POORNIMA
COLLEGE OF ENGINEERING

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Sample Assigment
(2017-18 to 2021-22)

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Campus: PCE	Course: B. Tech	Class /Sec:4th	Name of Faculty: Ms Shalini Puri
Name of Subject: Data Communication & Computer Network			Code:4CS4-07
Date of Preparation: 09/05/2019			Scheduled Date of Submission:17/05/2019

Q. No.	Questions	CO's	PO's
1	What is difference between analog and digital signal?	CO1	PO1
2	Distinguish the difference between UDP and TCP protocol.	CO2	PO2
3	Explain ARP and RARP address mapping protocol.	CO3	PO2
4	Explain leaky bucket algorithm in detail.	CO3	PO1
5	We measure the performance of a telephone line (4 kHz of bandwidth). When the signal is 20V, the noise is 6 mV. What is the maximum data rate supported by this telephone line?	CO4	PO2

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Campus: PCE. **Course: B.Tech.** **Class/Section: I year** **Date: 28 -1-2021**

Name of Faculty: Dr. Meena Tekriwal **Name of Subject: Engineering Chemistry** **Course Code: 1FY2-03**

Assignment-II

Max. Marks=35 **Time: 2 hour**

S. NO.	CO	PO	Marks	QUESTIONS
1	4	1	3	How coke manufactured by coal? Give process of carbonization.
2	4	1	3	How is Petrol quality measure by Octane number? Explain with structure of hydrocarbons.
3	4	1	3	Explain preparation of Paracetamol with chemical reaction.
4	4	1	3	Describe Pilling Bedworth's rule and ratio for corrosion of metal.
5	4	1	3	Explain reforming process of gasoline to improve its quality.
6	3	1	4	A coal sample of 0.96 g was burnt in a Bomb calorimeter, the following data was obtained- H = 7%, Weight of water taken in calorimeter = 520 g Water equivalent of calorimeter = 2200 g, T_1 = 23.4 °C, T_2 = 25.4°C Fuse wire correction = 10 cal. Acid correction=50cal. Calculate HCV and LCV in Kcal/Kg assuming the latent heat of steam is 580 cal/g

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7	3	1	6	1Kg of coal contain following constituents- C = 80 % O = 2 % N = 3% H = 6% Ash = rest Calculate the min. weight of air required for complete combustion of 1 Kg of coal, if 40 % excess air is supplied.
4	3	1	10	How can we differentiate proximate and ultimate analysis of coal? Explain the steps involved in proximate and ultimate analysis of coal. State the significance of each.

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Assignment Sheet-5

Campus: PCE **Course:** B.Tech. **Class/Section:** III **Date: :- 20/01/2019**

Name of Faculty: PKT **Name of Subject:** Design Machine of Machine Element-II **Code:** 6ME1A

Date of Preparation: …………..….. Scheduled Date of Submission: …………….

Q. No.	Questions	COs	POs	PSOs
1	A cast iron pulley transmits 20 kW at 300 RPM. The diameter of pulley is 550 mm and has four straight arms of elliptical cross-section in which the major axis is twice the minor axis. Find the dimensions of the arm if the allowable bending stress is 15 MPa. Mention the plane in which the major axis of the arm should lie.	CO2	PO2	PSO1
2	A flat belt is required to transmit 30 kW from a pulley of 1.5 m effective diameter running at 300RPM. The angle of contact is spread over 11/24 of the circumference. The coefficient of friction between the belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5 mm, density of its material is 1100 kg/m3 and the related permissible working stress is 2.5 MPa.	CO3	PO2	PSO2
3	A pulley of 0.9 m diameter revolving at 200 r.p.m. is to transmit 7.5 kW. Find the width of a leather belt if the maximum tension is not to exceed 145 N in 10 mm width. The tension in the tight side is twice that in the slack side. Determine the diameter of the shaft and the dimensions of the various parts of the pulley, assuming it to have six arms. Maximum shear stress is not to exceed 63 MPa.	CO2	PO2	PSO1
4	An open belt connects two flat pulleys. The pulley diameters are 300 mm and 450 mm and the corresponding angles of lap are 160° and 210°. The smaller pulley runs at 200 r.p.m. The coefficient of friction between the belt and pulley is 0.25. It is found that the belt is on the point of slipping when 3 kW is transmitted. To increase the power transmitted two alternatives are suggested, namely (i) increasing the initial tension by 10%, and (ii) increasing the coefficient of friction by 10% by the application of a suitable dressing to the belt. Which of these two methods would be more effective? Find the percentage increase in power possible in each case.	CO4	PO3	PSO2
5	An overhung pulley transmits 35 kW at 240 r.p.m. The belt drive is vertical and the angle of wrap may be taken as 180°. The distance of the pulley centre line from the nearest bearing is 350 mm. $\mu = 0.25$. Determine : 1. Diameter of the pulley ; 2. Width of the belt assuming thickness of 10 mm ; 3. Diameter of the shaft ; 4. Dimensions of the key for securing the pulley on to the shaft ; and 5. Size of the arms six in number. The section of the arm may be taken as elliptical, the major axis being twice the minor axis. The following stresses may be taken for design purposes : Shaft Tension and compression — 80 MPa, Key Shear — 50 MPa, Belt : Tension — 2.5 MPa, Pulley rim : Tension — 4.5 MPa, Pulley arms : Tension — 15 MPa	CO3	PO3	PSO2

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Solⁿ 1 given $P = 20 kW$ $N = 300$ rpm $d = 550$ mm $n =$
$\sigma_b = 15 MPa$

Also given that, major axis = 2 × minor axis

$a = 2b$

Torque, $T = \frac{P \times 60}{2\pi N}$

$T = \frac{20 \times 10^3 \times 60}{2 \times \pi \times 300} = 636.62$ N-M

Maximum bending moment

$n = 20$ of arms

$M = \frac{2T}{n} = \frac{2 \times 636.62}{4} = 318.3$ N-M

Section modulus $Z = \frac{\pi}{32} \times b \times (a)^2$

$= \frac{\pi}{8} b^3$

$\sigma_b = \frac{M}{Z} = \frac{318.3 \times 10^{-3} \times 8}{\pi (b)^3} = 15$

$b^3 = 54 \times 10^3$

$b = 37.806$ mm

$a = 2b = 75.613$ mm

→ the major axis will be in the place of rotation.

Sol 2:- given $P = 30$ kW, $d = 1.5$ m.

$\mu = 0.3$ $t = 9.5$ mm $\rho = 1100$ kg/m3

$V = \omega r = \frac{2\pi N}{60} \times r = 23.562$ m/s.

$(T_1 - T_2) v = P$

$(T_1 - T_2) 23.562 = 30 \times 10^3$

$T_1 - T_2 = 1273.24\ N$ — ①

$\frac{T_1}{T_2} = e^{\mu\theta}$

$\frac{T_1}{T_2} = e^{0.3 \times 2.88} = 2.373$ — ②

from ① & ②

$2.373 T_2 - T_2 = 1273.24$

$T_2 = 926.67$

$T_1 = 2199\ N$

mass $m = \rho \times A = 1100 \times 9.5 \times 6 \times 10^{-3}$

$m = 10.456\ kg/m$

centrifugal tension $T_c = mv^2 = 5801.56\ N$

$T_{max} = T_2 + T_c = \sigma \times b \times t$

$2199 + 5801.56 = 237506$

$b = 0.1225\ m$

$b = 122.5\ mm$

standard width of belt = 125 mm

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$D = 0.9m$, $N = 200\ rpm$ $P = 7.5\ kW$

$T_1 = 2T_2$ $n = 6$ $\sigma = 63\ MPa$

$v = \frac{2\pi N \times R}{60} = 9.426\ m/s$

$(T_1 - T_2) v = 7500 = P$

$T_1 - T_2 = 796\ N$

$2T_2 - T_2 = 796$

$T_2 = 796$

$T_1 = 2T_2 = 1592 N$

width of belt

Tension = 14.5 N/mm

$b = \frac{1592}{145} = 109.76 mm$

width $b = 112 mm$

Diameter of shaft

$T = \frac{P \times 60}{2\pi N} = \frac{7500 \times 60}{2 \times \pi \times 200}$

$= 358.1 N\cdot m$

we know $T = \frac{\pi}{16} \tau d^3$

$d^3 = \frac{16 \times 358.1 \times 10^3}{\pi \times 63}$

$d = 30.7 \approx 35 mm$

Dimension of various parts –

(a) width & thickness of pully.

width $B = 112 + 13 = 125 mm$

thickness $t = \frac{D}{300} + 2 = 5 mm$

(b) Dimension of arm –

Assume $M = \frac{2T}{N}$ $a = 2b$

$= \frac{2 \times 358.1}{6} = 119.367 N\text{-}m$

$Z = \frac{\pi}{32} \times b \times a^2 = \frac{\pi}{8} b^3$

$\sigma_b = 15 MPa$

$15 = \frac{M}{Z} = \frac{119.367 \times 10^3 \times 8}{\pi \times b^3}$

$b = 27.26 \approx 30 mm$

$a = 2b = 60 mm$

Dimension of Pulley —

Diameter $2d = 2 \times 35 = 70\ mm$

Hub length $= \frac{\pi}{2} \times d = \frac{\pi}{2} \times 35 = 55\ mm$

$l = \frac{2}{3} \times 125 = 82.33 \simeq 85\ mm$

Soln 4 given $d_1 = 300mm$ $d_2 = 450\ mm$ $\mu = 0.25$

$\theta_1 = 300$ $\theta_2 = 210^\circ$ $N_1 = 200\ rpm$

→ $\mu\theta_1 = 0.25 \times 2.8 \simeq 0.7$ smaller

$\mu\theta_2 = 0.25 \times 3.66 = 0.915$ larger

$v = \frac{\pi d N}{60} = \frac{\pi \times 0.3 \times 200}{60} = 3.142\ m/s$

$(T_1 - T_2) v = P$

$(T_1 - T_2) \times 3.142 = 3000$

$T_1 - T_2 = 955\ N$ — ①

$\frac{T_1}{T_2} = e^{\mu\theta} = e^{0.7} \simeq 2.015$ — ①

from ① & ②

$T_2 = 941\ N$
$T_1 = 1896\ N$

[illegible] is improved/

$T_1 = 2058.7$

power transmitted

$$P = (T_1 - T_2)V = (2058.7 - 1035) \times 3.142$$

$$\boxed{P = 3301 \text{ kW}}$$

(ii) Power transmitted when friction increased by 10%

$$\mu = 0.25$$

$$\mu' = 0.25 \times 1.1 = 0.275$$

$$\frac{T_1}{T_2} = e^{\mu\theta_1} = e^{0.275 \times 2.8} = 2.16$$

$$T_1 + T_2 = 2T_0 = 2 \times 1418.5 = 2837 \text{ N}$$

$$\boxed{T_2 = 898}$$

$$\boxed{T_1 = 1939 \text{ N}}$$

$$P = (T_1 - T_2)V = (1939 - 898) \times 3.142$$

$$\boxed{P = 3270 \text{ N} = 3.271 \text{ KW}}$$

power increase

(a) % increase when tension increased

$$= \frac{3.3 - 3}{3} \times 100 = 10\ \%$$

(b) % increase when friction increased

$$= \frac{3.271 - 3}{3} \times 100 = 9.03\ \%$$

⇒ we shall adopt the method of increas[ing] initial tension.

