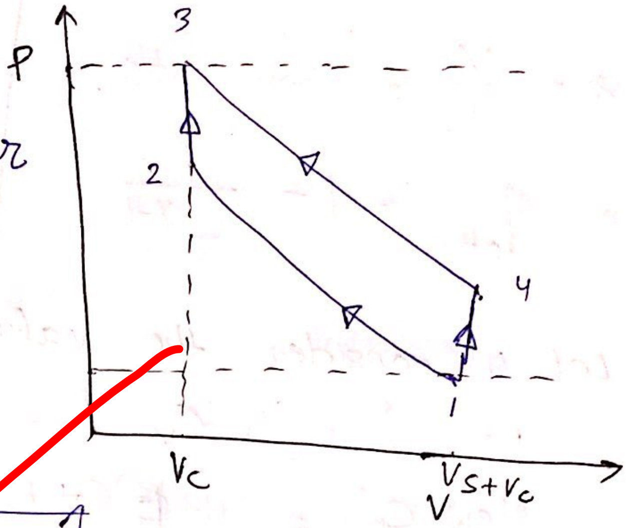
Total marks-234
Very good performance
Keep it up

1(a) <u>Otto cycle.</u>



Compression Ratio $= \frac{V_1}{V_2} = r$

then efficiency of otto cycle is given by

$$\eta_o = 1 - \frac{1}{r^{\gamma-1}}$$

$\gamma \rightarrow$ ratio of specific heat

Let C_v is changed by $p\%$. then New C_v

New C_v $\quad C_v' = C_v \cdot p + C_v$

New C_p $\ni$ $C_p' = C_v' + R$ $\quad$ [since R remains constant]

$$C_p' = C_v p + R + C_v$$

$$\text{new } \gamma' = \frac{C_p'}{C_v'} = \frac{C_v(p+1) + R}{C_v(p+1)}$$

$$= 1 + \frac{R}{C_v(p+1)}$$

$$\gamma' = 1 + \frac{(\gamma-1)}{p+1}$$

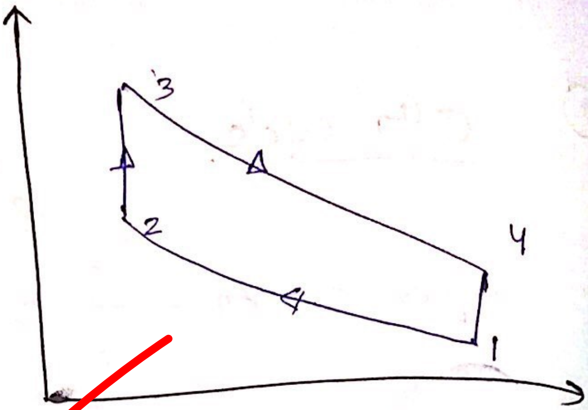
$$\gamma' - 1 = \frac{\gamma-1}{p+1}$$

$$\gamma' = \frac{p+\gamma}{p+1}$$

$$\eta_o = 1 - \frac{1}{r^{\left(\frac{\gamma-1}{p+1}\right)}}$$

1(a)

Otto Cycle



$r = \frac{V_1}{V_2}$ = Comp ratio.

Then. $\eta_{otto} = 1 - \frac{1}{r^{\gamma-1}}$

* Let us consider the value of C_v changes by p%

New $C_v' = (1+p)C_v$ — ①

New $C_p' = (1+p)C_v + R$ — ②

$\frac{②}{①} = \frac{C_p'}{C_v'} = \frac{(1+p)C_v + R}{(1+p)C_v} = 1 + \frac{R}{C_v(1+p)}$

$\left(\because \frac{R}{C_v} = \gamma-1\right)$

New $\gamma' = 1 + \frac{\gamma-1}{1+p}$

$$\boxed{\gamma' - 1 = \frac{\gamma-1}{1+p}}$$

New otto cycle efficiency

$$\boxed{\eta_{o,N} = 1 - \frac{1}{(r)^{\frac{\gamma-1}{1+p}}}}$$

% change in efficiency $= \frac{\eta_{o,N} - \eta_o}{\eta_o} \times 100$

$$= \frac{\left(1 - \frac{1}{r^{\frac{\gamma-1}{1+p}}}\right) - \left(1 - \frac{1}{r^{\gamma-1}}\right)}{\left(1 - \frac{1}{r^{\gamma-1}}\right)} \times 100$$

$$= \frac{\frac{1}{r^{\gamma-1}} - \frac{1}{r^{\frac{\gamma-1}{1+p}}}}{1 - \frac{1}{r^{\gamma-1}}}$$

Multiplying by $r^{\gamma-1}$

$$\frac{1 - r^{\gamma-1} - \frac{\gamma-1}{1+p}}{r^{\gamma-1} - 1}$$

$$\% \text{ change in } \eta = \frac{1 - r^{p(\gamma-1)}}{r^{\gamma-1} - 1} \times 100$$

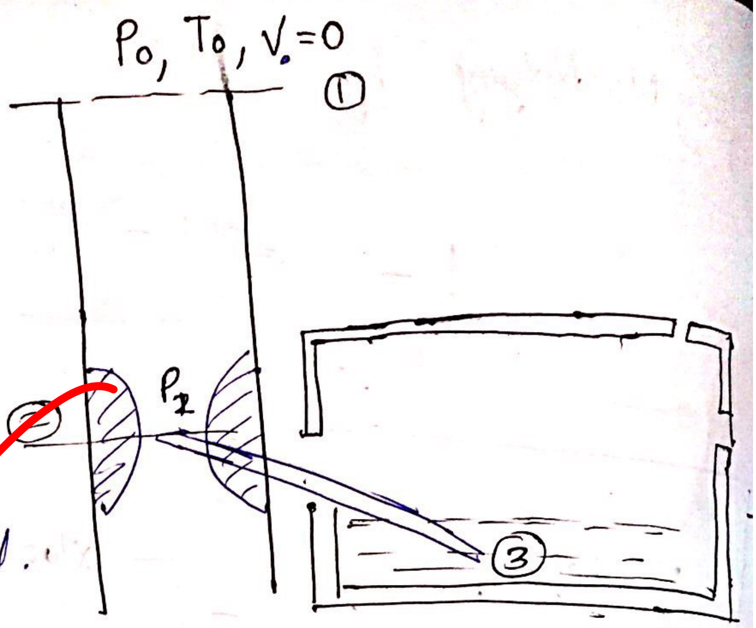
$p = 0.02$, $r = 8$

$$\% \text{ change in } \eta = \frac{1 - 8^{0.02(1.4-1)}}{8^{1.4-1} - 1} \times 100$$

$= -1.2929\%$ (decrease by 1.2929%)

12

1(b)



$P_0, T_0, V_0 \Rightarrow$ Pressure, Temp & velocity of Atmp air

$P_0 \downarrow$ Patmp

$P_2, T_2, V \Rightarrow$ " " " @ throat area

→ Assuming air to be incompressible & inviscid.

App. B.E^n b/w 1 & 2.

$$\frac{P_{atm}}{\rho g} + \frac{V_0^2}{2g} + Z = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2$$

$$V_2 = \sqrt{\frac{2(P_{atmp} - P_2)}{\rho}}$$

$$(V_2)_{actual} = C_v \sqrt{\frac{2(P_{atm} - P_2)}{\rho}}$$

mass flow rate of air $\Rightarrow \rho_a \cdot \frac{\pi}{4} D^2 \cdot \frac{C_c \cdot C_v}{C_d} \sqrt{\frac{2(P_{atm} - P_2)}{\rho}}$

$$= 1.2 \times \frac{\pi}{4} \times (0.02)^2 \times 0.85 \sqrt{\frac{2 \times 7000}{1.2}}$$

$$= 0.0346117 \text{ kg/s}$$

Similarly mass flow rate of fuel (Neglecting lip)

$$= \rho_f \cdot \frac{\pi}{4} d^2 \, C_{d_f} \sqrt{\frac{2(P_{atm} - P_2)}{\rho_f}}$$

$$= 750 \times \frac{\pi}{4} \times (0.00125)^2 \times 0.66 \sqrt{\frac{14000}{750}}$$

