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MECHANICAL ENGINEERING

Engineering Mechanics

By-Ravendar SIR

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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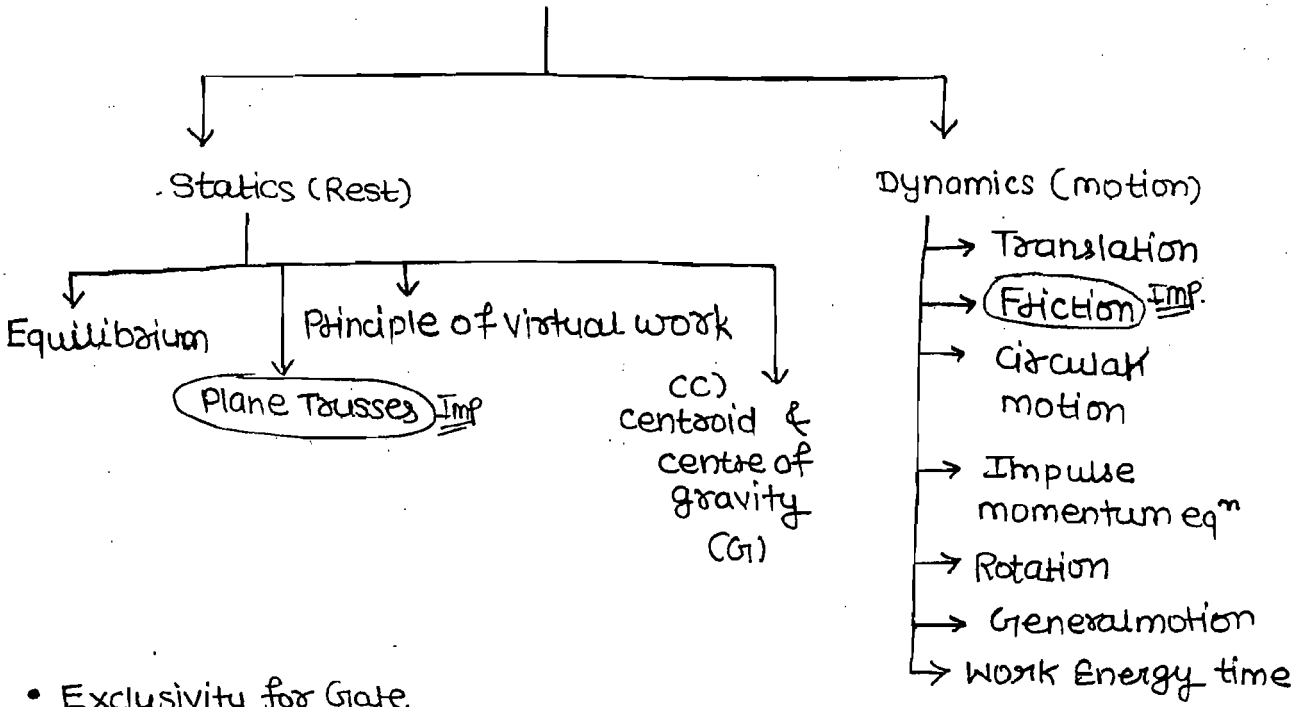
Engg. Mechanics

"Study of motion of rigid bodies under the action of external forces."



- Exclusivity for Gate
  - friction & its application
  - → Rolling friction
  - → wedge
  - → Screw Jack
  - → Application in vehicles
  - → Belt friction
  - * Langage's Equation

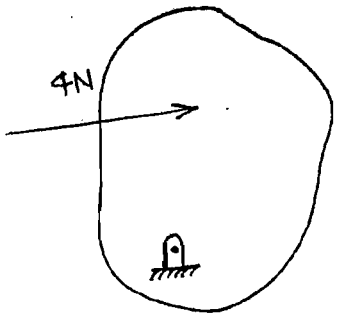
• **Actual Force :→**

If a force has been Acted on the body then it must have been applied by some other Body

• **Pseudo Force :→**

If a force is acted upon a body but has Not been applied by any other body.

To define a force →
- Magnitude (Intensity)
- direction (orientation)
- Point of application



• **Types of Forces**

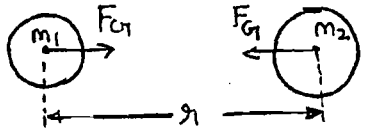
1. Gravity (W)

2. Contact Force (R) →
   - Normal Reaction (N)
   - friction (f)

3. Tension (T)

4. Spring Force (F_s)

• Gravity →



$$F_{G1} = \frac{G m_1 m_2}{r^2} \quad \star$$

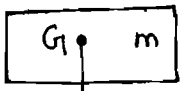
$G = 6.67 \times 10^{-11}$

$$g = \frac{G M_e}{R_e^2} \quad \star$$

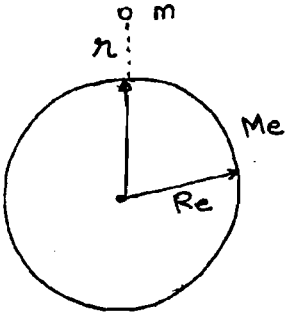
M_e = Mass of Earth

R_e = Radius of Earth

$$W = mg \quad \text{(Pulling)} \quad \star$$



mg ⇒ on mass m by Earth



$F_{G1} = \frac{G M_e m}{R_e^2}$

$F_{G1} = mg$

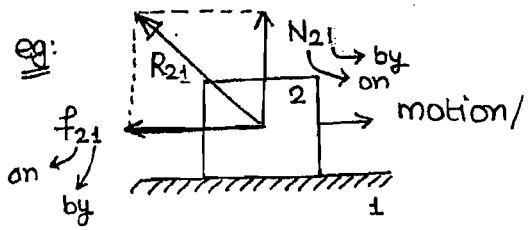
$(R_e + r \simeq R_e)$

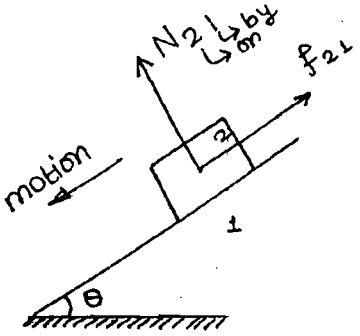
• contact Force →

→ Normal Reaction (Pushing)

→ Friction

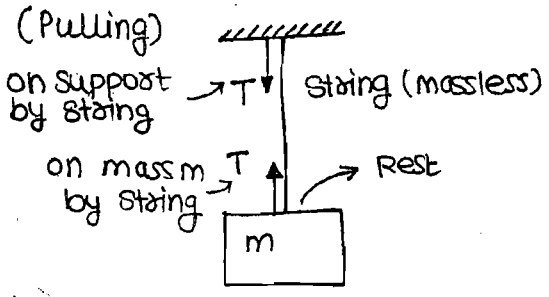
eg:



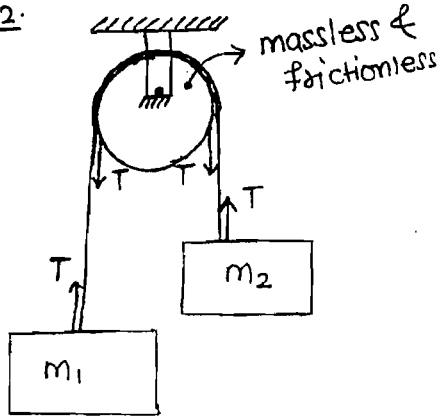


• Tension →

ex→1. (Pulling)



ex→2.



• Spring Force (F_S) ⇒

(Can be Pulling or Pushing)

$F_S = K(\Delta x)$ → elongation or Compression from Natural Length

↓ Spring Constant

- **Newton's First Law (NFL):→**

For a Particle → at the same Instant

if $\Sigma \vec{F} = 0$ then $\vec{a} = 0$

$\vec{a} = 0$

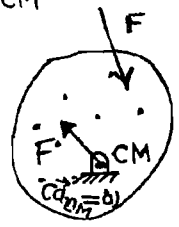
- Rest
- Uniform Linear Velocity

For a Rigid body

If $\Sigma \vec{F}_{ext} = 0$

then $\vec{a}_{CM} = 0$

Particle

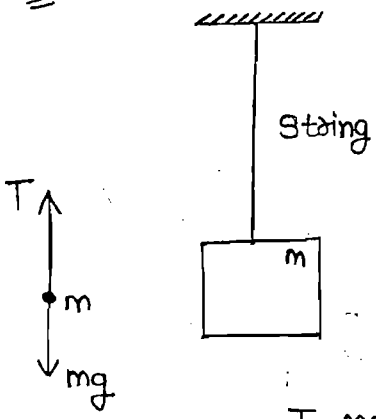


Rigid Body

$\vec{a}_{CM} = 0$

- Rest
- $\vec{V}_{cm}$ = Const.
- A Body is rotating about it's CM.

Eg:-1



(m) → Rest ⇒ $\vec{a}_{CM} = 0$

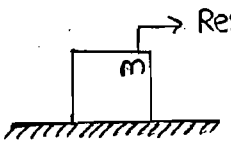
$\Sigma \vec{F}_{ext} = 0$

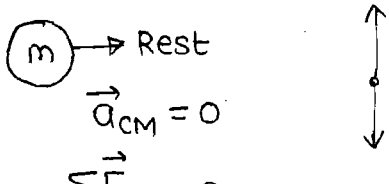
↳ Newton's 1st Law

$T - mg = 0$ [Newton's First Law]

$\boxed{T = mg}$ [NFL]

Eg:2





$\vec{a}_{CM} = 0$

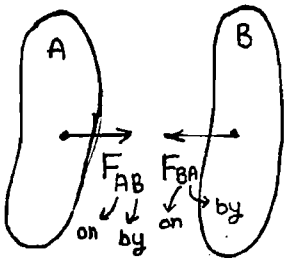
$\Sigma \vec{F}_{ext} = 0$

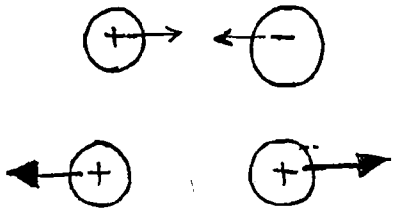
↳(NFL)

$N - mg = 0$

$\boxed{N = mg}$ [NFL]

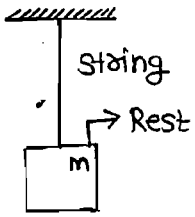
• Newton's Third Law (NTL) →

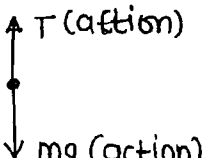




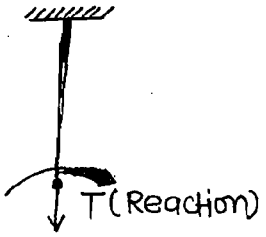
$$\vec{F}_{AB} = -\vec{F}_{BA}$$

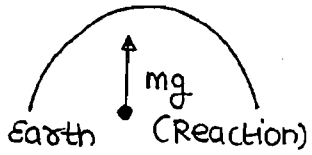
Ex: 1



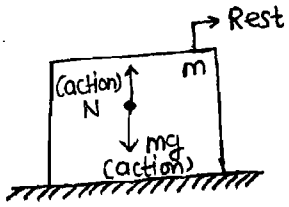


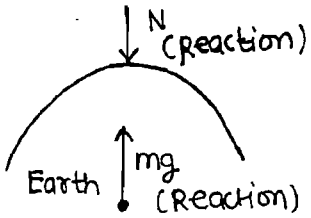
$$\downarrow g = \frac{GM_e}{R_e^2}$$





Ex: 2





Reading of weighting

"If a Body A exerts ~~one~~ Force on Body B. then certainly Body B will exert Force on Body A, they will equal in magnitude and opposite in direction, colinear in action and Same in Nature."

Imp
• F.B.D. ⇒ It is Representation of all the forces acting on the system by the surrounding

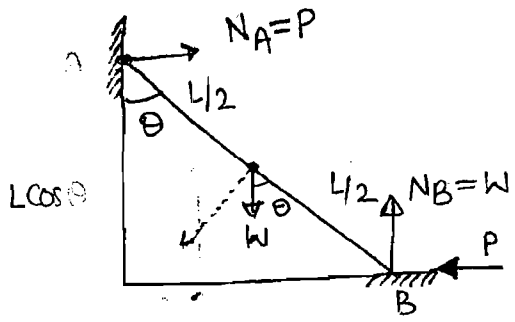
NOTE: → In FBD Surroundi. should not be shown.

- **Equilibrium** → Rest
  → uniform Linear velocity

(I) $\Sigma \vec{F} = 0$ $[\Sigma F_x = \Sigma F_y = \Sigma F_z = 0]$

(II) $\Sigma \vec{\tau} = 0$
(about any Point 'or' Line)

Que :



A uniform Ladder AB of Length L and weight W is held in equilibrium by Horizontal force P at B as shown in figure: Assume all the surfaces to be Smooth

find P

~~W X L = P tan~~

$\Sigma M_B = 0$

$W \sin\theta \times \frac{L}{2} = P L \cos\theta$

$$\boxed{P = \frac{W}{2}\tan\theta}$$

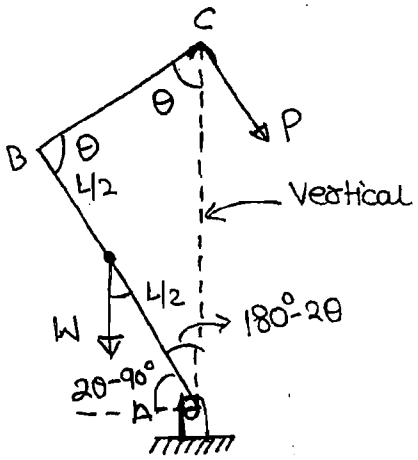
Que A uniform Rod of weight W and Length L is movable in vertical Plane about hinge at A but it is held in equilibrium by a ~~string~~ force P which is attached to a string BC Passing over a Smooth Peg C. If AB = AC then the force P is

(a) $W \cos\theta$

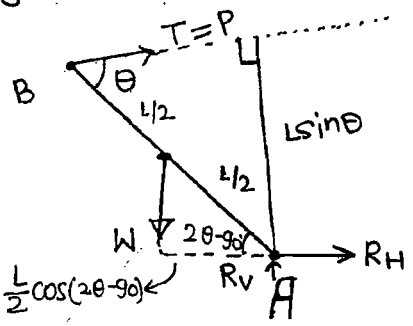
(b) $\frac{W}{\cos\theta}$

(c) $W \tan\theta$

(d) $W \sin\theta$



Considering equilibrium of Rod 'AB'



$\Sigma \vec{T}_A = 0$

$W \times \frac{L}{2}\cos(2\theta - 90) = P L \sin\theta$

$W = 2W \sin\theta\cos\theta = P\sin\theta$

$\boxed{P = W\cos\theta}$

- **Moment of a force 'or' Torque :→**

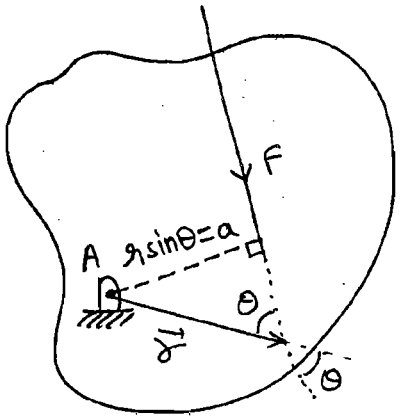
$(\vec{M}$ 'or' $\vec{T})$

$\vec{T}_A = \vec{r} \times \vec{F}$

$|\vec{T}_A| = rF\sin\theta$

$\boxed{|\vec{T}_A| = Fa}$

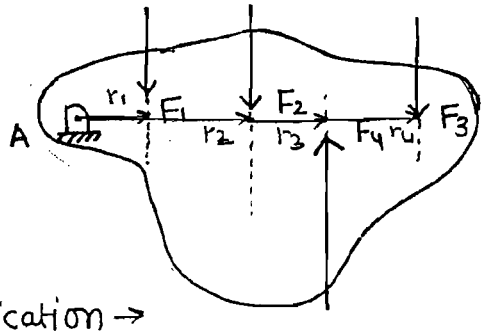
direction → $\perp_{A}^{r}$ inward through

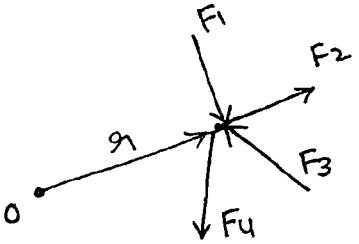


*** Imp: Property of Numericals (Vector algebra)

- **Varignon's Theorem**

For a concurrent force system Net Torque about a point will be Torque of resultant force about that point





$\Sigma \vec{T}_O = \vec{r}_1 \times \vec{F}_1 + \vec{r}_2 \times \vec{F}_2 + \vec{r}_3 \times \vec{F}_3 + \cdots$

$= \vec{r} \times \vec{F}_1 + \vec{r} \times \vec{F}_2 + \vec{r} \times \vec{F}_3 + \cdots$

$= \vec{r} \times (\vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \cdots)$

$\boxed{\Sigma \vec{T}_O = \vec{r} \times \vec{F}_R}$

Application →

For a concurrent force system

if $\Sigma \vec{F} = 0$

$\Sigma \vec{T} = 0$

↳ at any point

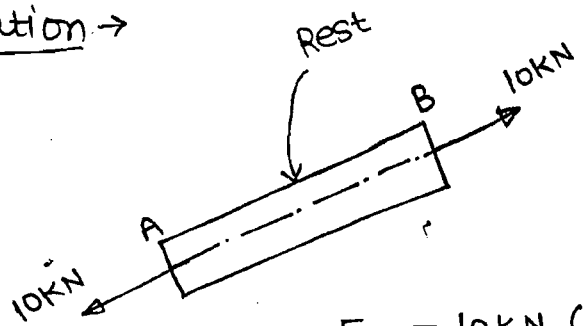
Ex. Joints in Truss

• Systems of Equilibrium: →

1. Two Force System →

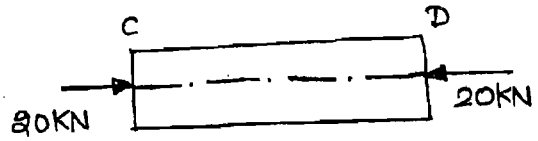
To keep a body in equilibrium under the action of two-force, they must be equal in magnitude and opposite in direction and colinear in action.

Application →



F_{AB} = 10KN (Tensile)

Intensity of Internal resisting force



F_{CD} = 20KN (Compressive)

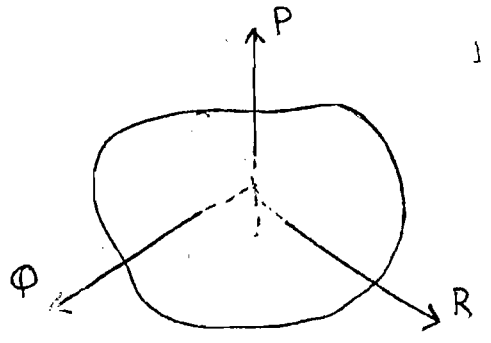
Intensity of internal resisting force in member CD

2. Three Force System →

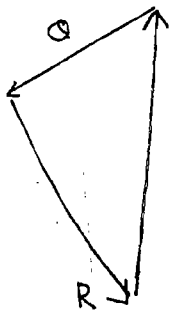
To keep a body in equilibrium under the action of 3 forces they must be coplaner and concurrent.

$\vec{P}, \vec{Q} \& \vec{R}$

(a) $\vec{P}+\vec{Q}+\vec{R}=0 \Rightarrow$ Coplaner



(b) $\Sigma\vec{T}=0$



(Force Triangle)

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FLUID MECHANICS

By: Varun Pathak Sir

Introduction

* A fluid is a substance that is having the ability to flow or deform continuosly under the action of shear force [Tangential force], No matter how much small the force is.

*→

*→ No slip condition or Maxwellian condition [Experimental]

*→ Free surface :

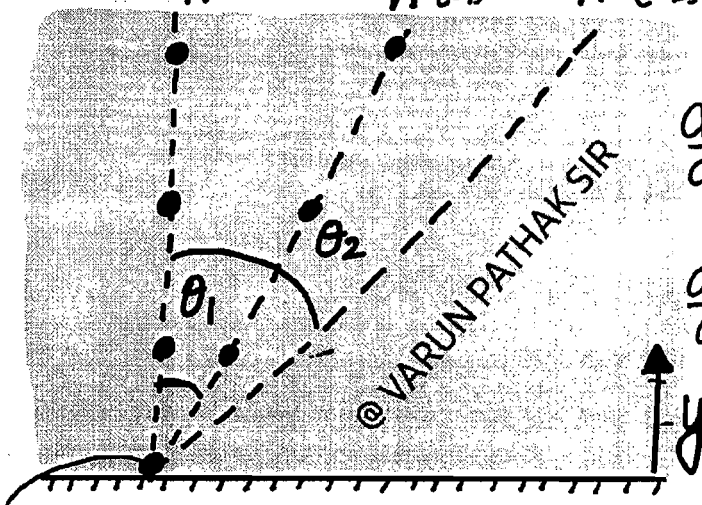
Difference between Solids & Fluids

① In case of solids the deformation is constant with respect to time whereas in case of fluids

deformation is continuos with respect to time i.e. In case of fluids Rate of Deformation $\left(\frac{d\theta}{dt}\right)$ is more important than deformation. @ VARUN PATHAK SIR

(2.) In case of solids on removal of load, solids will try to Regain their Original Shape where as fluids will never try to Regain original Shape.

Fluids



$\frac{d\theta}{dt}$ → Rate of Angular Deformation

$\frac{du}{dy}$ → Velocity Gradient

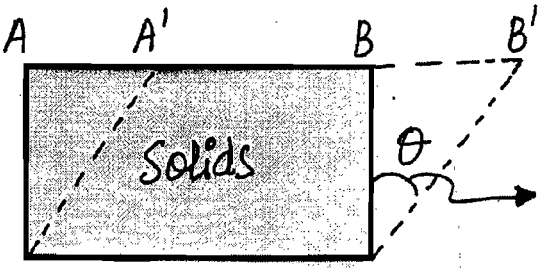
@ VARUN PATHAK SIR

No slip condition (or) Maxwellian condition

[Relative velocity between the Molecule and the Boundary is zero $V_R = 0$]

@ VARUN PATHAK SIR

Solids



Angular Deformation

Note : @ VARUN PATHAK SIR

The Intermolecular force of attraction between molecules of same nature is known as cohesion whereas intermo-lecular force of attraction between molecules of different Nature is known as adhesion.

