching to remote inaccessible ares.

⇒ Other tools in Distance Education.

① Data Storage tools like CD, DVD, BluRay and Holostore

② Cloud Computing

③ Public and Private Networks.

④ USB and other solid state storage devices.
⑤ Video conferencing.

⇒ Learning Management System (LMS)

① It is a tool which helps to develop Management Information Systems (MIS) and other integrated systems for improvement of education, administration, quality and delivery.

② It is useful in:
(a) Improvement in administration
(b) Develop learning, research and development programs
(c) Organise training programs.
(d) Documentation, tracking and reporting errors during education delivery and reception.
(e) Development and management of curriculum and syllabus.
(f) Online delivery of education and its processes.

③ eg- School Management Systems, College Management Systems, University Integration Systems etc.

⇒ Knowledge Networks

→ They help to create inter-communicated channels or open source platforms to share educational content and information.
→ It helps in improving content distribution and Intellectual Property Right (IPR) Reservation of important researches
eg-

① National Knowledge Network (NKN)

→ It is a multi-Gigabit interconnectivity program of the important educational research Institutions of India
→ The core network operates at 10 Gb/s connectivity and provides services at 1 Gb/s connectivity on end nodes.
→ It helps to share important educational content and research

AIR-1 Notes

Pages: 72

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AIR-1 ESE 2021

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Engineering Ethics

1) Basic concepts – Morals, Ethics, Values and Attitudes (MEVA)
2) Theory of ethics
3) Code of conduct and code of ethics
4) IPR and Plagiarism
5) Ethical dilemma and ethical issues
6) Corruption and whistleblower
7) Miscellaneous Topics
   (a) Environmental Topics
   (b) Business Ethics
   (c) Media Ethics etc.
8) Principles and Values that guide Engineering Ethics.

Relationship b/w

1) Science
2) Ethics
3) Engineering
4) Technology

→ Science is a body of systematized knowledge gathered by observing and measuring events.

→ Outstanding features of science:

1) Observation – Studies events of interest with as much precision and accuracy as possible.
   → Science permits controlled observation i.e experimentation to arrive at definite cause-effect relationship
2) Measurement – assignment of numbers to objects and events according to some rule.

→ To achieve definite cause-effect relationship:

1) Replication
2) Verification
3) Skepticism

} ensures Objectivity

→ Subjectivity leads to suspective cause-effect relationship or speculative

⇒ Engineering is transforming science to create products for human comfort and to create systems that maximize human efficiency and minimize human labour
→ application of science for practical purpose

⇒ Engineering is about process and Technology is about product otherwise there is not much difference b/w the two

⇒ Ethics is a (normative science) that enables the individual to distinguish b/w right and wrong and follow the path of righteousness.

Science

Positive
"what is"
"facts as they are"
↓
Physics, Chemistry, Biology

Normative
"what ought to be"
↓
speculative cause-effect relationship

⇒ Why should an engineer study ethics ?

1) Public Service ⇒ Public Welfare ⇒ Ethics

2) Ethical dilemma } => eg → Employer Loyalty V/s Public Loyalty.

↳ how to resolve.

⇒ MEVA → Morals, Ethics, Values and Attitudes

→ MEVA are mental constructs that serve as an instrument for behaviour regulation

↳ a human without ethics is like a beast loosed on the world (Camus)

⇒ Behaviour regulators → Thoughts
→ Emotions

⇒ How MEVA serves as an instrument for behaviours regulation

1) when our behaviour voilates our morals we experience "GUILT" (Emotion)

something which I dislike Guilt is an aversive state that an individual experiences when there occurs moral transgression (~~उल्लंघन~~)

2) When our behaviour violates our ethics we experience threat of social ostracization. (outcasted from society)

"SHAME"

⇒ Morals are far stronger and powerful behavior regulator as compared to ethics.

⇒ External forces v/s Internal forces.

Hedonism – physical pleasure
Altruism – selfless service to society.

Set of standards

Society places on itself (Ethics)

An individual places on himself (Morals)

to guide its/their choices, behaviour and actions.

