Q. 1 (a) Given

$$A = \begin{bmatrix} \frac{1}{2}(1+i) & \frac{1}{2}(-1+i) \\ \frac{1}{2}(1+i) & \frac{1}{2}(1-i) \end{bmatrix}$$

As we know for unitary matrix

$$A A^{\theta} = I$$

$$\bar{A} = \begin{bmatrix} \frac{1}{2}(1-i) & \frac{1}{2}(-1-i) \\ \frac{1}{2}(1-i) & \frac{1}{2}(1+i) \end{bmatrix}$$

$$(\bar{A})^T = A^{\theta} = \begin{bmatrix} \frac{1}{2}(1-i) & \frac{1}{2}(1-i) \\ \frac{1}{2}(-1-i) & \frac{1}{2}(1+i) \end{bmatrix}$$

$$A A^{\theta} = \begin{bmatrix} \frac{1}{2}(1+i) & \frac{1}{2}(-1+i) \\ \frac{1}{2}(1+i) & \frac{1}{2}(1-i) \end{bmatrix} \begin{bmatrix} \frac{1}{2}(1-i) & \frac{1}{2}(1-i) \\ \frac{1}{2}(-1-i) & \frac{1}{2}(1+i) \end{bmatrix}$$

$$= \begin{bmatrix} \frac{1}{4}(1+1+1+1) & \frac{1}{4}(\cancel{1}+\cancel{1}-\cancel{1}-\cancel{1}) \\ \frac{1}{4}(\cancel{1}+\cancel{1}-\cancel{1}-\cancel{1}) & \frac{1}{4}(1+1+1+1) \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$$

$\hookrightarrow$ ∴ A is unitary matrix

$$|A| = \frac{1}{4}(1+i)(1-i) - \frac{1}{4}(1+i)(-1+i)$$

$$= \frac{1}{4}\left[1+1-(-1-1)\right]$$

$$= \frac{1}{4} \times 4 = 1$$

$$\text{Adj } A = \begin{bmatrix} \frac{1}{2}(1-i) & -\frac{1}{2}(-1+i) \\ -\frac{1}{2}(1+i) & \frac{1}{2}(1+i) \end{bmatrix}$$

$$\because A^{-1} = \frac{\text{adj} A}{|A|} = \begin{bmatrix} \frac{1}{2}(1-i) & -\frac{1}{2}(-1+i) \\ -\frac{1}{2}(1+i) & \frac{1}{2}(1+i) \end{bmatrix}$$

Q. 1(b)

Case-1

$r_1 = 1.5\,m \qquad h_1 = 4m$

Vol. of ballon $V_1 = \pi r_1^2 h_1$

$$= \pi \times 1.5^2 \times 4$$

Case-2

$r_2 = 1.5 + 0.01 = 1.51\,m$

$h_2 = 4 + 0.05 = 4.05\,m$

Vol. of ballon $V_2 = \pi r_2^2 h_2$

$$= \pi \times 1.51^2 \times 4.05$$

% Change in vol. $= \dfrac{V_2 - V_1}{V_1} \times 100$

$$= \frac{\pi \times 1.51^2 \times 4.05 - \pi \times 1.5^2 \times 4}{\pi \times 1.5^2 \times 4} \times 100 = 2.6045\%$$

Ans.

Q. 1(d) Given -

$v_s(t) = 4 \cos \omega_0 t$ Volts

$i_s(t) = 3\cos(\omega_0 t - 30) + 2\cos(3\omega_0 t - 50)$ Amp.

(I)

$$V_{s\,rms} = \frac{4}{\sqrt{2}} = 2.828 \text{ Volt}$$

$$I_{s\,rms} = \sqrt{\frac{3^2}{2} + \frac{2^2}{2}} = 2.5495 \text{ Amp.}$$

(II)

$$P_{avg} = V_{s\,rms} I_{s,1\,rms} \cos\phi$$

$$= \frac{4}{\sqrt{2}} \times \frac{3}{\sqrt{2}} \times \cos 30^\circ$$

$$= 5.196 \text{ Watt}$$

(III)

$$V_{s1\,rms} = \frac{4}{\sqrt{2}} = 2.828 \text{ Volt}$$

$$I_{s1\,rms} = \frac{3}{\sqrt{2}} = 2.12 \text{ Amp.}$$

(IV)

$$g_{current} = \frac{I_{s1\,rms}}{I_{s\,rms}} = \frac{2.12}{2.5495} = 0.832$$

$$THD_{current} = \sqrt{\frac{1}{g^2_{current}} - 1} = 0.667$$

$$g_{voltage} = \frac{V_{s1\,rms}}{V_{s\,rms}} = 1$$

$$THD_{voltag} = \sqrt{\frac{1}{1} - 1} = 0$$

(V)

$$Pf = \frac{5.196}{2.828 \times 2.5495} = 0.721 \text{ lag.}$$

Q.1(e) A/c to ques.