*

Eg. Water in contact with Glass →
Mercury in contact with Glass →
Water in contact with Plastic Sheet →

Mechanics :

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- Engg. Mechanics
- SOM
- Fluid Mechanics

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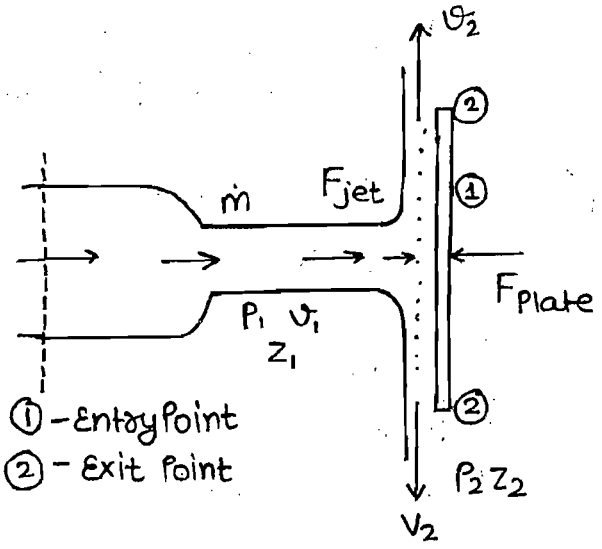
Fluid Machinery

- Impact of Jet
- Turbine
  - Impulse → Pelton Wheel
  - Reaction
    - Francis
    - Kaplan
    - Propeller
- Pump
  - Centrifugal Pump
  - Reciprocating Pump (ESE only)

Book :→ R.K. Bansal
D.S. KUMAR

Impact of Jet :→



Water → Reaction force
Plate → Initial force

Newton's II Law

F_{Plate} = Rate of change in Linear Momentum of jet

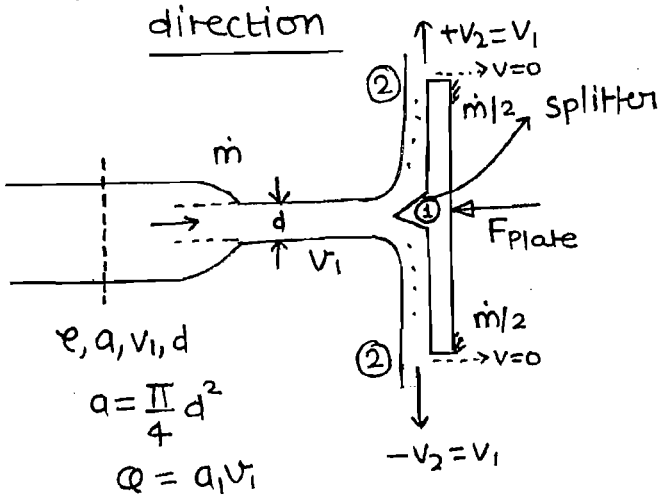
F_{Plate} = (Final - Initial) momentum of Water

$$\boxed{F_{jet} = -F_{Plate} = \dot{m}\vec{V}_1 - \dot{m}\vec{V}_2}$$

$\dot{m}$ = mass flow rate of Water which strike the Plate / body.

Case: I

Jet strikes Stationary Flat Plate in Normal direction



e, a, V_1, d

$a = \frac{\pi}{4} d^2$

$Q = a_1 v_1$

$P_1 = P_2 = P_{atm}$

$z_1 = z_2$

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2 + h_f$$

→ Smooth Plate ($V_2 = V_1$)

→ Rough Plate ($V_2 < V_1$)

$$\boxed{\dot{m} = \rho a V_1 = \rho Q}$$

$$\rightarrow F_x = F_N = \dot{m}V_1 - \left[\frac{\dot{m}}{2} \times 0 + \frac{\dot{m}}{2} \times 0\right]$$

$$\rightarrow F_x = F_N = \dot{m}V_1 = \rho a V_1^2 N$$

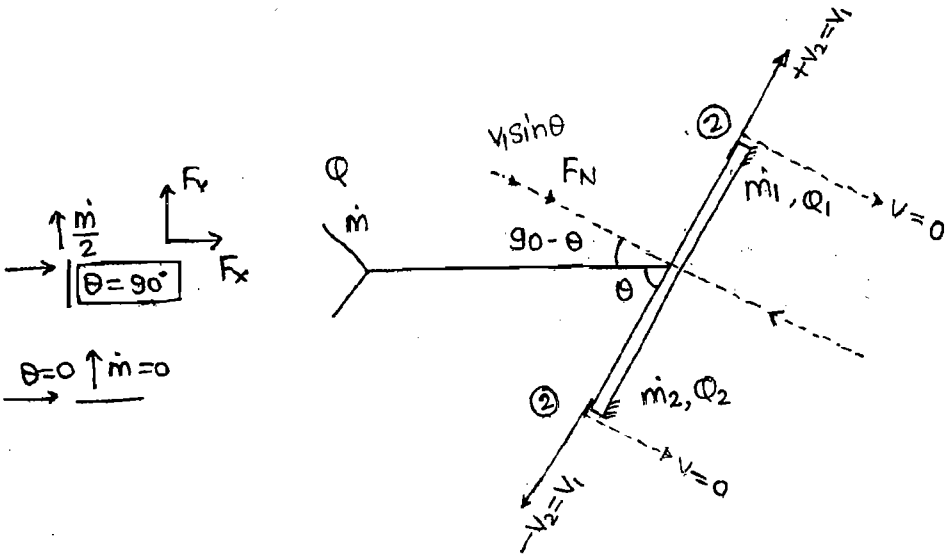
$$\rightarrow F_y = F_T = \dot{m} \times 0 - \left[\frac{\dot{m}}{2} \times V_2 + \frac{\dot{m}}{2}(-V_2)\right]$$

$$\boxed{F_y = F_T = 0}$$

NOTE→ When Jet Strikes over a Flat Plate then it Will apply the force only in Normal direction to Plate, there will not be any force in tangential direction to Plate.

Case: II

Jet Strikes Stationary Inclined Plate



$$\dot{m} = \dot{m}_1 + \dot{m}_2 \Rightarrow \boxed{Q = Q_1 + Q_2} \rightarrow (1)$$

$$\boxed{\dot{m} = \rho a V_1 = \rho Q}$$

$$F_N = \dot{m} V_1 \sin\theta - [\dot{m}_1 \times 0 + \dot{m}_2 \times 0]$$

$$F_N = \dot{m} V_1 \sin\theta = \rho a V_1^2 \sin\theta$$

$$F_X = F_N \sin\theta = \rho a V_1^2 \sin^2\theta$$

$$F_Y = F_N \cos\theta = \rho a V_1^2 \sin\theta \cdot \cos\theta$$

$\dot{m}_1, \dot{m}_2 / Q_1, Q_2 = ?$

$$\therefore \boxed{F_T = 0}$$

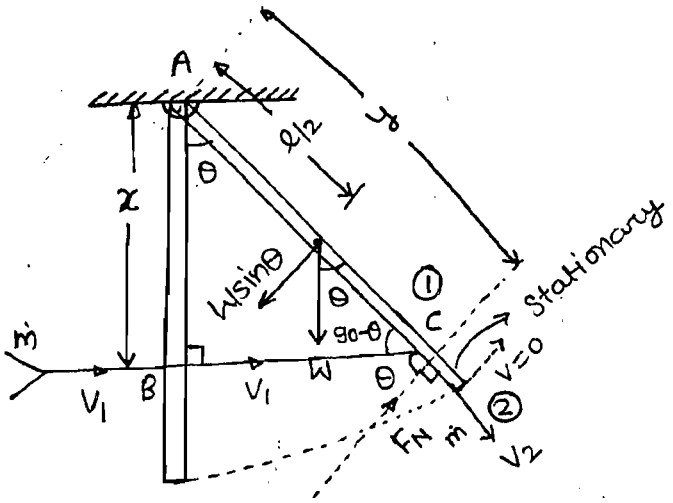
$$\rightarrow \quad \dot{m} V_1 \cos\theta - (\dot{m}_1 \times V_1 + \dot{m}_2 \times (-V_1)) = 0$$

$$Q \cos\theta - Q_1 + Q_2 = 0 \rightarrow (11)$$

$$Q = Q_1 + Q_2 \longrightarrow (1)$$

Case-III

Jet Strikes Vertical Hanging Plate



l = length of Plate

W = Weight of Plate = Mg

$\rightarrow \Sigma M_A = 0$

$\rightarrow F_y \cdot y = W \sin\theta \cdot \frac{l}{2}$

$\rightarrow \dot{m} = \rho a v_1$

$\rightarrow F_N = \dot{m} v_1 \cos\theta - \dot{m} \times 0$

$$\boxed{F_N = \rho a v_1^2 \cos\theta} \quad \text{(Newton)}$$

ΔABC

$$\cos\theta = \frac{x}{y} \Rightarrow y = \frac{x}{\cos\theta}$$

$$\rho a v_1^2 \cos\theta \cdot \frac{x}{\cos\theta} = W \sin\theta \cdot \frac{l}{2}$$

$$\boxed{\sin\theta = \frac{2\rho a v_1^2}{Wl} \cdot x}$$

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Heat And Mass Transfer

By-Kakkar SIR

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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Heat Transfer

- Introduction to Heat Transfer
- Thermal conduction
  - → Basic of Thermal Conduction
  - → Steady state 1-D Thermal Conduction
    - ↳ Without heat Generation
    - ↳ With heat Generation
  - → Conduction through Extended Surfaces (Fins)
  - ↳ Unsteady-state Heat Conduction
- Thermal Radiation
  - → Basics of Radiation
  - → Solid angle Concept
  - → Shape factor Concept
  - → Radiative heat transfer
- Heat Exchanger (DEVICE) Application
- Thermal Convection
  - → forced Convection (External flow)
  - → forced Convection (Internal flow)
  - ↳ free (Natural Convection)

External flow

GATE:→ min 5 to 6 marks

ESE:→ Prelims : (15-20) Questions of HT

150 Questions

mains :- (60-70) marks out of 300

Text Books

1. R. C. Sachdeva
2. P. K. Nag

Ref. Book

1-Incropera & Dewitt } for Ref. only
2. Cengel

worksheet → Telegram (AMIT KAKKAR SPEAKS) (Sir)
↓
workbook
↓
GATE (PYQ)
↓
ESE
↓
Any Text Book

Thermodynamics:→

This course is dealing with thermodynamic system b/w two equilibrium states i.e. we are able to calculate the Energy transfer in forms of Heat or work during the Process (change in equilibrium state)

But thermodynamics unable to tell about time consumed during the Process this is because thermodynamics is not dealing with mechanism of heat transfer.

Where mechanism of Heat transfer is clear then we can also calculate the time involved during the Process therefore "when the time associated in Study of Energy transfer then we study Heat transfer course."

As well as this course helps in designing of different equipments like Refrigerator, air conditioner or any Heat Exchanger like boiler, condensor, Radiator, evaporator, Economisor to achieve a desire heat transfer rate under given temp. diffrent

• Introduction to heat transfer.

• Basic Cause of heat transfer :→

Basic cause of heat transfer existance of temperature different.

whenever the difference of temp. exist within the medium or between media, heat transfer takes place. It always takes place from High temp. to Low temperature

• Different mechanisms of heat transfer :→

Heat transfer takes place by three different mechanisms

(I) Thermal Conduction

(II) Thermal Convection

(III) Thermal Radiation

• Symbols in heat transfer →

Q = Heat transfer ⇒ Unit = J

q = Rate of Heat transfer ⇒ unit = J/sec (W)

q'' = Rate of Heat flux ⇒ unit = W/m^2

q → Total heat transfer Per sec

q'' → Local Heat transfer Per sec
(Rate of Heat transfer Per unit Area)

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I.C Engine

BY- Amrinder Sir

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- Derivation
- Example
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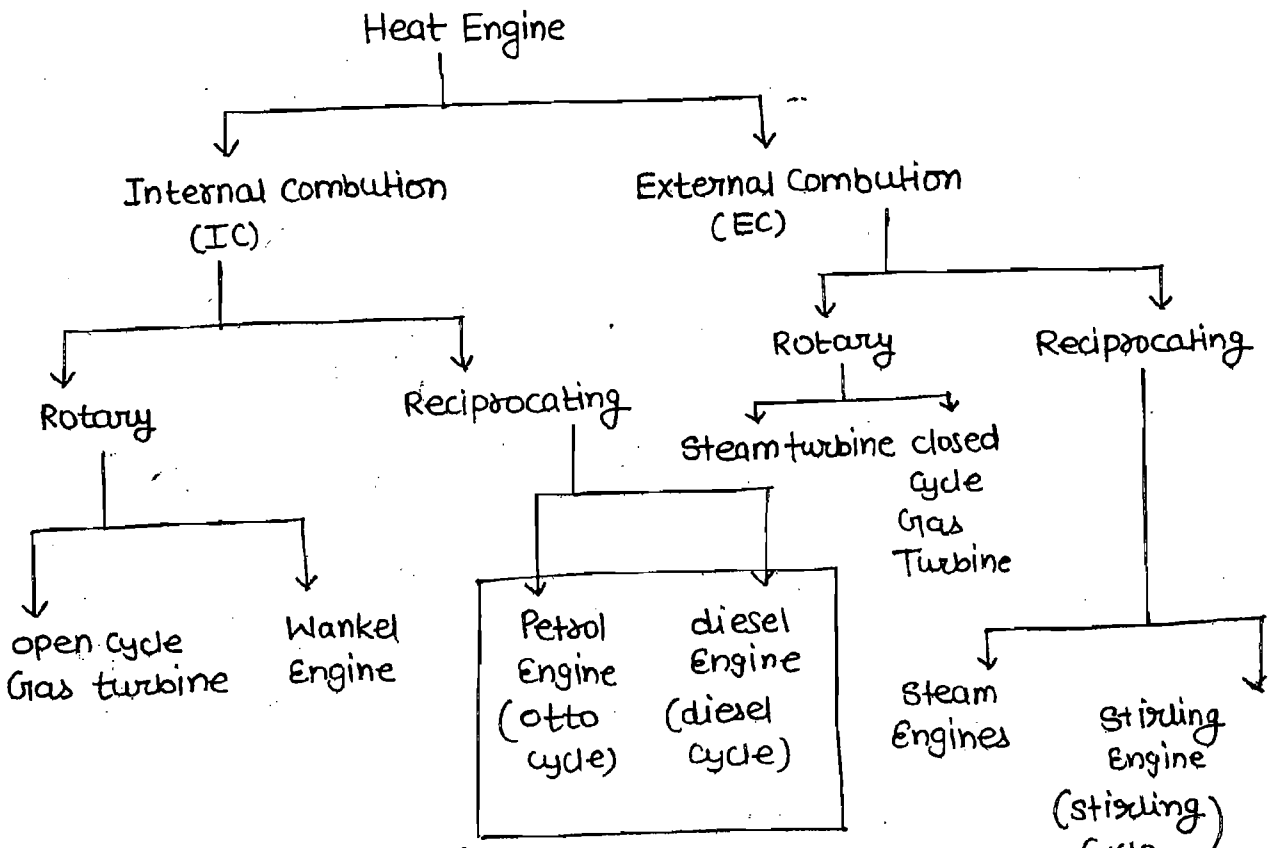
IC ENGINE

Books :

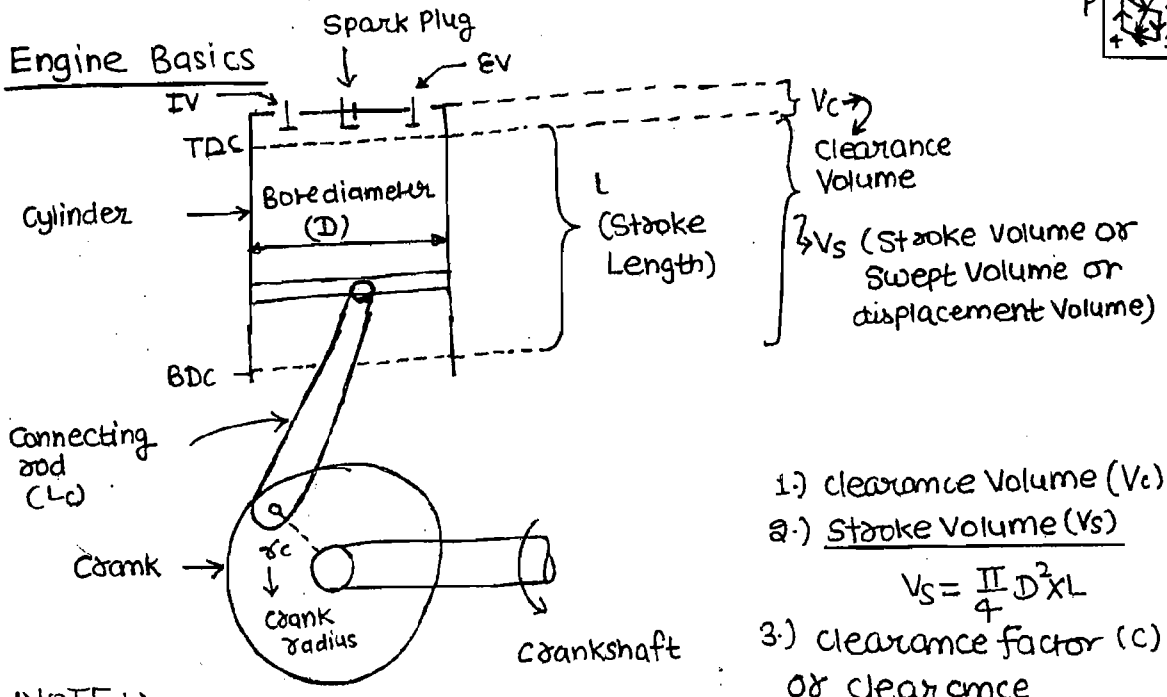
- V. Ganeshan
- Mathur and Sharma

(I) Engine Basics
(II) Air Standard Cycles → Otto, Diesel, Dual
(III) Thermochemistry
(IV) Performance Parameters
(V) Engine tests

Various types of Engines:→



• Engine Basics



NOTE:→

IV : Inlet Valve
EV : Exhaust Valve
TDC : Top dead centre
BDC : Bottom dead centre

1.) clearance Volume (V_c)

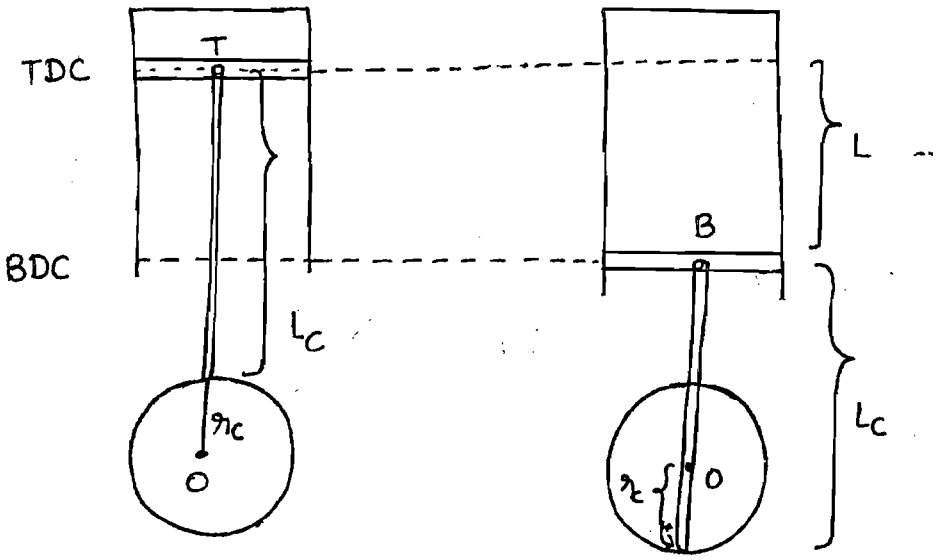
2.) Stroke Volume (V_s)

$$V_s = \frac{\pi}{4} D^2 L$$

3.) clearance factor (C)
or clearance ratio
or clearance Volume ratio ★

$$C = \frac{V_c}{V_s}$$

4.) $L = 2r_c$



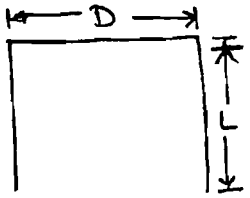
$$L = OT - OB$$
$$= (L_c + r_c) - (L_c - r_c)$$
$$\boxed{L = 2r_c}$$

(5) Average Piston Velocity ($\bar{V}_p$)

$$\bar{V}_p = 2L \times \frac{N}{60} \frac{\text{rev}}{\text{sec}} = \frac{2LXN}{60}$$

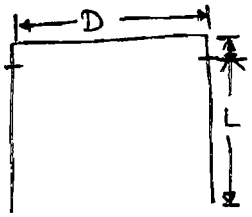
($N \rightarrow$ rpm; $2L \rightarrow$ dis/rev.)

(6)



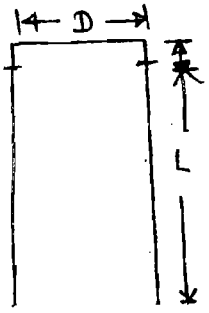
oversquare or Short stoke

$\frac{D}{L} > 1$



Square engine

$\frac{D}{L} = 1$



Under or Long square Stroke

$\frac{D}{L} < 1$

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INDUSTRIAL ENGINEERING

→ SAURABH PANDY SIR

Saurabh Pandy Sir
9891395224
(whatsapp)

Pandesaurabh22@gmail.com
(Saurabh.Pande.35)

• Saurabh Pande Sir

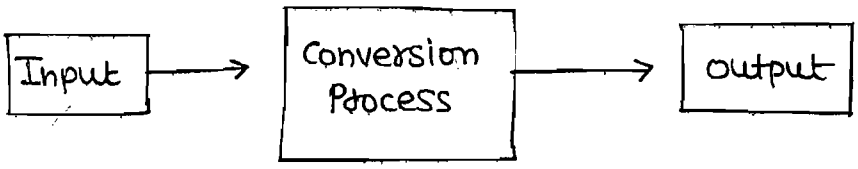
- Introduction & BEA
- Inventory **
- Sequencing
- PERT- CPM **
- Forecasting **
- Line Balancing
- Queuing
- Linear Programming (Graphical, simplex, Transportation, Assignment) *
- MRP & JIT
- PPC & Plant Layout
- Lean Manufacturing

GIATE → 6marks
(4 to 8 marks)

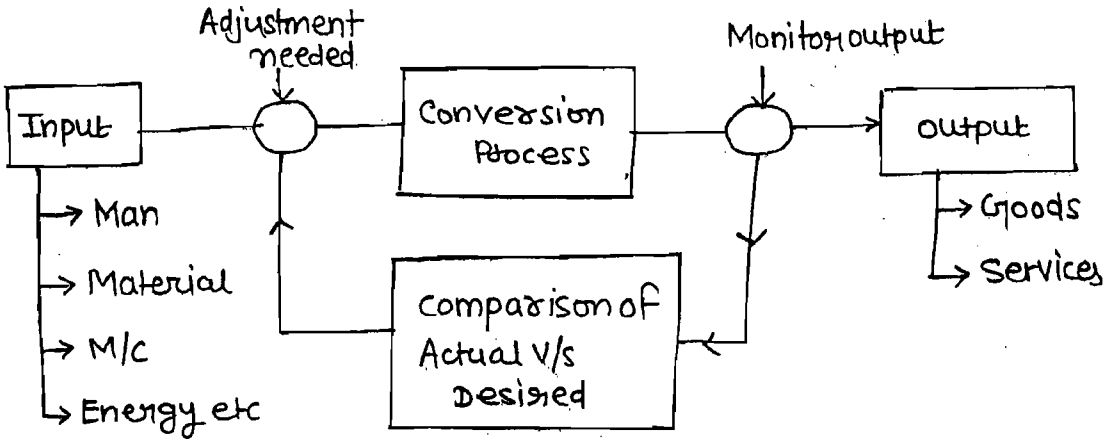
ESE → Prelims (8 to 12 questions)
Mains → 60 marks

Books:
- Hira & Gupta / Kanti Swarup / ND Vohra → For OR
- O.P. Khanna / Mahajan / Ravi Shankar → IE

Production:→ It is a step by step value addition process of converting one form of material into another form to increase a utility of the product for the user



Production System:→ It is an organised and effective process of converting Raw Material into final product with a feedback loop



Productivity:→

$$\text{Productivity} = \frac{\text{output}}{\text{Input}}$$

It is a quantative ratio blw what we produce and what we use as resources to produce them. Every organization always want to increase productivity by applying New technique and method.

Industrial Engineer:→

Industrial Engineer will concerned with design, Installation and improvement of production system, his objective is to elimate unproductive operations from the production system in order to increase productivity.

Production Manager:→ Production manager is concerned planning, controlling and directing the day to day working of production system. his objective is to produce goods & services of sigh quality and quantity at predetermined time and cost.

- **Cost in Production:→**

1. Prime or direct Cost = Direct Material + Direct Labour + Direct Expenses

2. Factory overhead = Indirect Material + Indirect Labour + Indirect Expenses
   or
   Factory Expenses
   - → cutting fluid,
   - → Grease, Lubricants,
   - → cotton, Jute, Stationary items etc
   - → Watchman, Superviser, Higher officers etc.
   - → Land, Rent Telephone bills, facility development, electricity bills etc.