MORALS	ETHICS
1) Morals are internal	1) Ethics are external
2) Personal	2) Societal
3) "GUILT"	3) "SHAME"

both provide motivation for action.

self discipline

self control.

e.g. Honesty

"abstract" ideals

3) when our behaviour violates our values we experience "CONFLICT"

within the individual → Hedonism V/S Altruism

b/w individual and society

between ~~different~~ individuals or society

4) when our behaviour violates our attitude we experience "DISSONANCE"

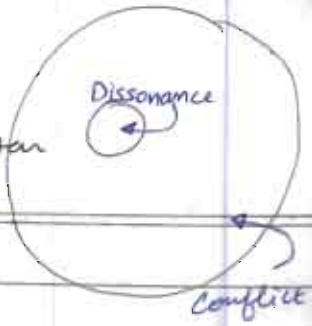
2 or more attitudes

attitude of behaviour

~~Before~~

Because I value (abstract) music

↳ therefore I have a positive attitude towards guitar (concrete)



Marshmallow experiment ⇒ Emotional Intelligence.

↳ Life is all about how to delay gratifications.

↳ succumb to temptations.

⇒ DISSONANCE → is a (negative drive) (something which we want to avoid.) state that an individual experiences when there occurs incompatibility b/w his attitudes or b/w his attitude and behaviour or discrepancy b/w his attitude and behaviours. (discrepant v/s congruent).

⇒ Why does MEVA often fails to act as a self regulatory mechanism

1) Selective perception and interpretation of ~~this~~ ones actions.
2) Justification of ones actions.

→ MORAL DISENGAGEMENT

→ Selective ~~deac~~ activation and deactivation of morals and values.

→ Selective perception of information and facts.

⇒ Why do we need laws when MEVA is in place

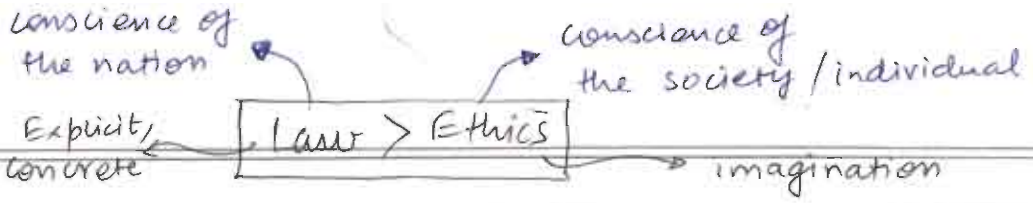
Behavior regulations can operate at 3 levels

- Individual (Moral) — fails due to moral disengagement
- Society (Ethics) — fails due to lack of evidence
- Institution (Law)
  - 1) Formal
  - 2) Explicit
  - 3) Works on Evidence.

} more or less informal

→ What is lawful may not be ethical.

→ What is ethical may be unlawful / illegal.



→ Mind is abstract, brain is concrete.

⇒ Moral arch of the universe bends at the elbow of justice

⇒ How to ensure that MEVA becomes an effective tool for behavior regulation

1. Reward pro-social behavior.
2. Punish anti-social behavior.
3. These rewards and punishment should be fair, systematic and consistent.
4. Seeing the role model being rewarded / punished can also change behavior.
5. Increasing the perceived probability that on the display of undesired behavior one will be ~~caught~~ caught, punished when caught and punishment will be severe and no one will buy one's justification.

Structure of MEVA – Building Blocks

(a) Cognitive (mind) → may or may not be factually correct.
["knowing"] → beliefs, opinions and ideas held by the individual towards the MEVA object. (abstract)
(Morals, Ethics, Values are all abstract) [Attitude is an exception]

(b) Affective → emotions and feelings generated wrt. MEVA object
→ provides energy for action
→ makes MEVA an evaluative tool
→ Hard to master as compared to cognition.
→ one approaches MEVA object with mixed feelings (eg. Eros / Thanatos)
(heart)

EROS — Life instinct THANATOS – Death instinct

(c) Action tendency components - Our readiness to respond in specific ways to MEVA object
→ predisposition (झुकाव) to act in specific ways.
↳ does not imply an actual response.

⇒ These 3 components of MEVA are generally consistent with one another and as well as the behaviour displayed.
⇒ Our thoughts, beliefs, action tendency and ultimate action should be consistent.

Nature of MEVA

i) Culture specific and Universal

Each culture is unique.
→ Challenges faced by the people of a given culture are also unique.
→ Therefore, to meet these challenges MEVA should be culture-specific.

⇒ India ⇒ Agrarian Economy.
↓
Joint family
⇗ ⇖
Collectivism — Patriarchal values.
↳ ill effect is Nepotism.