$$V_o = E_b + I_o R_a$$

$$\frac{3V_{mL}}{\pi}\cos\alpha - 6fL_sI_o = 400 + 20\times1$$

$$\frac{3\times230\times\sqrt{6}}{\pi}\cos\alpha = 400+20+6\times50\times4\times10^{-3}\times20 = 444$$

$\Rightarrow$ ~~444~~

$$\cos\alpha = \frac{444\times\pi}{3\sqrt{6}\times230}$$

$$\boxed{\alpha = 34.38^\circ}$$

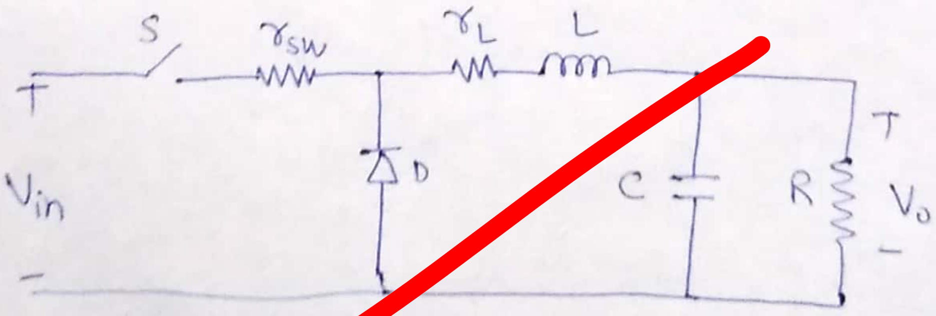
$$\Delta V_o = \frac{V_{do}}{2}\left[\cos\alpha - \cos(\alpha+\mu)\right]$$

$$6fL_sI_o = \frac{3V_{mL}}{2\pi}\left[\cos\alpha - \cos(\alpha+\mu)\right]$$

$$6\times50\times4\times10^{-3}\times20 = \frac{3\times\sqrt{6}\times230}{2\pi}\left[\cos34.38 - \cos(34.38+\mu)\right]$$

$$\boxed{\mu = 8.22^\circ}$$

Q.1(c)



Given $V_{in} = 50V$ $\quad V_D = 0.9V$ $\quad V_o = 20V$

$R = 4\Omega$ $\quad r_{sw} = 0.08\Omega$ $\quad r_L = 0.06\Omega$

$$P_S = P_o + P_L$$

$$V_S I_S = V_o I_o + I_S^2 r_{SW} + I_S^2 r_L + V_D I_o$$

$$V_S \cancel{I_S} = V_o \times \frac{\cancel{I_S}}{\alpha} + I_S^2 r_{SW} + I_S^2 r_L + V_D \times \frac{\cancel{I_S}}{\alpha}$$

$$V_S = \frac{V_o}{\alpha} + \alpha \frac{V_o}{R} r_{SW} + \frac{\alpha V_o r_L}{R} + \frac{V_D}{\alpha}$$

$$50 = \frac{20}{\alpha} + \frac{\alpha \times 20 \times 0.08}{4} + \frac{\alpha \times 20 \times 0.06}{4} + \frac{0.9}{\alpha}$$

$$50 = \frac{20.9}{\alpha} + 0.7\alpha$$

$$0.7\alpha^2 - 50\alpha + 20.9 = 0$$

$$\boxed{\alpha = 0.42}$$

$$\%\eta = \frac{P_o}{P_o + P_L} \times 100 = \frac{V_o^2/R}{\frac{V_o^2}{R} + I_S^2(r_{SW} + r_L) + V_D I_o} \times 100$$

$$= \frac{20^2/4}{\frac{20^2}{4} + \frac{0.42^2 \times 20^2}{4^2} \times 0.14 + \frac{0.9 \times 20}{4}} \times 100$$

$$= 95.132\%$$

Q. 2(a) ①

$$I = \int_{0.1}^{0.5} e^{-x^3}\, dx$$

Step size $h = \frac{0.5 - 0.1}{4} = 0.1$

x	0.1	0.2	0.3	0.4	0.5
$f(x)$	0.9990	0.9920	0.9734	0.9380	0.8825
	y_0	y_1	y_2	y_3	y_4