$$= 2.6245 \times 10^{-3} \text{ kg/s}$$

$$A/F = \frac{0.0346117}{2.6245 \times 10^{-3}} = 13.188$$ Ans

4

When nozzle lip is considered

mass flow rate of fuel

$$m_f = \rho_f \cdot \frac{\pi}{4} d^2 C_{df} \sqrt{\frac{\Delta P}{\rho_f}}$$

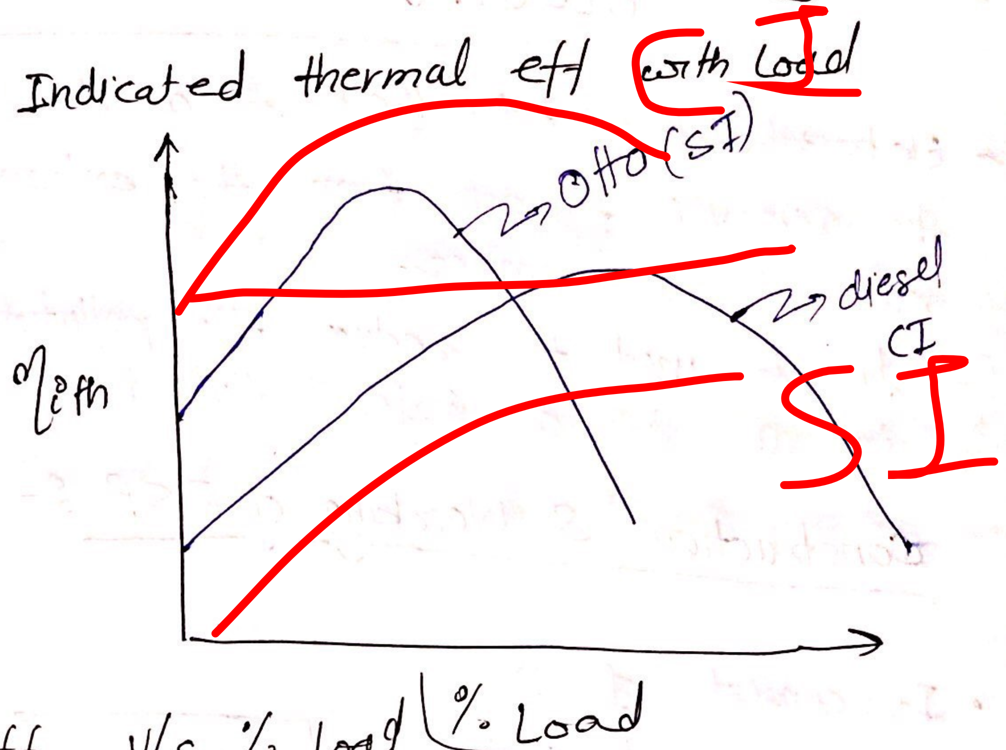
$$= 750 \times \frac{\pi}{4} \times (0.005)^2 \times 0.66 \sqrt{\frac{14000}{750}}$$

Q-1 (c) Methods Improving Performance of Engine

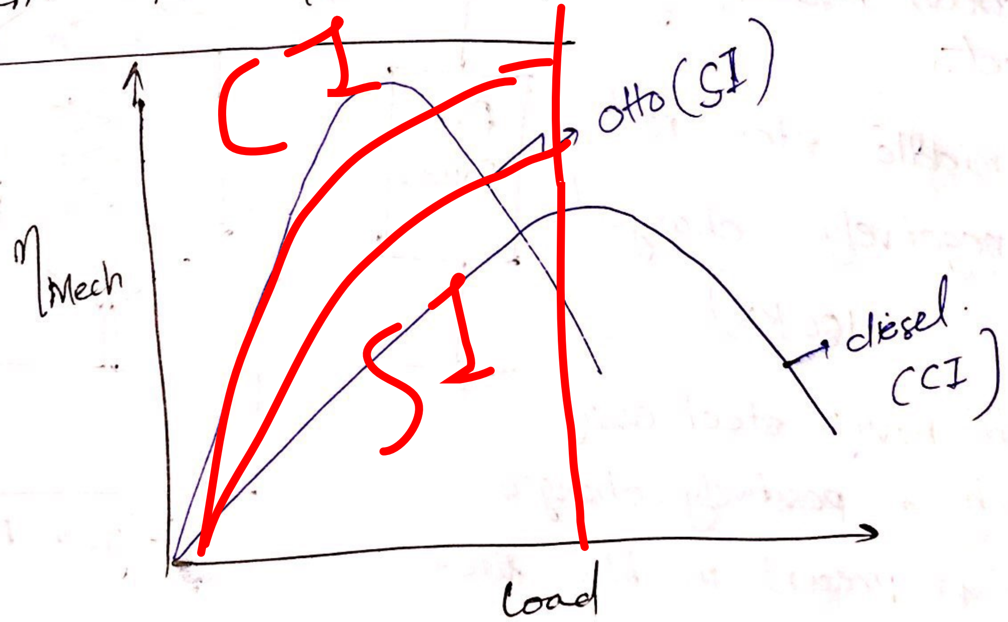
For SI Engine	For CI Engine
* Compression ratio b/w 6-12 but it should be @ lower side to prevent knocking	* Compression ratio should be high 16-22 & should be @ higher side
* Complex fuel structure should be used (Eg: Aromatics & cyclic structure	* Simple structure are heavy single bonds Eg: Paraffins
* fuel should have high Ignition delay	* Low Ignition delay fuel should be used.
* For heavy vehicles (high Power) Multicylindering engine of small piston is used	* Multicylindering does not prefered hence stroke length should be high
* Supercharging is done to Improve specific power	* Turbo charging is done to Improve efficeiency of the engine.
* TEL & Ethyle dibromide is used.	* Catalytic converter is used to reduce pollution.

Performance Curve for CI & SI Engine

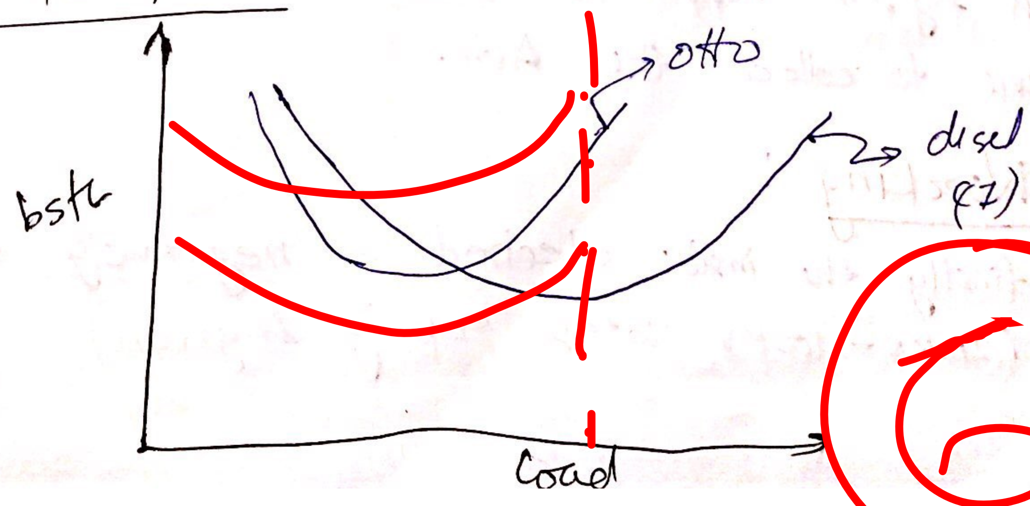
① Variation of Indicated thermal eff with Load



② Mech. eff V/s % Load



③ bsfc V/s % Load



6

Scanned with CamScanner

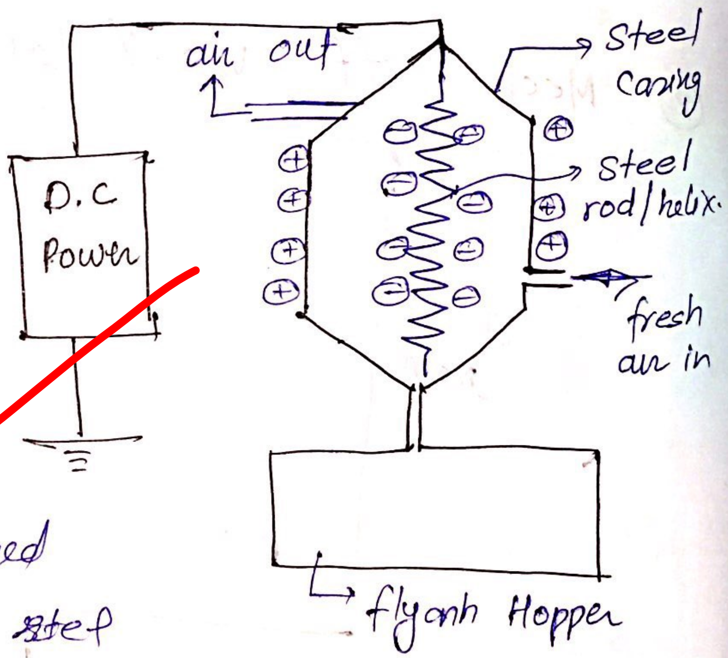
Q-1 (e)

ELECTROSTATIC PRECPITATOR (ESP)

- Electrostatic precipitator (ESP) is a device used for the removing fly ash from the exhaust of the cambustion chamber.
- It is used to reduce the pollution since flyash in air is a major pollutant.

Construction & Working of ESP :-

- It consist of 2 Electrods made up of steel.
- the middle steel rod is negatively charged (40 KV – 100 KV)
- It is having steel casing which is positively charged
- Air is present in b/w steel rods.
- A fly ash hopper is situated below which is use to collect the Ash.