↓
Promotes brotherhood and growth of society
~~Generosity, Voluntary Donation~~
eg - Patriotism, kindness, commitment
→ Every society aims to achieve social integration.
→ All values which promote brotherhood and bind people together will be universal.
→ Entity common to the human race is relatedness → Empathy
↳ compassion, integrity
⇒ Industrial economy
⇓
~~Nuclear family~~ ⇒ Individualism

means to destination ⇑ → MEVA are a means to an end

destination ⇑ → an end in itself

2) Instrumental v/s Intrinsic

external reason ⇑

eg- Honesty (Value) → for → Promotion (end)

eg- Honesty → for → the reason of Honesty (intrinsic reason ⇑) and for no other reason other than honesty.

↓ because honesty gives an individual satisfaction

⇒ What is intrinsic may become instrumental and something which is instrumental may become intrinsic.

⇒ Something which is instrumental remains instrumental even when it is no longer tied with the original motive.

3) Absolute v/s Relative

→ Means are independent of ends and ends cannot justify means.

→ A right is a right even when no body does it, a wrong is a wrong even when everyone does it.

→ Context independent.

→ Deontological approach ⇓ Duty bound

→ ends justify the means or all that ends well is well.

→ i.e. consequences determine the morality of an action.

→ focus should be on greatest good of the greatest number. ⇓ Extreme state → Majoritarianism

→ context dependent

→ Teleological approach ⇓ end bound.

Relativism → Teleological → Consequentialism

→ Utilitarianism ↳ Everything should be just in value of utility it holds.

MEVA is neither dynamic nor static, it is relatively permanent
↳ difficult to change MEVA once established.

(4) Dynamic v/s Static

Dynamic ⇓ Rapid change

Static ⇓ Immutable

Argument → Values help us to adjust in our environment and environment is ~~not~~ dynamic, so should values not be dynamic.

→ Statement (1) → With changing environment, what changes is behaviour and not the underlying MEVA.

→ i.e. the modes of expression of values change and not the value themselves.

→ Different behavioral modes of expression ensure uniqueness of an individual.

→ Statement (2) : MEVA provides the basis for our identity.

→ Identity gets formed after the investment of considerable time, labour and energy.

→ Because of this person is likely to resist any change in his identity ⇒ Relatively permanent nature of MEVA.

→ Statement (3) : Our identity provides us with a framework to deal with the objects around us.

→ The frame of reference given to us by our identity is likely to change when individual undergoes identity transformation.

→ Thus it puts the individual in emotional turmoil and no individual wants that ⇒ Relative permanency.