Sol^n 5

Given $P = 35 \text{ kW}$ $N = 240$ $\theta = 180^\circ$ $L = 35$

$\mu = 0.25$ $t = 10 \text{ mm}$

$T_0 = T_k = 50 \text{ MPa}$ $\sigma = 2.5 \text{ MPa}$ $\sigma_1 = 4$

① Dimension of pulley –

D = dia of pulley

$\sigma = 4.5 \text{ MPa}$

$4.5 \times 10^6 = \rho V^2 = 7200 V^2$

$V = 25 \text{ m/s}$

$V = \frac{\pi D N}{60} = 25 = \frac{\pi \times D \times 240}{60}$

$D = 2 \text{ m}$

② width of belt

$(T_1 - T_2) v = 35000$

$T_1 - T_2 = 1400 \text{ N}$ — ①

$\frac{T_1}{T_2} = e^{\mu\theta} = e^{0.25 \times \pi} = 2.195$ — ②

from ① & ②

$T_2 = 1172 \text{ N}$

$T_1 = 2572 \text{ N}$

$T_c = mv^2 = \rho A v^2 = 1000 \times 10 \times 6 \times 10^{-6} \times 25$
$= 6.25 b \text{ N}$

$T_{max} = \sigma b t = 2.5 \times 6 \times 10 = 25 b \text{ N}$

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we know, $T_{max} = T_1 + T_c$

$25 b = 2572 + 6.25 b$

$b = 137 \text{ mm} \approx 140 \text{ mm}$

③ Diameter of shaft

$T = \frac{P \times 60}{2 \pi N} = 1393 \text{ N-m}$

Bending $M = (T_1 + T_2 + 2T_c) L$
$= (1172 + 2572 + 2 \times 875) \times 0.35$
$= 1923 \text{ N-m}$

$T_e = \sqrt{T^2 + M^2} = 2375 \text{ N-m}$

$T_e = \frac{\pi}{16} \times T_s \times d^3$

$2375 \times 10^3 = \frac{\pi}{16} \times 50 \times d^3$

$d = 62.3 \approx 65 \text{ mm}$

④ Dimension of key –

$t = 12 \text{ mm}$

l = length of key.

$T = l w \tau \times d/2$

$1396 \times 10^3 = l \times 20 \times 50 \times \frac{65}{2}$

$l = 42.8 \text{ mm}$

$\text{length} = \frac{\pi}{2} \times 65 = 102 \text{ mm}$

⑤ size of arms

$a = 26$ given

$m = \frac{2T}{n} = 464333 \text{ N-m}$

$z = \frac{\pi}{8} 63$

$\sigma_6 = 15 = \frac{m}{z} = \frac{464333 \times 8}{\pi \times 63}$

$6 = 42.8 \approx 45 \text{ mm}$

$a = 26 = 90 \text{ mm}$

Sol^n 6 given $n = 1M$ $P = 95 \text{ kW}$ $d_1 = 300 \text{ mm}$

$N_1 = 1000 \text{ rpm}$ $N_2 = 375 \text{ rpm}$ $2\alpha = 40^0$

$\alpha = 20^0$

$a = 400 \text{ mm}^2$

$\sigma = 2.1 \text{ MPa}$ $\rho = 1100 \text{ Kg/m}^3$

we know, $\frac{N_1}{N_2} = \frac{d_2}{d_1} \Rightarrow d_2 = \frac{N_1}{N_2} \times d_1 = 800$ mm

dia of pulley $d_2 = 800$ mm

$$\beta = \sin^{-1}\left(\frac{d_2 - d_1}{2x}\right) = 14.47^\circ$$

$$\theta = 180^\circ - 2\beta = 151^\circ$$

$$V = \frac{\pi d_1 N_1}{60} = \frac{\pi \times 300 \times 1000}{60} = 15.71 \text{ m/s}$$

$$T_c = mv^2 = \rho A v^2 = 1100 \times 400 \times 10^{-6} \times (15.71)^2$$
$$= 108.6 \text{ N}$$

$$T_{max} = \sigma \times a = 2.1 \times 400 = 840 \text{ N}$$

we know that,

$$T_{max} = T_1 + T_c$$
$$T_1 = T_{max} - T_c = 840 - 108.6$$
$$T_1 = 731.4 \text{ N}$$

③ belts required $\quad P = (T_1 - T_2) v$

$$P = 10.171 \text{ kW}$$

No of belt $= \frac{95}{10.171} = 9.34 \approx 10$ belt

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② Diameter of shaft

$$T = \frac{P \times 60}{2\pi N_2} = 2420 \text{ N-m}$$

$$T_e = \frac{\pi}{16} \times \tau D^3 = 3181.4 \times 10^3 = \frac{\pi}{16} \times 42 \times D^3$$

$$D = 72.79 \text{ mm} \approx 75 \text{ mm}$$

Assignment Sheet-1

Campus: PCE   Course: B. Tech.   Class/Section: 2nd Year   Date: 20/09/2021

Name of Faculty: Surendra   Name of Subject: Material Science Engineering   Code: 3ME4-06

Date of Preparation: Scheduled Date of Submission:

Q. No.	Questions	COs	POs	PSOs
Q.1	Enumerate the different cubic crystal structures (with diagram) and estimate the number of atoms, coordination number and atomic packing factor for them.	1	1	1
Q.2	Identify and describe briefly various crystal imperfections with neat sketch.			
Q.3	Define briefly: (i) Miller indices (ii) Bauschinger's effect (iii) Phase rule (iv) Isomorphous alloy system (v) recovery , re-crystallization and grain growth (vi) Solid solution (vii) Equilibrium diagram	2	2	1
Q.4	Draw iron carbon equilibrium diagram and discuss clearly the various terms, phases and reactions involved in it.	2	1	1
Q.5	Explain binary system when two metal are completely soluble in the liquid state but only partly soluble in the solid state with suitable with neat sketch.	2	1	1
Q.6	Distinguish between homogeneous and heterogeneous nucleation for solidification of a pure metal . how does degree of under-cooling affect the critical nucleus size.	3	2	1
Q.7	Draw an equilibrium diagram of binary system with limited solid state and in which solubility decreases with decrease in temperature , also explain it briefly.	2	2	1
Q.8	Explain line dislocation and burger vector.	2	2	1
Q.9	Differentiate slip and twinning mechanism of deformation.	2	2	1
Q.10	Differentiate the hot and cold working, and elastic and plastic deformation.	3	1	1

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Q-1.> Enumerate the different cubic crystal structures (with diagram) and estimate the no. of atoms, co-ordination number and atomic packing factor for them.

Ans Basic Types of Crystal structure

1.> Simple Cubic crystal structure (S.C)
2.> Body centered crystal structure (B.C.C)
3.> Face centered crystal structure (F.C.C)
4.> Hexagonal close packed structure (H.C.P)

→ Primitive Unit cell or Simple Cubic Crystal

When constituent particles are present only on the corner position of a unit cell, it is called S.C.

Here, each atom at a corner is shared b/w eight adjacent unit cell.

Total number of atoms in 1 unit cell is $8 \times \frac{1}{8} = 1$ atom.

→ Body Centered Unit Cell :- Such a unit cell contains 1 constituent particle (atom, molecule or ion) at its body-centre besides the ones that are at its corner.

8 corners × $\frac{1}{8}$ per corner atom $= 8 \times \frac{1}{8} = 1$ atom

1 body centre atom $= 1 \times 1 = 1$ atom

∴ Total number of atoms per unit cell = 2 atoms

→ Face-Centred Unit Cells :- ~~Such~~ a unit cell contains 1 constituent particle present at the centre of each face besides the ones that are at its corner.

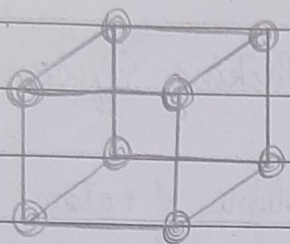
F.C.C 8 corners atoms × $\frac{1}{8}$ atom per unit cell = $\frac{8\times1}{8}$ = 1 atom
6 face centred atoms × $\frac{1}{2}$ atom per unit cell = $\frac{6\times1}{2}$ = 3 atom
∴ Total number of atoms per unit cell = 4 atoms.

H.C.P - This crystal structure shows 1 atom at each corner of the hexagon. The total corner atoms are thus 12. Each corner atom is shared by 6 unit cells. There is 1 atom on each hexagonal face centre
It is shared by 2 unit cells. The 3 atoms at Interior remain unshared. Average no. of atoms per unit cell

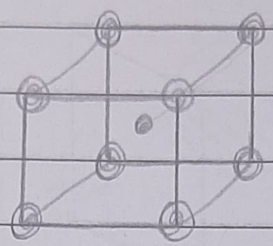
$= \frac{A}{6} + \frac{B}{2} + \frac{C}{1} \Rightarrow \frac{12}{6} + \frac{2}{2} + \frac{3}{1} = 2+1+3$

= 6 atoms.

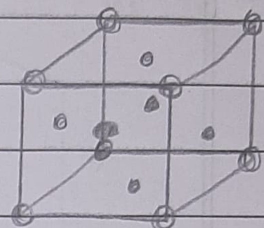
Co-ordination Number :-
The number of nearest neighbours of a particle is called CN.



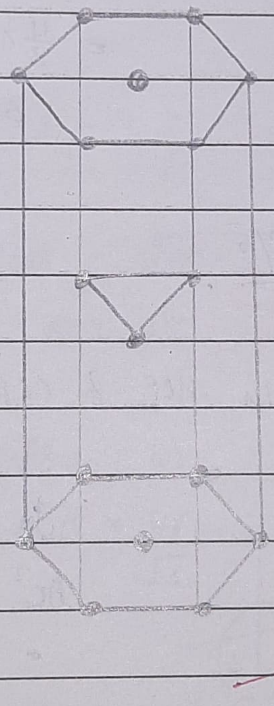
(S.C.)



(B.C)



(F.C)



(HCP)

* Packing Efficiency

1.) Simple Cubic Crystal –

As the particle touch each other along the edge. The edge length or side of the cube 'a' and the radius of each particle, r

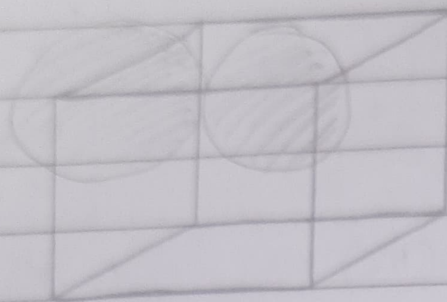
$a = 2r$

The volume of cubic unit cell $= a^3 = (2r)^3$

$= 8r^3$

Since, a simple cubic unit cell contains only 1 ...

The volume of the Occupied Space $= \frac{4}{3}\pi r^3$



∴ Packing Efficiency

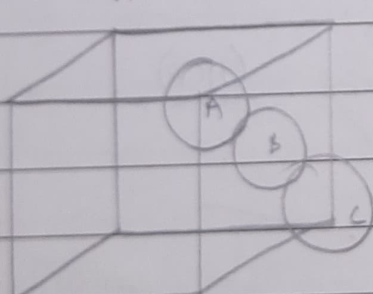
$$= \frac{\text{Volume of 1 atom}}{\text{Volume of cubic unit cell}} \times 100$$

$$= \frac{\frac{4}{3}\pi r^3}{8r^3} \times 100$$

$$= \pi/6 \times 100$$

$$= \underline{52.36\%}$$

2) Packing Efficiency in HCP & CCP structure



In △ABC

$$AC^2 = b^2 = BC^2 + AB^2$$

$$= 2a^2$$

$$\underline{b = \sqrt{2}a} \text{ (Hypotenuse)}$$

If r is radius of sphere

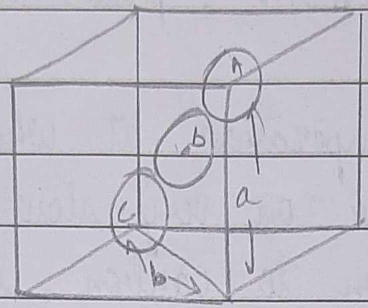
$$b = 4r = \sqrt{2}a$$

$$a = \frac{4r}{\sqrt{2}} = \underline{2\sqrt{2}r}$$

$$\text{packing Efficiency} = \frac{\text{Volume Occupied by 4 spheres in unit cell}}{\text{Total volume of unit cell}} \times 100$$

$$= \frac{4 \times (\frac{4}{3}\pi r^3)}{(2\sqrt{2}r)^3} \times 100 = \underline{74\%}$$

* Packing Efficiency of BCC



As, $b = \sqrt{2}a$ & edge length of cube $= a$

Now,

Hypotenuse (AC) $= \sqrt{a^2 + b^2} = \underline{\sqrt{3}a}$

~~where $a = 2r$, $b = 4r$~~

also,

$\sqrt{3}a = 4r$

$a = \frac{4r}{\sqrt{3}}$ or $\boxed{r = \frac{\sqrt{3}a}{4}}$

packing Efficiency $= \frac{\text{Volume occupied by 2 spheres in unit cell}}{\text{Total volume of unit cell}} \times 100$

$$= \frac{2 \times \frac{4}{3}\pi r^3 \times 100}{\left(\frac{4}{\sqrt{3}}r\right)^3}$$

$= \underline{\underline{68\%}}$

Q-4.) Draw iron carbon equilibrium diagram and discuss clearly the various Terms, phases and reactions involved in it?