Working :

→ firstly, the inside electrod is negatively charged (40KV – 100KV voltage supply is given)

- & casing is charged positively
- due to this high potential difference, the air b/w electrods gets ionised and dissociates into cation & anion. (positive & negative)
- ~~Positive~~ Negatively charged ion moves towards casing & it give charged to fly ash particle when it collides with fly ash.
- flyash is collected by the plate & Continuous Ramming to flyash happen causes the ash fell down
- This operation is done continously.

10

Q-3(a)

K = 8 (eigh cylinder) four st.

bore D = 9cm = 0.09 m

st. Len. L = 8 cm = 0.08 m

Comp. rato r = 7

N = 4500 rpm

arm length a = 50 cm = 0.5 m

Time of Testing t = 10 minute

dyn. reading m = 42 kg

mass of fuel consumed m_f = 4.4 kg

Calorific value CV = 44 MJ/kg

T_1 = 300K

P_1 = 1 bar

mass of air supplied $\dot{m}_a$ = 6 kg/min

① B.P.

(T) Load Torque = F.a = mg.a

= 42 × 9.81 × 0.5

= 206.01 N.m

Brake Power (BP) = T.ω = $\frac{T.\ 2\pi N}{60}$

$BP = \frac{2.\pi \times 4500}{60} \times 206.01$

BP = 97.08 kW Ans

• swept vol^m/sec = $\dot{V}_s = \frac{\pi}{4} D^2 L N \frac{K}{120}$ = $\frac{\pi}{4} \times 0.09^2 \times 0.08 \times \frac{8 \times 4500}{120}$

= 0.15268 m^3/s

② brake mean eff. pressure $P_{m,b}$

$$BP = P_{b,m} \cdot \dot{V}_s$$

$$97.08 = P_{b,m} \times 0.15268$$

$$\boxed{P_{b,m} = 635.84 \text{ KPa}}$$ Ans

③ Bsfc.

$$bsfc = \frac{\dot{m}f}{B.P} = \frac{4.4}{(10\times 60)(97.08)} = 7.554\times 10^{-5} \frac{Kg}{KJ}$$

($\dot{m}f$ → mass flow rate of fuel)

$$= 0.27194 \frac{Kg}{Kwhr}.$$

④ Brake specific air consumption :- (bsac)

$$bsac = \frac{Ma}{BP} = \frac{6}{60 \times \frac{97.08}{3600}}$$

$$\boxed{bsac = 3.708 \frac{Kg}{Kwhr}}$$ Ans

⑤ Brake thermal Eff.

$$\eta_{b,th} = \frac{BP}{mf \cdot CV} = \frac{97.08}{\frac{4.4}{10\times 60} \times 44000} = 0.3008$$

$$\boxed{\eta_{b,th} = 30.08\%}$$ Ans

⑤ Vol^m eff.

Applying Ideal Gas eq^n $P\dot{V}_a = \dot{m}_a RT$

$$100 \times \dot{V}_a = \frac{6}{60} \times 0.287 \times 300$$

$$= 0.0861$$

$$\boxed{\eta_v = \frac{\dot{V}}{\dot{V}_0} = 56.39\%}$$ Ans

⑥ A/F Ratio

$$= \frac{\dot{m}a}{\dot{m}f} = \frac{6\times 10}{4.4} = 13.636$$ Ans

20

Scanned with CamScanner

Q-3 (b)

Swept vol^m $V_s = 3000\ cm^3$

P_1 ~~BP~~ = 14 KW/m^3 of air/min.

volum. eff $\eta_v = 0.85 = \frac{\dot{V}_a}{V_s}$

$V_a = 0.85 \times 3000$

$V_a = 2550\ cm^3$

$\dot{V}_a = \frac{2550 \times 3500}{2}$

$= 4.462500 \times 10^6\ cm^3/min.$

$= 4.4625\ m^3/min.$

$BP_1 = 14 \times 4.4625 \times 0.8$

$BP_1 = 62.475\ KW \times 0.8$

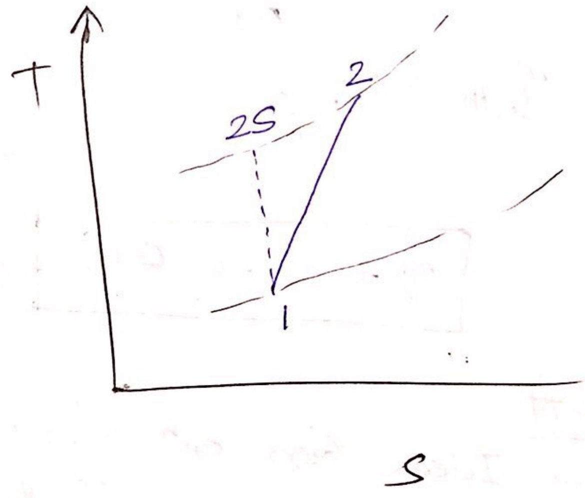
$BP_1 = 49.98\ KW$

After supercharging

$T_{2s} = T_1 (r)^{\frac{\gamma-1}{\gamma}}$

$= 300 \times 1.7^{\frac{0.4}{1.4}}$

$= 349.11$



$\frac{T_{2s} - T_1}{T_2 - T_1} = 0.8$

$T_2 = 361.89.$

Work done by Engine for supercharging

$$W = \dot{m}_a \left[C_{pa} (T_2 - T_1) \right]$$

$$= \rho V_a \left[C_{pa} (T_2 - T_1) \right]$$

$$= \frac{P_1}{RT_1} V_a \left[C_{pa} (T_2 - T_1) \right]$$

$$= \frac{101.83}{0.287 \times 300} \times \frac{4.4625}{60} \left[1.005 (361.39 - 300) \right]$$

$$= \underline{5.3987 \text{ KW}}$$

6

New air flow rate to cylinder

$$= 3000 \text{ cm}^3 \times \frac{3500}{2}$$

$$= 5.25 \text{ m}^3/\text{min}$$

$$BP_2 = 14 \times 5.25 = 73.5$$

but 5.3987 kW power given to blower

$$(BP_2)_{actual} = (73.5 - 5.3987)\, \eta_{mech}$$

$$= \underline{54.48 \text{ kW}}$$

change or increase in power

$$\Delta BP = BP_2 - BP_1$$

$$= 54.48 - 49.98$$

Please refer solution

$$= \underline{4.501 \text{ kW}}$$

Q - 3 (c)

pressure ratio $r_p = 8$

Temp @ entry to comp $T_1 = 300\,K$

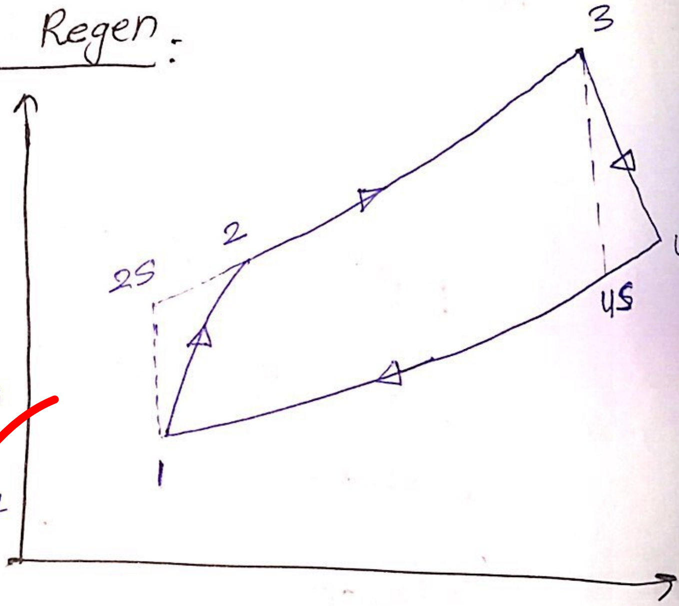
Temp at entry of Turb $T_3 = 1300\,K$

isent. eff of comp $\eta_c = 0.8$

isent eff of Turb $\eta_T = 0.85$

Eff of Regen. $\epsilon = 0.8$

(i) <u>thermal eff without Regen</u>:



Assump:

1. Air is a working substance
2. Air is assumed to be perfect gas
3. C_p, C_v, γ is constant

$$T_{2s} = T_1 (r_p)^{\frac{\gamma-1}{\gamma}}$$

$$= 300 (8)^{\frac{0.4}{1.4}}$$

$T_{2s} = 543.434K.$

$$\eta_c = \frac{T_{2s} - T_1}{T_2 - T_1} \Rightarrow 0.8 = \frac{543.434 - 300}{T_2 - 300}$$

$$\boxed{T_2 = 604.297\,K}$$

$T_3 = 1300\,K.$

$$T_{4s} = \frac{T_3}{r_p^{\frac{\gamma-1}{\gamma}}} = \frac{1300}{(8)^{\frac{0.4}{1.4}}} \qquad T_{4s} = 717.650\,K$$