3. Factory Cost = Prime cost + Factory overhead.

4. Total Cost = Factory Cost + Marketing, Advertising, transportation cost etc.

5. Selling Cost = Total Cost + Profit

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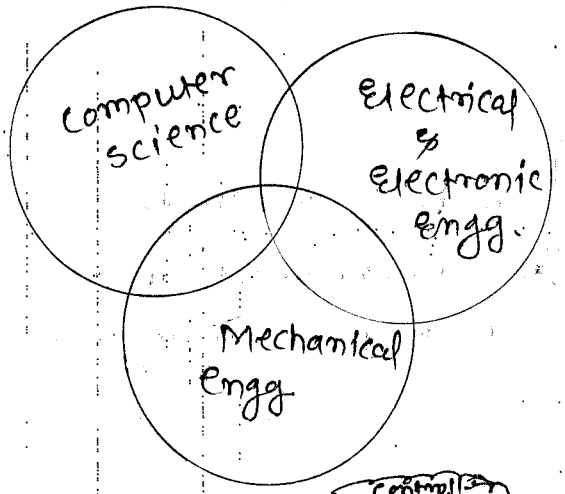
MECHATRONICS

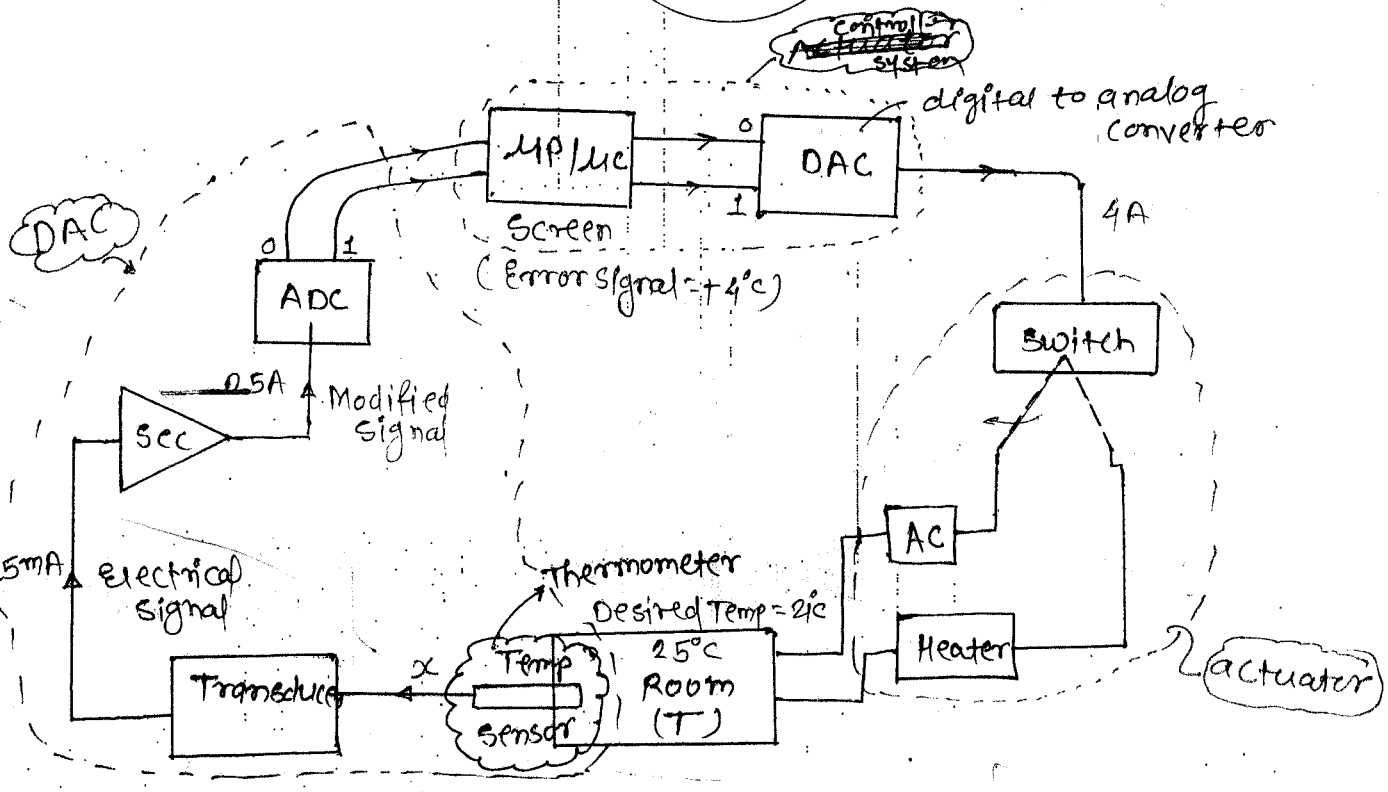
- Sensors & Actuators
- Programmable Logical devices
  - µp 8085
  - µc 8051
  - PLC
- Control Engineering

Sensors > Actuators > µp & µc > PLC > control engg.

Sequence of question / weightage

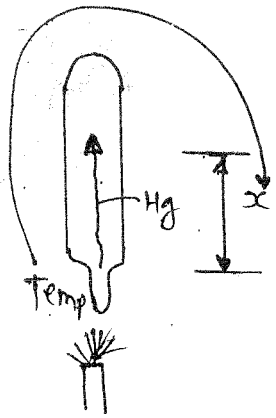


* Smart AC :-



9983322722

* SENSOR (thermometer) :-

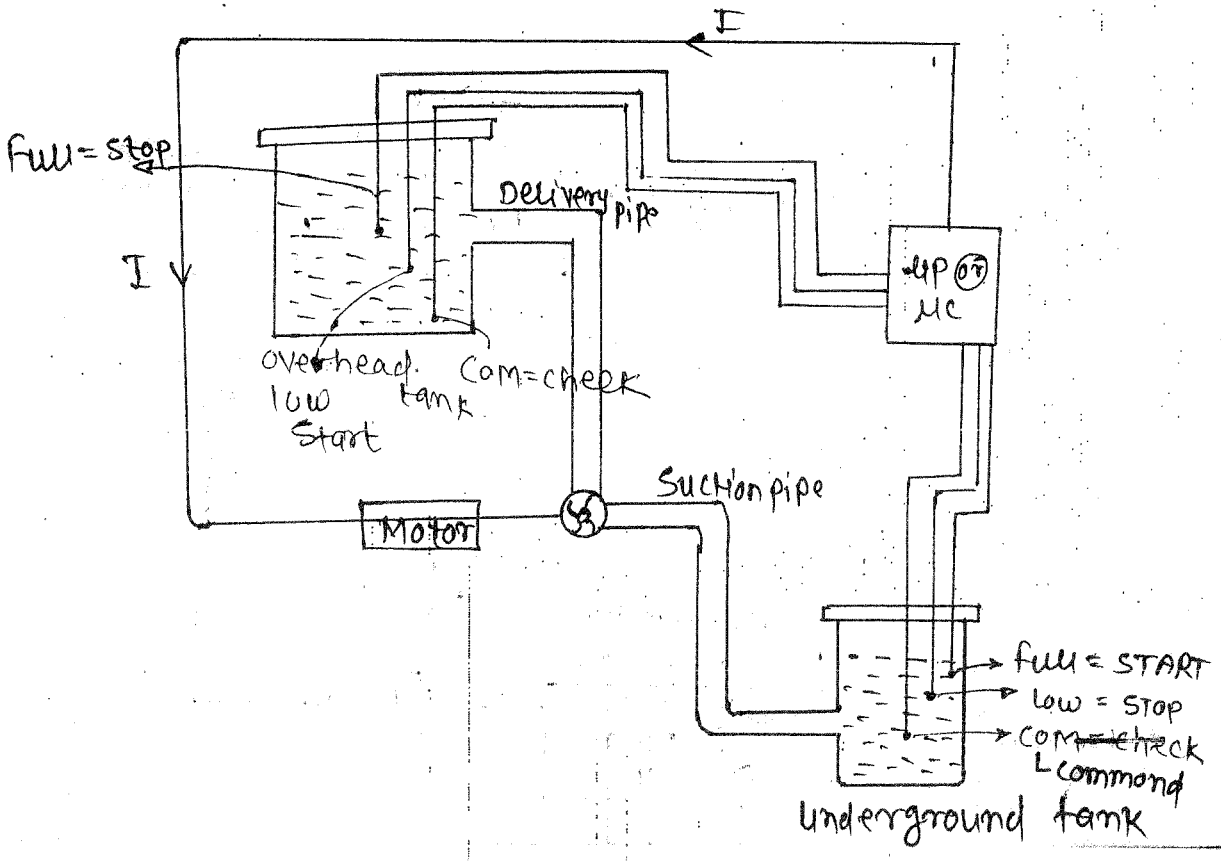


→ electrical form

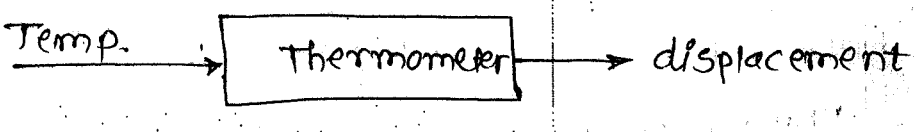
General electrical signal are analog in nature.

* Integration of electrical and electronic devices with the mechanical system lead to the development of ~~mechanical~~ mechatronics eng.

e.g. Overhead tank water filling mechanism.



* SENSOR:- It is a device which is used to sense physical quantities.



A sensor is a device which is used to convert physical quantities into measurable quantity.

Physical quantity	derived quantities	Passive electrical quantities	Active electrical quantities	Digital output.
Temp, Pressure, force, humidity Vibration sound light etc	x $\dot{x}$ $\ddot{x}$	R / L / C	V / I / P (P → power; I → current; V → voltage)	0 / 1.

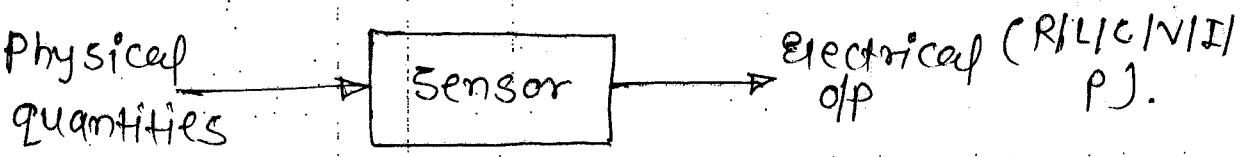
Main aim is to convert physical quantities into V/I/P.

A sensor is a device / an element which is used to produce signal relating to the quantity to be measured.

(or)

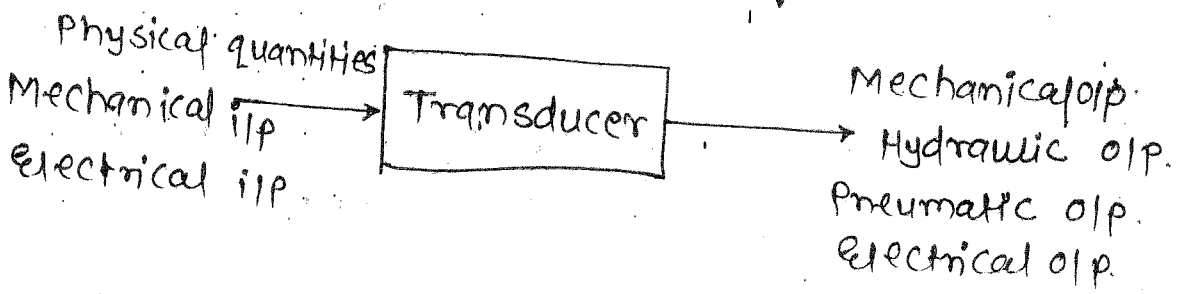
It is a device which produces o/p (usable) in response to a specific measurand.

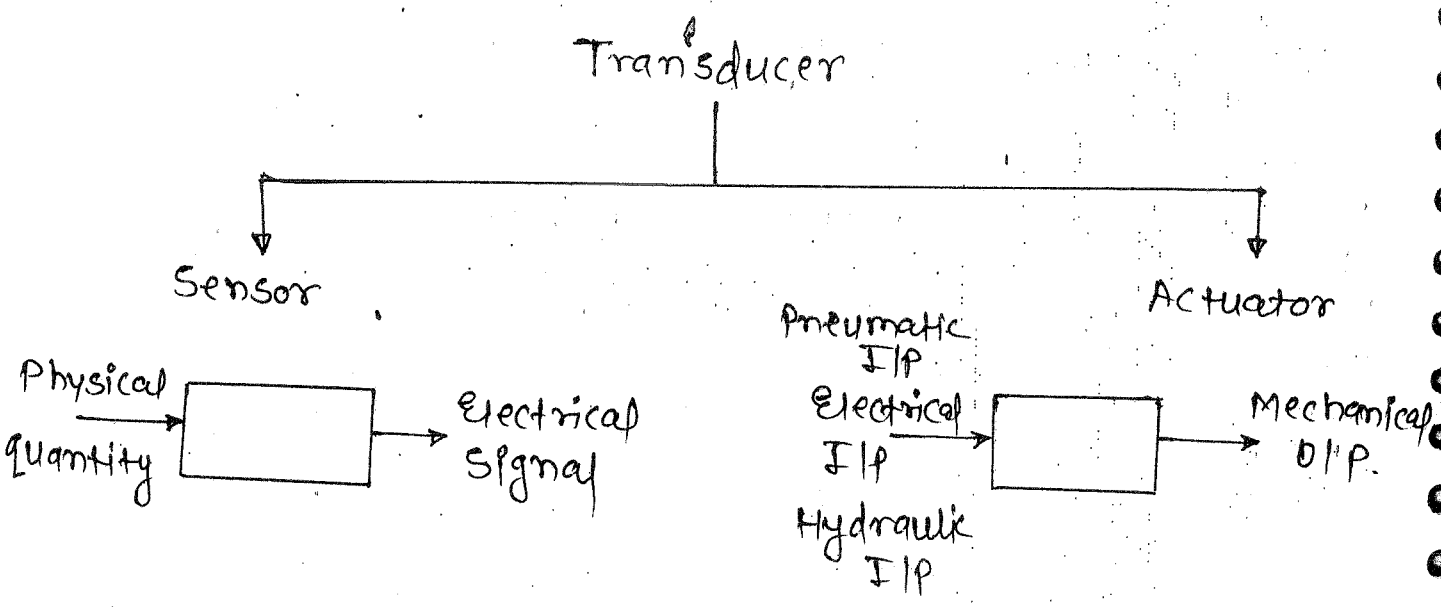
Mechatronics:-



Transducer :-

It is a device which one form of energy into another form.



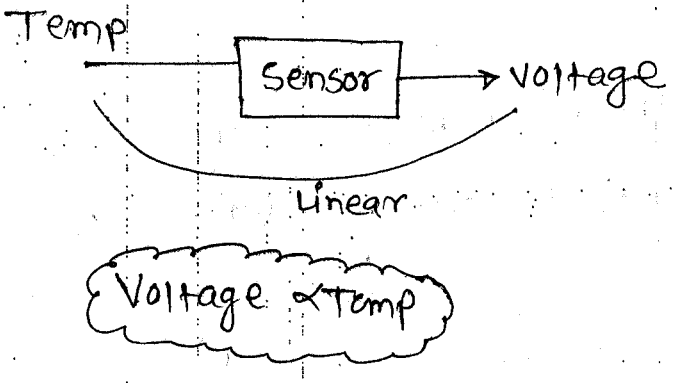


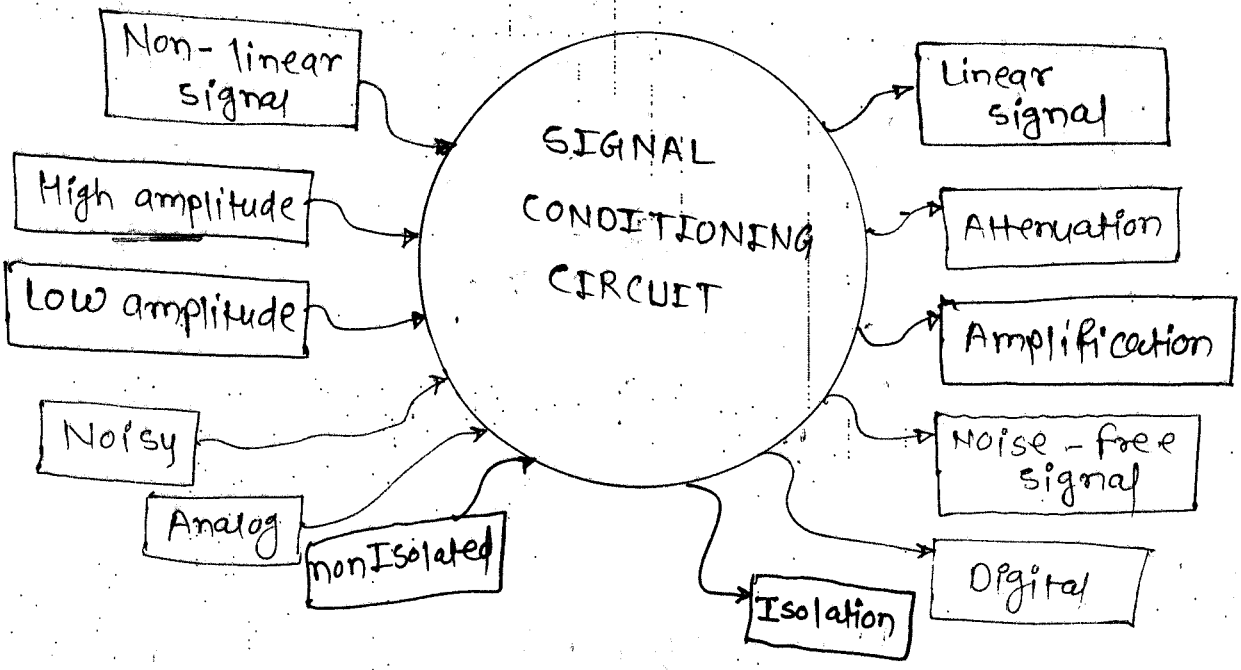
A transducer is a relative term which is used to convert one form of energy into another ~~form~~.

→ An actuator is a device which is used to generate mechanical o/p from a given input (generally electrical I/P).

Problem with signal produced by sensor :-

- Very weak signal
- Very strong signal
- noisy signal
- non-linear signal
- multiple signals.





The signals generally delivered by sensors are not appropriate for further use, a S.C.C is used to convert the sensor's signal into most appropriate form.

1> Amplifier :-

It is an electronic element which is used to enhance or amplify the input signal.

2> Attenuation :-

It is an electronic device which is used to reduce the amplitude of i/p signal.

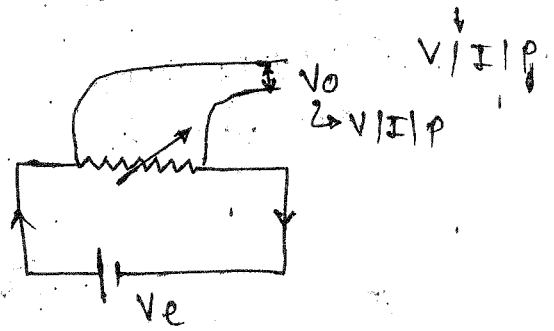
3> filtering :-

It is a process of removing/rejecting signals outside our pre-defined range.

- Low pass
- High pass

4> Excitation :-

Some circuits have/sensors have passive element as an o/p so an external excitation is required to generate desired o/p.

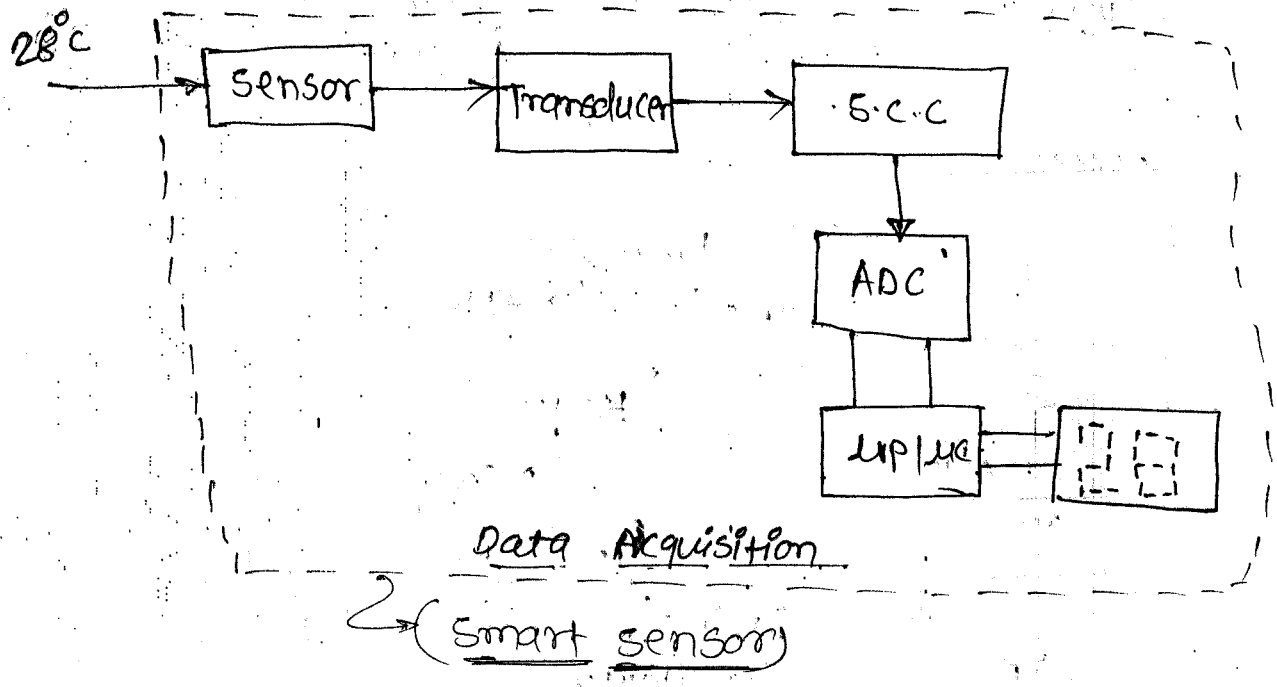


5> Linearization :-

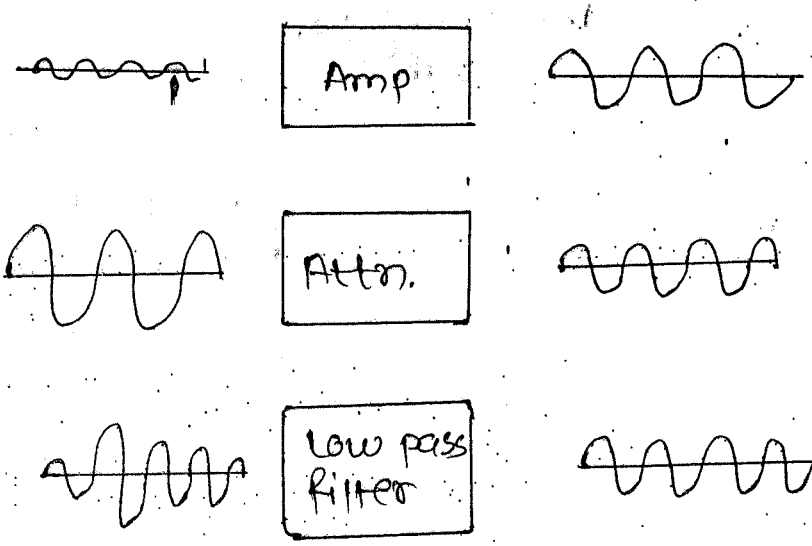
It is needed when the signal produced by sensor doesn't have a linear relation with input.

* Signal processing circuit :-

It converts the o/p / manipulated / conditioned signal of S.C.C into more appropriate form such that end user can understand the information.



SCADA ⇒ Supervisory control and Data Acquisition.