Ans-4 A map of the temperature at which different phase changes occur on very slow heating and cooling in relation to carbon, is called Iron-Carbon Diagram.

It shows :-

1.) Type of alloys formed under very slow cooling.
2.) Proper heat-treatment temperature and
3.) Properties of steels and cast iron

There are 3 invarient reactions

1.) Peritectic - (at 1490°C)
2.) Eutectic - (at 1150°C)
3.) Eutectoid - (at 725°C)

→ Peritectic - Liquid and 1 solid phase Transforms to 2nd solid phase.

$$\delta + L \xrightarrow[\text{cooling}]{\nabla} \gamma\text{-Austenite}$$

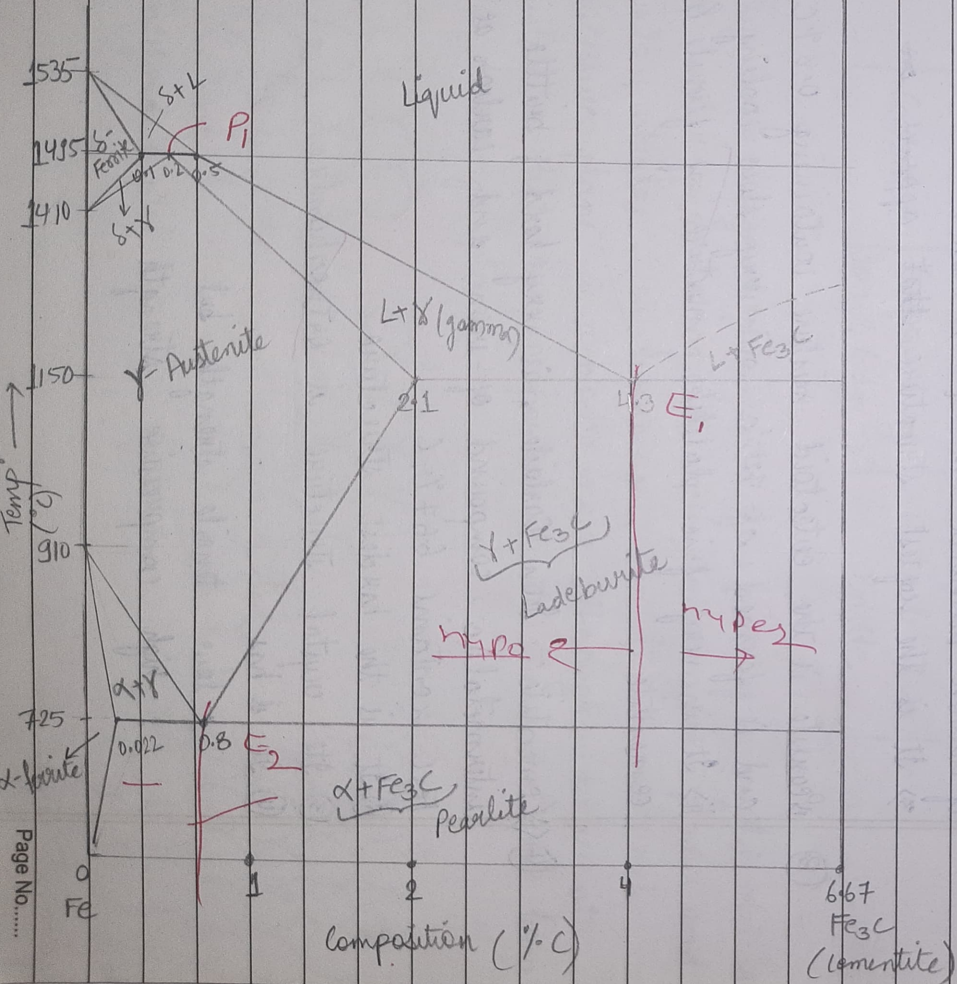
Eutectic - Liquid transforms to 2 solid phases

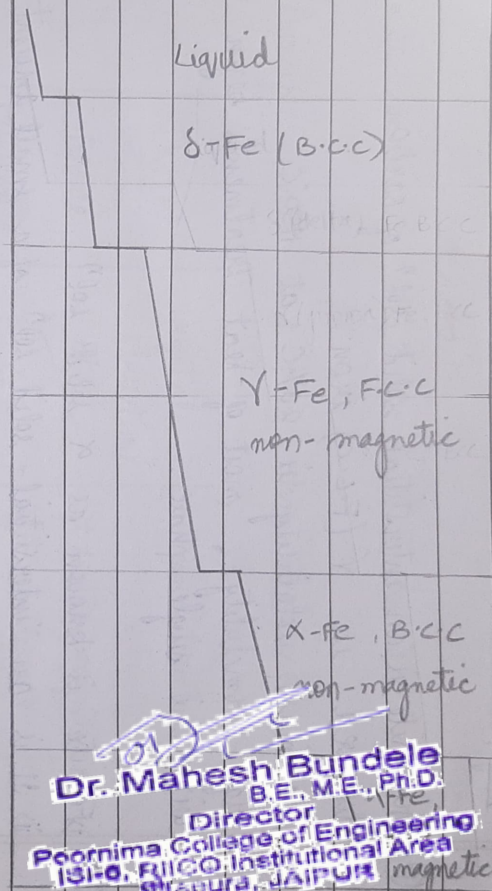
$$L \xrightarrow[\text{cooling}]{\nabla} \gamma + Fe_3C$$

(Ladeburite)

Eutectoid - one solid phase transform to 2 other solid phases

$solid_1 \rightarrow solid_2 + solid_3$ $\qquad \gamma \xrightarrow{\nabla} \alpha + Fe_3C$


1535
1495
1410
1150
910
725
Temp. (°C)
δ+L
P1
δ-Ferrite
0.1
0.2
0.5
δ+γ
Liquid
L+γ (gamma)
L+Fe3C
γ-Austenite
2.1
4.3
E1
γ+Fe3C
Ladeburite
hypo
hyper
α+γ
0.022
0.8
E2
α-ferrite
α+Fe3C
Pearlite
0
Fe
1
2
4
6.67
Fe3C
(Cementite)
Composition (% C)


Liquid
δ-Fe (B.C.C)
γ-Fe, F.C.C
non-magnetic
α-Fe, B.C.C
non-magnetic
magnetic

Terms

(1) Austenite is an interstitial solid solⁿ of carbon dissolved in γ (F.C.C) iron.
2) Maximum solubility is 2.0% C at 1150°C
3) High formability, most of heat treatments begin with this single phase.

(2) i) Ferrite is known as α solid solⁿ.
ii) It is an interstitial solid solⁿ of a small amount of carbon dissolved in α (BCC) iron.
3) It is the softest structure. ~~that appears on~~

(3) i) Pearlite is the eutectoid mixture containing 0.8% C and is formed at 725°C on very slow cooling.
ii) It is very fine platelike mixture of ferrite & cementite.

(4) (1) Cementite :- Iron Carbide, is very hard, brittle intermetallic compound of iron and carbon, as Fe_3C contains 6.67% C.
(2) It is the hardest structure
(3) Its crystal structure is orthorhombic.
(4) It is has
- low tensile strength but
- high compressive strength.

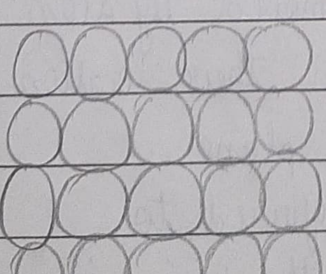
5) Ledeburite - It is the eutectic mixture of Austenite & cementite.

- It contains 4.3 % C and is formed at 1150°C.

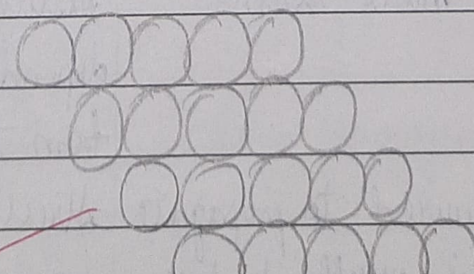
Principle phases and their characteristics

Phase	Crystal structure	Characteristics
Ferrite	BCC	Soft ductile, magnetic
Austenite	FCC.	Soft, moderate strength, non-magnetic
Cementite	Compound of Iron & Carbon Fe_3C	Hard & Brittle

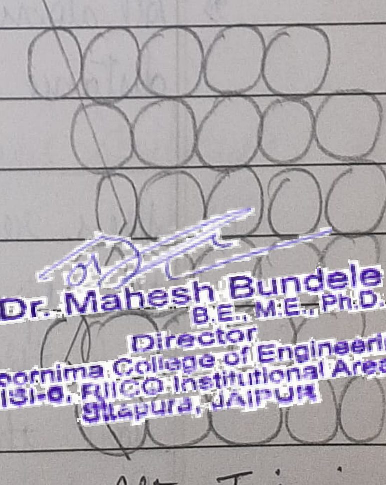
9) Slip is the large displacement of 1 part of a crystal relative to another part along the crystallographic planes and dir^n's, whereas, in twinning, the atoms in each successive plane in a block move through different distances that are proportional to their distance from the twinning plane.



Undefined Crystal



After slip



After Twinning

* Slip V/s Twin

	Slip	Twin
1)	Crystal lattice orientation is same after slip.	Crystal lattice orientation is different in twin zone.
2)	Slip is line defect.	Twin is surface defect.
3)	Commonly observed in BCC and FCC metals	Commonly observed in HCP metals.
4)	Stress required for slip is comparatively low.	Stress required for twin is comparatively higher
5)	Most dominant deformation in any crystal's plastic deformation	Observed for only some metals at some temp^n.
6)	Occurs in milli-seconds (slow).	Occurs in micro-seconds (fast).
7)	No sound is created	A clicking sound is created.
8)	Is thin lines under microscope	Is thick lines under microscope.
9)	All atoms move same distance	Distance moved by atom depends on their location from twin plane.
10)	Stress required to propagate the slip is usually higher than the stress required to start the slip.	Stress required to propagate the twin is usually lower than the stress required [illegible].
11)	Occurs at low strain rates.	Occurs at high strain rates.

Q-10) Differentiate the hot & cold working, and elastic and plastic deformation.

	HOT WORKING	COLD WORKING
1)	It is carried out above recrystallisation temp^r.	It is carried out below recrystallisation temperature.
2)	It refine grain size.	It distorted grain structure.
3)	Large deformation possible.	Less deformation
4)	Less force required.	Large force required.
5)	The material does not work hardened.	It causes strain hardening.
6)	Stress relieving not required.	Stress relieving required.
7)	Poor surface finish	Better surface finish then Hot working.
8)	Homogenous structure.	Non-Homogenous structure.

⇒ The change in shape and size of a metal (object) is called deformation.