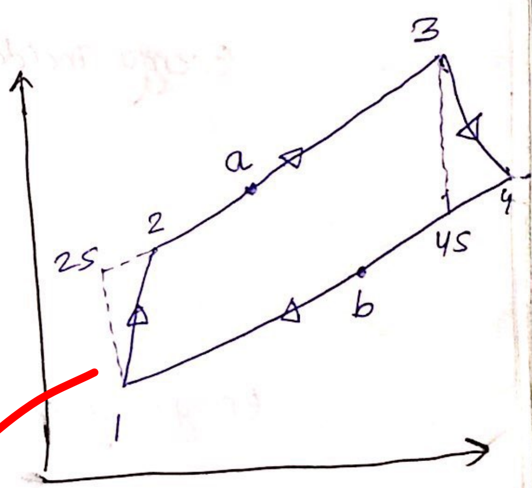
$$\eta_T = \frac{T_3 - T_4}{T_3 - T_{4s}} \Rightarrow 0.85 = \frac{1300 - T_4}{1300 - 717.650} \qquad \boxed{T_4 = 805\,K}$$

$$\eta = \frac{W_{net}}{Q_{supply}} = \frac{C_p[T_3 - T_4] - C_p[T_2 - T_1]}{C_p[T_3 - T_2]}$$

$$\eta = \frac{(1300 - 805) - (604.297 - 300)}{(1300 - 604.297)}$$

$$\boxed{\eta = 27.41\,\%}$$

(ii) When Regeneration.



Since T_2 & T_4 will Remain same, T_3 & T_1 also same

$$\epsilon = \frac{C_p[T_a - T_2]}{C_p[T_4 - T_2]}$$

$$0.8 = \frac{T_a - 604.297}{805 - 604.297}$$

$$\boxed{T_a = 764.86\,K}$$

$$\eta_g = \frac{W_{net}}{Q_s} = \frac{W_T - W_C}{Q_s} = \frac{C_p(1300 - 805) - C_p(604.297 - 300)}{C_p(1300 - 764.86)}$$

$$\eta_g = 35.63\%$$

$$\%\ \text{change in eff} = \frac{\eta_g - \eta}{\eta} = \frac{35.63 - 27.41}{27.41} \times 100$$

$$= \underline{29.989\,\%} \quad \text{Ans}$$

19

5(a) Power O/P of motor = 2 hP

$= 2 \times 746 = 1492\ W$

~~Power~~ g motor eff $\eta = 0.85$

Power supplied to motor $= \frac{1492}{0.85}$

$= 1755.29\ W$

cell area = $140 \times 140 = 19600\ mm^2$

cell eff $\eta_c = 0.13$

Energy incident on each cell = Hg X Area

$= 1.1 \times 10^3 \times 19600 \times 10^{-6}$

$= 81.56\ W$

Energy given to motor/cell

$E = 31.56\ \eta_c$

$E = 2.802\ W/cell$

Total no of cells req (n)

$n . E =$ Power supp to motor

$n \times 2.802 = 1755.29$

$n = 626.26$ cells

$n = 627$ cells

No. of modules Req $= \frac{627}{40} = 15.65 = 16$ modules are required.

Advantages of PV cells

① they use the waste solar energy to produce high Grade energy (electricity).

② they have low running & Maintenance cost.

③ They uses renewable energy ~~that~~ & does not produce pollution & noise.

④ No Turbine ~~but~~ boilers type heavy & moving part for production of electricity.

10

5(b) Grinding wheel.

1. A − 70 − K − 7 − V → bond.

- A ↓ Abrasive
- 70 ↓ Grain (or) Grit
- K ↓ hardness
- 7 ↓ structure

A → Aluminium Oxide (Abrasive)

70 → It denote Grain (or) Grit size
→ medium Grain size. (in b/w Course & fine)

K → It belongs to category [I − P] → hardness is Medium

7 → [0−7] dense structure [use to finishing]

V → Vetrified bond used.

② C - 36 - D - 9 - S - 28

C → Ceramics is the abrasives

36 → medium size Grains is present

D → [A - H] Category → SOFT WHEEL

9 → open structure .

S → Silicate bond (water Glass)

---

③ D - 250 - Z - 1 - R

D → Diamond is used as Abrasive

250 - very fine Grains of Abrasive

Z - very hard wheel is used .

1 - dense structure

R → Rubber bond b/w wheel & Abrasive

11

~~⑤ (c) Vulcanization of Rubber~~

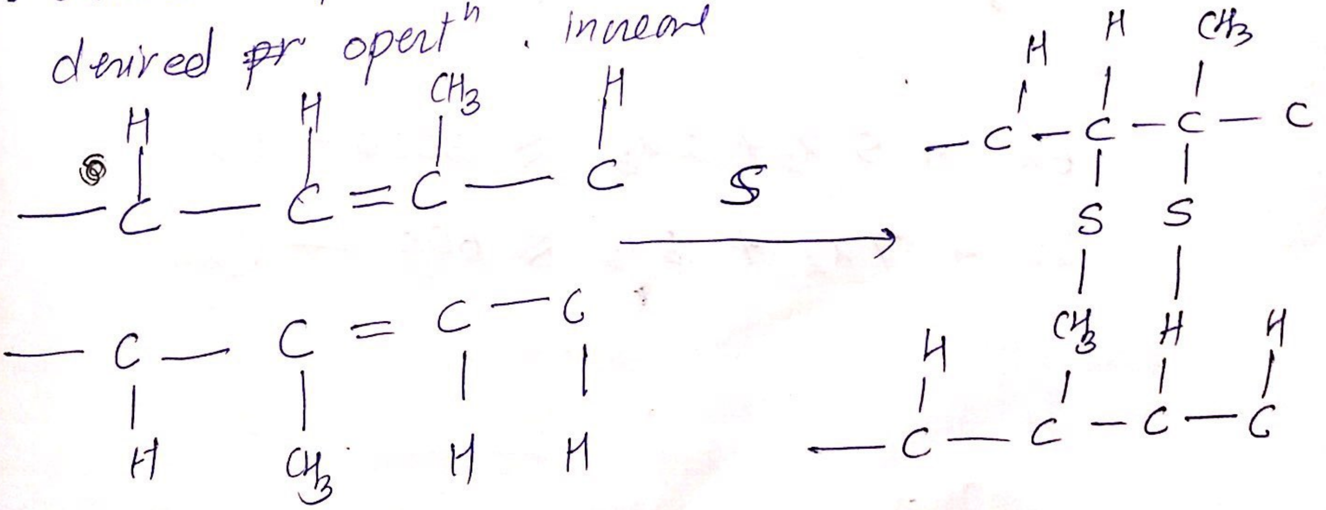
~~• Vulcanisation is Crosslinking of the polymer~~

(5) (c) # Vulcanization of Rubber

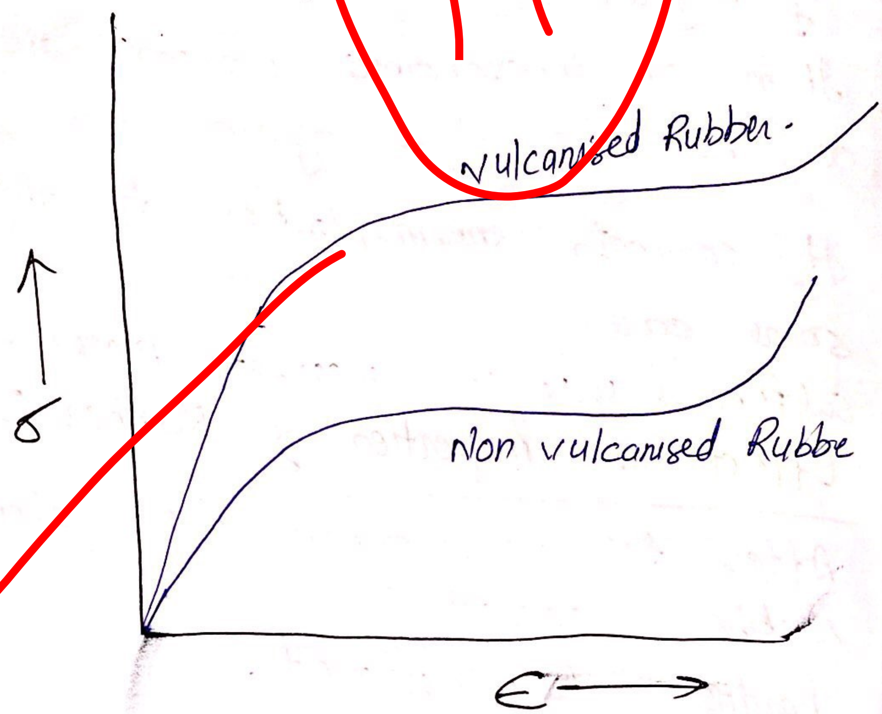
- It is the process of Crosslinking b/w the Chain of polymers
- It is an irreversible process since decroslinking can not be done again
- It converts thermoplastics to thermo settings in some cases
* Sulphur is used in vulcanisation process.