By Simpson's $\frac{1}{3}$rd rule –

$$I = \frac{h}{3}\left[(y_0+y_n)+2(y_2+y_4+\cdots)+4(y_1+y_3+\cdots)\right]$$

$$= \frac{0.1}{3}\left[(0.9990+0.8825)+2\times .9734+4\times(.9920+.9380)\right]$$

$$\boxed{I = 0.3849}$$

By Trapezoidal rule

$$I = \frac{h}{2}\left[(y_0+y_n)+2(y_1+y_2+\cdots)\right]$$

$$= \frac{0.1}{2}\left[(0.9990+0.8825)+2(.9734+.9920+.9380)\right]$$

$$\boxed{I = 0.384415}$$

(11) Given –

$$y''-2y'+2y = x+e^x\cos x$$

Auxillary eq^n

$$m^2-2m+2=0$$

$$m = 1\pm i$$

$$CF = e^x(c_1\cos x+c_2\sin x)$$

$$PI = \frac{1}{D^2-2D+2}(x+e^x\cos x)$$

$$= \frac{1}{(D^2-2D+2)}x+\frac{1}{D^2-2D+2}e^x\cos x$$

$$= \frac{1}{2\left[1+\frac{D^2-2D}{2}\right]}x+\frac{e^x}{(D+1)^2-2(D+1)+2}\cos x$$

Replace $D\to D+1$

$$= \frac{1}{2}\left[1+\frac{D^2-2D}{2}\right]^{-1} x + \frac{e^x}{D^2+1+\cancel{2D}-\cancel{2D}-\cancel{x}+\cancel{x}} \cos x$$

$$= \frac{1}{2}\left[1-\frac{D^2-2D}{2}\right] x + \frac{e^x}{D^2+1} \cos x$$

$-1+1=0$ Replace $D^2=-1$

Case fail

$$= \frac{1}{2}\left[x-0+1\right] + \frac{e^x}{2D} \cos x$$

$$= \frac{x+1}{2} + \frac{e^x \sin x}{2}$$

$\therefore$ Complete Solⁿ

$y = CF + PI$

$$\boxed{y = e^x(c_1\cos x + c_2 \sin x) + \frac{x+1}{2} + \frac{e^x \sin x}{2}}$$

Q. 2(b)(i)

$$I = \oint_C \frac{e^z}{\cos \pi z} \qquad |z| = 1$$

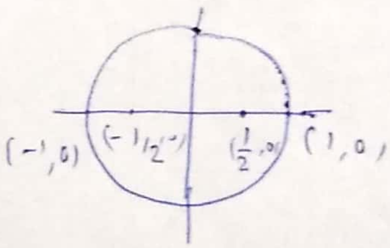
Singular pt.

$$\cos \pi z = 0$$

$$\cancel{\pi} z = \pm(2n+1)\frac{\cancel{\pi}}{2}$$

$$z = \pm(2n+1)\frac{1}{2}$$

$$= \pm\frac{1}{2}, \pm\frac{3}{2},$$



lies inside the unit circle

Residue for $z=\frac{1}{2}$: $R_1 = \lim_{z\to\frac{1}{2}} \left(z-\frac{1}{2}\right)\frac{e^z}{\cos \pi z}$ $\quad \frac{0}{0}$ form

By L-hospital

$$= \lim_{z\to 1/2} \frac{e^z + \left(z-\frac{1}{2}\right)e^z}{-\pi \sin \pi z}$$

$$R_1 = \frac{e^{1/2} + 0}{-\pi} = -\frac{e^{1/2}}{\pi}$$

Residue for $z = -\frac{1}{2}$: $R_2 = \lim_{z \to -\frac{1}{2}} (z+\frac{1}{2}) \frac{e^z}{\cos \pi z}$ $\quad \frac{0}{0}$ form

$$= \lim_{z \to -\frac{1}{2}} \frac{e^z + (z+\frac{1}{2})e^z}{-\pi \sin \pi z}$$

$$= \frac{e^{-1/2}}{-\pi}$$

By Cauchy residue theorem

$$\oint_C \frac{e^z}{\cos \pi z} dz = 2\pi i \text{ (Sum of residue lies inside the unit circle)}$$

$$= 2\cancel{\pi} i \left(-\frac{e^{1/2}}{\cancel{\pi}} - \frac{e^{-1/2}}{\cancel{\pi}} \right)$$

$$= -2i \left(e^{1/2} + e^{-1/2} \right)$$

$$\boxed{\oint_C \frac{e^z}{\cos \pi z} dz = -4.51 i}$$

(11) By using unit step funⁿ $f(t)$ can be written as —

$$f(t) = \sin t \left[u(t) - u(t-\pi)\right] + \sin 2t \left[u(t-\pi) - u(t-2\pi)\right] + \sin 3t \, u(t-2\pi)$$

$$= \sin t \, u(t) - \sin(t+\pi-\pi) u(t-\pi) + \sin 2(t-\pi+\pi) u(t-\pi) - \sin 2(t+2\pi-2\pi) u(t-2\pi) + \sin 3(t-2\pi+2\pi) u(t-2\pi)$$