When an external force acts on a body, the body tends to

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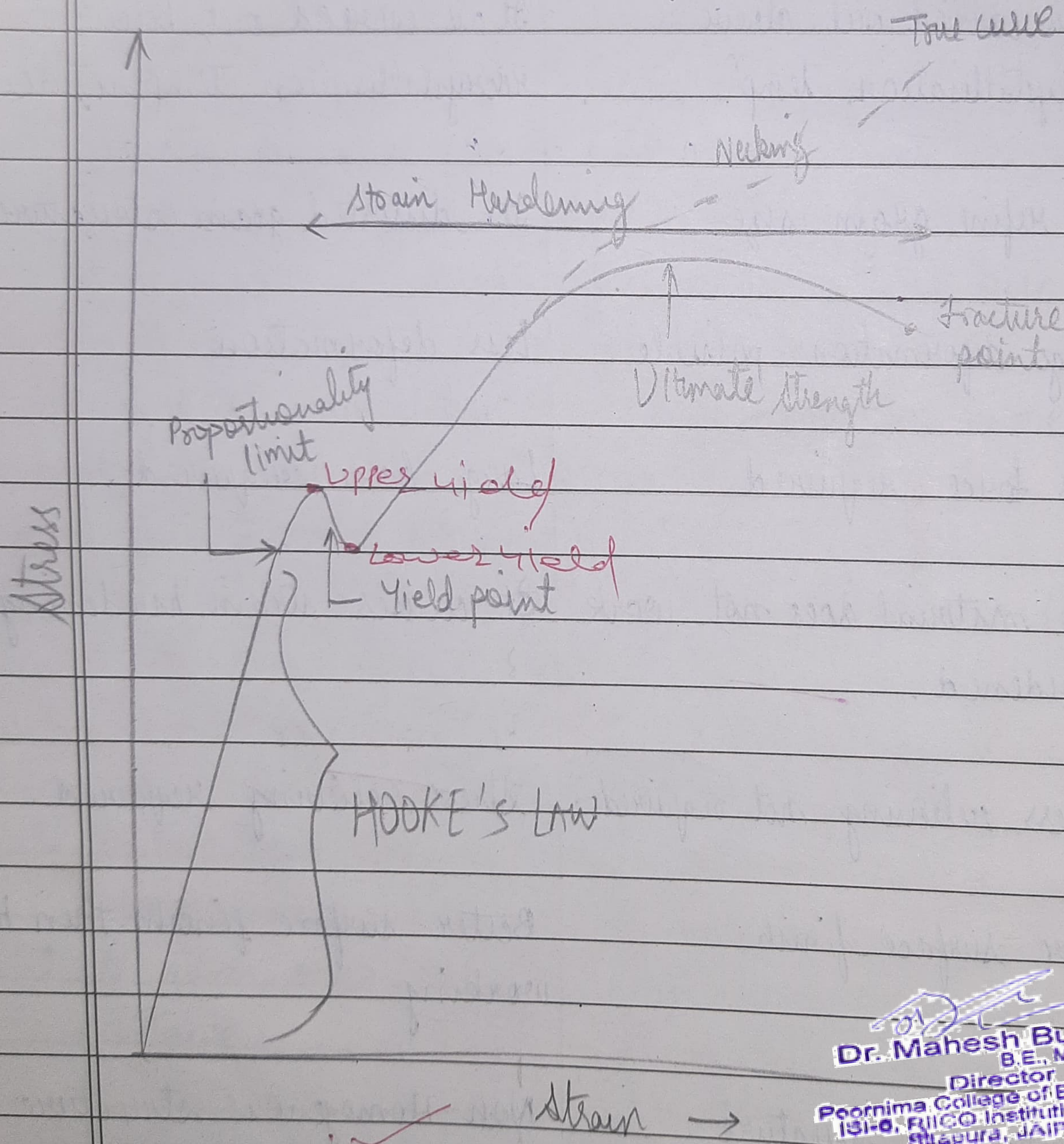
undergo some deformation. If the external force is removed and the body comes back to its original shape & size is called <u>elastic deformation</u>. When the stress is permanently deform the metal, it is called plastic deformation.



	Elastic Deformation	Plastic Deformation
1>	It is a temporary deformation under the action of external loading.	It is permenent deformation.
2>	Once the external load is removed from an elastically deformed body, it regains its original shape.	When the body is plastically deformed, it retains its deformed shape even after the removal of external load.
3>	Atoms of the material are displaced temporarily from their original lattice site. They return back to their original position after the removal of external load.	Atoms of the solid are displaced permanently from their original lattice site. They don't return back to the original position even after the removal of external load.
4>	It is characterized by the property Elasticity.	It is characterized by the property Plasticity.
5>	Amount of Elastic deformation is very small.	Amount of Plastic deformation is very large.
6>	External force required is quite small	Force required is larger.
7>	Energy absorbed by the material during Elastic deformation is called Module of resilience.	Total Energy absorbed by the material during Elastic & Plastic deformation is called Module of Toughness.
8>	Hooke's law of Elasticity is applicable within its elastic region	Hooke's law is not applicable if the material [is] plastically deformed.
9>	Displays Linear stress - strain behavior	Stress - Str[ain] [illegible] [non-lin]ear in plastic region.

	Elastic Deformation	Plastic Deformation
10>	Material first undergo elastic deformation under the application of external loading.	It occurs after it is elastically deformed due to the application of external loading.
11>	Mechanical & metallurgical properties of solid material remain unaltered when it is elastically deformed.	Many properties of solid material change considerably for plastic deformation.

Q-2.> Identify and describe briefly various crystal Imperfections with neat sketch.

⇒ Defects are classified based on their dimensionality

* point defect (0-D)
* Line defect (1-D)
* Surface defect (2-D)
* Volume defect (3-D)

1.> Point defects :-

i> Vacancy - absence of an atom in a lattice pt. where there is suppose to be an atom, Formed when atoms are removed from their lattice positions as a result of thermal fluctuations. (Schottky defects).

ii> Interstitial - Atom located in a (void position that is not part of lattice) within the

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crystal structure

Frenkel Defect :- A vacancy interstitial pair.

→ Substitutional Impurity - Impurity atoms that take up the lattice positions that are ordinarily occupied by the atoms that make up the crystal.

→ Interstitial Impurity - Impurity atoms that are present in the interstitial sites.

2.) Line defects

→ Dislocation - Boundary b/w 2 regions of a surface which are prefect themselves but are out of registry with each other. The resulting lattice distortion is centered along a line.

⇒ Burgers Vector, b :- A vector by which the lattice on 1 side of an internal surface containing the dislocation line is displace relative to the lattice on the other side.

2 Special Cases of dislocation

→ Edge Dislocation - b & normal vector along the dislocation line l are ⊥r.

→ Screw Dislocation - b & normal vector along the dislocation line l are ||.

3. 2-D defect
Unsaturated bond, surface always have an associated energy.
In equilibrium, shape of a given amount of crystal minimizes the total surface Energy.

4. 3-D defects →
1> Grain Boundary -
• Internal surfaces that seperates grains of different orientation.
• created in metals during solidification when crystal grow from different nuclei.

2> Volume defects :-
Crystal twins →
Grain boundary is not random, but have a symmetric.

3> Stacking faults :-
FCC, ABCABC, ___ ABCABCABC

4> Voids :-
The absence of a no of atoms to form surface similar to microcracks (broken bonds at the surface).

Q-3) Describe briefly :-

i) Miller Indices - Group of 3 number that indicates the orientation of a plane or set of ll planes of atoms in a crystal.

* Two or more planes can have same Miller Indices which can be -ve, 0, +ve depending on the intercept on the axes.

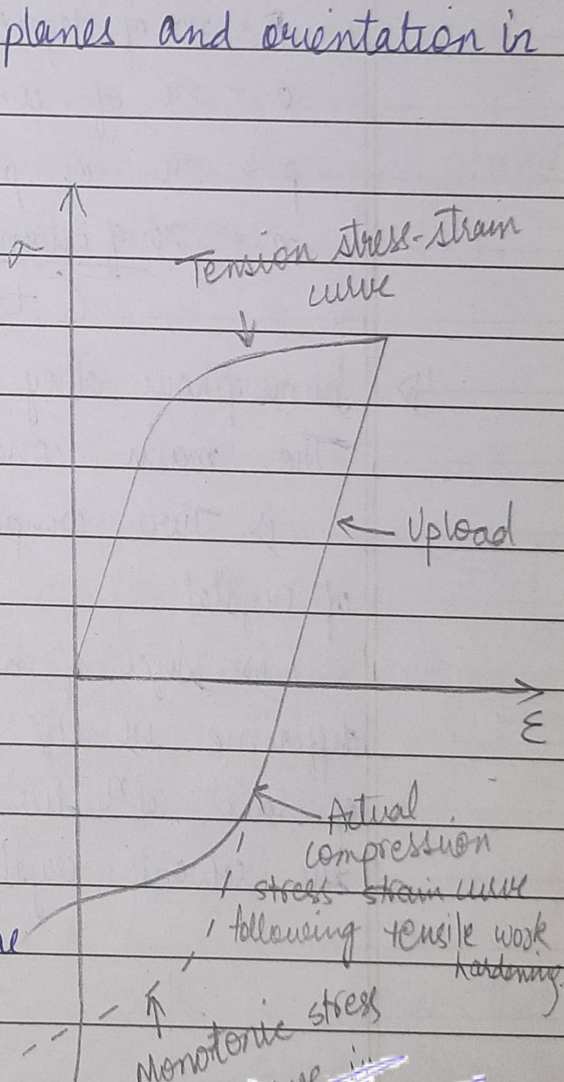
It ~~helps in~~ specific atomic planes and orientation in a crystal.

ii) Bauschinger's Effect -

1.) It refers to a decrease in the compressive yield stress due to work hardening in tension.

2.) It also refer to a decrease in the Tensile yield stress due to work hardening in compression.

3.) Work hardening can be used to increase the yield strength of a material, but it does so at the cost of a lower yield stress in the reversed dir^n of loading.



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3) Phase rule -

All changes which take place in a system consisting of several phases, in accordance with external conditions (temperature and pressure) conform to the so called phase rule.

$$F = C + n - P$$

F = no. of degree of freedom

C = no. of components

P = no. of phases in equilibrium

n = no. of external factors

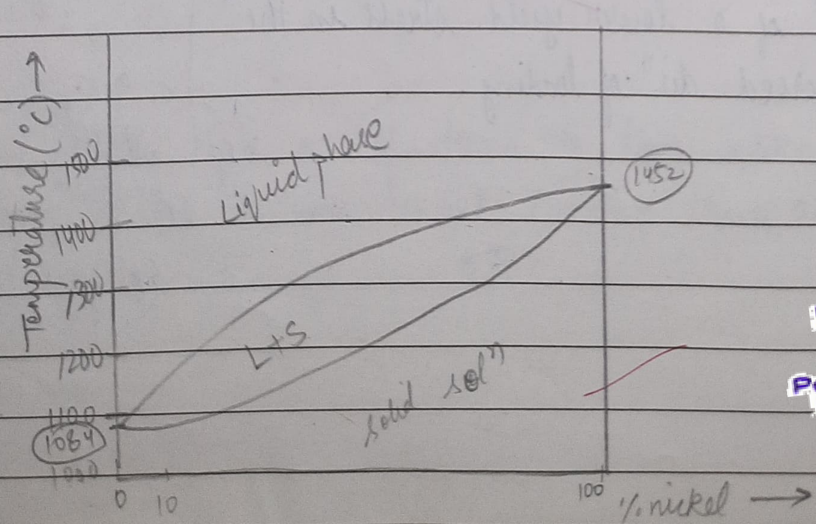
(temp, pressure, concentration)

4) Isomorphous alloy system

The main conditions are :-

i) Two components should have the same type of crystal

ii) Sizes of atoms should be very similar. A difference in size over 15% prevents the formation of solid solⁿ due to ~~pressure~~ extreme distortion of the solvent crystal lattice