Effect on Properties of Rubber :-

- After the vulcanisation the strength of the rubber increased
- hardness also increased.
- Vulcanised rubber can withstand at more temperature compared to that of non-valcanised
- Fatigue & ultimat tensile strength increases
- Increases the cost of rubber due to processing on it
- Over all operational life of component, as per desired ~~pr~~ opertn. increase



Stres strain Curve for Vulcanised & Non Vulcanised Rubber



---

5 (d)

Let

x_1 — No of product A produced

x_2 — " " B "

x_3 — " " C "

$$6x_1 + 5x_2 + 2x_3 \leq 5000 \quad \text{—(1)}$$

$$4x_1 + 7x_2 + 3x_3 \leq 6000 \quad \text{—(2)}$$

~~Let time for A = 6t~~

Let time to produce A = 6t

then " B = 3t

then " C = 2t

Total Time

$6tx_1 + 3tx_2 + 2tx_3 \leq 1600 \times 6t$

$6x_1 + 3x_2 + 2x_3 \leq 9600$ — (3)

$x_1 \geq 300$ — (4)

$x_2 \geq 250$ — (5)

$x_3 \geq 200$ — (6)

$$\frac{x_1}{3} = \frac{x_2}{4} = \frac{x_3}{5}$$

$Z_{max} = 90x_1 + 40x_2 + 30x_3$

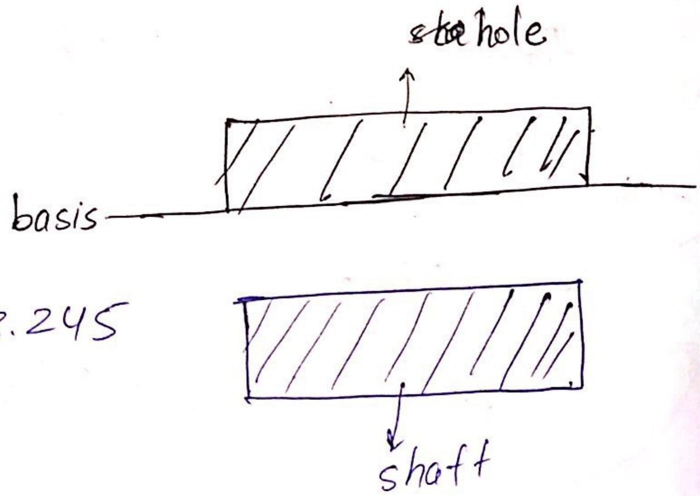
These ~~eq^n~~ eqq. can be computed out using software (or) Program.

11

5 (e)

Hole Basis syst

$65\, H_8 f_7$



$D = \sqrt{D_1 D_2}$

$= \sqrt{50 \times 80} = 63.245$

For shaft Tolerance

H 8 IT8 is used

$i = 0.45 \sqrt[3]{D} + 0.001 D$

$= 0.45 \sqrt[3]{63.245} + 0.001 \times 63.245$

$= 1.8561\ \mu m$

Hole Tolerance $= 25 i = 25 \times 1.8561$

$= 46.403\ \mu m$

$= 0.0464\ mm$

Hole size $= 65^{0.0464}_{0}$ — HOLE

fundamental deviation for hole $= 0$

for shaft upper deviation $= -5.5 (63.245)^{0.41}$

$= -30.11\ \mu m$

$= -0.03011\ mm$

Fundamental deviation of shaft $= -0.03011\ mm$

shaft Tolerance $= 16 i = 0.02969\ mm$

$65^{-0.03011}_{-0.0598}$

8

Scanned with CamScanner

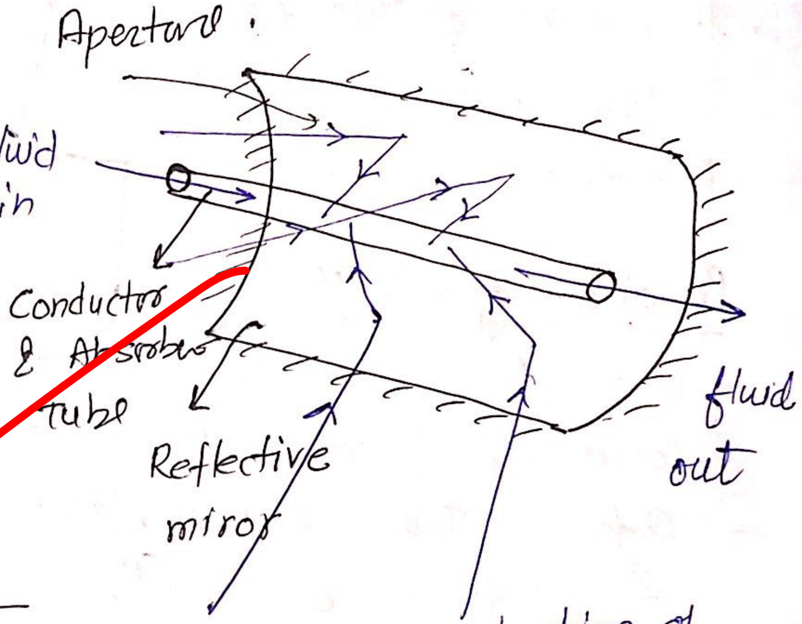
Q- 6 (a)

1. Cylinderical parabolic concentrator

Construction:

① Reflecting Mirror

It consist a parabolical shaped mirror which is used to Reflect the Radiation incident on it.



② ~~Conc~~ Absorber Tube

It is having low diameter, hence concentration of energy is higher & losses are less.

Principle of Working:

- Thermal Radiation incident on the cylinderical parabolic dish from Random direction.
- due to the property of parabola ~~the~~ Geometry, the Total incident Radiation is focused on a a tube carrying water.
- this heat is absorber by blackned surface & transfer to the heating fluid.

② Linear Fresnel Lens collector :-

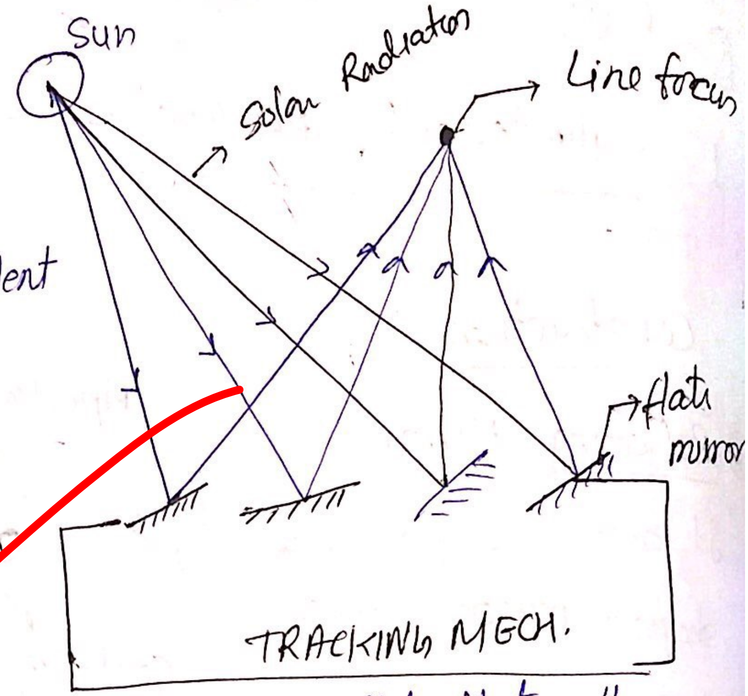
It consist of flat mirror which used to concentrate the solar Radiation Incident on it

Scanned with CamScanner

Construction.

→ It consist of series of flat mirrors ~~that~~ on which the Sun Radiation incident

→ It consist of ~~...~~ a Tube line on which the Radiation concentrate



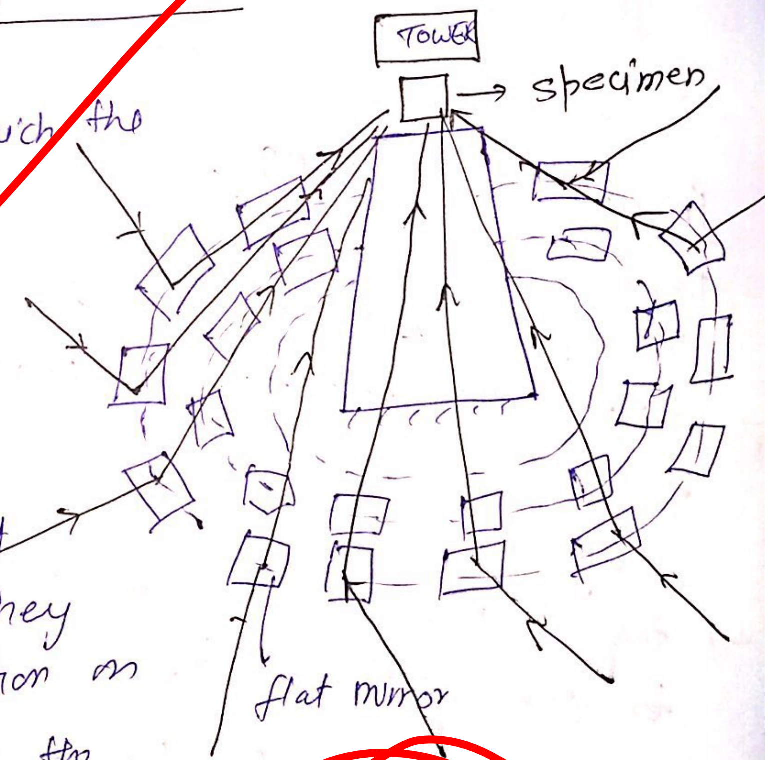
Principle of working

- When Solar Radiation Incident on the flat plate, they concentrate it onto the line of Tubing
- Surface of Tubes are blackned & Absorb Radiation & Transfer to Liquid.