Data Acquisition systems are the group of process they are used to measure real world physical quantities (or) conditions & converting them into digital numerical values which can be manipulated by controllers &

Q.1 (b)

Voltage sensitivity $\rightarrow$ $E_{(V)} = 38.740 + 3.3\times10^{-2}\theta^2 + 2.07\times10^{-4}\theta^3 - 2.2\times10^{-6}\theta^4$

$$S = \frac{dE}{d\theta} = 38.74\times100 + 3.3\times10^{-2}\times100\times100 + 2.07\times10^{-4}\times100\times100\times100 - \frac{2.2\times10^{-6}\times100\times100\times100\times100}{100}$$

$$= 38.74 + 3.3 + 2.07 - 2.2$$

$$= 41.91$$

Q. An ammeter requires a change of 3A in its coil for produce a change in deflection of pointer by 12mm. What is static sensitivity. ?

displacement sensitivity.

I/P $\rightarrow$ 3A

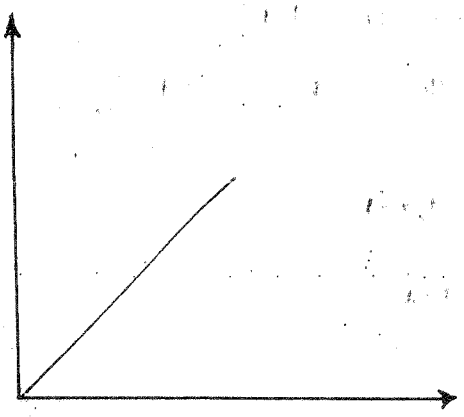
O/P $\rightarrow$ Reading — 12mm

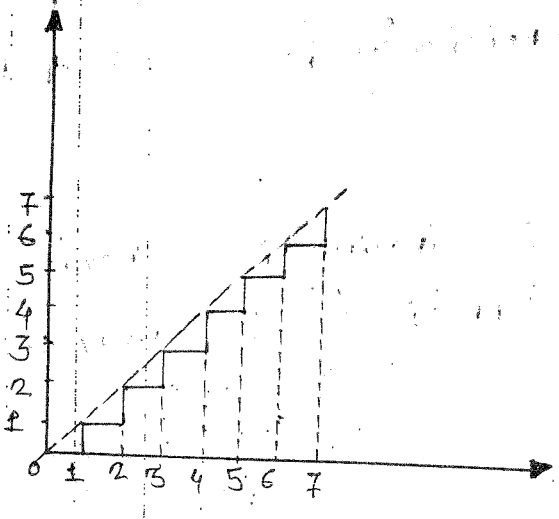
$$S = \frac{12mm}{3A} = 4\ mm/A$$

---

* RESOLUTION :-

2 $\rightarrow$ Least count of a sensor.





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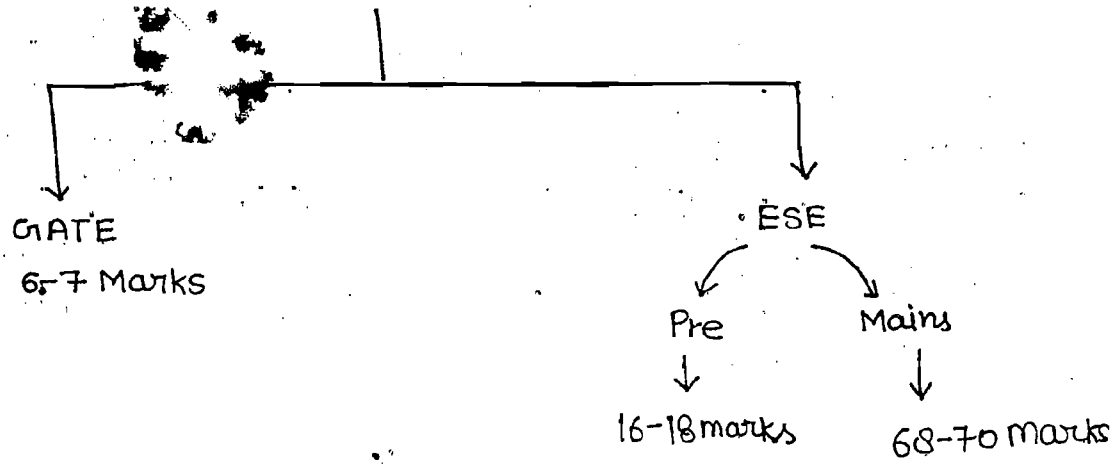
MACHINE DESIGN (MD)

(or)

MACHINE ELEMENT DESIGN (MED)

(or)

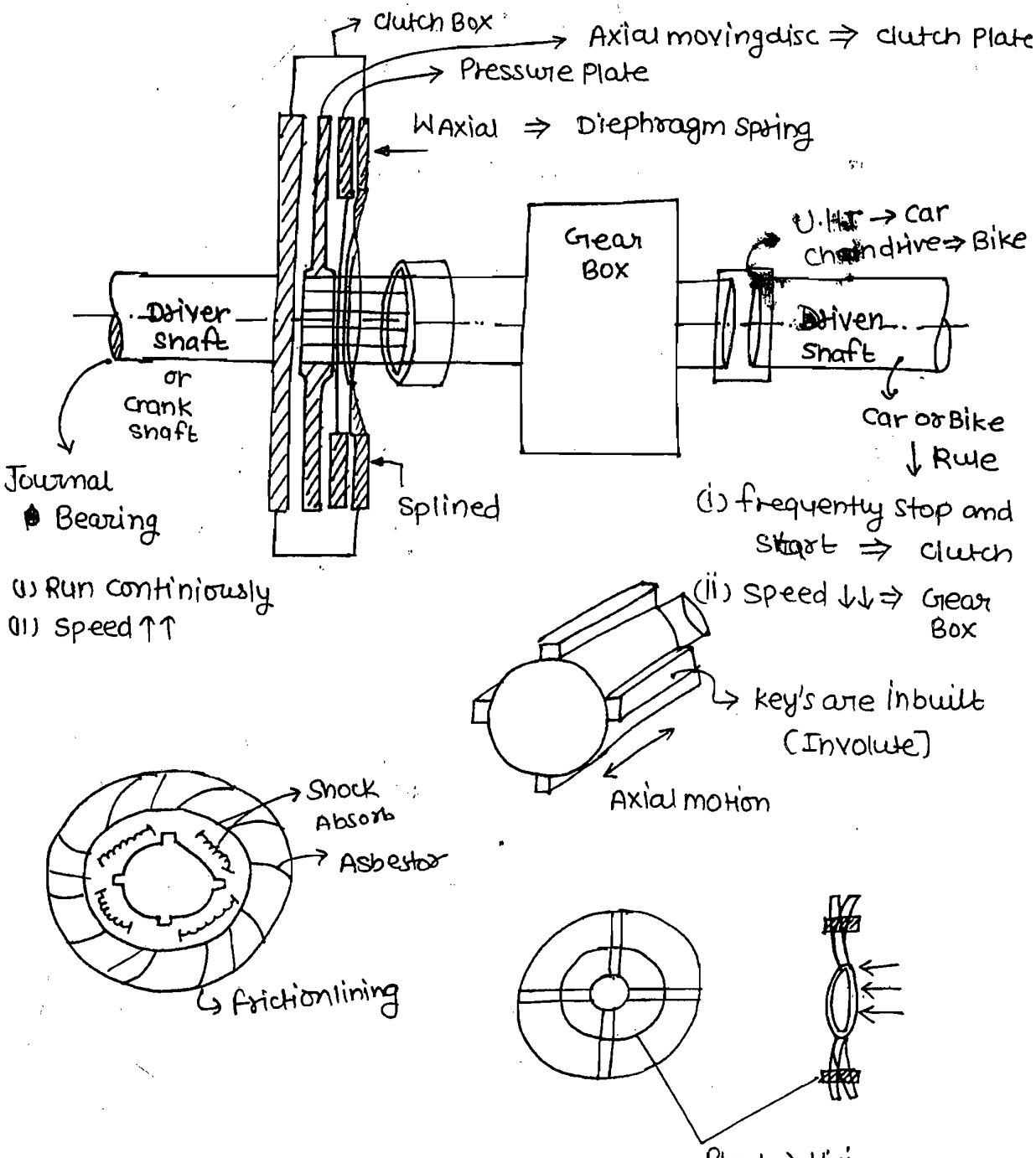
DESIGN OF MACHINE ELEMENT (DME)



(I) Clutches
(II) Brakes
(III) Gear ⇒ (Spur Gear)
(IV) Riveted Joint
(V) Bolted Joint
(VI) Welded Joint
(VII) Bearing
(VIII) Fatigue design of shaft
(IX) Spring
(X) Design of flywheel [only ESE]

clutch :→

It is defined as a machine element which is use to engage and disengage driver and the driven shaft at the wheel without stopping the prime mover.



Q Why clutches are prefer at high speed side

Ans → Power = $T_f \times \omega$ ↑↑↑

High speed

T_f → Required torque Less
⇓
Clutch design Simple

→ To minimize wear and Losses
clutch @ Low speed side
Power = $T_f \cdot \omega$ ↓↓↓
↓
(Torque Required will be more)

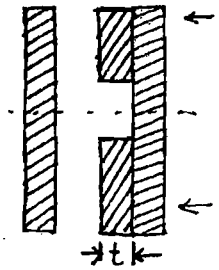
clutch

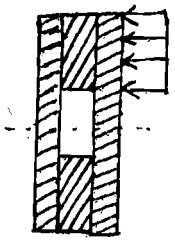
Wear friction is responsible for wear

[UPT]
NEW CLUTCH
(Uniform wear नहीं होता है)

wear friction $\propto V$ → Linear Velocity

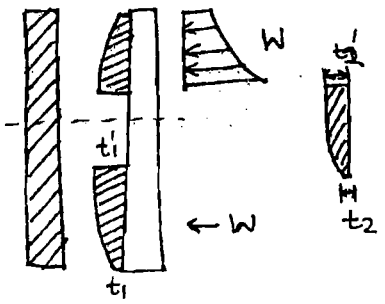
wear friction $\propto P$ → Pressure

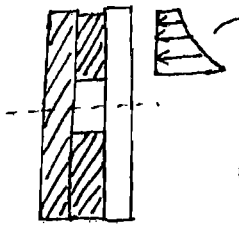




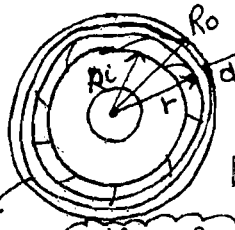
P_{ind} = uniform Pressure
⇓
Perfect Engage

[UWT]
OLD CLUTCH
(Uniform wear होता है)





P_{ind} → Non uniform Pressure
⇓
Perfect Engage नहीं होता है



R_o → outer radius of Lining
R_i → Inner radius of Lining

$P_{ind} = \dfrac{W}{\pi (R_o^2 - R_i^2)}$

$P_{ind} = P$ (uniform Pressure Theory) (UPT)

$\int_{R_i}^{R_o} 2\pi r \cdot dr \cdot P = \int_0^W dw$

$\boxed{P_{ind} = \dfrac{W}{\pi (R_o^2 - R_i^2)}}$

New Clutch

For Safe Cond^n
$P_{ind} \le P_{per}$ (or) P_{allow}

$\dfrac{W}{\pi (R_o^2 - R_i^2)} \le P_{per}$

$W_{max} = \pi (R_o^2 - R_i^2) P_{per}$ → Strength of New Lining in terms of Load

Pressure · r = constant ⇒ P · r = C
wear friction = constant
⇓
Uniform wear Theory (UWT)

$\int 2\pi r P \cdot dr = \int dw$

$2\pi \int_{R_i}^{R_o} \frac{c}{r} \cdot r dr = W \Rightarrow \boxed{c = \dfrac{W}{2\pi (R_o - R_i)}}$

$\boxed{P_{ind} = \dfrac{W}{2\pi r (R_o - R_i)}}$

$t - t_1 > t - t_1'$, $t_1 - t_2 = t_2 - t_2'$

For Safe cond^n
$(P_{ind})_{max} \le P_{per}$

$\uparrow P_{ind} = \dfrac{W}{2\pi r (R_o - R_i)}$

$(P_{ind})_{max} = \dfrac{W}{2\pi R_i (R_o - R_i)}$

$\dfrac{W}{2\pi R_i (R_o - R_i)} \le P_{per}$

$W_{max} = 2\pi R_i (R_o - R_i) P_{per}$ → Strength of old lining

New clutch

Frictional torque

$F_r = \mu R_N = \mu dW = 2\pi r dr \cdot p \cdot \mu$

$$\int dT_f = \int_{R_i}^{R_o} 2\pi\mu p r^2 dr = 2\pi\mu p \int_{R_i}^{R_o} r^2 dr$$

$$\boxed{T_{f_{max}} = \frac{2}{3}\mu\pi P_{per}(R_o^3 - R_i^3)}$$

Old clutch

$$\int dT_f = \int_{R_o} 2\pi\mu \cdot p \cdot r^2 dr$$

$$T_f = 2\pi\mu \int_{R_i} \frac{c}{r} \cdot r^2 dr$$

$$T_f = \pi\mu c (R_o^2 - R_i^2)$$

$$c = \frac{W}{2\pi(R_o - R_i)}$$

$$T_{f_{max}} = \mu W_{max}\left(\frac{R_o + R_i}{2}\right)$$

$$\boxed{T_{f_{max}} = \mu\pi P_{per} R_i (R_o^2 - R_i^2)}$$

NEW CLUTCH $\Rightarrow$ UPT

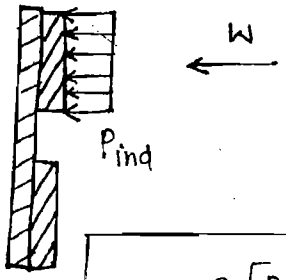
$\Downarrow$

$P_{ind} = c$

- $P_{ind} = \dfrac{W}{\pi(R_o^2 - R_i^2)}$
- Safe condition

$P_{ind} \le P_{per}$

- $W_{max} = \pi(R_o^2 - R_i^2) P_{per}$
- $T_{f_{max}} = \frac{2}{3}\mu\pi P_{per}(R_o^3 - R_i^3)$



$$\boxed{R_{eff} = \frac{2}{3}\left[\frac{R_o^3 - R_i^3}{R_o^2 - R_i^2}\right]}$$

OLD CLUTCH $\Rightarrow$ UWT

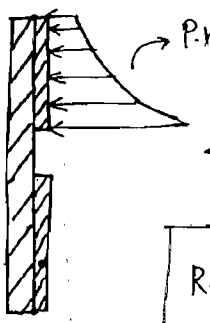
$\Downarrow$

$P \cdot r = c$

- $P_{ind} = \dfrac{W}{2\pi r(R_o - R_i)}$

Safe condition

- $(P_{ind})_{max} \le P_{per}$
- $W_{max} = 2\pi R_i (R_o - R_i) P_{per}$
- $T_{f_{max}} = \mu\pi P_{per}(R_o^2 - R_i^2)$



$$\boxed{R_{eff} = \frac{R_o + R_i}{2}}$$

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MECHANICAL ENGINEERING
Power Plant Engineering
By-Bansal Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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Power Plant

1. Gas Turbine.
2. Rankine Cycle → (PS / VCRS)
3. Rec. Comp
4. Cen. Comp
5. AFC
6. IT
7. RT
8. Binary vapour cycle
9. Boiler & its comp.
10. Condn & Cooling Towers } ESE
11. Comp. Flow – Gate
12. Misc? Topic
    (nozzle & diffusers) ×
    (nuclear PP) ×

Ref. Books:

- P K Nag → Inter
- R - Yadav → Num.
- Ganeshan → Gas Turbine
- S.M. Yaha → comp. flow

GAS TURBINE

Engine:

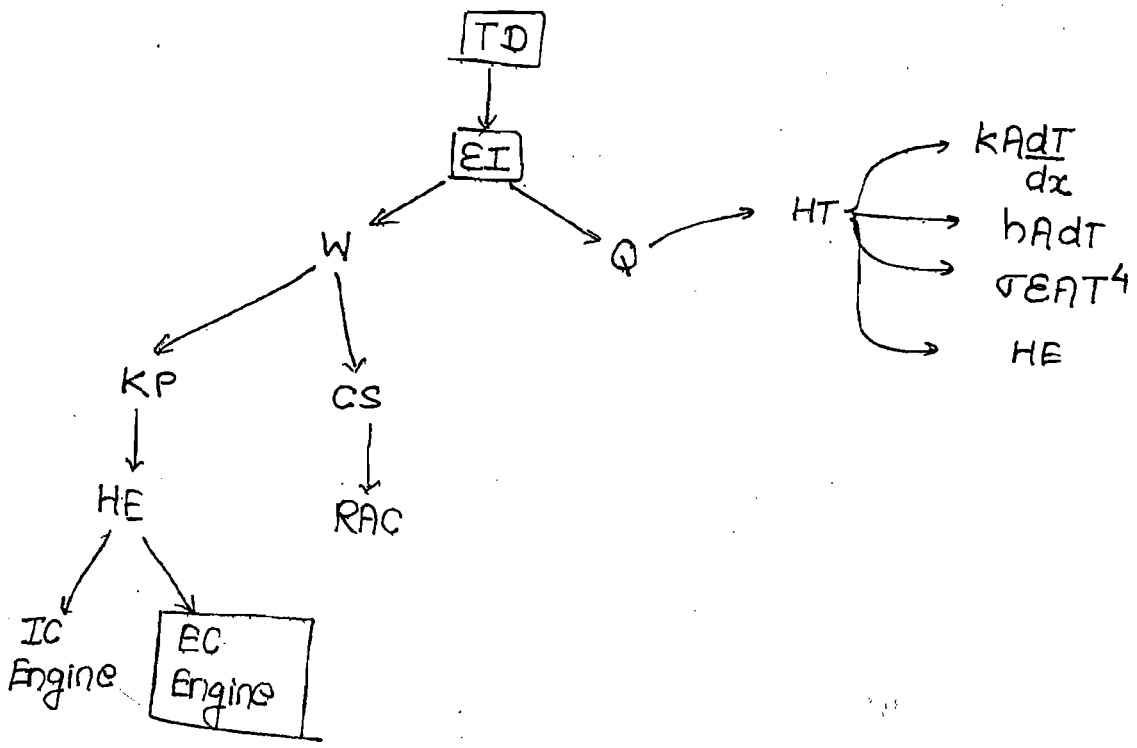
It is a Mechanical Device which convert 1 form of Energy into another useful form of energy.

IC Engine:

In this, combustion & expansion takes place at a same location. (or) fuel itself is the working fluid.

EC Engine:

In this, combustion & expansion takes place at diff. location (or) products of combustion are transfere their heat to the another working fluid. which is utilized for producing some useful output.



Advantage of Gas Turbine over IC Engine:

(i) Compact i.e. Weight to Power Ratio is less.

(ii) These can be rotating at high speed.

(iii) Easy Balacing.

(iv) Simple Mechanism.

Disadvantage of Gas Turbine:

(i) As the compressor is used in the gas turbine, handeling the gaseous phase of the working fluid. Therefore the compressor work is not negligible in comparisn to the turbine work which will reduces the net work o/p. & finally the efficiency decreases.

(1) $\eta = \frac{W_{net}}{Q_s} = \frac{W_T - W_C}{Q_s}$

$\downarrow W_{net} = W_T - W_C \uparrow$

$\downarrow \quad \downarrow$

$\int v_g dP \quad \int v_g dP$

(2) High Heat Resistance Material are required as these are subjected to Higher Temp continuously.

(3) High speed Reduction Gears are required as the value of centrifugal forces are high at Higher Speed.

$F_c = m r \omega^2$

$F_c = m r \left(\frac{2\pi N}{60}\right)^2 \quad \therefore F_c \propto N^2$

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MECHANICAL ENGINEERING

Casting & Welding

BY- Vinod Sir

- Theory
- Explanation
- Derivation
- Example
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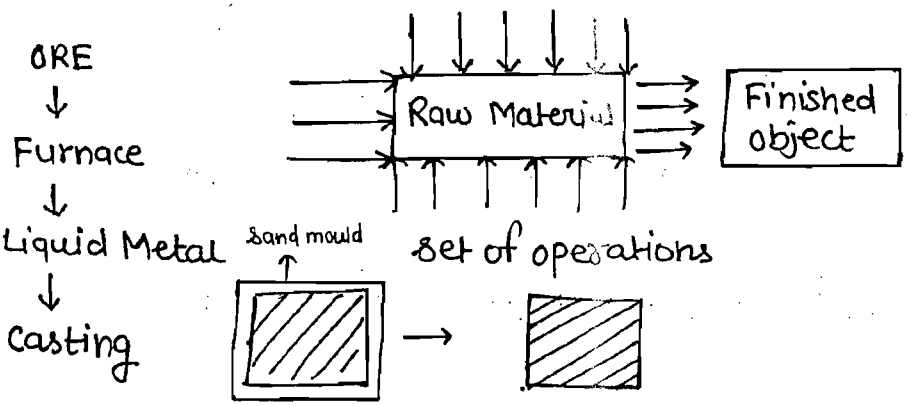
• Manufacturing Process :→

Manufacturing :→ It is a Process of converting raw Material into a finished Product.

It is a Process of value addition to raw material such that final object is having more value in market when compare to raw Material.



• Classification of Manufacturing Process :→

1. Casting
2. Forming
3. Fabrication Process
4. Material removal Process

A. zero Process

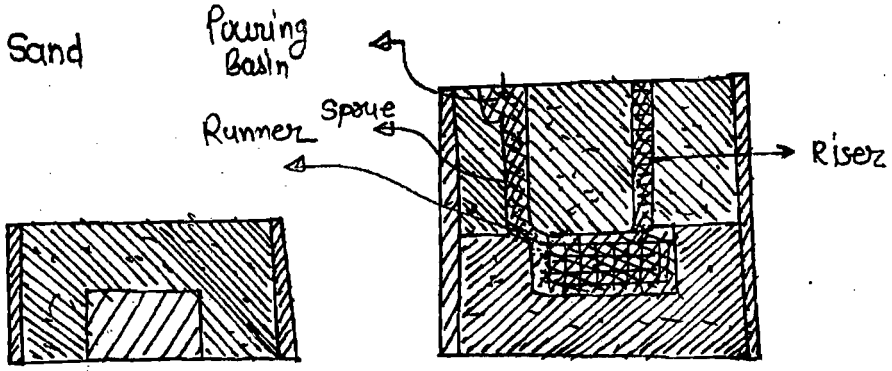
B. Additive Process

C. Subtractive Process

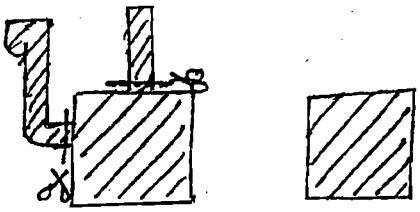
Casting:→ It is a process in which molten liquid metal is allow to solidify in a predefined mould cavity.