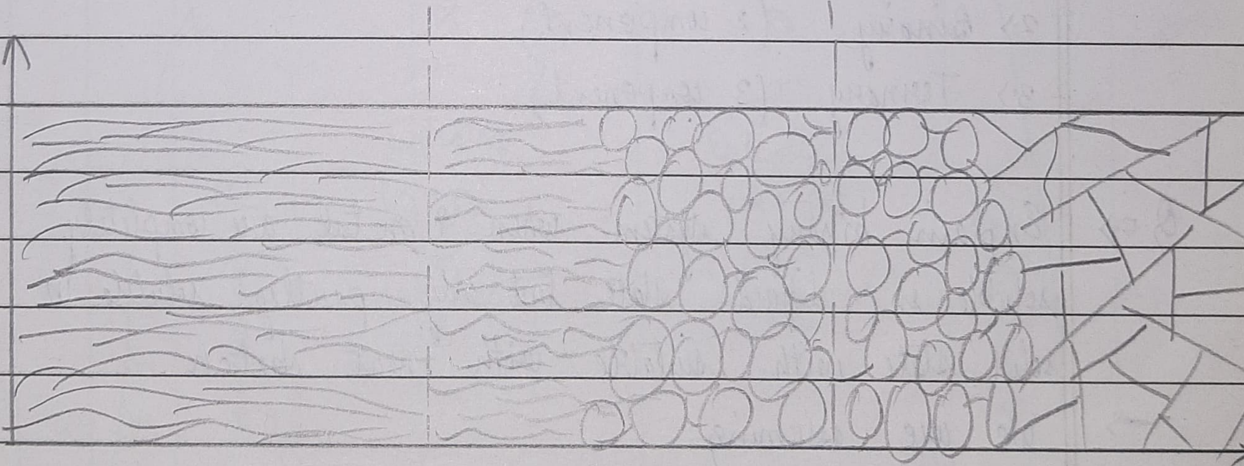
5> Recovery, Recrystallisation and grain growth

Recovery - Occurs below recrystallization temp^r, stresses in the highly deformed regions are relieved.

Recrystallization — Within a certain temp^r range, new equiaxed and strain-free grains are formed to replace older grains.

Grain Growth - Grains begin to grow in size and exceed the original grain size when temp^r is raised further.

~~6> Solid solution - It is.~~



6> Solid solution - It is a mixture of 2 crystalline solids that consist as a new crystalline, solid or crystal lattice. The substance may be soluble over a partial or even complete range of relative conc., producing of crystal.

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7.) Equilibrium Diagram –
Constitutional Diagram
Phase Diagram

It enable the phase content of the alloys to be determined at any temperature and composition. They enable the phase transformation to be followed in heating and cooling the alloy under equilibrium conditions i.e when all processes in the given system are reversible.

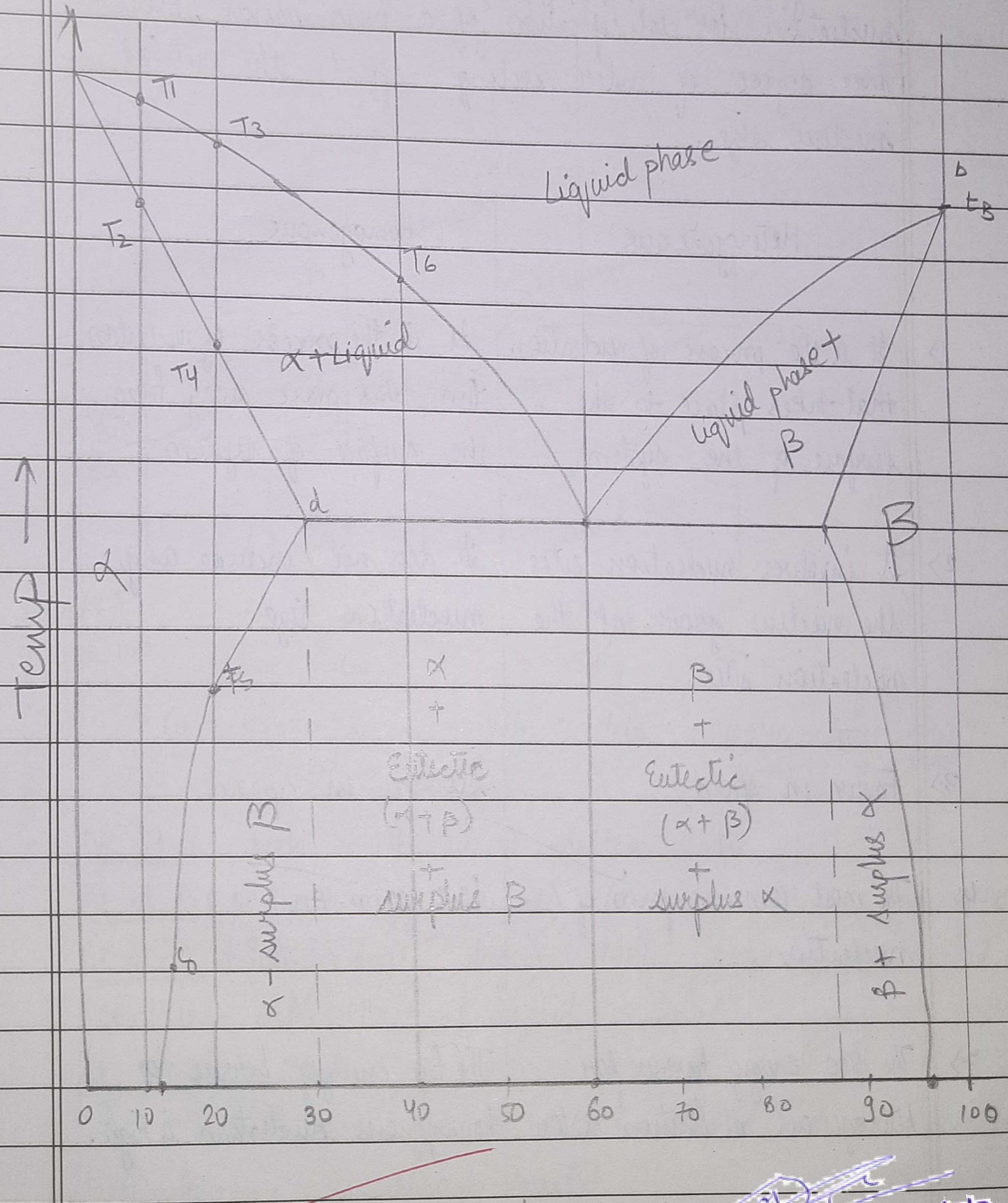
It is classified as –

1.) Unary (1 component)
2.) Binary (2 component)
3.) Ternary (3 component)

Q-5.) Explain binary system when 2 metal are completely soluble in liquid state but only partly soluble in solid state with suitable with neat sketch.

→ We are assuming
Metal A + Metal B

Metals are completely soluble in liquid state but partially soluble in solid state.



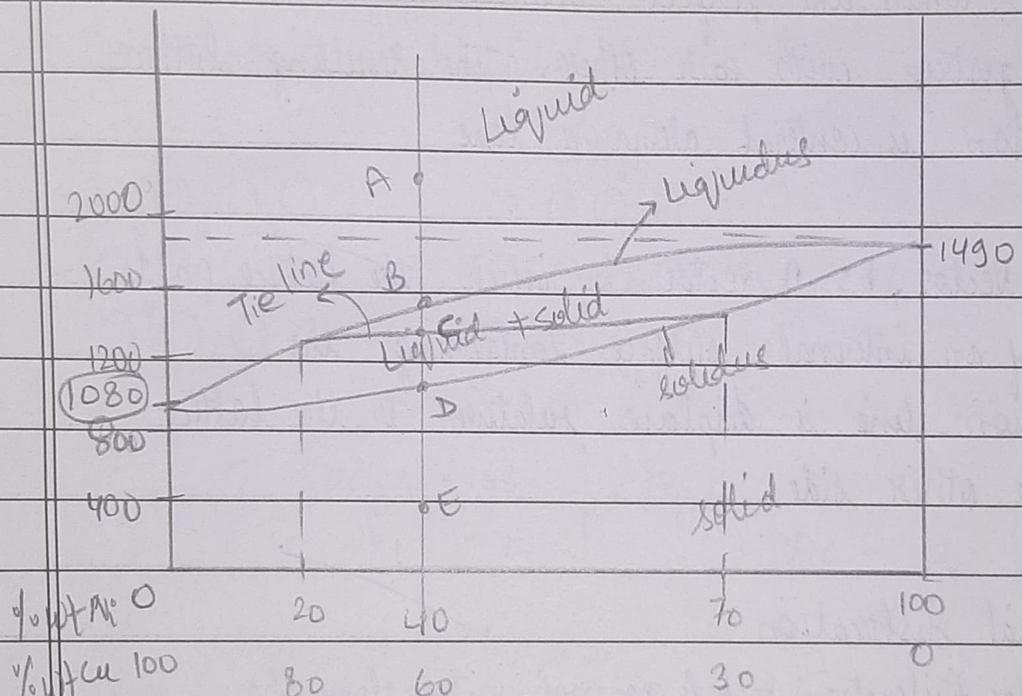
T1
T3
T2
T6
T4
Liquid phase
b
t_B
α + Liquid
Liquid phase + β
d
β
α
Temp →
α + Eutectic (α + β) + surplus B
β + Eutectic (α + β) + surplus α
α - surplus β
β + surplus α
0 10 20 30 40 50 60 70 80 90 100
% Metal B

Q-6.) Distinguish b/w homogenous & heterogeneous nucleation for solidification of a pure metal. How does degree of under cooling affect the critical nucleus size.

	Heterogeneous	Homogenous
1.)	It is the process of nucleation that takes place to the surface of the system	It is the process of nucleation that takes place away from the surface of system.
2.)	It involves nucleation sites, the nucleus grows at the nucleation sites.	It does not include any nucleation size.
3.)	Faster in speed.	Slower in speed
4.)	The most common form of nucleation.	Less common
5.)	The free energy barrier for heterogenous nucleation is low.	The free energy barrier for homogenous nucleation is high.
6.)	The surface area that contributes to the growth of nucleus is low.	Surface area that contributes to the growth of nucleus ...

The greater the degree of undercooling of a liquid the smaller the critical radius of nuclei formed.

Q-7) Draw an equilibrium diagram of binary system with limited solid state and in which solubility decreases with decrease in temperature, also explain it briefly.



$$\% Cu = \frac{40-20}{70-20} \times 100 = 40\% \quad ; \quad \% Cu = \frac{70-40}{70-20} \times 100 = 60\%$$

liq   solid

At pt. A, both metals are at molten state.

At pt. B (on the line of Liquidus), Cu metal starts forming nuclei.

At pt. C (Intermediate stage), Metals ~~are in~~ semi-solid form contains both phase (liquid + solid)

At pt. D (solidus),

There is grain growth in Cu metal whereas nuclei starts forming in Nickel metal.

At pt. E (solidifies),

Metal solidifies completely.

Q-8> Explain line dislocation & burger vector.

⇒

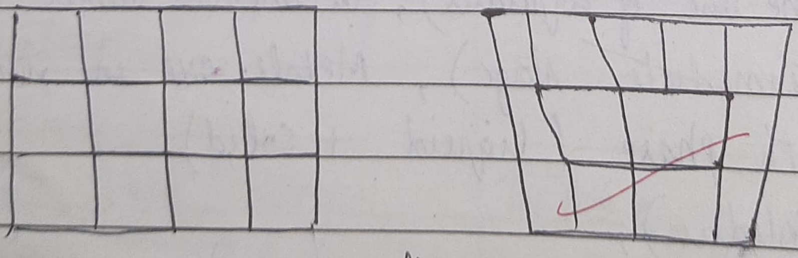
Line Dislocation - Boundary b/w 2 regions of a surface which are perfect themselves but are out of registry with each other. The resulting lattice distortion is centered along a line.

Burgers Vector, b: A vector by which the lattice on 1 side of an internal surface containing the dislocation line is displace relative to the lattice on the other side.