③ Central Tower Receiver

Construction

- Central Tower on which the Solar Rad. is Concentrated
- Reflective mirrors
- specimen



Principle of working

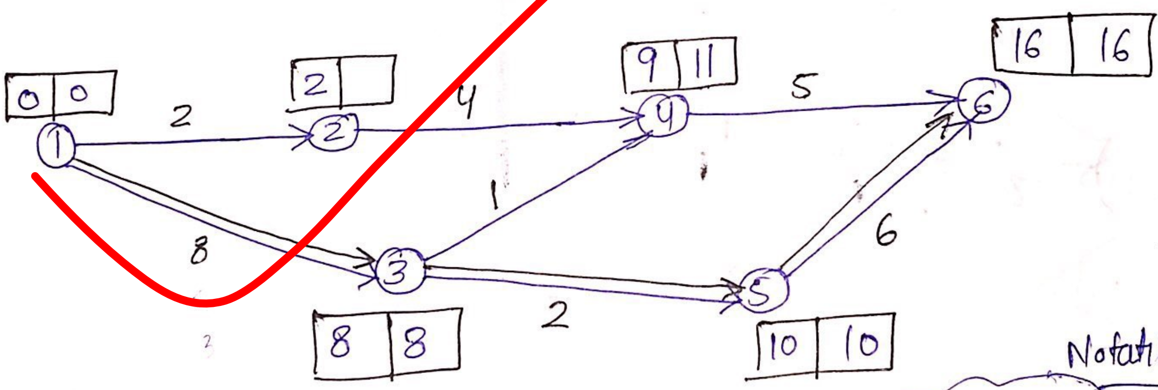
Solar Radiation incident on the flat mirrors. they Concentrate the Radiation on Central Tower to heat the specimen.

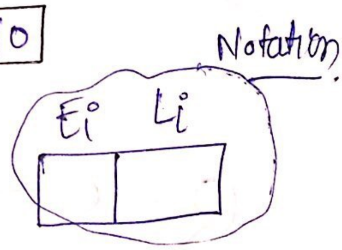
→ Tracking mechanism is used to track sun rays.

15

6(b)

Activity (i-j)	Time Est (week) Normal	Crash	Direct cost est (1000) Normal	Crash	Cost slop (ΔC/Δt)
1-2	2	1	10	15	5
1-3	8	5	15	21	2
2-4	4	3	20	24	4
3-4	1	1	7	7	—
3-5	2	1	8	15	7
4-6	5	3	10	16	3
5-6	6	2	12	36	6





Critical path 1-3-5-6

- Normal completion time = 16 weeks

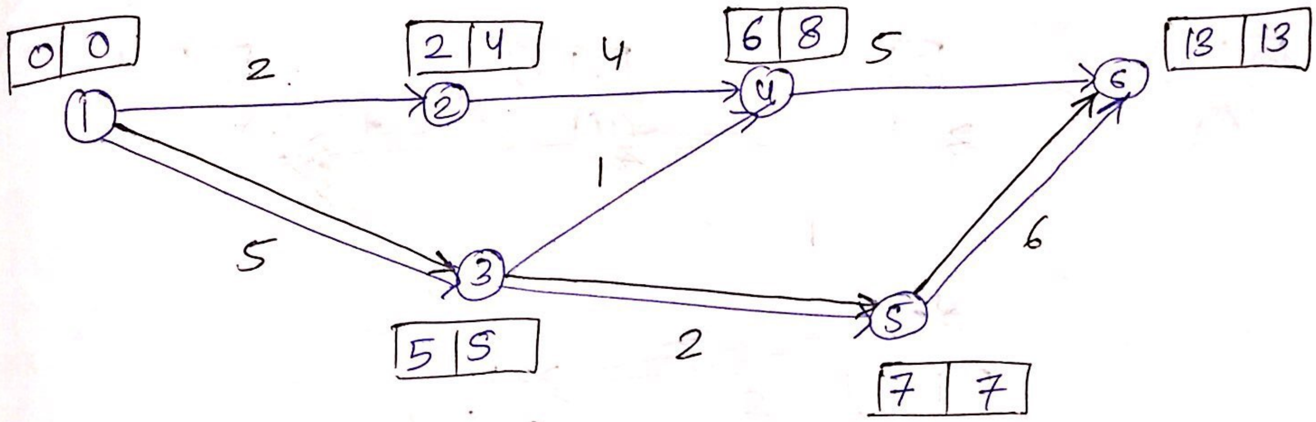
Total Normal cost = Direct cost + Indirect cost

Direct cost = 82 thousands

Ind. cost = 5×16 = 80 thousand

TC = 82+80 = 162 thousand

Now crashing the activity 1 – 3 by 3 days



T_E = 13 day

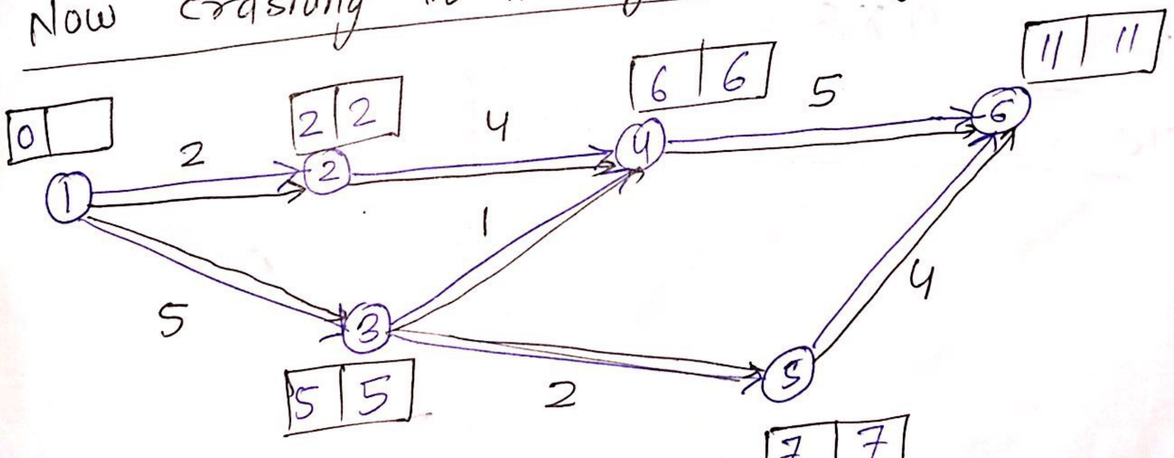
TC = DC + IDC

DC = 82 + 3×2 = 88 thousands

IDC = 5×13 = 65 thousand

TC = 153 thousands.

Now crashing the Activity 5–6 by 2 days.



all paths are critical path

1 – 2 – 4 – 6

1 – 3 – 4 – 6

1 – 3 – 5 – 6

TC = DC + IDC

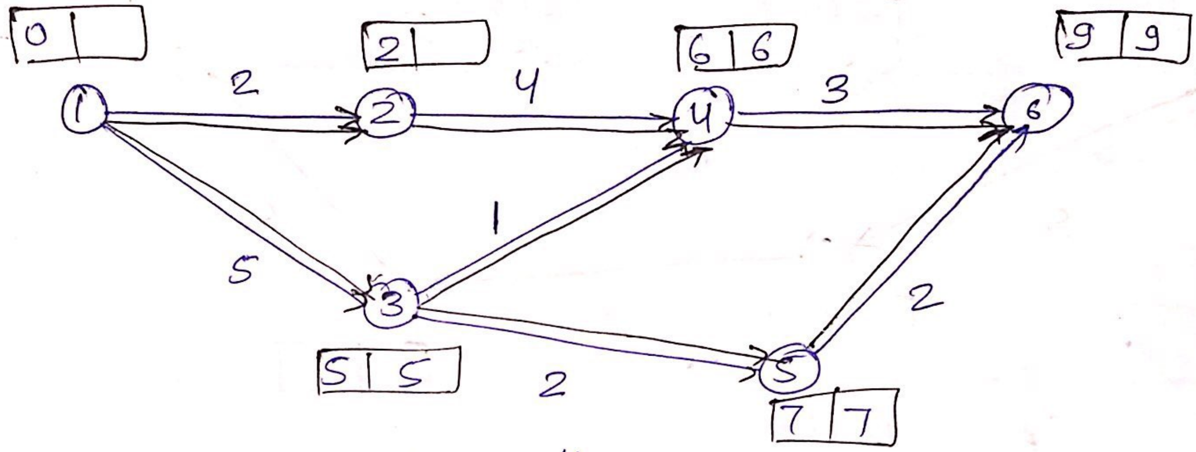
DC = 82 + 3×2 + 2×6 = 100 th

IDC = 5×11 = 55

TC = 155 thou.