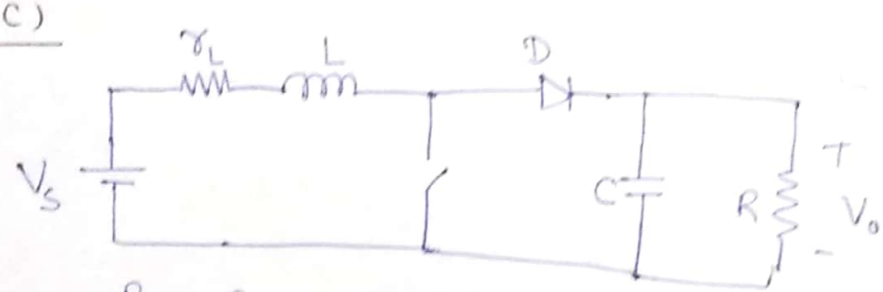
$$= \sin t\, u(t) + \sin(t-\pi)u(t-\pi) + \sin 2(t-\pi)\, u(t-\pi) - \sin 2(t-2\pi)\, u(t-2\pi) + \sin 3(t-2\pi)\, u(t-2\pi)$$

$$\Big\downarrow \text{LT}$$

$$= \frac{1}{s^2+1} + \frac{e^{-\pi s}}{s^2+1} + \frac{e^{-\frac{\pi s}{2}}}{\left(\frac{s}{2}\right)^2+1} - \frac{e^{-\frac{2\pi s}{2}}}{\left(\frac{s}{2}\right)^2+1} + \frac{e^{-\frac{2\pi s}{3}}}{\left(\frac{s}{3}\right)^2+1}$$

$$\boxed{F(s) = \frac{1+e^{-\pi s}}{s^2+1} + \frac{e^{-\frac{\pi s}{2}} - e^{-\pi s}}{\left(\frac{s}{2}\right)^2+1} + \frac{e^{-\frac{2\pi s}{3}}}{\left(\frac{s}{3}\right)^2+1}}$$

Q. 2(C)



By Power balance -

$$P_s = P_o + P_L$$

$$V_s I_L = V_o I_D + I_L^2 r_L \quad -(1)$$

$$\because \quad I_D = (1-D) I_L$$

Substitute I_D in eq^n (1)

$$V_s I_L = V_o (1-D) I_L + I_L^2 r_L$$

$$V_s = V_o(1-D) + I_L r_L \quad -(2)$$

$$\because \quad I_D = \frac{V_o}{R}$$

$$I_L = \frac{V_o}{R(1-D)}$$

from eq^n (2)

$$V_s = V_o(1-D) + \frac{V_o\, r_L}{R(1-D)}$$

$$\frac{V_s}{1-D} = V_0\left[1 + \frac{r_L}{R(1-D)^2}\right]$$

$$\boxed{V_0 = \frac{V_s}{1-D} \times \left[\frac{1}{1 + \frac{r_L}{R(1-D)^2}}\right]}$$

$\because$

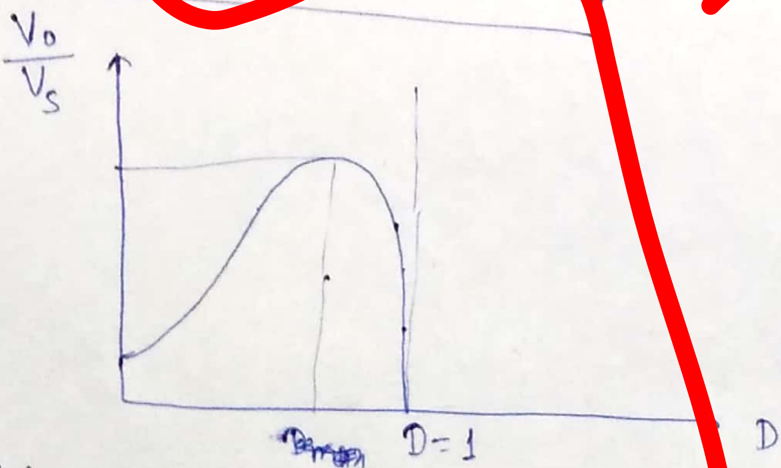
$$\eta = \frac{P_0}{P_0 + P_L}$$

$$= \frac{V_0^2/R}{\frac{V_0^2}{R} + I_L^2 r_L}$$

$$= \frac{V_0^2/R}{\frac{V_0^2}{R} + \frac{V_0^2\, r_L}{R^2(1-D)^2}}$$

$$\boxed{\eta = \frac{1}{1 + \frac{r_L}{R(1-D)^2}}}$$

17



Q.4(b) Given –

$V_s = 220\,V$ $R = 0.1\,\Omega$ $L = 10\,mH$ $E_b = 100\,V$

$\because$ Chopper operated in 1st & 4th quadrant it means it is class D chopper.

for motoring mode -

$$V_o = E_b + I_o R_a$$

$$I_o = \frac{V_o - E_b}{R_a}$$

$$10 = \frac{(2\alpha_m - 1) V_s - E_b}{R_a}$$

$$10 = \frac{(2\alpha_m - 1) \times 220 - 100}{0.1}$$

$$\boxed{\alpha_m = 0.7295}$$

$$\therefore \boxed{\alpha_c = 1 - \alpha_m = 0.27045}$$

for regenerative breaking -

$$V_o = E_b - I_o R_a$$

$$I_o R_a = E_b - [(2\alpha_R - 1) V_s]$$

$$10 \times 0.1 = 100 + (2\alpha_R - 1) \times 220$$

$$\boxed{\alpha_R = 0.275}$$

Power returned to the source $= E_b I_o - I_o^2 R_a$

$= 100 \times 10 - 100 \times 0.1$

$= 990$ watt

$\therefore$ It is a class D chopper.