2 special dislocation

Edge Dislocation - b & normal vector along the dislocation line l are ⊥^{r}.

Screw Dislocation - b & normal vector along the dislocation line l are ||.



Edge Dislocation

20/11/2024

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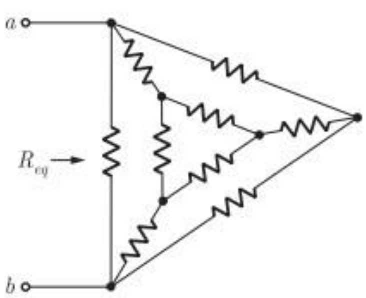
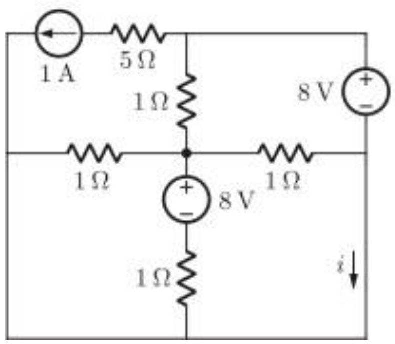
Assignment Sheet 1

Campus: PCE **Course**: B. Tech. **Class/ Section**: 3rd Semester **Date**: 30 August, 2020

Name of Faculty: Mr. Manish Kumar **Name of Subject**: Network Theory **Code**: 3EC4-06

Date of Preparation: 30 August, 2020 **Schedule date of Submission**: 7 September, 2020

Q. No.	Questions	COs	POs	PSOs
1	In the given circuit, each resistor has a value equal to 1Ω.  What is the equivalent resistance across the terminals a and b?	CO 1	PO 1	PSO 1
2	In the figure shown, the current i (in ampere is ______  	CO 1	PO 1	PSO 1

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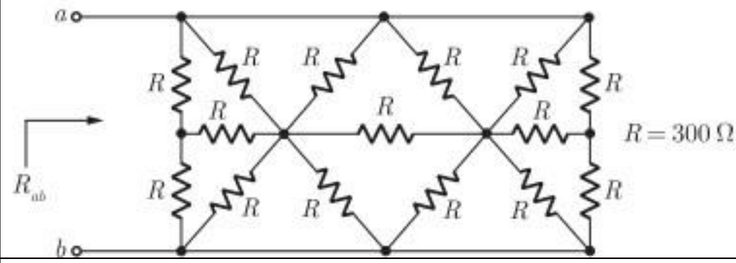
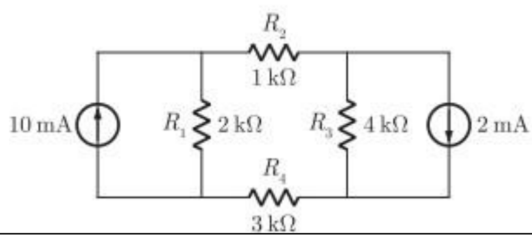
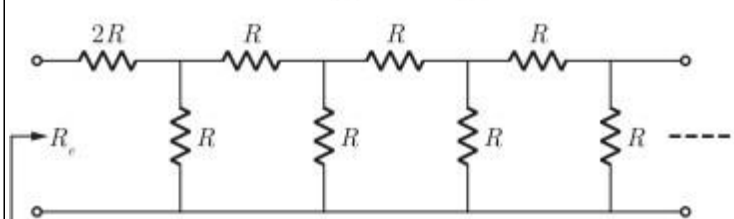
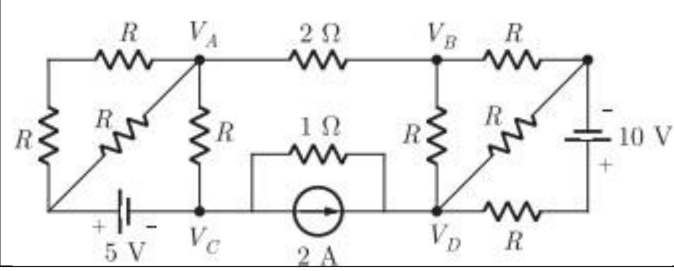
Sitapura, JAIPUR

3	In the network shown in the figure, all resistors are identical with $R = 300\Omega$. The resistance R_{ab} (in Ω) of the network is________. 	**CO 2**	**PO 1**	**PSO 1**
4	The magnitude of current (in mA) through the resistor R_2 in the figure shown is_______. 	**CO 2**	**PO 1**	**PSO 1**
5	A Y-network has resistances of $10\,\Omega$ each in two of its arms, while the third arm has a resistance of $11\,\Omega$. In the equivalent Δ-network, the lowest value (in Ω) among the three resistances is _____.	**CO 1**	**PO 1**	**PSO 1**
6	The equivalent resistance in the infinite ladder network shown in the figure is R_e 	**CO 2**	**PO 1**	**PSO 1**
7	If $V_A - V_B = 6$ V then $V_C - V_D$ is 	**CO 3**	**PO 1**	**PSO 1**

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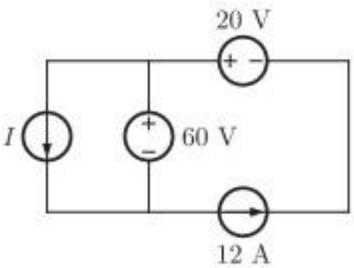
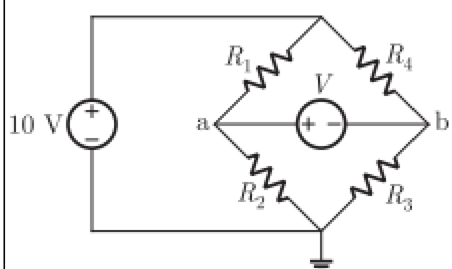
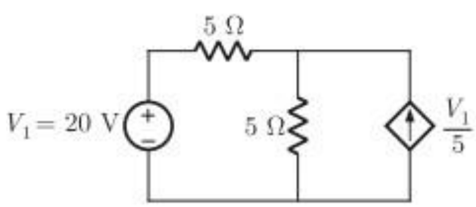
8	In the interconnection of ideal sources shown in the figure, it is known that the 60 V source is absorbing power.  Which of the following can be the value of the current source I? (A) 10 A (B) 13 A (C) 15 A (D) 18 A	**CO 3**	**PO 1**	**PSO 1**
9	If $R_1 = R_2 = R_4 = R$ and $R_3 = 1.1R$ in the bridge circuit shown in the figure, then the reading in the ideal voltmeter connected between a and b is 	**CO 3**	**PO 1**	**PSO 1**
10	The dependent current source shown in the figure  (A) delivers 80 W (B) absorbs 80 W (C) delivers 40 W (D) absorbs 40 W	**CO 3**	**PO 1**	**PSO 1**

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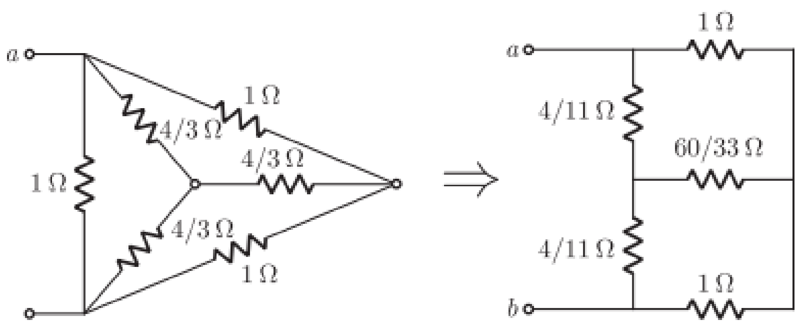
Solution of Assignment Sheet 1

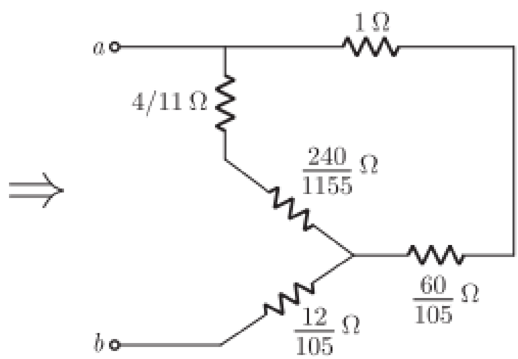
Campus: PCE **Course**: B. Tech. **Class/ Section**: 3rd Semester **Date**: 6 Sept., 2020

Name of Faculty: Mr. Manish Kumar **Name of Subject**: Network Theory **Code**: 3EC4-06

Date of Preparation: 6 September, 2020 **Schedule date of Submission**: 7 September, 2020

Q. No.	Solution of Assignment Sheet 1
1	





$$\text{So, } R_{ab} = \frac{12}{105} + \left(\frac{240}{1155} + \frac{4}{11}\right) \parallel \left(1 + \frac{60}{105}\right)$$

$$= 0.1143 + 0.41485$$

$$= 0.53\,\Omega$$

$$= \frac{8}{15}\,\Omega$$

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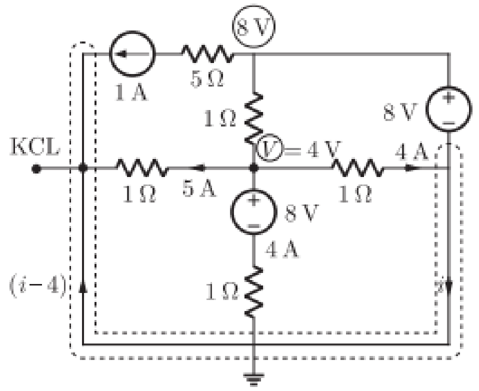
2	

Nodal

$$\frac{(V-8)}{1}+\frac{V}{1}+\frac{(V-8)}{1}+\frac{V}{1}=0$$

$$4V = 16$$

$$V = 4 \text{ Volts}$$

Now KCL

$$i-4+4+1=0$$

$$i = -1A$$

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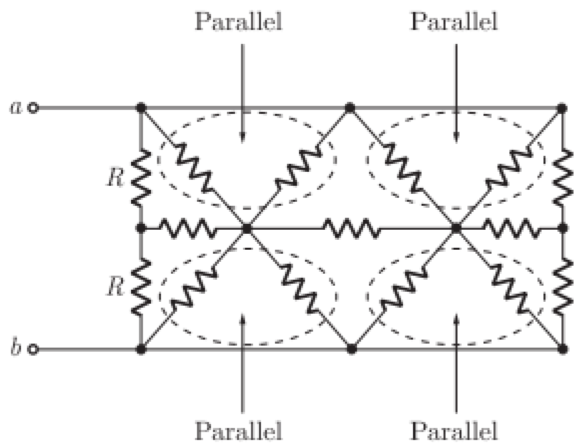
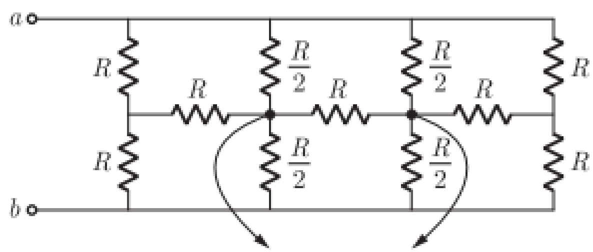
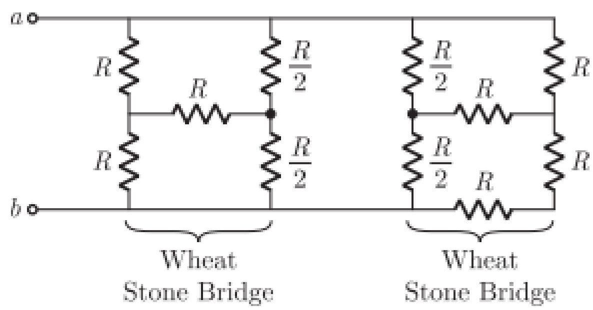
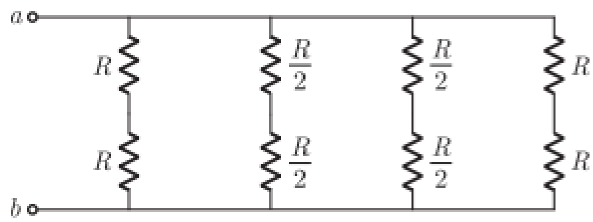
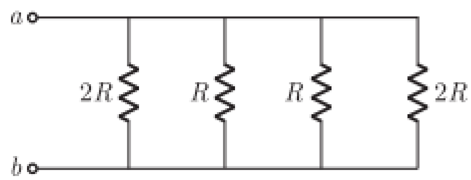
3	The equivalent resistance across terminal *a*-*b* is obtained by solving the circuit as   both the node will be at the same potential and thus R will be open since $i = 0$ in that