Hedonism —Emotional Turmoil→ Altruism

(5) Some Innate v/s Largely Acquired

Inborn

→ some emotional predispositions and behavioral orientations may be pre-acquired

As a result of Socialization

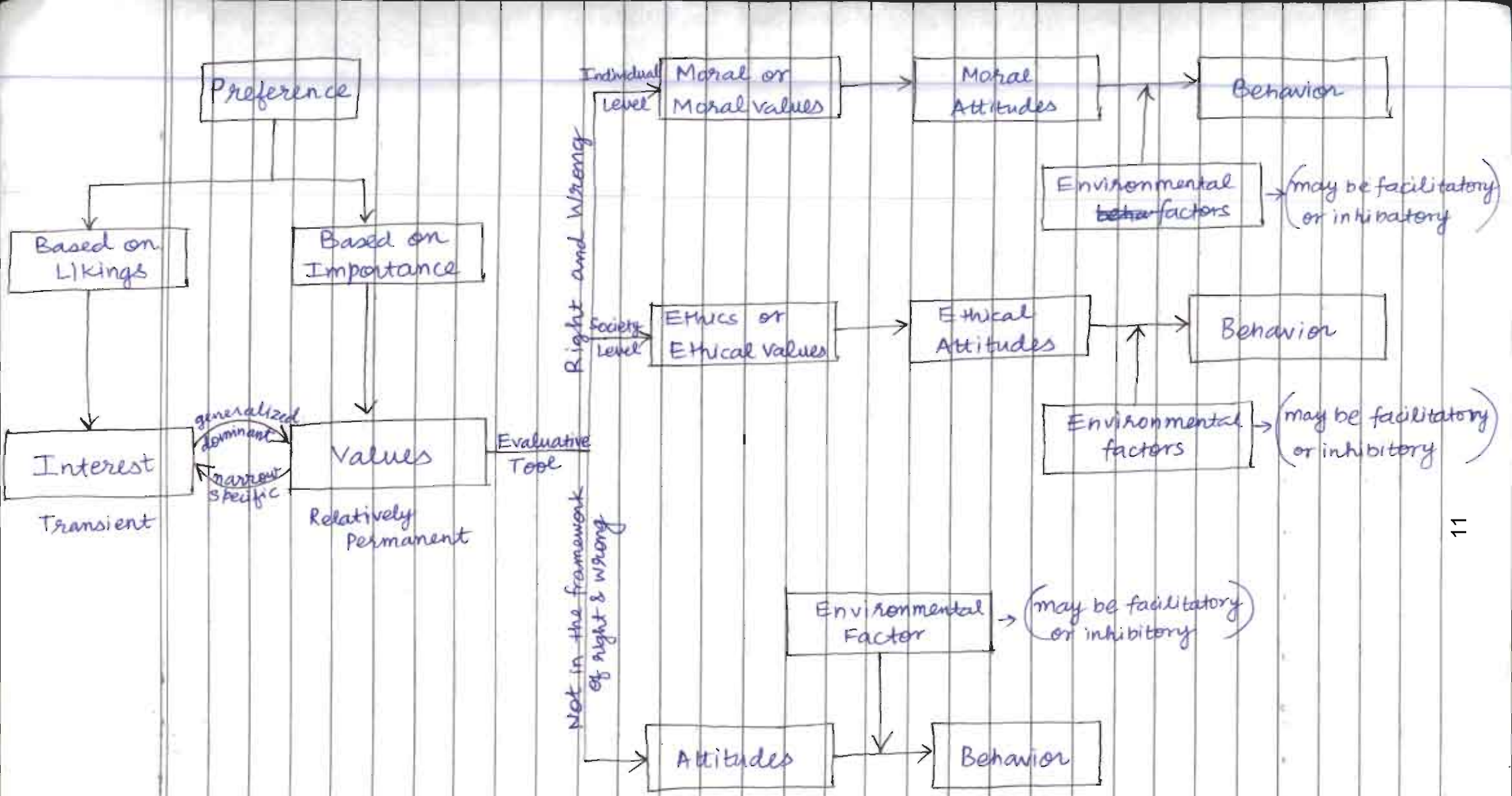
but MEVA is principally acquired

⇒ Inference from flowchart

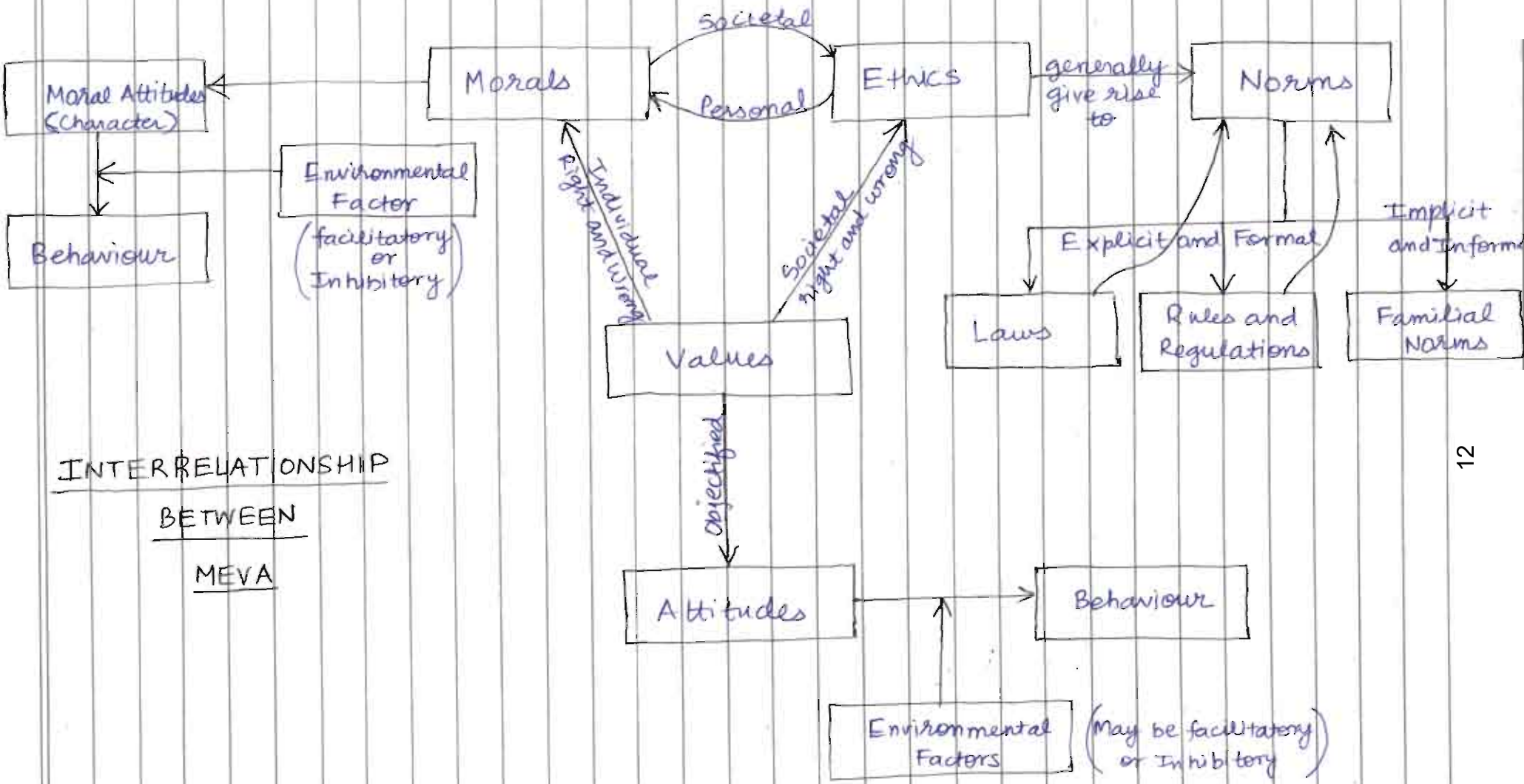
1) Values are general determinants of behavior and attitudes are specific ~~behavior~~ determinants of behavior.
i.e. attitude predicts behavior better than values.