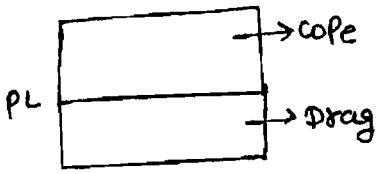
After solidification by breaking the mould required shape of the object is produced

1. Pattern
2. Moulding Sand
3. Tools

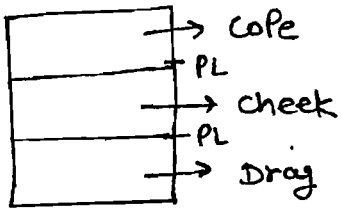


draw spike

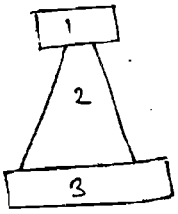




Two Box



Three Box



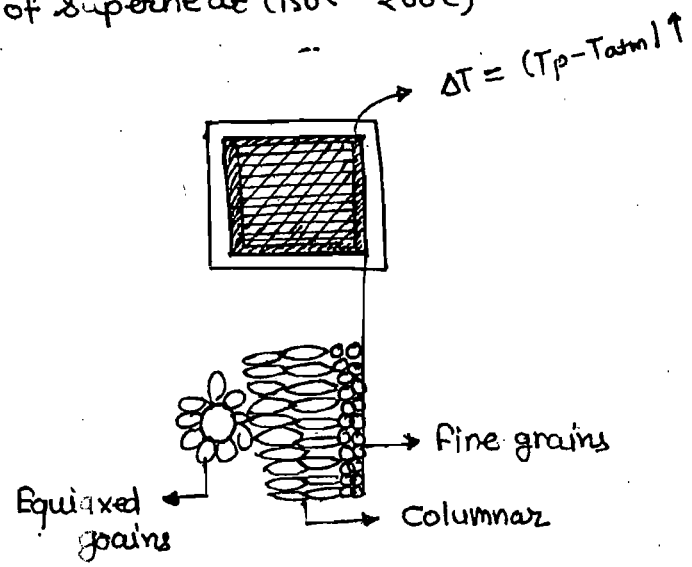
Advantanges:→

1. Complex shapes of the object can be easily produced
2. Less expensive process
3. Ductile and Brittle materials can be easily produced.
4. Large size objects can be produced by casting only. (100-150 Ton)
   eg. Machine tools Bed (lathe Bed), Road Roller, Turbine housing etc

$T_p = T_m + \Delta t$ → degree of superheat (150°c – 200°c)

T_m → Melting temp.

T_p → Pouring temp.



·Limitations of casting:→

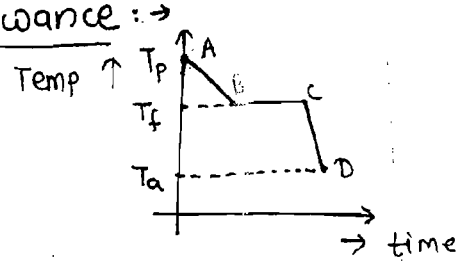
1. Casting objects are not having smooth surface finish.
2. It is Laborious and time consuming process.
3. There is a possibility of gas defects can be formed in the casting.
4. Due to Non-uniform cooling, non-uniform Grain-structure is produced in the casting because of this Non-uniform Mechanical Properties will be produced in the casting.

Pattern:→ It is replica of final casting to produced with some allowances.

Allowances:→

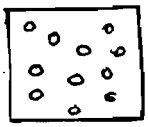
1. Shrinkage or contraction
2. Draft or Taper
3. Machining or finish
4. Shake or Rapping
5. Distortion or camber

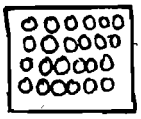
1. Shrinkage Allowance:→

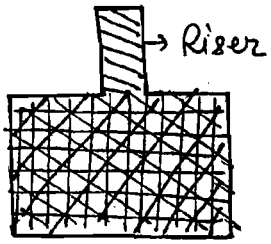


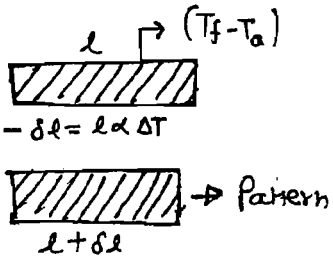
$(t_s)_r > (t_s)_c$

$t_s \rightarrow$ Solidification time

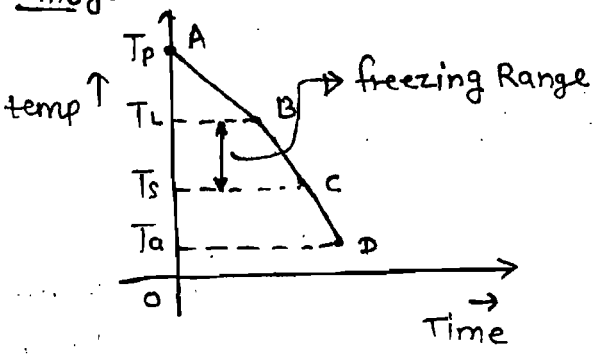








Alloy:



when Liquid metal is allowed to solidify in the cavity there is a contraction or shrinkage of the material. When the Liquid Metal is cooled from Pouring to freezing temp. Shrinkage is Liquid Shrinkage.

During Phase transformation shrinkage is Solidification Shrinkage

With the solid casting is cooled from freezing to ambient temp. the shrinkage is solid shrinkage.

Liquid and Solidification Shrinkage can be compensated by Providing riser. Solid Shrinkage can be compesated by Providing Shrinkage allowance in the Pattern.

- Shrinkage Value: →

(i) Bismuth → Negligible
(ii) Whitemetal → 5mm/m
(iii) Cast Iron → 10mm/m
(iv) Aluminium → 13mm/m
(v) Brass → 15mm/m
(vi) Copper → 17mm/m
(vii) Steels → 20mm/m
(viii) Lead & Zinc → 23mm/m

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Refrigeration and Air Conditioning

- Basic Concept
- VCRS
- Ref
- VARS
- RBC
- Ref Equipment

- Psychrometry
- Summer & winter AC

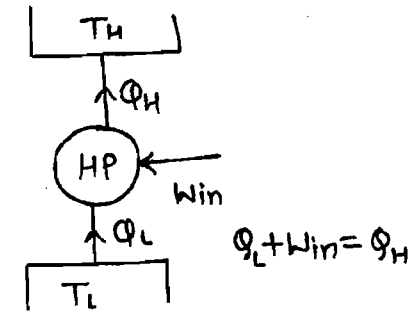
BOOKS: CP Arora
PL Ball

BASIC CONCEPTS

- **Refrigeration Effect** :- It is the amount of heat which is required to extract from the Storage space in order to provide & maintain lower temperature than that of surroundings.

Refrigerant → It is the working fluid or working substance which is use to extract the heat from the storage space

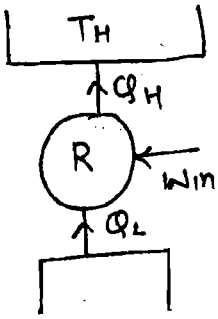
COP→ Coefficient of Performance or Energy Performance or EPR ratio :→ $COP = \frac{DE}{W_{in}}$



$Q_L + W_{in} = Q_H$

$$(COP)_{HP\ Actual} = \frac{Q_H}{Q_H - Q_L}$$

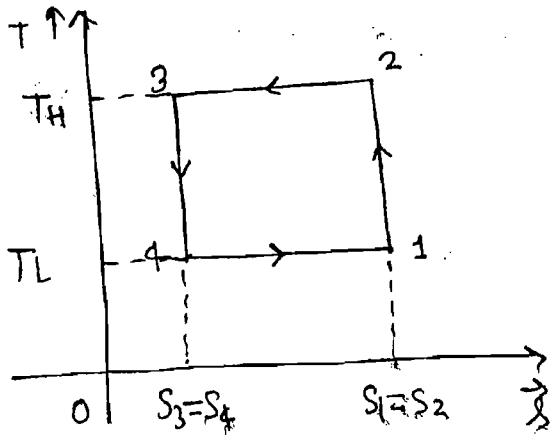
$$(COP_{HP})_{Ideal} = \frac{T_H}{T_H - T_L}$$



$$(COP)_{R\ Actual} = \frac{Q_L}{Q_H - Q_L}$$

$$(COP_R)_{Ideal} = \frac{T_L}{T_H - T_L}$$

- **Ideal Refrigeration Cycle or Reversed Carnot Cycle :→**



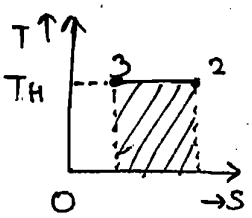
Process 1-2 Rev. adiabatic Compression

Process 2-3 Isothermal Heat rejection

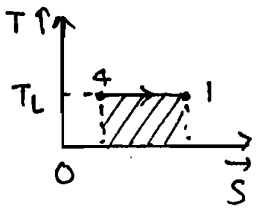
3-4 Isentropic Expansion

4-1 Isothermal heat addition

$$COP = \frac{DE}{W_{NET}} \qquad W_{Net} = Q_{Net} = \cancel{Q}^{\,0}_{1-2} + Q_{2-3} + \cancel{Q}^{\,0}_{3-4} + Q_{4-1}$$



$$dQ_{2-3} = T(S_F - S_I) = T_H(S_3 - S_2) = -T_H(S_1 - S_4) \quad \text{— (2)}$$



$$dQ_{4-1} = T_L(S_1 - S_4) \quad \text{— (3)}$$

Use eqn (2) & (3) in eqn (1)

$$W_{Net} = Q_{Net} = -T_H(S_1 - S_4) + T_L(S_1 - S_4)$$

$$\boxed{W_{Net} = Q_{Net} = (T_L - T_H)(S_1 - S_4)} \quad \text{— (4)}$$

$$\boxed{W_{Net} = -ive}$$

From eqn (4) we can say that our System under Consideration is a work absorbing device.

$$W_{Input} = (T_H - T_L)(S_1 - S_4)$$

$$COP = \frac{DE \longrightarrow Q_{4-1} = T_L(S_1 - S_4)}{(T_H - T_L)(S_1 - S_4)}$$

$$\boxed{COP = \frac{T_L}{T_H - T_L}}$$

NOTE:-

1. Reversed carnot COP is a function of temp. limits only

2. If there are 'n' number of Rev. Refrigerator are operating between same temp. limits with different working fluids, then the value of max. possible COP or Ideal COP or Reversed carnot COP are having same value.

3. Reversed Carnot COP is independent of working fluid

4. Producing Ice at 0°C

(a) $(COP)_{Sumer} > (COP)_{winter}$

~~(b)~~ $(COP)_S < (COP)_W$

(c) $(COP)_S = (COP)_W$

(d) Can't say

Summer	Winter
$T_L = 0°C$	$T_L = 0°C$
$T_H = 30°C$	$T_H = 10°C$

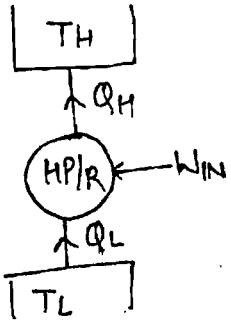
T_L = constant — $(COP)_S < (COP)_W$

$(T_H)_S > (T_H)_W$

Relationship between Heat Pump COP & COP of Refrigerator: →

$$COP_{HP} = COP_R + 1$$

$$1 + COP_R = \frac{T_L}{T_H - T_L} + 1 = COP_{HP}$$



The above expression is applicable b/w same temp. limits

RSE

BY RAHUL SIR

BASIC

ENERGY: It is capacity to produce an effect.

Energy can be:

(i) Stored within a system

(ii) Can be transferred from one system to another

Oil Crisis of 1973:

This year brought an end to the era of secure and cheap oil. In October of that year, OPEC (Organisation of petroleum Exporting countries) put ban on oil production and started oil-pricing control strategy. The year "1973" is called as year of oil shock.

Government of all countries took this matter very seriously and for the first time, a need for developing source of energy was felt.

Classification of energy Resources:

1. Based on Usability of Energy:

a) Primary energy resource:

These are resources already present in nature prior to undergone any human made transformations. E.g., Coal, crude oil, sunlight, wind, vegetation, uranium.

These are located, explored, extracted, processed and are converted to a form as required by the consumer. These resources are generally available in raw form (i.e., cannot be used as such) and are, therefore known as raw energy resource.

b) Secondary energy resource:

The form of energy which is finally supplied to a consumer for utilization is called as secondary energy resource.

E.g., Electrical energy, thermal energy (in the form of steam or hot water), chemical energy (in the form of hydrogen), oil

2. Based on traditional use:

a) Conventional energy resource:

Energy resources which are being traditionally used for many decades and were in common use around the oil crisis, are called as conventional energy resource.

E.g., Fossil fuel, Nuclear and hydro resources.

b) Non-conventional energy:

Energy resources which are considered for large scale use after oil crisis. E.g., Solar, wind, biomass, etc.

3. Based on long-term availability:

a) Non-renewable energy resource:

Resources which are finite and do not get replenished (fill up again) after their consumption are called as non-renewable energy resource. E.g., Fossil fuel, uranium. These are also called as brown energy, because produces pollution.

b) Renewable energy resource:

Resources which are renewed by nature again and again and their supply is not affected by the rate of their consumption are called as renewable energy resource.

These are also called as green energy as produces very less or no pollution.

E.g., Solar, wind, Geothermal, Ocean (tide, wave, thermal), biomass, Hydro

Difficulties in harnessing renewable energy:

- It is present it dilute form (useful energy is very less).
- It is highly fluctuating type of energy. It depends on weather conditions. Hence, continuous supply of such energy can't be ensured always.
- Large area of land is required to produce energy for commercial applications.

Aim of subject:

To find replacement of fossil fuel.

Syllabus:

1.SOLAR RADIATION

2. SILAR COLLECTOR

3. SOLAR APPLICATION

4. ENERGY STORAGE

5. BIOMASS ENERGY

6. WIND ENERGY

7. TIDAL ENERGY

8. PHOTO-VOLTAIC CONVERTORS

9. FUEL CELL

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MECHANICAL ENGINEERING

ROBOTIC

By-GUNJAN Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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Khushal K. Katore.

Mechatronics And Robotics :-

Mechatronics :-

- Microprocessor & Microcontrollers,
- Architecture, Programing, I/O, computer interfacing,.
- Programmable logic controller
- Piezoelectric accelerometer.
- Hall effect sensor
- Optical Encoder.
- Resolver,
- Inductosyn,
- Pneumatic and Hydraulic actuators,
- Stepper motor

Control Systems :-

- Mathematical modeling of physical systems,
- Control signals
- Controllability and observability.

Robotics :-

- Robot classification
- Robot specification, notation,
- Direct & inverse Kinematics
- Homogeneous coordinates &
- Arm equation of four axis SCARA Robot

* Robotics *

* Introduction :-

- Origin of the word 'robot' can be traced in the Czech word 'robota' which means "forced or compulsory labour". (KAREL CAPEK sci-fic writer)
- The "official" defination of an industrial robot is provided by the Robotics Industries Association (RIA), formerly the Robotics Institute of America (RIA):-

"An industrial robot is a reprogrammable, multifunctional (malfunctional), manipulator designed to move materials, parts, tools, or special devices through variable programmed motions for the performance of a variety of tasks".

Manipulator → Robot arm.

- IS CRANE a ROBOT ?
  → although crane also has a manipulator but it is always controlled by human operator.
  Crane → Manual handling system.

End effector → Gripper → attached to the last joint of robotic arm used for holding or grasping an object.

* Indian Scenario :-

1> NETRA → (flying) Surveillance Robot, UAV → Unmanned aerial vehicle.
- NETRA → Network Traffic analysis
- Developed by DRDO → "CAIR" (Lab) Centre for Artificial intelligence & Robotics.

NETRA Robot can intercept voice traffic signals and identify the device using words such as bomb, blast etc in real time response.

* Asimov's three laws of Robotics :-

- First law (Human safety) :-
  - A robot may not injure a human being or through inaction, allow a human to be harmed.
- Second law (Robots are slaves) :-
  - A robot must obey orders given it by human beings, except where such orders would conflict with the first law.
- Third law (Robot survival) :-
  - A robot must protect its own existence as long as such protection does not conflict with the first or second law.

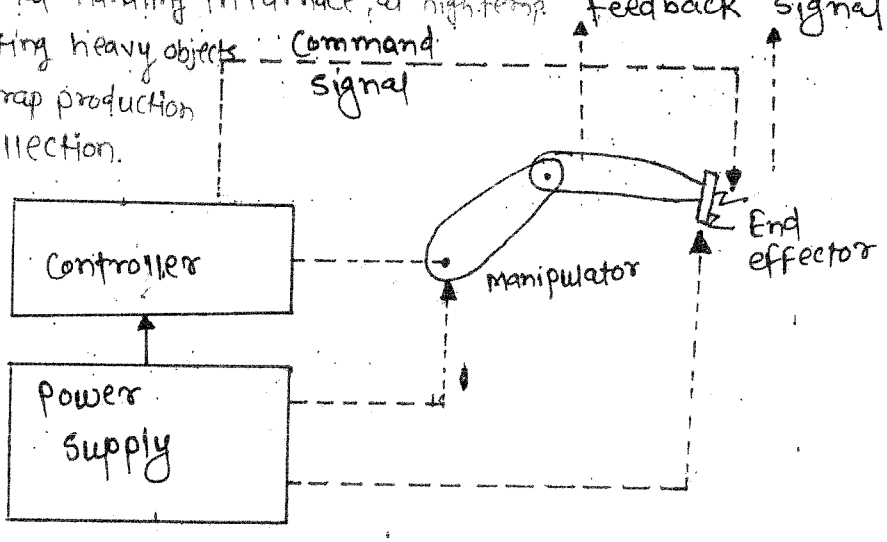
- It is interesting to note that in the real world, industrial robots obeys law that are the opposite of the ones stated above! A robot may injure a human, it may not obey humans and it also may not protect its own existence.

* 4D's of Robotics :-

- If one of 4D's exist then use of Robot is justified.
  - D - Dangerous → Material handling in furnace, at high temp.
  - D - Difficult task - lifting heavy objects
  - D - Dull operation - Scrap production
  - D - Dirty → Garbage collection.

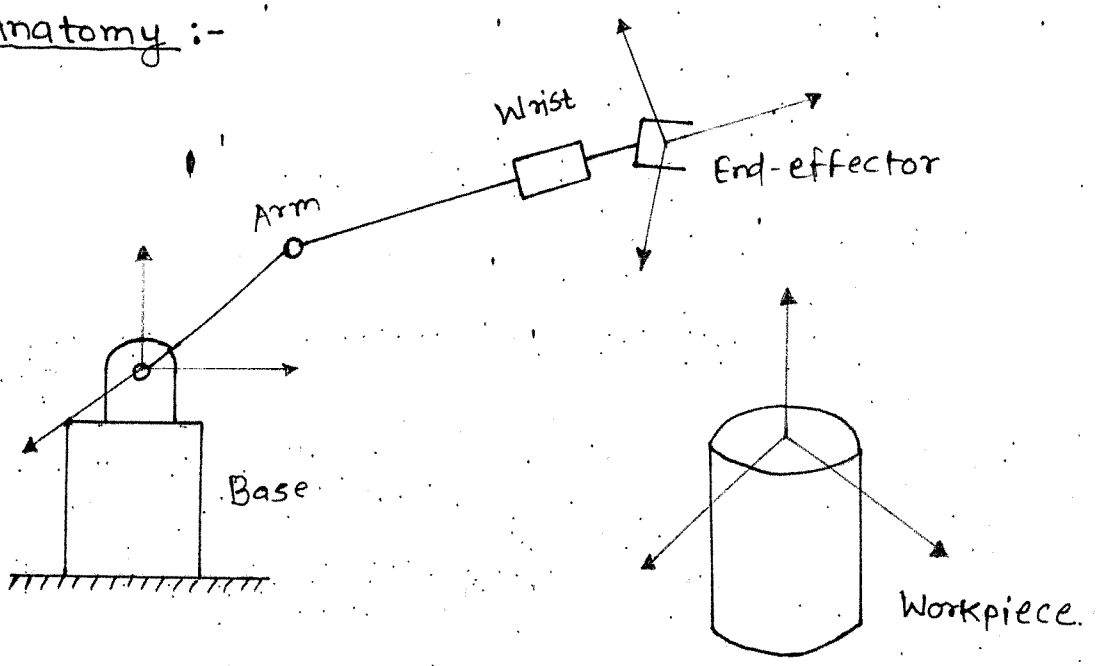
Components.

1. Manipulator
2. End effector
3. Actuator & sensor
4. Power supply.
5. controller.



9. Which is the following is not among the five basic part of a robot.
   a) peripheral tools
   b) End effectors
   c) controller
   d) actuator and sensor.

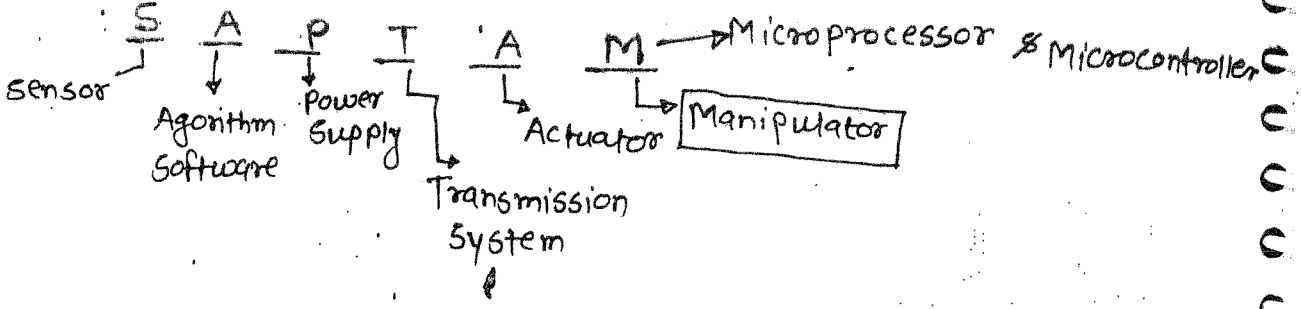
* Robot Anatomy :-



- Robot anatomy is concerned with the physical construction of the body, arm and wrist of the machine.
- The robot body is attached to the base and the arm assembly is attached to the body
- At the end of the arm is the wrist. the wrist consists of a number of components that allow it to be oriented in a variety of positions.
- Relative movements b/w the various components of the body, arm, and wrist are provided by a series of joints.
- The body, arm & wrist assembly is sometimes called as manipulator.

→ either rotary or sliding motion.

- Attached to the robot's wrist is a hand or a tool called the "end effector".
- The end effector is not considered as part of the robot's anatomy.
- The arm and body joints of the manipulator are used to position the end effector.
- The wrist joint of the manipulator are used to orient the end effector.



1> Actuator :- that trigger's the motion. Actuator receives signals from controller, and then provides motion to manipulator & end-effector.

- Actuators are basically prime movers providing both force and motion.
- Pneumatic cylinders, hydraulics, permanent magnet motors, stepper motors, linear motors are some conventional actuators.
- More advanced onee are based on hi-tech polymers, shape memory alloys, piezo patches and pneumatic muscles.
- Brushless servo motor also exist for low noise levels, and printed armature motors are used for quick response.

2> Transmission systems :-

- The transmission system used in robot to transmit power and motion consists of chains, timing belts, metal belts, cables and pulleys and linkages.
- Gear boxes and harmonic drives serve to provide speed reduction.

- Ball screws are used with suitable mechanisms to convert rotary motion to linear motion and if needed back to oscillatory motion.
- Drives stiffness is an important consideration in robotics and so also is backlash

3) Power supplies :-

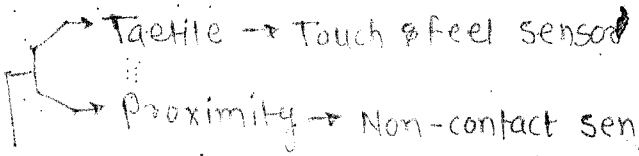
a) Hydraulic & pneumatic power packs:

These consist of a motor driving a positive displacement pump or compressor to generate the high pressure fluid flow. In using hydraulic systems the necessity of having an oil tank increases the weight of the system, additionally the issue of ensuring that the oil is free of contaminants is to be handled.

- In pneumatics power pack dry air is desired.

b) Electric motors :

It use what are known as PWM (pulse width modulation) amplifiers. These are electronic devices, consisting of transistors used as switches to rapidly switch on and off the supply in controlled manner to control motor speeds. Such drives have higher efficiency.



3) Sensor and Electronics :-

optical encoder ↓ Visual sensor.

- The sensor for feedback in robots consists of tachometers & encoders and potentiometers to sense motor motions, simple switches, force sensors, acceleration sensors, optical systems, special cameras and vision systems.