$\therefore$ Switching freq $= \frac{5\ kHz}{2} = 2.5\ kHz$

Q. 4(a) (ii)

Given funⁿ

$$f(z) = \frac{1-e^{pz}}{z^4}$$

Residue at its Pole $= \lim_{z\to 0} \frac{1}{(4-1)!} \frac{d^{4-1}}{dz^{4-1}} \left(\cancel{z^4} \times \frac{1-e^{pz}}{\cancel{z^4}} \right)$

$$= \lim_{z\to 0} \frac{1}{3!} \frac{d^3}{dz^3} (1-e^{pz})$$

$$= \lim_{z\to 0} \frac{1}{6} \left[\frac{d^2}{dz^2} (0 - pe^{pz}) \right]$$

$$= \lim_{z\to 0} \frac{1}{6} \left[\frac{d}{dz} (-p^2 e^{pz}) \right]$$

$$= \lim_{z\to 0} \frac{1}{6} \left[-p^3 e^{pz} \right]$$

$$= -\frac{p^3}{6}$$

A/c to ques.

Residue at its Pole $= -4/3$

$$\cancel{-}\frac{p^3}{\cancel{6}} = \cancel{-} \, 4/\cancel{3}$$

$$p^3 = 8$$

$$\boxed{p = \sqrt[3]{8} = 2}$$

(iii) Langrange's mean Value theorem –

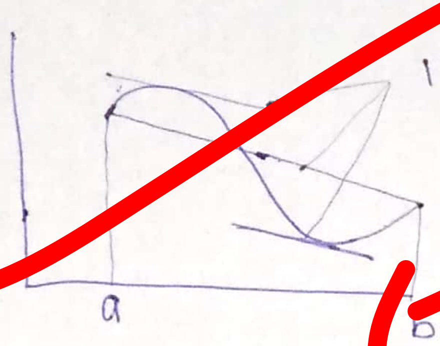
It state that if any funⁿ

(i) Continuous in $[a, b]$

(ii) Differentiable in (a, b)

(iii) Then there exist a pt

$$f'(c) = \frac{f(b)-f(a)}{b-a}$$



$\parallel^r$ to each other

← Physical significance of this theorem.

(1) Prob. of ~~x~~ throwing 6 by A

(1, 5) (2, 4) (3, 3) (4, 2) (5, 1)

$P_A = \frac{5}{36}$

Prob. of throwing 7 by B

(1, 6) (2, 5) (3, 4) (4, 3) (5, 2) (6, 1)

$P_B = \frac{6}{36}$

Prob. of winning A –

A (or) $\bar{A}\,\bar{B}\,A$ (or) $\bar{A}\,\bar{B}\,\bar{A}\,\bar{B}\,A$ (or) ...

$\frac{5}{36} + (1-\frac{5}{36})(1-\frac{6}{36}) \times \frac{5}{36} + (1-\frac{5}{36})(1-\frac{6}{36})(1-\frac{5}{36})(1-\frac{6}{36})(\frac{5}{36}) + \ldots$

$$P(A) = \frac{5/36}{1-(1-\frac{5}{36})(1-\frac{6}{36})} = \frac{30}{61}$$

Prob. of wining B –

$\bar{A}\,B$ (or) $\bar{A}\,\bar{B}\,\bar{A}\,B$ (or) $\bar{A}\,\bar{B}\,\bar{A}\,\bar{B}\,\bar{A}\,B$ (or) ...

$(1-\frac{5}{36}) \times \frac{6}{36} + (1-\frac{5}{36}) \times (1-\frac{6}{36})(1-\frac{5}{36}) \times \frac{6}{36} + \ldots$

$$P(B) = \frac{(1-\frac{5}{36}) \times \frac{6}{36}}{1-(1-\frac{6}{36})(1-\frac{5}{36})} = \frac{31}{61}$$

Q. 4(c) (i) Given –

$$f = x^2 - y^2 + 2z^2$$

$$\Delta f = 2x\hat{i} - 2y\hat{j} + 4z\hat{k}$$

$$\Delta f\Big|_{(1,2,3)} = 2\hat{i} - 4\hat{j} + 12\hat{k}$$

$$\overline{PQ} = \cancel{Ex} \; \overline{P} - \overline{Q}$$

$$= (1-5)\hat{i} + (2-0)\hat{j} + (3-4)\hat{k}$$

$$= -4\hat{i} + 2\hat{j} - \hat{k}$$

Unit vector $\hat{a} = \dfrac{\overline{PQ}}{|PQ|} = \dfrac{-4\hat{i} + 2\hat{j} - \hat{k}}{\sqrt{4^2+2^2+1}}$