2) Every attitude may convert into behavior provided environmental factors are facilitatory. If the environment is inhibitory generally a positive attitude may not result into behavioral action. [It is possible that moral/ethical attitude prevail over environment]

3) Everything is not black and white (right and wrong) there exist shades of grey. eg - Aesthetic attitude is neither moral nor ethical.



RELATIONSHIP BETWEEN MORALS, ETHICS, ATTITUDES AND BEHAVIOR



INTERRELATIONSHIP BETWEEN MEVA

Inference from flowchart

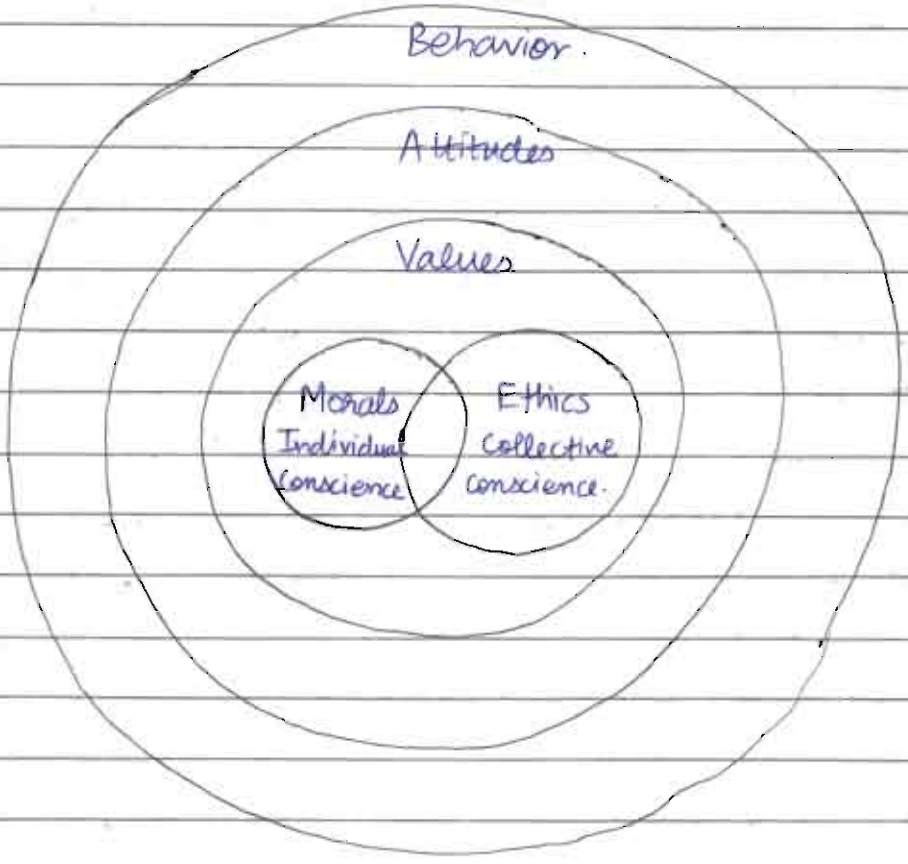
1) When a single man leads to a social change → bottom up.
When government " " " " → top down.