- There are a host of electronic circuits, motor controllers, analog to digital converter and digital to analogue converters, frame grabbers and so on utilized to handle sensors and vision system and convert the inputs from them into a form usable by the processor for control of the entire system in conjunction with the algorithms and software developed specifically for the purpose.

4> Software :-

- The software used consists of several levels.
- Motor control software consists of algorithms which help the servo to move smoothly utilizing the data from feedback units.
- At the next level there is software to plan the trajectory of the end effector and translate the same into commands to individual motor controllers.
- The output of sensors is also to be interpreted and decision made
- At the highest level there is software which accepts commands from the user of the robot and translates it into appropriate actions at the lower level.

5> Manipulators :-

- The mechanical unit, often called the "arm" that does the actual work of the robot.
- It is composed of mechanical linkages and joints with actuator to drive the mechanism directly or indirectly through gears, chains or ball screws.
- Manipulator are built as serial chains or parallel chains or occasionally a combination of both.

- Links and joints (revolute and prismatic) that are mostly used in manipulators.
- In spatial manipulators (open chains) adjacent axes are parallel or pendicular to each other.

6) End effectors :-

- The special tooling for a robot that enables it to perform a specific task.
- Two type.
  - Gripper - to grasp and manipulate objects (e.g. parts during work cycle.
  - Tools - to perform a process e.g. spot welding, spray painting.

* Joints and Links :-

- The individual bodies that make up a robot are called links.
- for example an assembly of two gears connected by a common shaft is treated as a link.
- Link of a robot are coupled by kinematic pairs and joints
- A joint couples to links and provide physical constraints on the relative motions b/w the links.
- They are termed as either lower or higher pair joints.

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Strength Of Material

By-Krishna Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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STREGTH OF MATERIAL

OR

MECHANICS OF MATERIAL

OR

MECHANICS OF SOLIDS

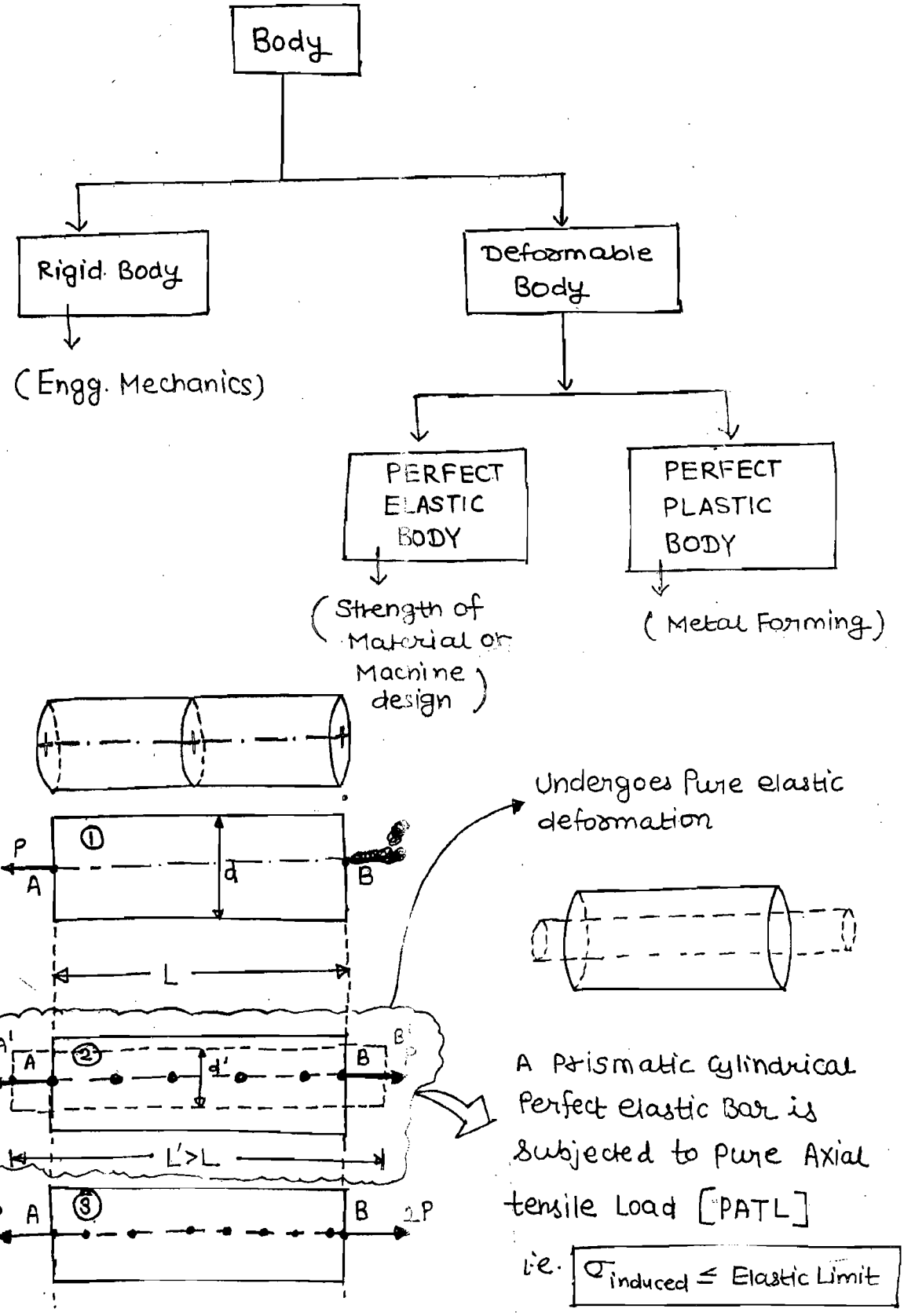
OR

MECHANICS OF STRUCTURE

OR

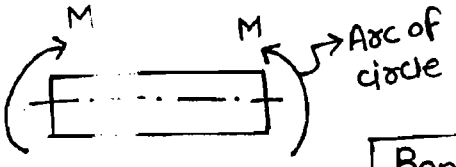
MECHANICS OF PERFECT ELASTIC BODIES

- $\sigma_{induced} \leq$ Elastic Limit $\Rightarrow$ Perfect elastic Body
- $\sigma_{induced} >$ Yield Strength $\Rightarrow$ Perfect Plastic Body



i.e. Shear force = Bending moment = Twisting moment = 0

Axial load = Constant



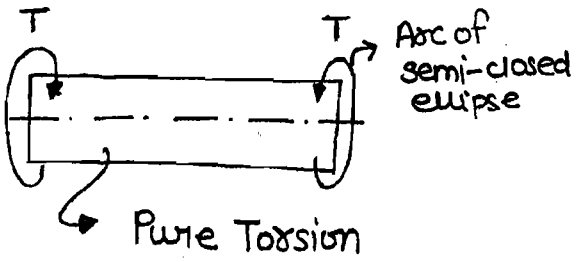
Pure Bending

Bending → Two equal Parallel opposite Couple eccentric axia load

i.e.

Axial Load = Shear Force = Twisting Moment = ZERO

Bending moment = Constant



Torsional Couple → Two equal and opposite Parallel eccentric tranverse shear Load.

Axial Load = Shear force = Bending Moment = zero

Torsional Moment = Constant

Pure Axial Load

$$\sigma_a = \frac{P}{A} \; ; \; \delta_L = \frac{PL}{AE}$$

$$SV = \frac{PL}{E}(1-2\mu)$$

$$FOS = \frac{\text{Failure stress}}{\text{Per Stress}}$$

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Theory Of Machine

By-Amit Kakkar Sir

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- Explanation
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THEORY OF MACHINES

-: By

AMIT KAKKAR SIR

Amit Kakkar Speaks (Telegram channel)

(YOUTUBE) Channel

- 3-Points [ways to making Easy Life]

1. Have some Patience
2. कुछ बर्दाश्त करना है।
3. बहुत कुछ नजरअंदाज करना है।

- Syllabus [Gate, Ese, ISRO, DRDO, BARC....]
  ↓
  TOM

Kinematics of machines

Kinetics (dynamics) of machine

Mechanical Vibrations

1. Simple Mechanism
2. Motion Analysis
   - → Velocity Analysis
     - I-centre method
     - Relative velocity method
   - → Acceleration Analysis
3. Gears
4. Gear Trains
5. Governors
6. Motion Analysis of single-slider crank Mechanism
7. Flywheels
8. Balancing
9. Gyroscope

- Mechanical Vibrations
- CAM & FOLLOWERS

Mechanical Engineering

↓

Engg. of Mechanics

↓

Study of Motion (DYNAMICS)

(kinematics) ↓ ↓ (Kinetics)

Study of motion without considering the Basic case of motion i.e. Force

$\vec{V} = \frac{d\vec{s}}{dt}$

$\vec{a} = \frac{d\vec{V}}{dt}$

$\vec{j} = \frac{d\vec{a}}{dt}$

Study of motion with the Considering the basic cause of motion i.e. force

Dynamics Viscosity (μ) → $\frac{N\text{-}s}{m^2}$

Kinematic Viscosity (ν) = $\frac{\mu}{\rho}$

$= \frac{m^2}{s}$

- Text Book
  - → S.S. Rattan
  - → Prof V.P. Singh

- Reference Book (For Teachers)
  - → Shigley
  - → Norton
  - → Thomas Beven

- Weightage of TOM :→

GIATE → Min 8 marks from TOM

ESE

↳ Prelims : (22-30) Questions of TOM
(150 Total Questions)

↳ Mains : min. 125 marks of TOM
(300 marks of Paper-II)

After Learning Concepts

Thermodynamics

Books : Cengel & Boles ⇒ Theory

P.K. Nag ⇒ Questions

Questions → Work Book → Class / G drive

Theory Book

→ GATE Previous Year

→ ESE PYQ (5 Year)

→ GATE OTS

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HW

TH-B

P-224

Q8, Q9

"Reversible & Irreversible"

↳ Video

Prime

Youtube

Amrinder Sir entropy

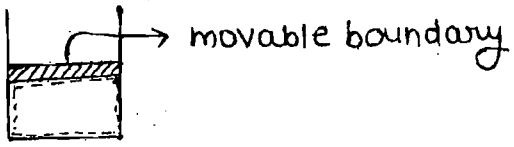
"Civil Services questions"

*Thermodynamics –

It is a branch of science which deals with energy interaction and its effect on system and surrounding.

→ Energy – It is the Ability to cause changes.

→ System – It is a fixed mass (control mass) system or a region in a space (control Volume) where our study is focused.

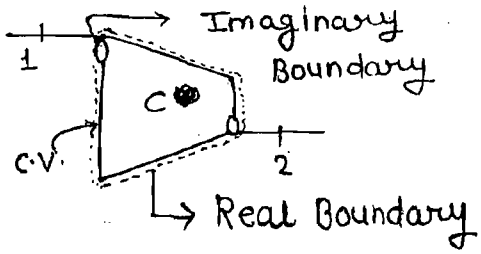


→ Surrounding – Everything except the system becomes surrounding.

- The Part of surrounding which is direcHy affected by the system is called Immediate surrounding.

→ Boundary – It is a real or imaginary surface which separates the system from the surrounding.

Boundary can be fixed or movable.

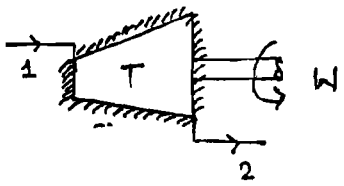


Type of System :→

Type of system	Mass	Energy	Example
1. closed	X	✓	Piston cylinder without valves
2. open	✓	✓	Piston cylinder with valves
3. Isolated	X	X	Perfectly insulated thermos universe

	Mass	Work	Heat
Insulated	✓	✓	×
Isolated	×	×	×

→ eg. insulated turbine



- Properties of the System :→

Any characteristics of the System is called as the Property of the System. and the Properties can be classified as :

1. Intensive (Intrinsic) :→

Independent of mass of the System under Consideration.

eg. P, T, e, u, velocity (c), thermal conductivity (k)

NOTE: All Specific Properties are intensive Properties,

eg. h, s, u, w, q, C (Specific heat)

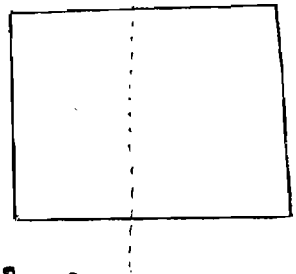
2. Extensive (Extrinsic) : →

Depense of mass of the System Under Consideration.

eg. E, V, m, Entropy, Enthalpy, Internal Energy

$C_{rms}^2 \propto T$

$\frac{1}{2} m_1 c_1^2 + \frac{1}{2} m_2 c_2^2 + \cdots = \frac{1}{2} \Sigma m C_{rms}^2$



$P_L = P$

$T_L = T$

$V_L = V/2$

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Current Affair

By- PANDEY Sir

- Theory
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Current Affairs

Dynamic
- → National Events
  - – Political
  - – Economic
  - – Environment
  - – Sports
- → International Events

Static
- → Books & Authors
- → Imp. Personalities
- → Imp. Places
- → World Heritage site
- → Culture Related
- → Govt. Programmes & Policies

Dynamic

Political Developments

1) Azadi ka Amrit Mahotsav

15th Aug. 1947 + 75 = 2022
↑
1st + 75 = 2021

→ India celebrated on 15th Aug 2021, 75th Independence Day
On 15th Aug 2022, 76th Independence Day
On 15th Aug 2022, 75th Independence Anniversary
75 Yrs completed of Independ.

→ With this India entered into Amritkaal from year 2021 upto 2047 (25 Yrs)

→ Our PM Narendra Modi laid the foundation for the vision of Amritkaal in the form of Amritmahotsav.

→ Slogan for Amritkaal:
"Sabka saath, sabka vikas, sabka vishwas, sabka Prayas"

1) PM Gati Shakti Yojna

- It was announced with a 100 Lac crore fund.

2) 75 New Vande Bharat Trains to be rolled out in 75 weeks of Azadi ka Amrit Mahotsav.

→ On 12th March 2021, Azadi ka Amrit Mahotsav was announced by our PM. It will continue upto 15th Aug 2023.

3) Announcement of distribution of 'fortified rice'.

→ Fortification is the process of addition of Vitamins and Minerals such as Iron, Iodine, Zinc, Vitamin-A & D to staple food such as Rice, Wheat, Oil, Milk and salt to improve the nutritional value and provide public health benefits with minimum risk to health.

→ Fortification is done by the process of coating in which vitamins and minerals are added with wax in liquid form and then it is spread in food.

→ The fortified food is mixed in the ratio of 1:100 (fortified rice).

→ The fortified rice was distributed through Ration stores but at few places it was rejected by the people as they said that it is "Plastic Rice".

→ Fortified rice is distributed in India to fight the problem of Malnutrition.

→ Due to fortification, no change in the cooking process and their is no harmful effect also.

2) Pradhan Mantri Gati Shakti National Master Plan

→ Launched on 13th Oct 2021 for providing multi-model connectivity infrastructure to various economic zones, PM Gati Shakti National Master Plan was announced.

→ The approach was driven by 7 engines. These are Railways, Roads, Waterways, Ports, Logistics Parks, Airports and Mass Transport.

3) Vande Bharat Trains

→ Vande Bharat Trains are semi high speed indigeneous trains
→ It is manufactured by Hyderabad based engineering firm Medha.
→ These trains are the major steps in the indian railways that are providing high comfort at low cost.
→ First Vande Bharat Train was manufactured at Integrated Rail Coach Factory Chennai under make in India project with the cost of hundred crores.
→ Earlier, India used to buy train coaches from France at a cost of 400 Crores. Therefore it has reduced the cost by 75%.
→ These coaches are more fuel efficient because the coaches are made up of Aluminium. Hence they are lighter involves lesser cost and consumes lesser electricity.

Note: Intelligent Braking System (Used in Vande Bharat Trains)
It is based on power regeneration technology.
Also used in electric vehicles these days.

→ The Vande Bharat express train can achieve the max^{m} speed of 180 Km/hr. Therefore it can reduce the journey time upto 50% also.
→ These coaches are equipped with Wi-Fi, CCTV cameras, Automatic doors, Rotating chairs and Bio-vacuum Toilets.
→ These Trains were initially launched with the name of "TRAIN-18" because it could be manufactured within a record time of 18 months only.
→ TRAIN-18 uses distributed power technology in which each of the coaches are self propelled.
→ Vande Bharat trains was also criticized because the coaches are made up of Aluminiums and they were called as flying coffins on tracks but Indian Railway developed KAVACH system i.e, Anti Train Collision Avoidance

system. It was tested by Indian Railway on March, 2022 by Railway Minister Ashwini Vaishnav itself.

→ KAVACH system was developed with the code name of TCAS: Train Collision Avoidance System. It used RFID technology to detect the locomotives on Tracks. It used ultra high frequency RFID technology that can detect the trains from a distance of 200m also. In future, RFID technology will be integrated with 4G LTE (Long Term Evolution) also.

Note: In Union Budget 2022, our finance minister Nirmala Sitharaman has announced to launch 400 new Vande Bharat Trains in India within the next 3 Yrs.

PRESIDENTIAL ELECTION 2022

→ India is a republic country. It means that the head of the state is elected.

→ Head of the country India is The President. Hence there is a provision of election of the President of India.

→ While in Britain, it is not a Republic therefore the head of the state is not an elected person.

→ The President of India position must not be vacant. Hence, election for the new president takes place before the expiry of the term of old president.

→ In 2022, 16th presidential election took place on 18th July 2022 to elect the 15th President of India.

→ There is only one president who continued for two consecutive terms was Dr. Rajendra Prasad.

→ The election for the president of India is different than the election for Prime Minister.

→ The President of India is only a nominal head of the country Therefore the elaborate procedure for the election of president is not followed as in the case of Prime Minister.

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ENGINEERING DRAWING

By-Himadri Shekhar Sir

- Theory
- Explanation
- Derivation
- Example
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GENERAL PRINCIPLES OF DESIGN, DRAWING, SAFETY

telegram @himadri_shekhar

- Himadri Shekhar.

Syllabus

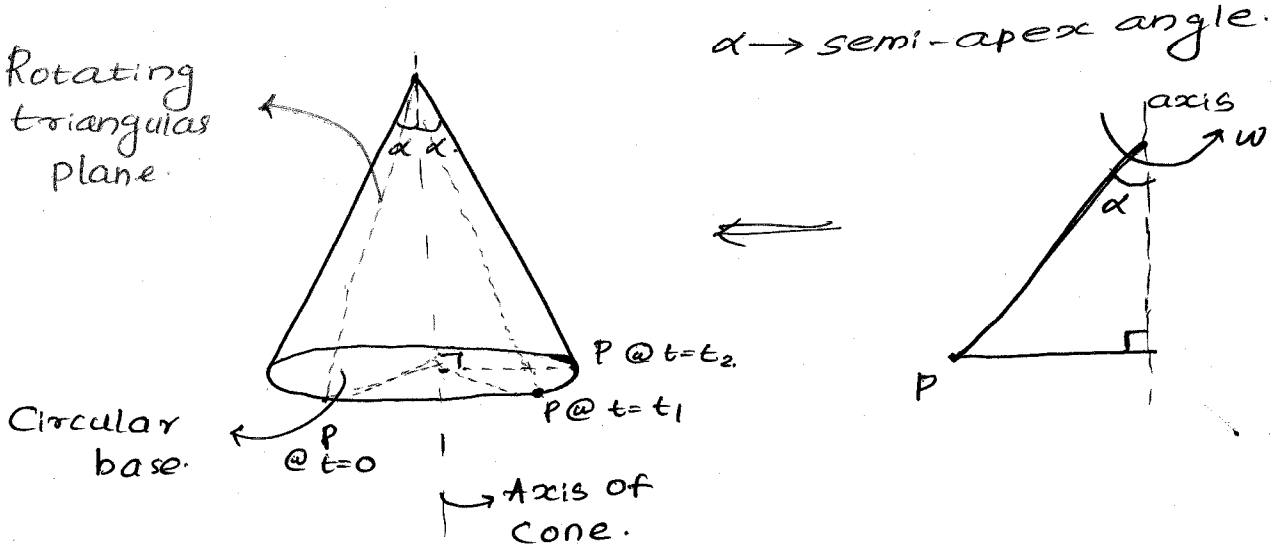
DRAWING

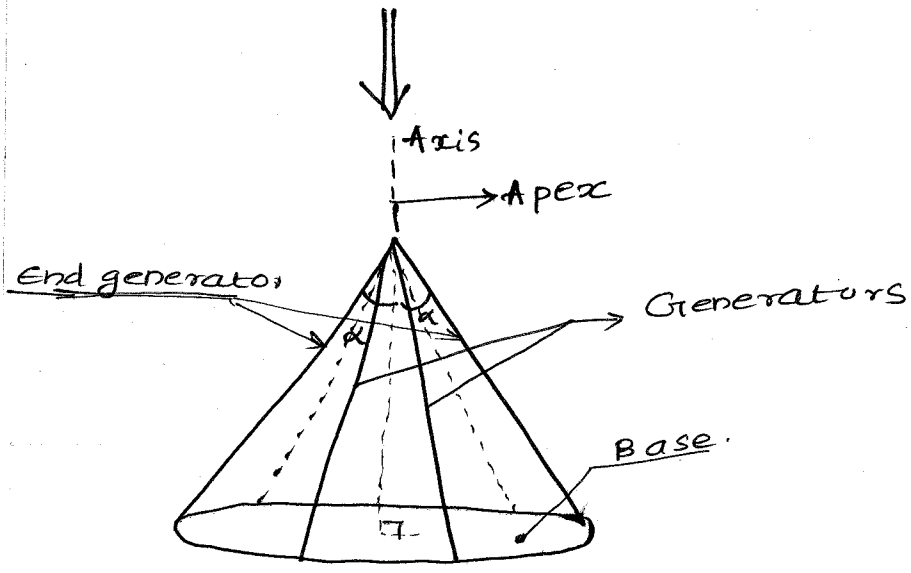
- Conic Section

I) Conic section defined as section of cone.

Basic concept:

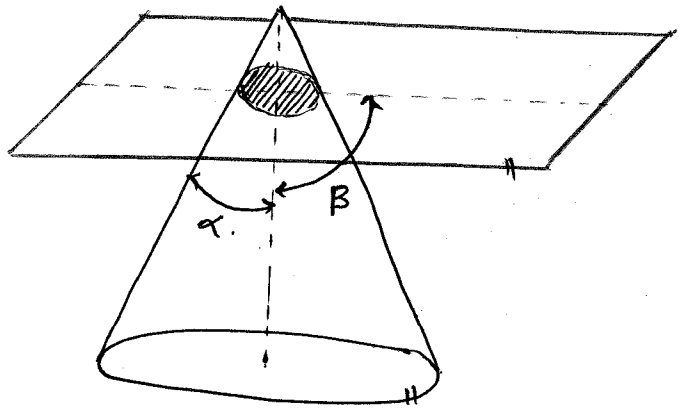
- formation of right circular cone.





Right circular cone.

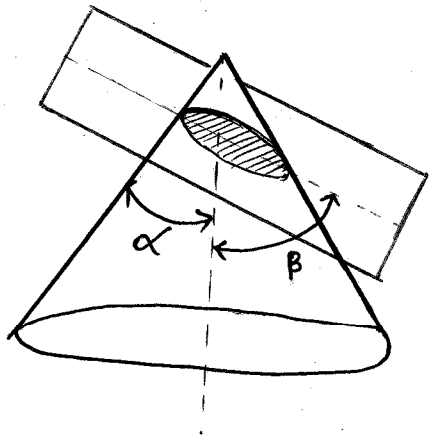
ⓐ CIRCLE



$\beta = 90°$

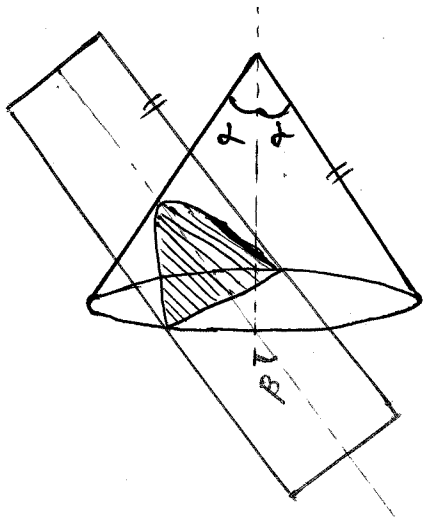
Section is parallel to base of cone.