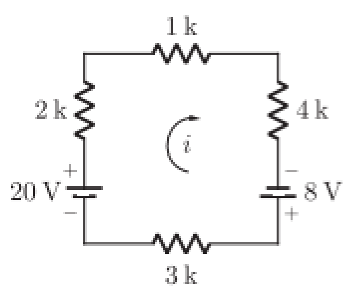




Hence, $R_{ab} = \frac{R}{3} = \frac{300\,\Omega}{3} = 100\,\Omega$

4

We convert both the current source into equivalent voltage source as



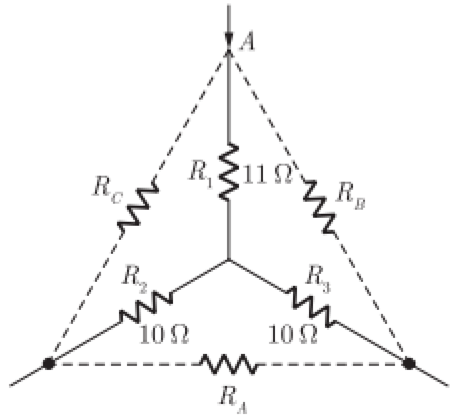
Applying KVL in the circuit,

$$-20 + (2 + 1 + 4 + 3)i - 8 = 0$$

Hence, $i = \frac{28}{10} = 2.8$ mA.

5

For the given problem, we sketch the Y-network as



For the given Y-network; we obtain the equivalent resistances of Δ-network as

$$R_A = \frac{R_1R_2 + R_2R_3 + R_1R_3}{R_1}$$

$$= \frac{11 \times 10 + 10 \times 10 + 11 \times 10}{11} = 29.09\,\Omega$$

$$R_B = \frac{R_1R_2 + R_2R_3 + R_1R_3}{R_2}$$

$$= \frac{11 \times 10 + 10 \times 10 + 11 \times 10}{10} = 32\,\Omega$$

$$R_C = \frac{R_1R_2 + R_2R_3 + R_1R_3}{R_3}$$

$$= \frac{11 \times 10 + 10 \times 10 + 11 \times 10}{10}$$

$$= 32\,\Omega$$

Hence, the lowest value among the three resistance is

$$R_A = 29.09\,\Omega$$

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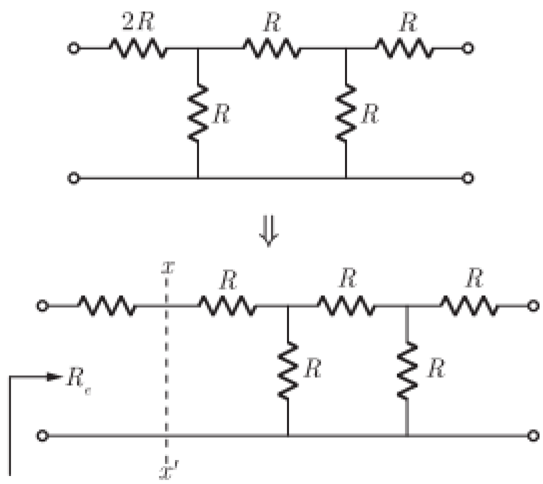
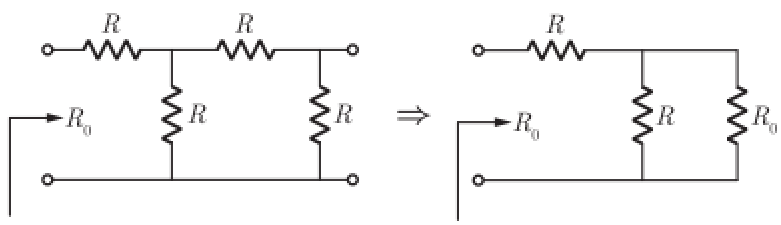
6

We consider one section of the given infinite ladder network.



Again, considering the section right to xx',



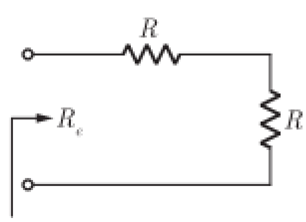
So, the equivalent resistance is

$$R_0 = R + \frac{RR_0}{R + R_0}$$

or $R_0(R + R_0) = R(R + R_0) + RR_0$

or $$R_0 = \left(\frac{1+\sqrt{5}}{2}\right)R = 1.6180R$$

Thus, the equivalent circuit is



From the circuit, we get the equivalent resistance as

$$R_e = R + R_0 = 2.6180R$$

Hence, $$\frac{R_e}{R} = 2.6180$$

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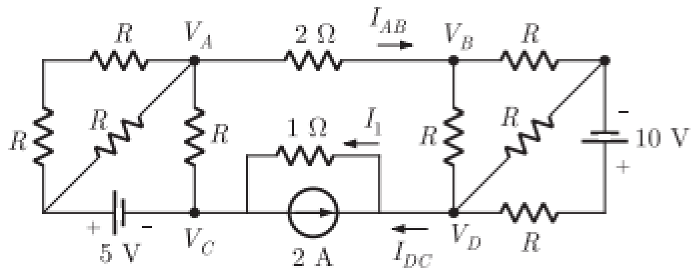
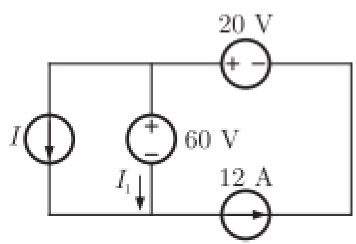
7	For a one port network current entering one terminal, equals the current leaving the second terminal. Thus the outgoing current from A to B will be equal to the incoming current from D to C as shown i.e. $I_{DC} = I_{AB} = 3$ A  The total current in the resistor 1 Ω will be $I_1 = 2 + I_{DC}$ (By writing KCL at node D) $= 2 + 3 = 5$ A So, $V_{CD} = 1 \times (-I_1) = -5$ V
8	Circuit is as shown below  Since 60 V source is absorbing power. So, in 60 V source current flows from + to - ve direction So, $I + I_1 = 12$ $I = 12 - I_1$ I is always less then 12 A So, only option (A) satisfies this conditions.
9	Here $V_a = 5$ V because $R_1 = R_2$ and total voltage drop is 10 V. Now $V_b = \frac{R_3}{R_3 + R_4} \times 10 = \frac{1.1}{2.1} \times 10 = 5.238$ V $V = V_a - V_b = 5 - 5.238 = -0.238$ V

<table>
<tr>
<td>10</td>
<td></td>
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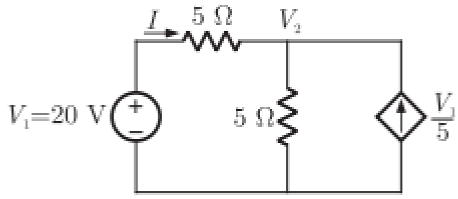
Applying KCL at for node 2,



$$\frac{V_2}{5}+\frac{V_2-V_1}{5}=\frac{V_1}{5}$$

or $$V_2 = V_1 = 20 \text{ V}$$

Voltage across dependent current source is 20 thus power delivered by it is

$$PV_2\times\frac{V_1}{5}=20\times\frac{20}{5}=80 \text{ W}$$

It deliver power because current flows from its +ive terminals.

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</tr>
</table>

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Answer Script of Assignment-1

Q.1 (a) Unit of Refrigeration

* Unit of Refrigeration is tonne of Ref. which is described as Amount of heat extracted or absorbed from 1 tonne (1000kg) of water at 0°C to convert it in 1 tonne of Ice at 0°C in 24 hrs.

1 tonne = 3.51 kW
= 210 kJ/min.
= 14000 kJ/hour

(2.5)

(B) COP of Refrigeration & Heat Pump

* COP of Ref. = Desired Refrigerating effect / work input

$= Q_e / W_{inp}$

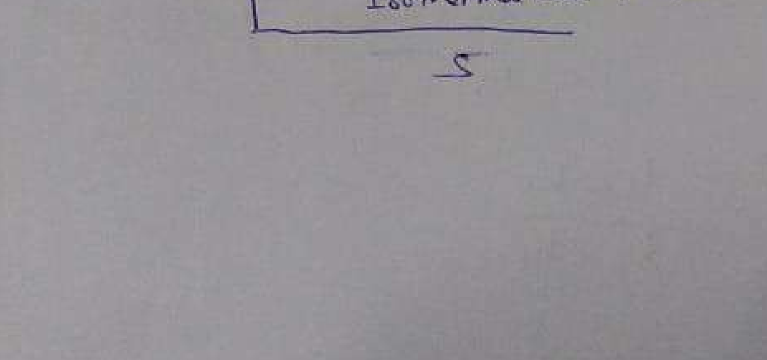
COP of HP $= 1 + COP_{ref}$

$= \frac{Q_e + W_{inp}}{W_{inp}} = 1 + \frac{Q_e}{W_{inp}} = 1 + COP_{Ref}$

(2.5)

(C) Carnot Ref. Cycle & its COP

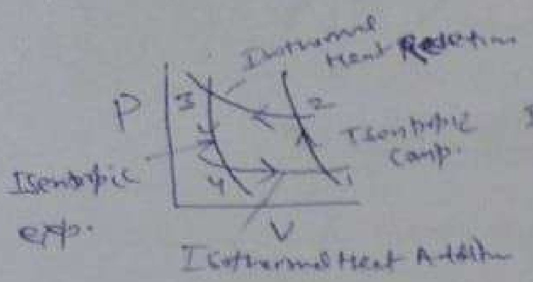
*



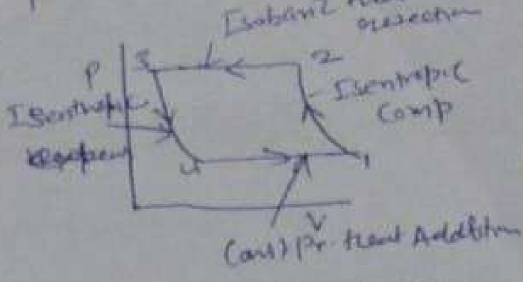
$COP_{ref.\ (Ideal)} = \frac{T_L}{T_H - T_L}$

(5)

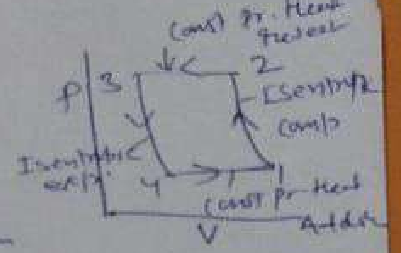
Q.2 Comp Pv & TS Diag for Rev. Carnot Cycle, VCRS Cycle, Bell Coleman Cycle



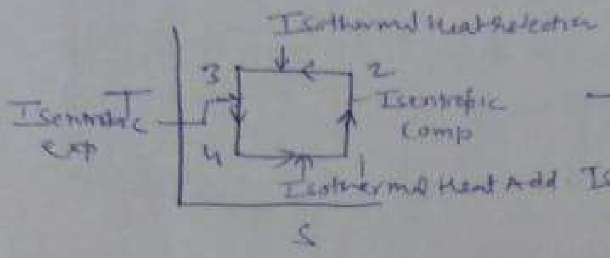
P-v Diag. (R.C.C)