2) Ethics may change into morals and morals may change into ethics.

3) Cost-Benefit analysis governs who prevails over morals or ethics when they contradict each other.

4) Ethics is broad while Norm is specific.

5) Similarly laws are broad and rules and regulations are specific.



⇒ Development of MEVA

→ MEVA developed as a result of socialization.

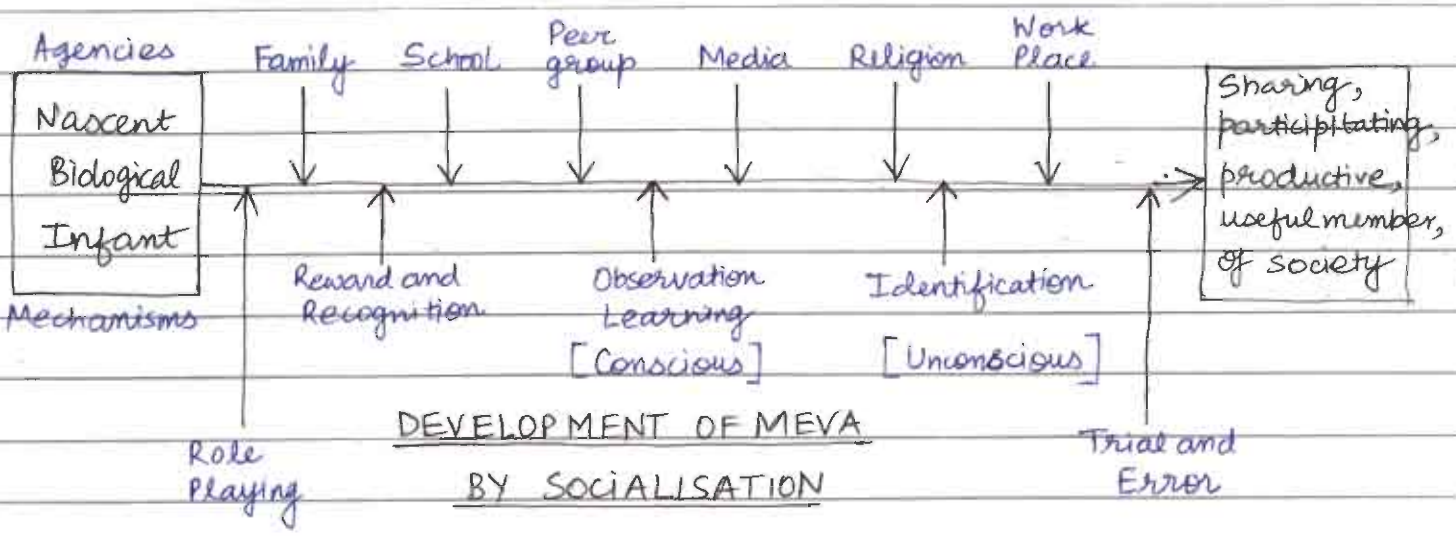
→ Socialization – It is a life long process of shaping an individuals' social tendencies so that he becomes and remains a useful and productive member of it's society.

OR

→ Socialization - is the process by which:

(a) Culture is transmitted from 1 generation to next.

(b) Individual develops his personality by learning the contents of it's culture. Personality is culture transmitted into an individual while culture is personality of individuals combined.



DEVELOPMENT OF MEVA BY SOCIALISATION

An individual guided by self preservation drive —— Conversion by Socialisation. ——→ A relatively selfless individual.