ⓑ ELLIPSE



$\alpha < \beta < 90°$

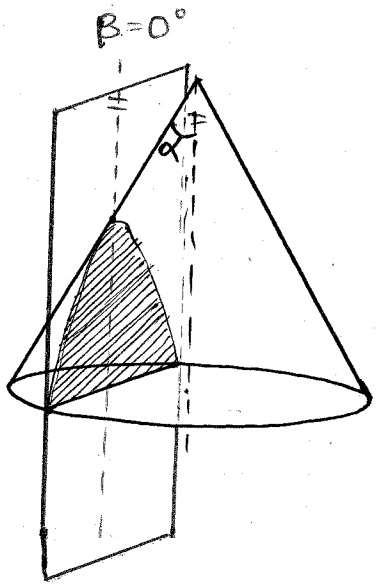
ⓒ PARABOLA



$\beta = \alpha$

Section plane is parallel to one of the end generator.

④ HYPERBOLA



$0 \leq \beta < \alpha$

Note:

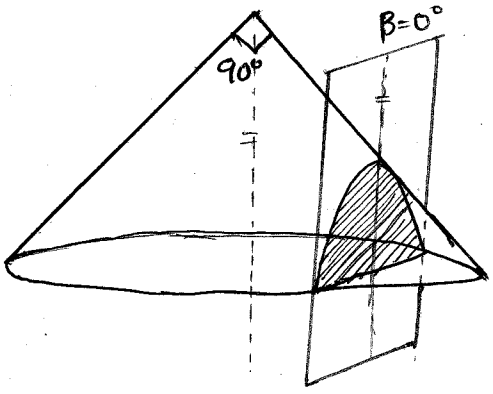
① Only circle & elipse cuts all the generators of the cone.

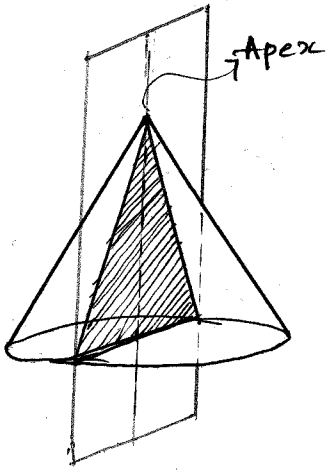
② A hyperbola becomes a rectangular hyperbola when

(i) Apex angle ; $2\alpha = 90°$

(ii) The section plane is parallel to the axis of cone, $\beta = 0°$

(iii) The section plane must not pass through the apex of cone.





③ If section plane passes through Apex of the cone then,

An isoceles Δle is formed

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ESE -2023 PRELIMS PAPER-1

Standards & Quality And Maintenance
By-Sagar Sonkar Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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Standards & Quality

Practises in production, construction maintanece & Services

By Sagar Sonkar

tel: Sagarsonkar

mail: Sagarsonkar@gmail.com

10 Q - 2 omarks

- Maintenance
- sampling
- Quality
- Quality control tool
- Process capability
- Six sigma
- TQM
- ISO
- Quality in construction
- Quality in service sector
- Inventory
- line balancing
- LPP

→ Mechanical - IE - Questions, Problems asked

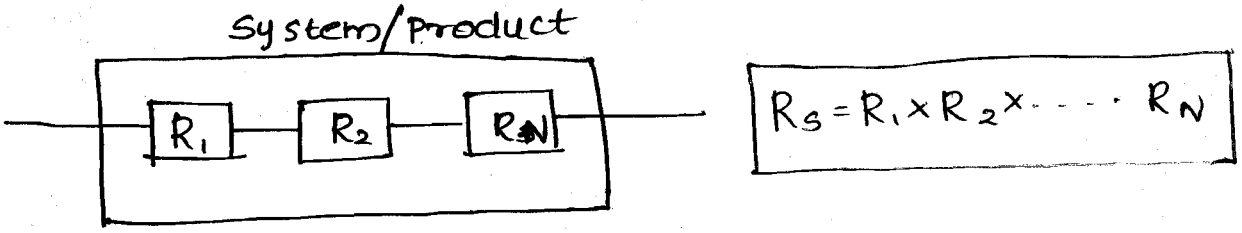
Lec 1

Maintenance.

Reliability

- Reliability is concept of Quality of performace
- No product is guaranteed with 100% certainity to function properly.
- However company know that high reliability is an important part of Customer oriented Quality and try to build it into the product design
- The reliability of system is depend on the reliability of individual components.

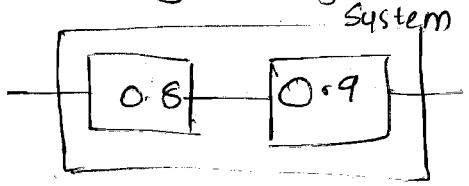
For series connection:



R_S ⟶ Reliability of system

R_1 ⟶ Reliability of component ① etc...

Problem 1: Assume that a product has two component both of which must work for the product to system. component 1 has reliability of 80% & component 2 has reliability of 90%. Compute the reliability of system



$R_S = R_1 \times R_2$

$= 0.8 \times 0.9$

$= 0.72$

$= \underline{72\%}$

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ESE-2023 GS PAPER-1

ENVIRONMENT

BY- Vinay Tripathi Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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Environment & Energy

Vinay Tripathi Sir
9899193917

⇒ Syllabus

** 1) Basics of Environment
2) Biodiversity
** 3) Environmental pollution (EP) & Environmental Degradation (E·D) } Applied in nature ∴ also helpful for current affairs (Air, water pollution, waste management)
4) Climate change & Global warming
5) Environmental Biotocol, Convention & Treaties (1 Question)
6) Ozone hole & Related issues.
7) Energy
8) Environmental Impact Assessment (EIA).

⇒ Marks

20% questions of Paper-I
↓
12 to 15 Questions.
eg- In 15 Qus
7 to 8 are conceptual & conventional
6-7 (concept + Current)

Current Affair
Made easy magzine (Annual)
(Paper ke 1 month phale tak ka padhale hai)

⇒ Study Materials

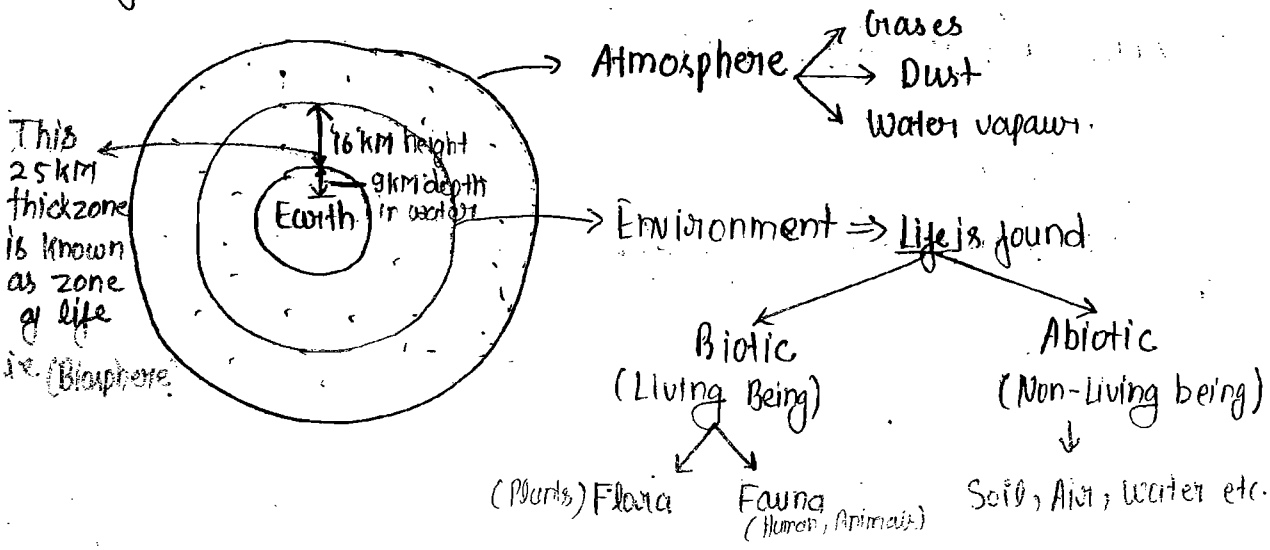
- Class notes
- Previous year questions
- Theory book
- Current Magzine

Chapter - 1 Basics of Environment

Environment ?

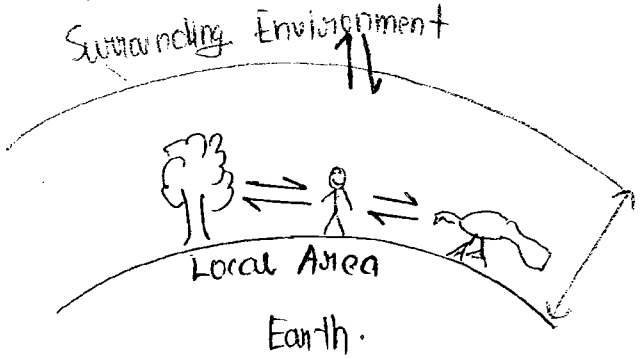
Definition - Environment has been derived from french word "Environner" / "Environ" which means to surround something.

Therefore, Environment refers, that surround of earth where life is found becz of favourable Biotic & Abiotic components / factors.



Ecology ⇒ Eco + logy

Eco → Environment
logy → Science



⇌ (Interaction)
⇓
Means exchange of energy & matters (eg- as food)

→ The word Ecology is Greek term.

→ Ecology is made from "Oikos" & "Logos" where Oikos means Habitat / Abode place (रहने का स्थान) & Logos means to study or describe.

→ The term "Ecology" was 1st time coined (& defined) by Ernst Hackel (German Scholar) in 1869 A.D.

Definition - Ecology is a science under which we use to study Interaction of Flora & Fauna among themselves & their combined interaction of Flora & Fauna with surrounding environment.

→ Approaches to study Ecology :-

- **Autecology** (Population Ecology) (meaning)
  - → Under it interaction is studied among individuals of same species. (like, Human - Human, Bird - Bird).
- **Synecology** (Community Ecology)
  - → Under it interaction is studied among individuals from different species. (like flora & fauna of diff. 2 species)

Ecosystem :-

→ Concept given by A.G. Tansley in 1935, However it was elaborated in detail by "E.P. Odum".

↓

known as father of Ecosystem, Ecology.

→ Ecosystem (kind of system in the environment).

↓

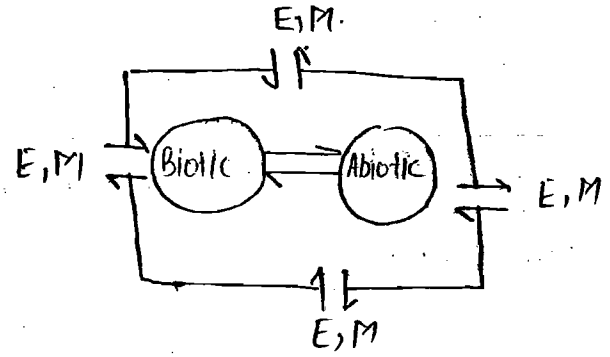
(Eco = Environment) + (System)

↓

System is an entity which is made from more than one elements where all Elements are interconnected with each other in such a way that if functioning of one element get affected then others are also affected.

(Ex - [illegible])

Definition – Ecosystem is a type of system which is mainly made from biotic & Abiotic components where they are related in such a way that they ... behave as one entity & Interact with their surrounding for exchange of Energy(E) & Matter (M). Therefore Ecosystem is an example of Open System.



E = Energy
M = Matter

Note –

⇒

Types of Systems	Circulating	Exist in
Open System	E, M	Nature
Close System	E, ~~M~~ – Stop	Lab
Isolated System	~~E, M~~ – Stop	Mental Map @ Imagination.

Thermoflask is an ex- of close system.

⇒ Types of Ecosystem –

(1) Natural Ecosystem

- Terrestrial Ecosystem (TE)
  - ex- Forest, Grassland, Desert etc.
- Aquatic ecosystem (AE)
  - ex- Ocean (Marine Ecosystem)
    - Seas
    - River, Lakes Ponds etc.

2) Artificial Ecosystem

- Terrestrial Ecosystem (TE)
  - ex- Zoo Garden etc.
- Aquatic Ecosystem (AE)
  - ex- Aquarium

[redacted] **Structure of Ecosystem**

(1) Biotic Components (Living being)

(a) Producer / Autotrophs
→ They make their food themselves.

Ex- Flora (Trees, Plants)

(b) Consumers / Heterotrophs
→ They can't make their food by themselves i.e, they are dependent on other for food intake.

Ex- Fauna (Human, Rabbit etc)

(2) Abiotic Components. (Non-living being)

(a) Physical Elements - Soil, air, water, Sunlight, temp etc.

(b) Energy -

(i) Inorganic Energy -
Ex - Nutrients like Manganese, N_2, Potash, Phosphorous, Sulphur etc.

(ii) Organic energy -

	Fat	Carbohydrate	Protein
1gm ⇒	9 calorie	4.5 calorie	4.5 calorie
	g fat	g carbohy.	g protien

(a) ⇒ Details of Producer / Autotrophs

(1) Phototroph
Are those living being who make their food in the presence of Sunlight i.e Their source of energy is Sunlight.

Ex Plant

(2) Chemotroph (नाले मे) (Found in stagnant water mainly)
Are those producers who make their food through chemosynthesis & chemical reaction is their main source of energy.

Ex - Cyanobacteria / Blue green Algae. Single celled Algae

(b) ⇒ Details of Consumers / Heterotrophs -

(1) Macro Consumer (becz. of large body size)

(2) Micro - consumer (becz. of small - size)

They are divided on the basis of:
- → Locomotion capacity ((kaun jada chal raha hai aur kaun kam))
- → Food intake habit
  - (Can eat all) Generalist
  - Specialist (They are choosy)

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ESE 2023 PRELIMS PAPER-1

PROJECT MANAGEMENT

By-AMIT DIXIT Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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UPSC
ESE 2022
Basics of Project Management
Lecture 1

By: Amit Dixit

What is Project?

- According to the **PMBOK** a project is "a **temporary endeavor** undertaken to **create a unique** project service or result"

- According to the Project Management Institute (PMI), the term Project refers to **"to any temporary endeavor with a definite beginning and end"**

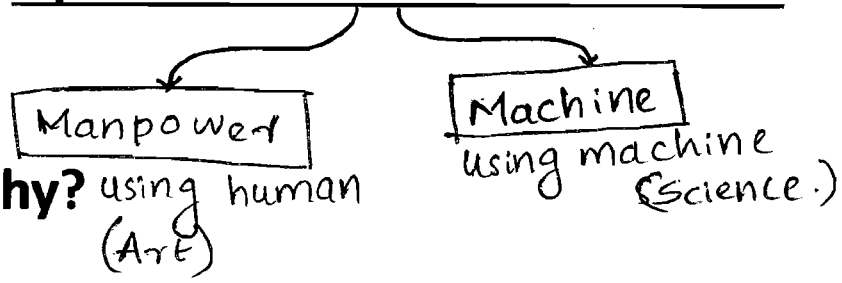
- **PMBOK - Project Management Body of Knowledge (book whose sixth edition was released in 2017, Originally published in 1996)**

What is Project?

- Temporary endeavor
- Unique creations
- Group of well defined sequence of activities
- Having goal/ goals to meet organization's needs
- Having Time Limitation

What is Project Management?

- A temporary endeavor undertaken to create a unique product or service by "**Optimal utilization of resources**"



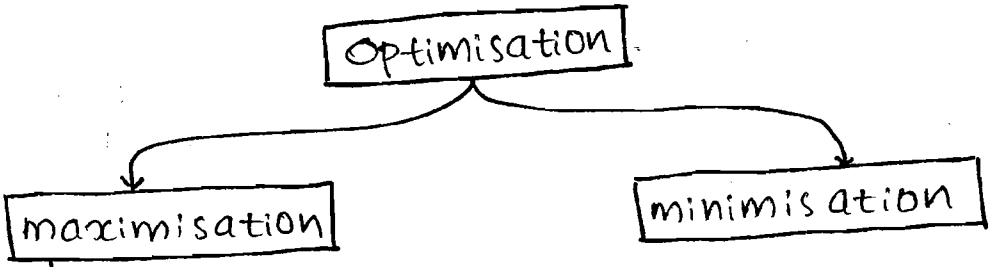
Both Art & Science. Why?

Optimal Utilization of Ms

- Man
- Machine
- Material
- Method
- **Money**

⇒Use this for better utilization of Mankind

⇒Very important it is



↳ Quality should be maximised up to a certain level

Project in Loss

- Total Revenue = 90 Crores
- Total completion cost = 95 Crores

→ 85 Crore: Material
→ 10 Cr - Manpower salary

for example "BHEL" - Govt company

↓

Lack of projects → Manpower & M/c are idle.

What to do??

If not taken project - 10 cr loss
If taken - 5 cr loss.

∴ We should take project [save 5cr]

Note: cost price = 80/-
Selling price = 100/-

turnover (Revenue) = 100/-
Profit = 80/-

Project's Major Characteristics

A clear start and end date

A project has boundaries : we will be having limited resources

A project creates something new

A project is not business as usual

painter: exception.

A painting artist (Renowned) — his/her each work is project as it sells its business.

Other Characteristics of Project

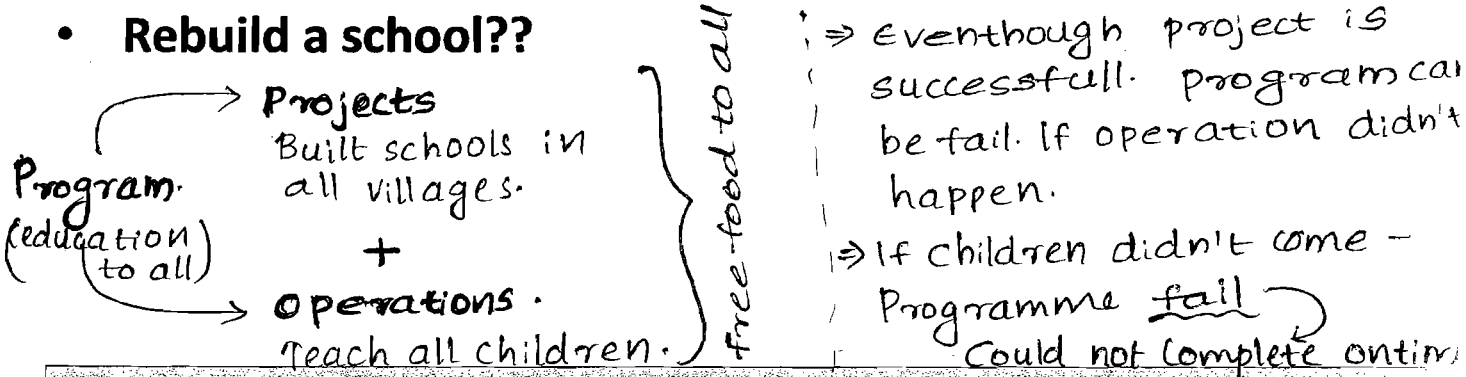
1. **Skilled Staff**
2. **Coordination** : Very major issue.
3. **Made to order**
4. **Subcontracting**
5. **Risk and uncertainty** : Can see everywhere.

Difference between Program & Project

Programs focus on the coordination of a number of related projects and other activities, over time, to deliver benefits to the organization

- Program is "a portfolio of projects and activities that are coordinated and managed as a unit such that they achieve outcomes and realize benefits" – **Disaster Relief Program**

- Projects are focused on the efficient creation of outputs; programs are focused on delivering outcomes
- **Rebuild a school??**



Four Dimensions of a Project

- Inherent size (usually measured in terms of value)
  - Money
  - time.

a • The degree of technical difficulty in creating the output – ISRO

- The complexity of the relationships with the stakeholders (ego)

b • The degree of uncertainty involved in the work – ISRO.

a'b – tunnel making @ hill

b'a – Powerplant

⇒ Any person who is benefited – +ve stake holder

⇒ Any person opposite going down – -ve stake holder

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ESE -2023 PRELIMS PAPER-1

Basic Of Material Science
By-Suneel Tiwari Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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Basics of Material Science

50 - 150.

Source of study: -Suneel kumar Tiwari

(1) class notes.
(2) Theory book → compulsory
(3) Workbook → Questions
(4) Test series → Questions (Telegram channel)

Content:

1. Introduction
2. Atomic structure & Chemical bonding.
3. Crystallography.
4. Electric properties of materials
5. Magnetic properties of materials
6. Mechanical properties of material
7. ceramics
8. polymers.
9. composites
10. Phase diagram and Alloys

} Theory book + Video lecture

Contact

Whatsapp: 7982814980

Telegram: t.me/anunadd22

Anunaad..... let's be in Resonance

Chapter 1 Introduction

What is material science?

→ Material science involves ~~in~~ investigating the relationship that exists b/w the structure & properties of materials.

↳ In contrast, material engineering deals with the study of behaviour of engineering components such as vehicle facilities, machines, building etc.

Material

↳ It is defined as something which consists of matter.

↳ It is the stuff with the help of which something can be made.

↳ Engineering materials can be classified as

① Metals & alloys
② Ceramics & glasses
③ organic polymers.
④ Composites

Structure

↳ The structure of material relates to the arrangement of its internal components.

↳ Structures can be classified as:

@ Nuclear structure: It tells about the number of Protons & Neutrons in the nucleus. It is studied by Nuclear Spectroscopic techniques such as Nuclear Magnetic Resonance (NMR) and Mossbauer

(b) electronic structure:

It tells us about the arrangement of electrons in the various orbits of atoms that constitute the solid.

(c) Crystal structure:

⇒ It tells us about the atomic arrangemei within a crystal.

⇒ In a crystal, atoms are arranged in regular and periodic manner.

⇒ The crystal structure is studied with the help of a unit cell.

⇒ Unit cell is the smallest group of atom by repeating which in all directions periodically, the crystal structure can be developed

(d) Micro structure:

⇒ It is observed under the optical microscope which can magnify a structure upto about 1500 times without loss of information.

⇒ Structures obtained by using a microscope with a much higher magnification than the optical microscope such as structure obtained in electron microscop which is 1000000 ~~mg~~ times magnified is known as substructure.

(e) Macro structure:

⇒ structure which can be observed with bake eye is known as macro structure.

⇒ The internal symmetry of crystalline material may reflect in the external

Form of crystal also.

Property

A property is a material character in terms of the kind and magnitude of response to a specific imposed stimulus (excitation).