Now options: (4-6) & 5-6 crashing by 2 days

(1-2) & (3A5) ↳ by



all are critical path.

$T_E = 9$ days

$TC = DC + IDC$

$DC = 82 + 3 \times 2 + 6 \times 2 + 3 \times 2 + 6 \times 2$

$= 118$ thousands Rs

$IDC = 9 \times 5 = 45$

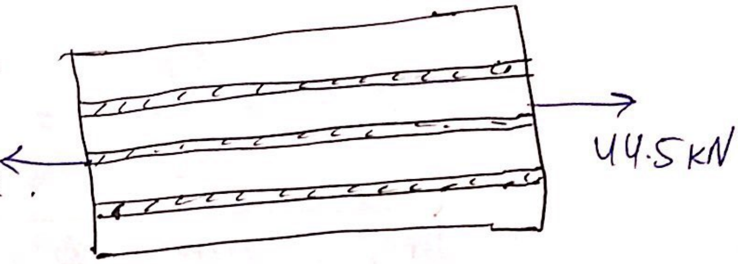
TC = 163 thousand Rs.

19

6 (c)

70% poly.C — Matrix

30% Aramid — fibre.



$A = 320\ mm^2$.

deformation in both will be same.

$P_m \rightarrow$ Load on matrix

$A_m \rightarrow$ Area of "

$P_f \rightarrow$ Load on fibre

$A_f \rightarrow$ Area " "

$$\Delta_f = \Delta_m$$

$$\frac{P_f \cdot L}{A_f \cdot E_f} = \frac{P_m L}{A_m E_m}$$

$$\frac{P_f}{P_m} = \frac{A_f E_f}{A_m E_m} = \frac{0.3 \times 131}{0.7 \times 2.4}$$

$$\boxed{\frac{P_f}{P_m} = 23.393}$$ Ans

$P_f - 23.393 P_m = 0$ — (1)

$P_f + P_m = 44.5kN$ — (2)

Solving (1) & (2)

$$\boxed{\begin{aligned} P_f &= 42.67\ kN \\ P_m &= 1.824\ kN \end{aligned}}$$

stress on fibre

$$\sigma_f = \frac{P_f}{A_f} = \frac{42.67 \times 10^3}{820 \times 0.3}$$

$$\boxed{\sigma_f = 444.48 \text{ MPa}}$$

stress on Matrix

$$\sigma_m = \frac{P_m}{A_m} = \frac{1.824 \times 10^3}{0.7 \times 320} = 8.14 \text{ MPa}$$

strain in composite

$$\epsilon_m = \epsilon_f \qquad \epsilon = \frac{\sigma}{E} = \frac{\sigma_f}{E_f} = \frac{\sigma_m}{E_m}$$

$$\epsilon = \frac{444.48}{131 \times 10^3} = 3.393 \times 10^{-3}$$

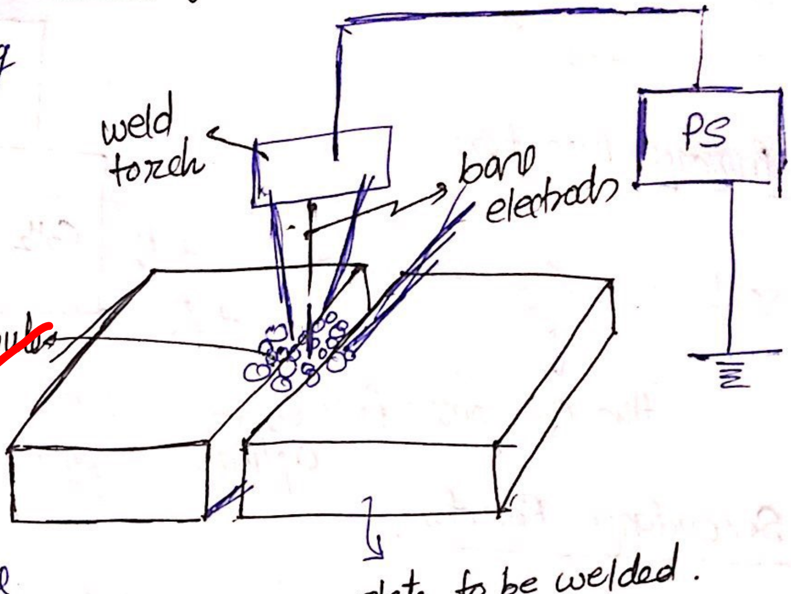
20

Scanned with CamScanner

8(a)

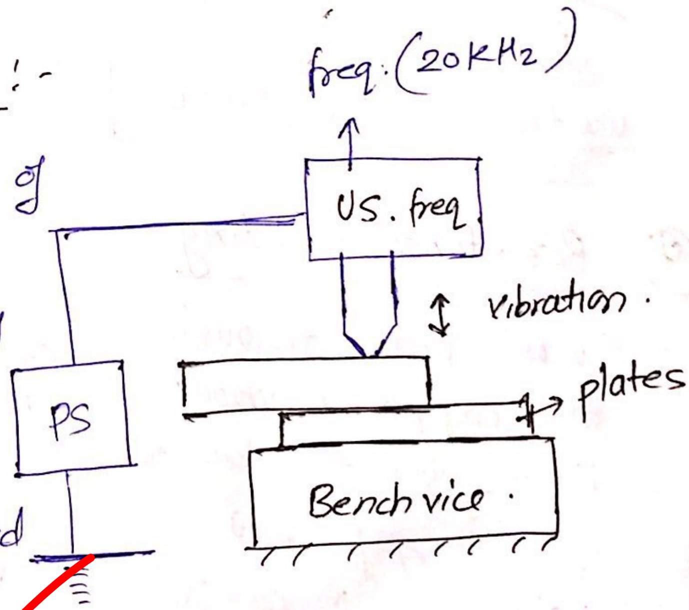
1. Submerged Arc Welding :-

- Submerged arc welding is used to weld high thickness plates.



* Submerged Arc welding used in mom product^n (CaF_2)
* the current flows throw bare electrode & the arc is surrounded by the Grannuls of CaF_2.
* these Granul avoid the UV rays to come out. & prevent from weld spatter
* Grannules provent oxide formation.

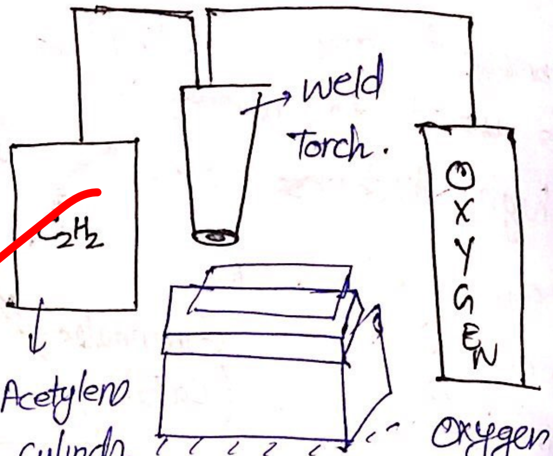
2. Ultrasonic Welding :-



- It comes to the category of the solid state welding
- It utilizes the high frequency about 20 KHz.
- due to the rubbing action & friction heat is Generated & hence pressure to it to weld by the other plate
- less heat affected zone will be produced & there will not be any tendency to from oxide formation.

③ GAS Welding :-

Gas welding utilises chemical Energy to joint 2 metals.