Dir^n derivative $= \nabla f \cdot \hat{a}$

$$= (2\hat{i} - 4\hat{j} + 12\hat{k}) \cdot \frac{-4\hat{i} + 2\hat{j} - \hat{k}}{\sqrt{21}}$$

$$= \frac{-8-8-12}{\sqrt{21}} = -\frac{28}{\sqrt{21}}$$

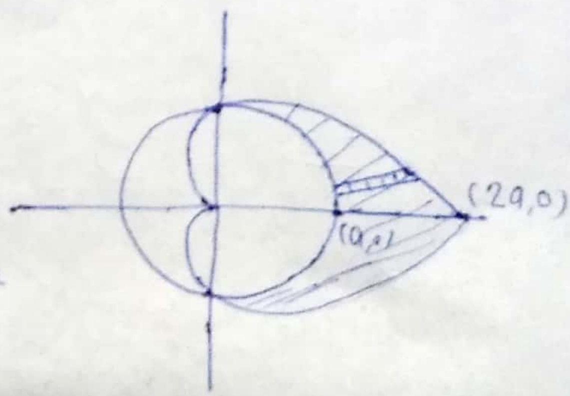
Max^n value $= |2\hat{i} - 4\hat{j} + 12\hat{k}| = \sqrt{2^2+4^2+12^2}$

$$= 2\sqrt{41}$$

(ii) Given –

$$r = a(1+\cos\theta)$$

$$r = a$$



Intersection of the curve

$$a = a(1+\cos\theta)$$

$$\theta = (2n+1)\pi$$

$$I = 2\int_{0}^{\pi/2}\int_{r=a}^{r=a(1+\cos\theta)} r\,dr\,d\theta$$

$$= \cancel{2}\int_{0}^{\pi/2} \frac{r^2}{\cancel{2}}\Big|_{r=a}^{a(1+\cos\theta)} d\theta$$

$$= \int_{0}^{\pi/2} \left[\left(a(1+\cos\theta)\right)^2 - a^2\right] d\theta$$

$$= a^2 \int_{0}^{\pi/2} \left(\cancel{1} + \cos^2\theta + 2\cos\theta - \cancel{1}\right) d\theta$$

$$= a^2 \int_{0}^{\pi/2} \left[\frac{1+\cos 2\theta}{2} + 2\cos\theta\right] d\theta$$

$$= \frac{a^2}{2}\int_{0}^{\pi/2} \left(1 + \cos 2\theta + 4\cos\theta\right) d\theta$$

$$= \frac{a^2}{2}\left[\frac{\pi}{2} + \frac{\sin 2\theta}{2}\Big|_{0}^{\pi/2} + 4\sin\theta\Big|_{0}^{\pi/2}\right]$$

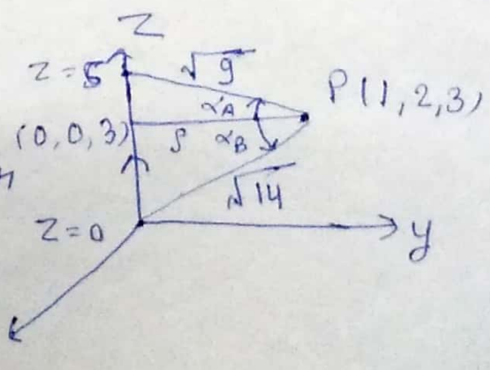
$$= \frac{a^2}{2}\left[\frac{\pi}{2} + 0 + 4(1-0)\right]$$

$$I = \frac{a^2}{2}\left[\frac{\pi}{2} + 4\right] = \frac{(\pi+8)a^2}{4} \text{ sq. unit}$$

Q.5(a) As we know —

$$H = \frac{I}{4\pi\rho}\left(\sin\alpha_B - \sin\alpha_A\right)\hat{a}_\phi$$

where $\rho = \sqrt{1^2 + 2^2} = \sqrt{5}$



$$\cancel{\tan}\,\alpha_A = \frac{\cancel{3-5}}{\sqrt{5}} = -\frac{2}{\sqrt{5}}$$

$$\sin\alpha_A = -\frac{2}{3}$$

$$\sin\alpha_B = \frac{3}{\sqrt{14}}$$

$$\hat{a}_H = \hat{a}_\ell \times a_{\perp r}$$

$$= \hat{a}_z \times \frac{\hat{a}_x + 2\hat{a}_y}{\sqrt{5}}$$

$$H = \frac{10}{4\pi \times \sqrt{5}}\left(\frac{3}{\sqrt{14}} + \frac{2}{3}\right)\hat{a}_z \times \frac{\hat{a}_x + 2\hat{a}_y}{\sqrt{5}}$$