Properties of solid material can be-

① Mechanical property.
② electrical property
③ Magnetic property
④ Thermal property
⑤ optical property
⑥ Deteriorative property

ESE

21. Consider the following statements:

1. Material science deals with strength & stiffness behaviour of components (concrete, iron. Buildings, machines, Vehicle facilities etc) based on their respective to imposed stresses (forces, moments, torque etc)

2. Material properties are dependent on their microstructure and response to force field and surface interactions.

Which above statements is/are correct

ⓐ 1 only ⓑ 2 only ⓒ Both ⓓ Nota

Ans: ⓑ

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I.C.T

By-Saurbh Pandey Sir

- Theory
- Explanation
- Derivation
- Example
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- Previous Years Question With Solution

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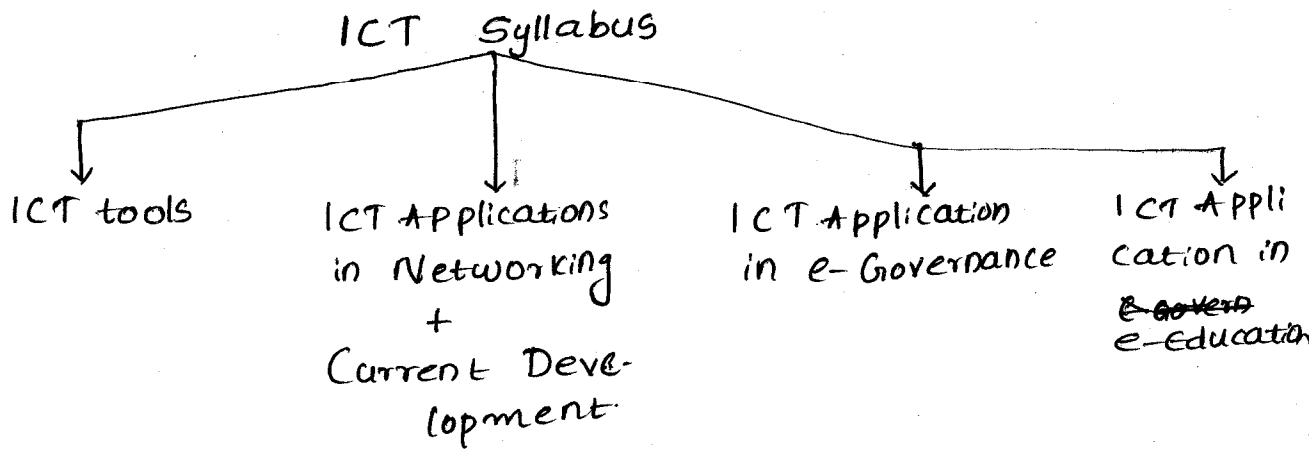
ICT

by Saurabh pandey
9646269236 (whatsapp)

→ ~~Applications~~ of Information and communication in the field of e-Governance, networking and e-Education.

① ICT tools
② e-Governance
③ Networking
④ e-Education.



ICT applications in e-Governance

Governance:
Broomo

A good governance means 'maximum benefits' for maximum number of people.

1999: Under the chairmanship of Sri Atal Bihari Vajpayee It was decided that 'Good Governance can't become succesful until & unless we have e-governance.

[25th Dec : Good Governance Day]

2000 : IT act was launched. (Information Technology Act) → start of e-Governance in India

A new ministry MoICT (Ministry of Information and communication Technology) was started

3 departments under this ministry.

- Deptt. of IT
- Deptt. of Telecommunication
- Deptt. of Post

2015 - MoICT →
- MeITy : Min. of electronics & Information Tech ★
- MoCB : Min. of communication & Broadcasting.

IT ACT, 2000

→ IT Act 2000 was launched in very basic clause.
- No punishment provision, no social media, digital payment system, no e-commerce clause was mentioned in it.

- Even today, Same IT Act is followed. Which is very weak.

Amendments in IT Act 2000:

- Amendment was brought in year 2008.
- By this amendment, clause (A) was added in Sec. 66.
- U/s 66(A): It says that if any person/group harms the image of another person such as public figure, historical figure, religious figure, women's dignity, child's pornography on social media then, it will be considered as a criminal offence.

  Directly he/she will send to jail and only comes out when he gets bail.

  (But Misused) ⟶ Clause Removed.

  As civil offence.

- In 2017, (A) of Sec. 66 was abolished on the basis that ~~right~~, as it violates the right to freedom of speech and expression.

  Right to say/comment on any politician, expression to say against / No (Not for foreigners)

- OTT (Over The Top) platform such that Netflix, Amazon prime etc. need to be brought under an unified rule, so that unwanted content can be checked.

Data Privacy & Data Security

→ for data privacy and data security, Sri. krishna committee was established, This report says :- [Sri. B.N Sri krishna]

① All internet based platform that are engaged in collecting critical data of the person then, such platform must have their data centres within the Indian boundary.

Any such data which indicates private information of a person or should not be made public.

Critical data
↳ Private data (Bank password, balance, PIN)

It is also called as Localisation of data so that IT act can be made applicable on it.

② An authorised govt. agency will check these data centres and if it finds any such data which is against the peaceful harmony of country or against the security of country then such data would be detected from their source.

Note: IT based companies are opposing it on the basis that it violates the right to privacy of the people.

③ If any organisation stores / transfers people's data then it requires prior permission.

Note: Now data becomes a commodity

→ In **2020-21** these clause made applicable for OTT Platform also

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ESE-2023 Prelims Paper-1
Ethics & Values
By-Saurbh Pandey Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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D , E /E / **4.** / E /E /
/E D E /KE E /E / **6.** KD /

,GATE , TEST @

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- **GATE**

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Lec 1

Ethics for ESE-2023 Prelims.

10-11 questions.

-by Saurabh Pandey

① Public welfare is superior/has more priority than personal welfare/Interest/Values.

#Ethics

⇒ It refers to principles of action that implemen or promote moral or ethical values.

⇒ Moral Value refers to the standard of right conduct.

⇒ Ethics gives a sense of responsibility it implies the willingness to accept the conss quences of action.

⇒ For a profession like engineering, ethics draws on line what is right & what is wrong and also abo ut what is important

⇒ Ethics is a prescription of do's & dont's and it tells about the prohibition & conduc

⇒ The ethical values are derived from the philosphical thoughts, religious values, traditions from the society, law, and also from modern scientific development

Why ethics should be followed ?

⇒ Ethics is a reflection of people's decisio values & principles

⇒ It is a branch of philosphy that aim. to answer what is right & what is wrong and also about what should I do in a given situation

Types of ethics.

- 4 types of ethics

① Normative Ethics
② Applied Ethics
③ Descriptive Ethics
④ Meta ethics.

① Normative Ethics means doing to others what we want others to do to us

for eg: If you do not want others should lie to you then you should also do not lie to them. Or if you do not want others to be dishonest to you then do not be dishonest to others.

② Applied ethics:

eg: ① Suicide is a criminal offence (now it is not criminal off)

② Abortion: should be allowed or not.

③ Foeticide: Gender selective foeticide is considered as a criminal offense.

④ Euthenasia: Mercy killing for a person who is in vegetative state. Mercy killing is allowed on the basis that the person

- Applied ethics means the branch of ethics that consist of the analysis of specific controversial and moral issues.
- It helps to identify the relative issue and ask what is right (or) wrong in a particular situation & attempts to provide answer to it.
- Absortion: In many countries it is not allowed since it is considered as equivalent to taking another life.

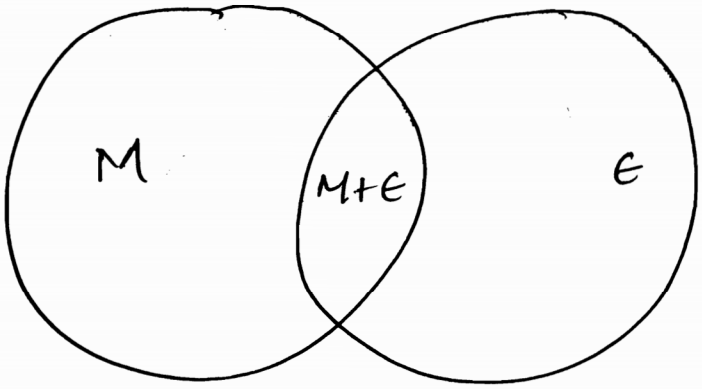
⑤ Capital punishment is opposed by many countries because these countries say that since human can not give life to anybody ∴ we should also not take anybodys life. While some countries allows capital punishment on the basis that capital punishment is on the basis of it is according to the sense of justice.

⑥ Digitalisation / Digital technology: has created a privacy issue

③ Descriptive ethics: is a part of comparitive ethics where the ethics of one society varie with the ethics of another society.

④ Meta ethics: talks about the nature of morality. It asked question such as ethical values are human created and therefore only those ethical values are correct that are naturally occcuring.

Morality Vs Ethics



⇒ Morality ⟶ Individual
Ethics ⟶ People/Society

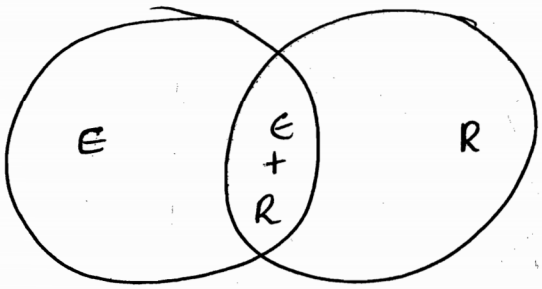
⇒ Morality is considered as good values / good conduct that applied on individual / self.

⇒ Ethics is considered as good values / good conduct that ~~mora~~ applied on society / people.

⇒ for an engineer / professional ethics is superior than morality.

⇒ Morality are the good values that applies for individual.

Ethics Vs Religion.



MATHEMATICS

GATE → 13-15 M

ESE → 15 Questions

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Syllabus:

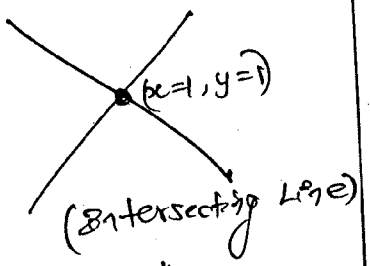
1. Linear Algebra
2. Probability
3. Calculus
4. Vector Calculus
5. Differential Equation
6. Complex number
7. Numerical Methods.
8. Laplace Transform.
9. Fourier Series

* LINEAR ALGEBRA :

study of Linear system of equation :

$x+2y=3 \rightarrow (1)$

$2x+3y=5 \rightarrow (2)$



(Intersecting Line)

⇓

Unique soln

$x+2y=3 \rightarrow (1)$

$2x+4y=6 \rightarrow (2)$

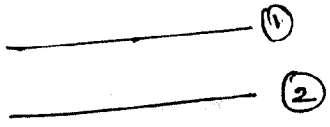
Coincident Line

⇓

Infinite soln

$x+2y=3 \rightarrow (1)$

$x+2y=5 \rightarrow (2)$



Parallel line

⇓

No solution.

If there are more than two variables

⇓

we cannot plot graph and prove about the soln

⇓

∴ To get soln → we find Rank

⇓

∴ we study Matrix, in Linear Algebra

Matrix :

$A = [a_{ij}]_{m \times n}$ → No. of rows → horizontal

$m \times n$ → No. of column → vertical

a_{ij} ⇒ Element of matrix

$i \rightarrow$ row $j \rightarrow$ column

R → Row
C → column

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}_{m \times n}$$

$R_1, R_2, \ldots, R_m$

$C_1, C_2, \ldots, C_n$

(i) If $m \neq n$ ⇒ Rectangular Matrix

(ii) If $m = n$ ⇒ Square matrix

↓

Diagonal element exist only in square matrix.

↓

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{21} & a_{22} & a_{33} \end{bmatrix}$$

principal diagonal
main diagonal
leading diagonal
primary diagonal
diagonal elements

Trace of A = Sum of main diagonal elements

↓

$Tr(A) = \sum a_{ij} \quad \forall \; i = j$

(i) for diagonal element $\Rightarrow i=j \ \forall i,j$

(ii) for lower diagonal element $\Rightarrow i>j \ \forall i,j$

(iii) For upper diagonal element $\Rightarrow i<j \ \forall i,j$

(iv) for other than diagonal element $\Rightarrow i \neq j, \forall i,j$

(or)

off diagonal element

(v) corresponding element $= a_{ij} \& a_{ji} \ \forall i,j$

Ex: $a_{31} \& a_{13}$

$a_{23} \& a_{32}$

---

* Diagonal Matrix :

All off diagonal element = 0 & Atleast one diagonal element must not be zero

eg:

$$\begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}, \quad \begin{bmatrix} a & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

(non-zero)

where a, b, c are non-zero.

Pb: Minimum no. of zeroes in diagonal matrix of order 'n'?

Minimum No. of zeroes = total no. of element − no. of primary diagonal element

$= (n \times n) - n$

$= n^2 - n = \boxed{n(n-1)}$

** ∴ Minimum no. of zeroes $= n^2 - n$

Max no. of zeroes $= n^2 - 1$ **

* Identity Matrix :

$I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, $I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

I_n = Identity matrix of order n

* Scalar Matrix :

$A = K \cdot I$

Ex: $\begin{bmatrix} 7 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 7 \end{bmatrix} = 7I_3$

Note :
All Scalar Matrix are Diagonal matrix but
All Diagonal matrix are Not Scalar matrix

* Upper Triangular Matrix : (UTM)

$A = [a_{ij}]_{m \times n} \Rightarrow a_{ij} = 0 \ \forall \ i > j$

Ex: $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 0 & 0 & 6 \end{bmatrix}$

* Lower Triangular Matrix (LTM) :

$A = [a_{ij}]_{m \times n} \Rightarrow a_{ij} = 0 \ \forall \ i < j$

Ex: $\begin{bmatrix} 1 & 0 & 0 \\ 2 & 3 & 0 \\ 4 & 5 & 6 \end{bmatrix}$

* Column matrix : (Column Vector)

$A = [a_{ij}]_{n \times 1}$

Ex: $\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \end{bmatrix}_{4 \times 1}$

ONLY ONE COLOMN

* Row matrix : (Row Vector)

$A = [a_{ij}]_{1 \times n}$

$A = [1 \quad 2 \quad 3 \quad 4]_{1 \times 4}$

ONLY ONE ROW

* Transpose matrix (A^T)

$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \Rightarrow A^T = \begin{bmatrix} 1 & 4 & 7 \\ 2 & 5 & 8 \\ 3 & 6 & 9 \end{bmatrix}$

* Symmetric Matrix :

* $A^T = A$

* $a_{ij} = a_{ji}$

Ex: $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$

* Skew-symmetric matrix:

**

$$A^T = -A$$

$$a_{ij} = -a_{ji} \quad \forall\, i \neq j$$

$$A = \begin{bmatrix} 0 & 2 & 3 \\ -2 & 0 & 5 \\ -3 & -5 & 0 \end{bmatrix}$$

$$A^T = \begin{bmatrix} 0 & -2 & -3 \\ 2 & 0 & -5 \\ 3 & 5 & 0 \end{bmatrix}$$

* All leading diagonal elements must be zero

$$A^T = \begin{bmatrix} 0 & 2 & 3 \\ -2 & 0 & 5 \\ -3 & -5 & 0 \end{bmatrix} = -A$$

Note:

Sum of all elements of skew symmetric matrix = ZERO

Ex: $A = \begin{bmatrix} 2 & 5 \\ 6 & 8 \end{bmatrix}$; $A^T = \begin{bmatrix} 2 & 6 \\ 5 & 8 \end{bmatrix}$

$$\frac{A+A^T}{2} = \frac{1}{2}\begin{bmatrix} 4 & 11 \\ 11 & 16 \end{bmatrix} = \begin{bmatrix} 2 & 11/2 \\ 11/2 & 8 \end{bmatrix} \rightarrow (1) \rightarrow \text{symmetric matrix}$$

$$\frac{A-A^T}{2} = \frac{1}{2}\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & -1/2 \\ 1/2 & 0 \end{bmatrix} \rightarrow (2) \rightarrow \text{skew symmetric matrix}$$

$$(1)+(2) \Rightarrow \begin{bmatrix} 2 & 5 \\ 6 & 8 \end{bmatrix} = A$$

***

$$\therefore \boxed{A = \left(\frac{A+A^T}{2}\right) + \left(\frac{A-A^T}{2}\right)}$$

Any square matrix = symmetric matrix + skew symmetric matrix

Note:

Every square matrix can be expressed as the sum of symmetric & skew-symmetric matrix.

* Singular matrix: $|A| = 0$

* Non singular matrix: $|A| \neq 0$

* Invertible matrix

⇓

A^{-1} exist

$$A^{-1} = \frac{\text{Adj } A}{|A|}$$

A^{-1} exist only when $|A| \neq 0$ (i.e non-singular)

* Complex matrix :

$$A = \begin{bmatrix} 1+i & 3-2i \\ 2+i & 5 \end{bmatrix}$$

Conjugate of A ⇓ $\bar{A}$ $= \begin{bmatrix} 1-i & 3+2i \\ 2-i & 5 \end{bmatrix}$

Conjugate transpose $(\bar{A})^T$ (or) $A^\theta = \begin{bmatrix} 1-i & 2-i \\ 3+2i & 5 \end{bmatrix}$

* Hermitian matrix :

$(\bar{A})^T = A$

$a_{ij} = \bar{a}_{ji}$

Main diagonal Element are "purely Real"

ex: $A = \begin{bmatrix} 4 & 1+i \\ 1-i & 5 \end{bmatrix}$

* Skew-Hermitian Matrix:

$(\bar{A})^T = -A$

$a_{ij} = -\bar{a}_{ji}$

Main diagonal Element are "zero (or) purely Imaginary"

Ex: $A = \begin{bmatrix} i & -1+i \\ 1+i & i \end{bmatrix}$

* operation of matrix :

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \quad ; \quad B = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$$

* Addition :

$$A+B = \begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix} = B+A$$

$\boxed{A+B = B+A}$ ← Cummulative (two matrix)

$\boxed{A+(B+C) = (A+B)+C}$ ← Associative (three matrix)

Addition operation are cummulative & Associative

* Subtraction :

$$A-B = \begin{bmatrix} -4 & -4 \\ -4 & -4 \end{bmatrix} \quad ; \quad B-A = \begin{bmatrix} 4 & 4 \\ 4 & 4 \end{bmatrix}$$

$\boxed{A-B \neq B-A}$

Subtraction is Neither cummulative Nor Associative

* Scalar Multiplication :

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \qquad B = kA \Rightarrow B = \begin{bmatrix} ka_{11} & ka_{12} \\ ka_{21} & ka_{22} \end{bmatrix}$$

k ↓ scalar

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ENGLISH

* 1. Correction of sentences.
* 2. Vocabulary
3. Critical Reasoning.
4. Analogy.

1. Question Tag
2. Usage of
   a) As soon as
   b) No sooner than
   c) Hardly when
   d) Scarcely when / before
3. Degree of comparison
4. Articles.
5. Tenses + If clause.
6. Reported speech.
7. Preposition
8. Parts of speech.
9. Concords and corrections.

Sentences: 4 kinds

(i) Assertive → Positive / Negative

(ii) Introgative

(iii) Imperative

(iv) Exclamatory

Special verb (24)

am, is, are, was, were

has, have, had, do, does, did

may, might, must, need, dare

used to, ought to

will, would, shall, should, can, could.

Negative:

To make a negative sentence, put not after the special verb.

Introgative:

To make an introgative sentence, put the special verb at that starting of the sentence.

Example: Dhoni is a perfect Gentleman (Positive)

Dhoni is not a perfect Gentleman (Negative)

Is Dhoni a perfect Gentleman (Introgative)

Non special Verb:

borrow: do / does / did

do: Present tense without 's'

does: present tense with 's'

did: Past tense.

NOTE: When we borrow do, does and did put the root verb in negative and introgative.

Example: He goes to temple.

He does not go to temple.

Does he go to temple ?

Example: He went to temple.

He did not go to temple.

Did he go to temple ?

DO, Does, Did, these three always take root verb.

Question Tag

After giving a statement we sometimes confirm if the listener is accepting or not with out statement. This confimation is called Question Tag.

NOTE: Question Tags are of mainly two kinds:

(i) To a positive statement, Negative Tag is added.

Only short forms are used.

In the place of nouns use pronouns.

Question tag should be ended with ~~special verb.~~ pronoun.

Example: The clock is running fast, isn't it ?

I am a teacher of English, aren't I ?

We are the ilk of middeeasy, aren't we ?

↓

meaning: family

My ~~drive~~ neighbour comes tomorrow, does n't he ?

If the gender is not specified give preference to male.

All the students went to picnic, did not they.

(ii) If the statement is negative, the question tag is ~~negative~~ positive.

Example: I am not a teacher of English, am I?

My friend does not know the address, does he?

Formula: Special verb + pronoun.

Usage of:

Hardly, rarely, scarcely, barely, never, seldome

NOTE: These words always give negative sense. In the case of these words, the question tag is +ve.

Example: He hardly comes to my house, does he?

Barking dogs seldom bite, do they?

They never came to my house, did they?

Usage of:

have, has, had

These three act as two kinds:

(i) main verb (give the meaning of possessing)

(ii) Special verb (does not give any meaning)

Example: He has (m.v) a car, ~~does he?~~ doesn't he?

He has (s.v.) purchased a car, hasn't he?

He had (s.v) solved the problem, hadn't he?

He had (M.V) a problem earlier, didn't he?

Usage of

Everyone, Everybody, Someone, somebody, noone, nobody.

NOTE: These six ~~verb~~ words take singular verb at the time of statement but in question tag, these words take plural verb.

In the place of all these words we have to write they.

Singular verb	Plural verb
is	are
was	were
has	have
does	do

Example: Everyone is coming, ~~isn't everyone~~ X
aren't they ?

Everyone likes music, don't they ?

Every one has mobile, don't they ?

Every one has given mobile, haven't they ?

None is coming, aren't they ?

No one supports curruption, do they ?

10/10/2021

Usage of

a few = positive
few = Negative

a little = positive
little = negative

Example: He asked me a few books, didn't he ?

He asked me few books, did he ?

He wants a little, doesn't he ?

He wants little, does he ?

Usage of

making imperative in as question tags.

Imperative:

Rule:

1. Subject YOU in absent (But the meaning is implied in it)
2. Sentence begins with V_1
3. Expresses command or request

NOTE: Imperatives generally take will you in question tags.

Example : come here, will you ?

A sentence that is satisfied with these three rules is called imperative.

Example: Go there , will you ?

Don't come here, will you ?

Shut up , can't you ? } ← Expresses command only.

Get lost , can't you ? }

Keep silence, can't you ? }

* If the statement begins with Let's or Let us , the question is always "shall we?"

Example: Let's staut the work, shall we ?

Let's not staut the work, shall we ?

* Let him go, will you ?

* If the statement begins with so ,a) to a positive statement Question tag is also positive.

b) to a negative statement . Question tag is also negative.

Example:

So, you are coming, are you?

So, you are not coming aren't you?

Usage of a) as soon as

b) No sooner than

c) Hardly-when

d) Scarcely - when / before

These four words are called Idiomatic Expression. These four words give the same meaning. i.e. "immediately".

Usage of No-sooner than:

No sooner connects with than

Rules: 1. put no sooner in the place of as soon as.

2. Change the as soon as into introgative form.

3. Put than before the second sentence.

Example: As soon as I went home, I had rest.
No sooner did I go home than I had rest. } same meaning

As soon as the baby sees the doctor, she will cry.

No sooner does the baby see the doctor than she will cry.

Usage of hardly when:

1. Put hardly in place of as soon as.
2. Change the as soon as sentence into had + V_3 form and then change into introgative form.
3. Put when before the second sentence.

Example:

As soon as I went home, I had rest.

Hardly had I gone home when I had rest.

Usage of scarcely $\frac{\text{when}}{\text{before}}$

Rule: The same rules of hardly - when are applicable.

Example: As soon as the principal enterned the class room, all the students stood up.

Scarcely had the principal entered the classroom when all the students stood up.

→ As soon as he had explained the topic, students felt happy

No sooner, had he explained the topic than students felt happy.

Scarcely had he explained the topic when students felt happy.

Hardly had he explained the topic when students felt happy.

Degree of comparision:

Three forms of the objective and adverbs are called as "Degree of comparision."

a) Positive degree — 1. as-as (accepting sense)
2. so-as (negative sense)

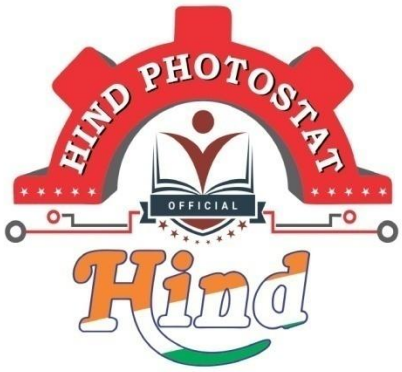
b) Comparative degree — (Takes than.)

c) Superlative degree — (Takes the)

Important pt.

i) Positive degree, comparative degree sensentces are alway ended with the special verb.

ii) Positive degree comparative degree sentences always take subjective person.



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