Primary Reaction

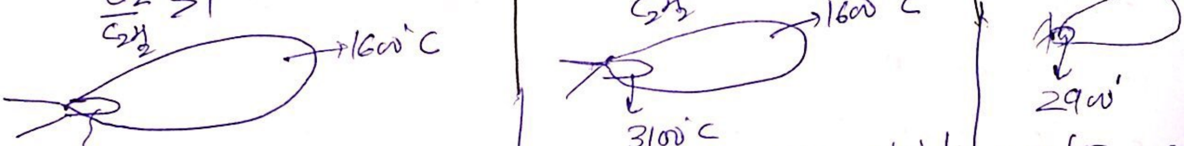
$$C_2H_2 + O_2 \longrightarrow 2CO + H_2 + \Delta$$

↓ this O_2 comes from O_2 cylinder

Secondary Reaction

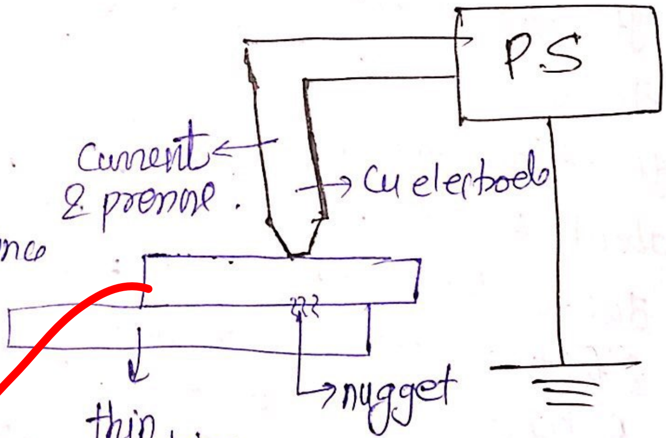
$$2CO + H_2 + 1.5\,O_2 \longrightarrow 2CO_2 + H_2O + \Delta$$

oxidising flame	Neutral flame	Reducing flame
$\frac{O_2}{C_2H_2} > 1$	$\frac{O_2}{C_2H_2} = 1$	$\frac{O_2}{C_2H_2} < 1$
1600°C, 3300°C	1600°C, 3100°C	2900°
use for, Cu, Brass, Bronze	use for, MS, stainless steel	use for CI, HCS



④ Resistance welding

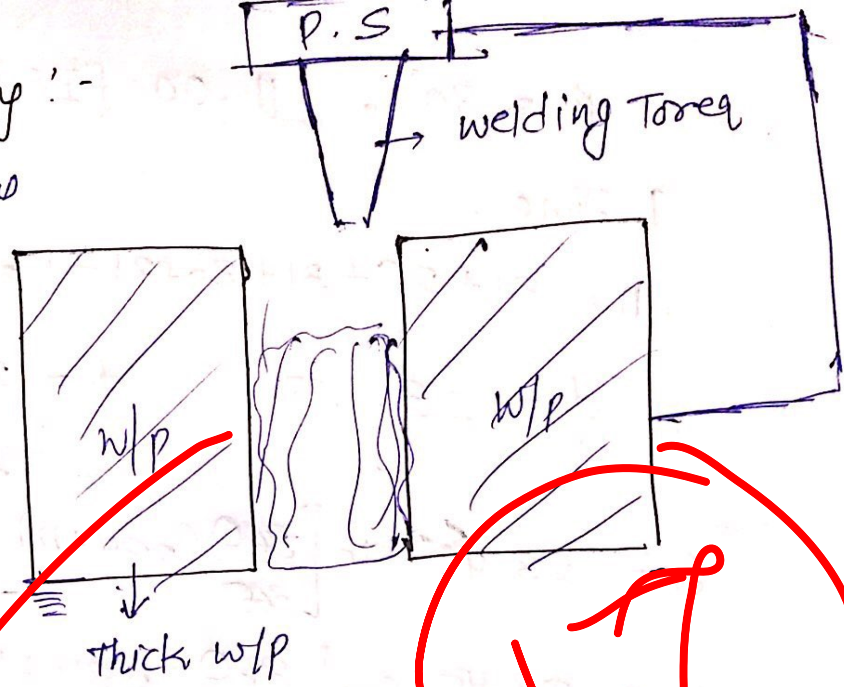
- Current passes through the copper electrode
- hence due to Resistance of air gap b/w plate, when current passes through it heat is Generated



→ that heat utilized to melt & then pressure is applied that weld the thin strip.

→ ~~No heat effect~~ used for thin plates.

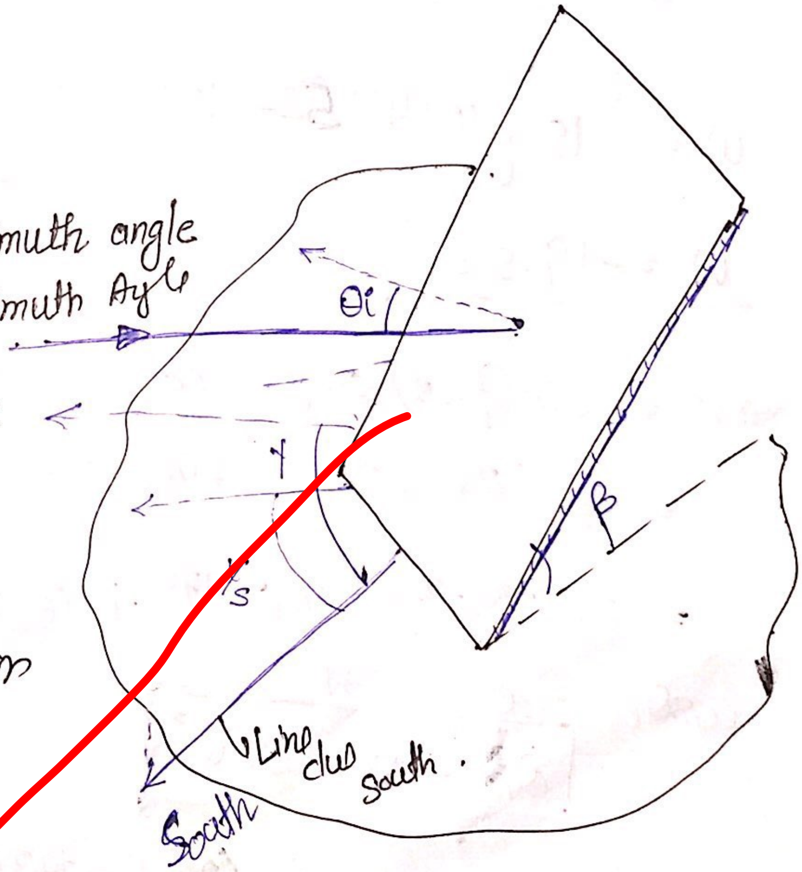
Electroslag Welding :-



- This welding Technique is used for the thick plates. and high thickness of weld
- Electroslag welding is done only in the horizontal
  # because the thickness is high.
- the melten metal swims on the weld pool & the metal is filled by weld torch

17

Q-8 (b)



γ → solar Azimuth angle

γ_s → surface Azimuth Angle

β → tilt angle

θ_i → Incidence angle

δ → declination

$\beta = 30^\circ$, 11.00 [IST]

I June.

$n = 31 + 29 + 31 + 30 + 31 + 1 = 153$

$\phi = 28^\circ .35'$ $\qquad \phi = 28.583^\circ$

$\delta = 23.45 \sin\left[\frac{360}{365}(284+n)\right]$

$= 23.45 \sin\left[\frac{360}{365}(284+153)\right]$

$= 22.174^\circ$

$LAT = 11:00 - 4\left[\left(81+\frac{44}{60}\right) - \left(77+\frac{12}{60}\right)\right]$

$= 10:41:52$

$\omega = 15\left[10:41:52 - 12:00:00\right]$

$\omega = -19.533^\circ$

$\cos\theta_i = \sin(\phi-\beta)\sin\delta + \cos(\phi-\beta)\cos\delta \cdot \cos\omega$

~~$= \sin(28.583-30)\sin(19.533) + \cos(28.583-30)\cos(-19.533)\cos$~~

$= \sin(28.583-30^\circ)\sin(22.174) + \cos(28.583-30)\cos(22.174)\cos(-19.533)$

$\cos\theta_i = 0.86314$

$\boxed{\theta_i = 30.328^\circ}$

No of day hours $= \frac{2}{15}\cos^{-1}(-\tan\phi \cdot \tan\delta) = \frac{2}{15}\left[\cos^{-1}(-\tan 28.58 \cdot \tan 22.1\ldots\right.$

$= 13.71$ hours

Q- 8 (c)

$\alpha = 0.2$

Month	Demand(units)	Forecaste(u)	Error
March	350	400	− 50
April	440	390	50
May	450	400	50
June	460	410	50
July	495	420	75
Aug	510	435	75

Forecaste for next mont (April)

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

$= 400 + (0.2)(-50)$

$= 390$

Forecaste of month May

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

$= 390 + (0.2)(50)$

$= 400$

Forecaste for month June

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

$= 400 + 0.2(50) = 410$

Forecaste for month July

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

$= 410 + 0.2(50) = 420$

Forecaste of the month Aug

$$F_t = F_{t-1} + \alpha(D_{t-1} - F_{t-1})$$
$$= 420 + 0.2(75)$$
$$= 435$$

$$\text{Tracking signal} = \frac{RSFE}{MAD}$$

Running some forecaste error =

$$= -50 + 50 + 50 + 50 + 75 + 75$$

$$RSFE = 250$$

$$MAD = \frac{50+50+50+50+75+75}{6} = 58.333$$

$$\text{Tracking signal} = \frac{RSFE}{MAD} = \frac{250}{58.333}$$

$$= 4.2857$$

19