$$\boxed{H = -0.468\,\hat{a}_x + 0.234\,\hat{a}_y}\ \text{A/m}$$

Q.5 (b) Given —

$$J = 4.5\,e^{-2r}\,\hat{a}_z \ \text{A/m}^2 \qquad 0 < r < 0.5$$

$$I = \iint J \cdot dS$$

$$= \int_0^{2\pi}\int_0^{0.5} 4.5\,e^{-2r}\,\hat{a}_z \cdot r\,dr\,d\phi\,\hat{a}_z$$

$$= 4.5\int_0^{2\pi}\int_0^{0.5} r\,e^{-2r}\,dr\,d\phi$$

$$= 4.5 \times 2\pi \int_0^{0.5} r\,e^{-2r}\,dr$$

$$= -9\pi\left[\frac{r e^{-2r}}{2} + \frac{e^{-2r}}{4}\right]_0^{0.5}$$

$$= -9\pi\left[\frac{0.5e^{-1}}{2} + \frac{e^{-1}}{4} - \frac{1}{4}\right] = 1.8678\ \text{A}$$

By Ampere circuital law

$$\oint H \cdot dl = I$$

$$H \times 2\pi r = \frac{I}{\pi \times 0.5^2} \times \pi r^2$$

$$\overline{H} = \frac{4.5\, e^{-2r}\, \hat{a}_z}{2\pi \times 0.5^2} \times r$$

$$\boxed{\overline{H} = 2.8648\, r\, e^{-2r}\, \hat{a}_z}$$

Q. 5(c)

Given –

$$m(t) = A \tanh(\beta t)$$

$$\frac{dm(t)}{dt} = A\beta\, \mathrm{sech}^2(\beta t)$$

$$\left.\frac{dm(t)}{dt}\right|_{max} = A\beta$$

To avoid slope overload error

$$\left.\frac{dm(t)}{dt}\right|_{max} \leq S \cdot f_s$$

$$S \geq \frac{A\beta}{f_s}$$

$$S_{min} = A\beta T_s$$

Q. 5(d)

Given –

$f_m = 10\,\text{KHz}$

$A = 1$ Volt Peak to Peak

$A_m = \frac{1}{2}$ Volt

To avoid slope overload error –

$$\left.\frac{dm(t)}{dt}\right|_{max} \leq S \cdot f_s$$

$$A_m \omega_m \leq S \cdot f_s$$

$$\frac{1}{2} \times 2\pi \times 10\,kHz \leq S \cdot 10 \times 2 \times \cancel{5kHz}$$

$$\boxed{S \geq \frac{\pi}{20} = 0.157}$$

$$SNR = \frac{\left(\frac{1}{2}\right)\frac{0.5^2}{2}}{\frac{0.157^2}{12}} = 60.854$$

$$\text{in dB} = 17.84\ dB$$

Q.5(e) ~~In file di~~

In computer different kind of file allocations are available which is given below –

(I) Contiguous allocation

(II) Linked "

(III) Indexed "

· Contiguous allocation – In this file is store at different ~~case~~ track. To access the data we have to access the individual track. In this we can access only one track data at a time. It is time consuming

· Linked Allocation – In this file is stored in link list form. It eliminate the disadvantage of contiguous allocation. To access the data we have to access the address of the track.

Indexed allocation –

In indexed allocation data is stored in the indexed pointer in the form of block. Here we ~~xxxx~~ can to access multible file data simultaneaully.

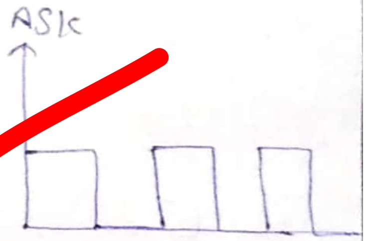
Q.6(a) (i)

Different types of ~~binary~~ digital binary modulation scheme are given below –

- ASK
- FSK
- PSK

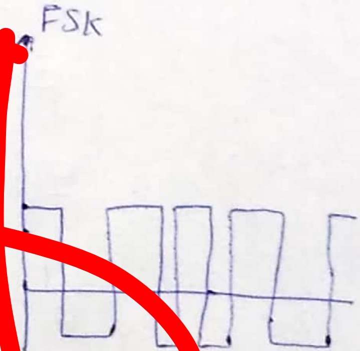
ASK

- It is just like AM in analog modulation.
- $P_e = \frac{1}{2} \operatorname{erfc} \sqrt{\frac{E_b}{4\eta}}$
- $S(t) = \begin{cases} A_m \cos 2\pi f_c t & S \to 1 \\ 0 & S \to 0 \end{cases}$