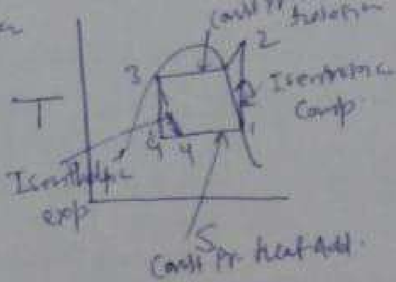


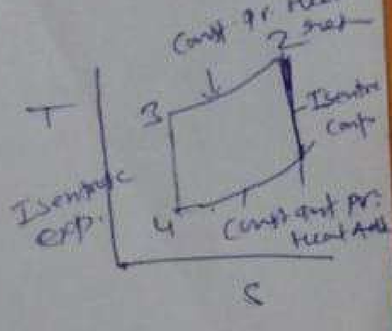
PV Diag (VCRS)



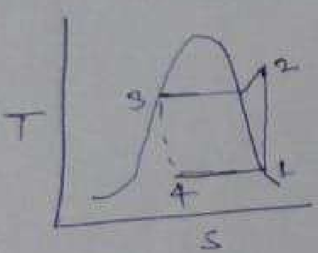
P-V Diag (Bell Coleman)







Q.3 Derive the COP of VCRS & Effect of Parameters on COP
(9)



$$COP = \frac{\text{Refrigerating effect}}{\text{Work input}}$$

Refrigerating effect = $h_1 - h_4$

h_4 = Enthalpy of Refrigerant at point 4 and after ~~Comp.~~ expansion or Before evaporator

h_1 = Enthalpy of Refrigerant at point 1 or before entering to Comp. or after evaporator

Work input = $h_2 - h_1$

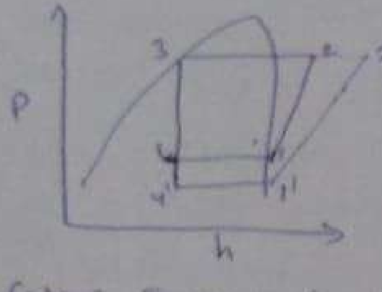
h_2 = Enthalpy of Refrigerant after Comp.

h_1 = " " " Before Comp.

$$COP = \frac{h_1 - h_4}{h_2 - h_1}$$

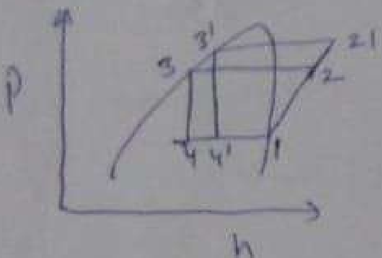
(5)

3.6 Case-1 Decrease in Evaporator Pressure



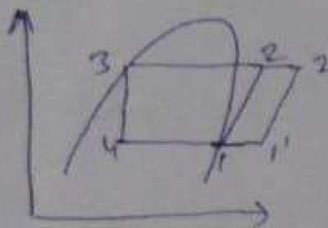
↓RE ↑W.I ↓COP ↓V.E due to Increase in Pr Ratio

Case-2 Increase in Condenser Pressure:-



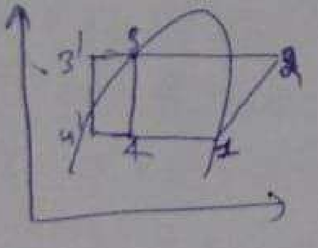
↓RE ↑W.I ↓COP ↓V.E Same Reason

Case-3 Superheating



↑RE ↑W.I COP ↑↓ R-12 NH_3

Case-4 Sub Cooling



↑RE W.I = No change COP ↑

(5)

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Assignment 1 (Answer Script)

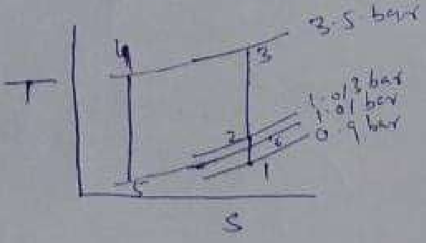
Q.4 A Simple Air Ref. Cycle — with exp & comp → Isentropic

given :- Q - 10 TR, $P_1 = 0.9$ bar $T_1 = 10°C = 10 + 273 = 283K$ $P_2 = 1.013$ bar

$P_5 = P_6 = 1.01$ bar $T_6 = 25°C = 25 + 273 = 298K$ $P_3 = 3.5$ bar

$T_4 = T_3 - 50°C$

1. Power required to take the load of cooling in the cabin,
2. COP of the System



We know that for Isentropic Process

$$T_2/T_1 = \left(\frac{P_2}{P_1}\right)^{\gamma-1/\gamma} = \left(\frac{1.013}{0.9}\right)^{\frac{1.4-1}{1.4}} = (1.125)^{0.286} = 1.1034$$

Therefore $T_2 = T_1 \times 1.034 = 283 \times 1.034 = 292.6K$

Similarly $\frac{T_3}{T_2} = \left(\frac{P_3}{P_2}\right)^{\frac{\gamma-1}{\gamma}} = \left(\frac{3.5}{1.013}\right)^{\frac{1.4-1}{1.4}} = (3.45)^{0.286} = 1.425$

$T_3 = T_2 \times 1.425 = 292.6 \times 1.425 = 417K = 144°C$

$T_4 = 144 - 50°C = 94°C = 367K$

Similarly $\frac{T_5}{T_4} = T_4 \times 0.7 = 367 \times 0.7 = 257K$

mass of air $m_a = \frac{210Q}{C_p(T_6 - T_5)} = \frac{210 \times 10}{1(298 - 257)} = 512$ kg/min.

$P = \frac{m_a C_p (T_3 - T_2)}{60} = \frac{512 \times 1 (417 - 292.6)}{60} = 106$ kW

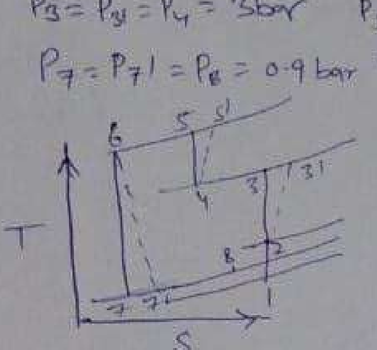
$COP = T_6 - T_5 / T_3 - T_2 = 298 - 257 / 417 - 292.6 = 0.329$

Q.5 Boot Strap Cooling

given :- Q = 10 tonne $T_1 = 20°C = 20 + 273 = 293K$ $P_1 = 0.85$ bar $P_2 = 1$ bar

$P_3 = P_{3'} = P_4 = 3$ bar $P_5 = P_{5'} = P_6 = 4$ bar $\eta_{c_1} = \eta_{c_2} = 80\% = 0.8$ $\eta_T = 85\% = 0.85$

$P_7 = P_{7'} = P_8 = 0.9$ bar $T_8 = 20°C = 20 + 273 = 293K$ $\gamma = 1.4$ $C_p = 1$ kJ/kgK



For Isentropic Process 1-2

$$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}} = \left(\frac{1}{0.85}\right)^{\frac{1.4-1}{1.4}} = (1.176)^{0.286} = 1.047$$

Similarly 2-3

$$\frac{T_3}{T_2} = \left(\frac{P_3}{P_2}\right)^{\frac{\gamma-1}{\gamma}} = \left(\frac{3}{1}\right)^{\frac{1.4-1}{1.4}} = (3)^{0.286} = 1.37$$

$T_3 = T_2 \times 1.37 = 306.8 \times 1.37 = 420.3K = 147°C$

$\eta_{c_1} = \frac{T_3 - T_2}{T_{3'} - T_2} = \frac{420.3 - 306.8}{T_{3'} - 306.8} =$ $T_{3'} = 448$ K ... °C

DETAILED LECTURE NOTES

∴ 50% Enthalpy of Air discharged from the main Comp. is removed in the first Heat exchanger

therefor temp. of air leaving the first H.E.

$T_4 = 0.5 \times 175.7 = 87.85°C = 360.85 k$

Now for 4-5 $T_4 = 0.5 \times 175 = 360.85 k$

$\frac{T_5}{T_4} = \left(\frac{P_5}{P_4}\right)^{\frac{\gamma-1}{\gamma}} = \left(\frac{4}{3}\right)^{0.286} = 1.085$

$T_5 = 118.5°C$

$\eta_{C_2} = 0.8 = \frac{T_5 - T_4}{T_{5'} - T_4} = \frac{30.65}{T_{5'} - 360.85} = 126.16°C$

Since 30% enthalpy of air discharged from the auxiliary comp. is removed in second H.E. therefore temp. of air leaving the second H.E.

$T_6 = 0.7 \times 126.16 = 88.3°C = 361.3 k$

similarly 6-7

$T_7 = T_6 \times 0.653 = 361.3 \times 0.653 = 236°k = -37°C$

$\eta_T = \frac{T_6 - T_{7'}}{T_6 - T_7} = 0.85 = \frac{316.3 - T_{7'}}{361.3 - 236} = 254.8k = -18.2°C$

Pref. $= m_a = \frac{210\,Q}{C_p(T_8 - T_{7'})} = \frac{210 \times 10}{1(293 - 254.8)} = 55 kg/min$

$P = m_a C_p \frac{(T_{3'} - T_2)}{60} = 130 kW$

$COP = \frac{210\,Q}{m_a C_p (T_{3'} - T_2)} = \frac{210 \times 10}{55 \times 1\,(448.7 - \ldots)}$

Assignment Sheet-1

Campus: PCE Course: B.Tech. **Class/Section: III year A & B** **Date: 21/03/2022**

Name of Faculty: Dr. Narayan Lal Jain **Name of Subject:** RAC **Code:** 6ME5-11

Date of Preparation: 19/03/2022 **Scheduled Date of Submission: 25/03/2022**

Q. No.	Questions	COs	POs	PSOs
Q.1	Explain the following: Unit of Refrigeration, COP of Refrigeration, Heat Pump, Ideal Refrigeration (Rev. Carnot) Cycle and its COP.	1	1	2&3
Q.2	Compare the PV and TS Diagram for Rev. Carnot Cycle, VCRS Cycle, Rev. Brayton(Bell Coleman) Cycle	1	1	2&3
Q.3	Derive the COP of VCRS and explain the effect of Various parameters on the COP.	2	2	2&3
Q.4	A simple air cooled system is used for an aero plane having a load of 10 tones. The atmospheric pressure and temperature are 0.9 bar and 10°C respectively. The pressure increases to 1.013 bar due to ramming. The temperature of the air is reduced by 50°C in the heat exchanger. The pressure in the cabin is 1.01 bar and the temperature of air leaving the cabin is 25°C. Determine: 1. Power required to take the load of cooling in the cabin; and 2. C.O.P. of the system. Assume that all the expansions and compressions are isentropic. The pressure of the compressed air is 3.5 bar.	2	2	2&3
Q.5	A boot-strap cooling system of 10 TR capacities is used in an aero plane. The ambient air temperature and pressure are 20°C and 0.85 bar respectively. The pressure of air increases from 0.85 bar to 1 bar due to ramming action of air. The pressure of air discharged from the main compressor is 3 bar. The discharge pressure of air from the auxiliary compressor is 4 bar. The isentropic efficiency of each of the compressor is 80%, while that of turbine is 85%. 50% of the enthalpy of air discharged from the main compressor is removed in the first heat exchanger and 30% of the enthalpy of air discharged from the auxiliary compressor is removed in the second heat exchanger using rammed air. Assuming ramming action to be isentropic, the required cabin pressure of 0.9 bar and temperature of the air leaving the cabin not more than 20° C, find : 1. the power required to operate the system, and 2. the C.O.P. of the system. Draw the schematic and temperature -entropy diagram of the system. Take γ = 1.4 and Cp= 1 kJ/kg K.	2	2	2&3

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