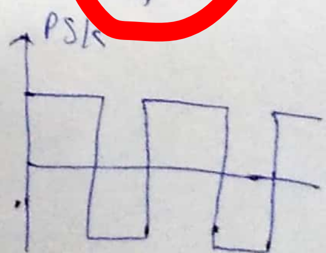
FSK

- It is just like FM in analog modulation.
- $P_e = \frac{1}{2} \operatorname{erfc} \sqrt{\frac{E_b}{2\eta}}$
- $S(t) = \begin{cases} A_m \cos 2\pi f_{c_1} t & S \to 1 \\ A_m \cos 2\pi f_{c_2} t & S \to 0 \end{cases}$



PSK –

- It is just like PM in analog modulation
- $P_e = \frac{1}{2} \operatorname{erfc} \sqrt{\frac{E_b}{\eta}}$
- $S(t) = \begin{cases} A_m \cos 2\pi f_c t & S \to 1 \\ -A_m \cos 2\pi f_c t & S \to 0 \end{cases}$



(11) Difference b/w PPM & PCM –

PPM	PCM
• It is band pass modulation	• It is base band modulation
• It is similar to pm in analog modulation	• It encodes the I/P signal into corresponding binary value.
• Quantizer is not used	• Quantizer is used
• ~~Accu~~ Not accurate as PCM	• More accurate
• Noise does not affect much.	• Quantizer error is main problem.

Q. 5 (c) (1)

Given –

$A = 5cm^2$

$d = 3mm$

$V = 50 \sin 10^3 t$

$\varepsilon = 2\varepsilon_0$

$$E = \frac{V}{d} = \frac{50 \sin 10^3 t}{3 \times 10^{-3}} = \frac{50 \times 10^3}{3} \sin 10^3 t$$

$$J_d = \frac{\partial D}{\partial t}$$

$$\frac{I_d}{A} = \varepsilon \frac{\partial E}{\partial t}$$

$$I_d = 5 \times 10^{-4} \times 2 \times 8.854 \times 10^{-12} \times \frac{50 \times 10^3 \times 10^3}{3} \cos 10^3 t$$

$$\boxed{I_d = 1.4757 \times 10^{-7} \cos 10^3 t} \; A$$

(11) Given –

$E = \frac{10^6}{r}\hat{a}_r$ $\quad a = 50mm$

$\quad b = 100mm$

$\epsilon = 10\epsilon_0$

$V = -\int \bar{E}\cdot dl$

$= -\int \frac{10^6}{r}\hat{a}_r \cdot dr\hat{a}_r$

$= -\int_b^a \frac{10^6}{r} dr$

$= -10^6 \ln r \Big|_b^a$

$$\boxed{V = 10^6 \ln\frac{b}{a} = 10^6 \ln\frac{100}{50} = 0.6931\times10^6 V}$$

$C = \frac{Q}{V} = \frac{\iint D\cdot ds}{-\int E\cdot dl}$

$= \frac{\iint \epsilon\bar{E}\cdot ds}{V} = \frac{\epsilon\int_0^1\int_0^{2\pi}\frac{10^6}{r}\hat{a}_r \cdot r\,d\phi\,dz\,\hat{a}_r}{V}$

$= \frac{10\times8.854\times10^{-12}\times10^6\times2\pi\times200\times10^{-3}}{0.6931\times10^6}$

$$\boxed{C = 160.53\ pF}$$

$E = \frac{1}{2}CV^2 = \frac{1}{2}\times160.53\times\cancel{10^{-12}}\times0.6931^2\times\cancel{10^{12}}$

$$\boxed{E = 38.5583\ \text{Joule}}$$

Scanned with CamScanner

Optical fibre -

- It is used Now a day in communication for transferring the information from one pt. to another pt.
- Its works on the principle of total internal refection.
- It has mainly 3 components -
  - core
  - cladding
  - Buffer.

Advantage -

- In this ~~los~~ losses are $\min^n$ as compare to conducting cu wire.
- It is less costly as compare to conducting cu wire.
- It has less chaces of information leakage as compare to conducting cu wire.

(ii)

← 16 bit →

Tag	LO	WO
5bit	5bit	6bit
00010	00100	000000

$$LO = (00100)_B = 4$$

Data is start from 4th ~~col~~. row -

0		B_{28}		B_{28}
1		B_{29}		B_{29}
2		B_{30}		
3		B_{31}		
4	~~B_0~~	B_{32}	B_0	
5	~~B_1~~	B_{33}	B_1	
6	~~B_2~~	B_{34}		
7	~~B_3~~	B_{35}		miss
8	~~B_4~~	B_{36}		
9	~~B_5~~	B_{37}	miss	
10	~~B_6~~	B_{38}		
11	~~B_7~~	B_{39}		B_9
12			B_8	
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28	B_{24}			
29	B_{25}			
30	B_{26}			
31	B_{27}	B_{27}		
	1st	2nd		

Total misses

$= 40 + 16 = 56$

16